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ENCYCLOPÆDIA BRITANNICA.

Suicide.

SUICIDE, the crime of ſelf-murder, or the perſon who commits it.

We have often wiſhed to ſee a hiſtory of crimes drawn up by a man of ability and reſearch. In this hiſtory we would propoſe that the author ſhould deſcribe the crimes peculiar to different nations in the different ſtages of ſociety, and the changes which they undergo in the progreſs of civilization. After having arranged the hiſtorical facts, he might, by comparing them with the religion and the knowledge of the people, deduce ſome important general concluſions, which would lead to a diſcovery of the cauſe of crimes, and of the remedy moſt proper to be applied. Some crimes are peculiar to certain ſtages of ſociety, ſome to certain nations, &c.

1 Suicide among the Jews.

Suicide is one of thoſe crimes which we are led to believe not common among ſavage nations. The firſt inſtances of it recorded in the Jewiſh hiſtory are thoſe of Saul and Ahitophel; for we do not think the death of Samſon a proper example. We have no reaſon to ſuppoſe that it became common among the Jews till their wars with the Romans, when multitudes ſlaughtered themſelves that they might not fall alive into the hands of their enemies. But at this period the Jews were a moſt deſperate and abandoned race of men, had corrupted the religion of their fathers, and rejected that pure ſyſtem which their promiſed Meſſiah came to Jeruſalem to announce.

2 Among the Greeks.

When it became remarkable among the Greeks, we have not been able to diſcover; but it was forbidden by Pythagoras, as we learn from Athenæus, by Socrates and Ariſtotle, and by the Theban and Athenian laws. In the earlieſt ages of the Roman republic it was ſeldom committed; but when luxury and the Epicurean and Stoical philoſophy had corrupted the ſimplicity and virtue of the Roman character; then they began to ſeek ſhelter in ſuicide from their misfortunes or the effects of their own vices.

3 The Bramins and Gentoos.

The religious principles of the bramins of India led them to admire ſuicide on particular occaſions as honourable. Accuſtomed to abſtinence, mortification, and the contempt of death, they conſidered it as a mark of weakneſs of mind to ſubmit to the infirmities of old age. We are informed that the modern Gentoos, who ſtill in moſt things conform to the cuſtoms of their anceſtors, when old and infirm, are frequently brought to the banks of rivers, particularly to thoſe of the Ganges, that they may die in its ſacred ſtreams, which they believe can waſh away the guilt of their ſins. But the maxims of the bramins, which have encouraged this practice, we are aſſured by Mr Holwell, are a corruption of the doctrines of the Shaſtah, which poſitively forbid ſuicide under the ſevereſt puniſhment. The practice which religion or affection has eſtabliſhed among the Gentoos, for women at the death of their huſbands to burn themſelves alive on the funeral pile, we do not think ought to be conſidered as ſuicide, as we are not anxious to extend the meaning of the word; for were we to extend it thus far, it would be as proper to apply it to thoſe who chooſe rather to die in battle than make their eſcape at the expence of their honour. Thus we ſhould condemn as ſuicides the brave Spartans who died at Thermopylæ in defence of their country; we ſhould alſo be obliged to apply the ſame diſgraceful epithet to all thoſe well-meaning but weak-minded Chriſtians in this iſland, who in the laſt century choſe rather to die as martyrs than comply with commands which were not morally wrong. According to the Gentoo laws, "it is proper for a woman after her huſband's death to burn herſelf in the fire with his corpſe. Every woman who thus burns ſhall remain in paradiſe with her huſband three crore and fifty lacks of years. If ſhe cannot, ſhe muſt in that caſe preſerve an inviolable chaſtity. If ſhe remain chaſte, ſhe goes to paradiſe; and if ſhe do not preſerve her chaſtity, ſhe goes to hell."

Suicide. *Sullivan's Phil. Rhap.* vol. ii. *Holwell's Intereſting Events*, &c. vol. i.

4 Among the Americans, *Robertſon's America.*

A cuſtom ſimilar to this prevailed among many nations on the continent of America. When a chief died, a certain number of his wives, of his favourites, and of his ſlaves, were put to death, and interred together with him, that he might appear with the ſame dignity in his future ſtation, and be waited upon by the ſame attendants. This perſuaſion is ſo deeply rooted, that many of their retainers offer themſelves as victims; and the ſame cuſtom prevails in many of the negro nations in Africa.

5 the Japaneſe, and *Raynal's Hiſt. of the Eaſt and Weſt Indies*, vol. i.

If we can believe the hiſtorians of Japan, voluntary death is common in that empire. The devotees of the idol Amida drown themſelves in his preſence, attended by their relations and friends, and ſeveral of the prieſts, who all conſider the devoted perſon as a ſaint who is gone to everlaſting happineſs. Such being the ſuppoſed honours appropriated to a voluntary death, it is not ſurpriſing that the Japaneſe anxiouſly cheriſh a contempt of life. Accordingly it is a part of the education of their children "to repeat poems in which the virtues of their

Suicide.

ancestors are celebrated, an utter contempt of life is inculcated, and suicide is set up as the most heroic of actions."

6 Scythians,

A notion seems also to have prevailed among the ancient Scythian tribes, that it was pusillanimous and ignoble for a man whose strength was wasted with disease or infirmity, so as to be useless to the community, to continue to live. It was reckoned an heroic action voluntarily to seek that death which he had not the good fortune to meet in the field of battle. Perversion of moral feeling does not spring up, we hope, spontaneously in any nation, but is produced by some peculiarities of situation. A wandering people like the Scythians, who roamed about from place to place, might often find it impossible to attend the sick, or to supply from their precarious store the wants of the aged and infirm. The aged and infirm themselves, no longer able to support the character of warriors, would find themselves unhappy. In this way the practice of putting to death such persons as were useless to the community might originate, and afterwards be inculcated as honourable; but he who put an end to his infirmities by his own hand, obtained a character still more illustrious.

7 and Scandinavians.

The tribes of Scandinavia, which worshipped Odin the "father of slaughter," were taught, that dying in the field of battle was the most glorious event that could befal them. This was a maxim suited to a warlike nation. In order to establish it more firmly in the mind, all were excluded from Odin's feast of heroes who died a natural death. In Asgardia stood the hall of Odin; where, seated on a throne, he received the souls of his departed heroes. This place was called *Valhalla*, signifying "the hall of those who died by violence." Natural death being thus deemed inglorious, and punished with exclusion from Valhalla the paradise of Odin, he who could not enjoy death in the field of battle was led to seek it by his own hands when sickness or old age began to assail him. In such a nation suicide must have been very common.

8 It prevailed much in the decline of the Roman empire.

As suicide prevailed much in the decline of the Roman empire, when luxury, licentiousness, profligacy, and false philosophy, pervaded the world, so it continued to prevail even after Christianity was established. The Romans, when they became converts to Christianity, did not renounce their ancient prejudices and false opinions, but blended them with the new religion which they embraced. The Gothic nations also, who subverted the Roman empire, while they received the Christian religion, adhered to many of their former opinions and manners. Among other criminal practices which were retained by the Romans and their conquerors, that of suicide was one; but the principles from which it proceeded were explained, so as to appear more agreeable to the new system which they had espoused. It was committed, either to secure from the danger of apostasy, to procure the honour of martyrdom, or to preserve the crown of virginity.

9 Too common in modern times, but not more so in England than in other countries.

When we descend to modern times, we lament to find so many instances of suicide among the most polished nations, who have the best opportunities of knowing the atrocity of that unnatural crime. The English have long been reproached by foreigners for the frequent commission of it; and the "gloomy month of November" has been stigmatized as the season when it is most common. But this disgraceful imputation, we think, may be justly attributed, not to the greater frequency of the crime in England than in other places, but to the custom of publishing in the newspapers every instance of suicide which is known. Mr Moore, who lately published a full inquiry into this subject, was at great pains to obtain accurate information concerning the perpetration of this crime in different countries. Mercier, who wrote in 1782, says, that the annual number of suicides in Paris was then about 150. He does not tell us how he came by the information; but we have the authority of the Abbe Fontana for asserting, that more persons put an end to their lives in Paris than in London. The Abbe had this information from the lieutenant of the police. Mr Moore was informed by one of the principal magistrates of Geneva, that in that city, which contains about 25,000 inhabitants, the average number of suicides is about *eight*. The average number of suicides, from what cause soever, for the last 28 years, has been 32 each year for London, Southwark, and Westminster. In Edinburgh, which contains 80,000 inhabitants, we are convinced the average number of suicides does not exceed *four*. Mr Moore found, from the accounts with which he was favoured by the several coroners of the county of Kent, that for the last 18 years the number has been upwards of 32 each year. Kent is supposed to contain 200,000 inhabitants, and London 800,000. It is easy therefore to see, that in the metropolis many instances of suicide must occur which are never the subject of legal inquiry, and consequently never made known to the world. Whereas in the country towns and villages of Kent it is scarcely possible to conceal such an action as self-murder from the knowledge of the whole neighbourhood. The calculation therefore respecting Kent we may receive as true, while we must increase the average number in London very considerably. Mr Moore computes the average number of suicides in England every year at a thousand; but the principles on which he founds this opinion are so imperfect and vague, that we do not think it can be depended on as coming near the truth.

Suicide.

Mercier's Tableau de Paris.

10 The number of suicides in Paris, London, Geneva, &c. according to the best accounts.

11 In what rank and situation suicide is most common.

It might lead to some interesting conclusions to compare together, not only the number of suicides in different countries, but also the rank and principles, the sex and age, of those unhappy persons by whom it has been committed. Mercier says, that at Paris it was the lower ranks who were most commonly guilty of it; that it was mostly committed in garrets or hired lodgings; and that it proceeded from poverty and oppression. A great many, he says, wrote letters to the magistrates before their death. Mr Moore's correspondent from Geneva informed him, that from the year 1777 to 1787 more than 100 suicides were committed in Geneva; that two-thirds of these unfortunate persons were men; that few of the clerical order have been known to commit it; and that it is not so much the end of an immoral, irreligious, dissipated life, as the effect of melancholy and poverty. By the information obtained from the coroners of Kent, it appears, that of the 32, three-fourths have destroyed themselves by hanging; that the proportion of males to females has been about two-thirds of the former; that no one season of the year is more distinguished for this crime than another; and that suicide is upon the increase. Our accounts respecting the city of London are very imperfect; but we think ourselves intitled to conclude, that suicide is more common among the great and wealthy

Moore's Full Inquiry into the Causes of Suicide.

Suicide.

wealthy than among the lower ranks, and that it is uſually the effect of gaming and diſſipation.

12 Phyſical cauſes to which it has been aſcribed in Britain.

Thoſe who have inquired into the cauſes of ſuicide in Britain have enumerated many phyſical as well as moral cauſes. They have aſcribed it to the variableneſs of our climate, to the great uſe of animal food, to ſtrong ſpirituous liquors, to tea, and to the ſulphureous exhalations of the pit coal uſed as fuel, which are ſaid to produce a depreſſion of ſpirits and nervous affections. Of our climate, we have no cauſe to complain, nor have we any reaſon to impute any of our vices to its influence. There are many climates much more unfavourable where ſuicide is ſcarcely known. That an exceſſive quantity of groſs animal food, or of ſtrong liquors, or of tea, will powerfully affect the human conſtitution, we will not deny: but before we conſider theſe as cauſes, it muſt firſt be determined, whether thoſe who are guilty of ſelf-murder be much addicted to them; and if they are, whether there be not other cauſes much more violent in their nature which have operated on their mind; for we ought not raſhly to attribute vicious effects to any of thoſe things which ſeem to have been created on purpoſe for the comfort or convenience of man. We are rather ſurpriſed to find that coal is mentioned even as a diſtant cauſe of ſuicide; for it is one of the bleſſings of our iſland; and a good coal fire we have always found rather conducive to good ſpirits than injurious to them.

13 And moral cauſes.

Among the moral cauſes which are ſuppoſed to cooperate in producing ſuicide in Britain, the freedom of our conſtitution and laws is reckoned one. That rational liberty ſhould have any tendency to encourage crimes of any kind, a Chriſtian philoſopher can never allow; for ſuch an opinion is totally diſcountenanced by enlightened views of nature. Mercier has aſcribed the frequency of ſuicide in Paris to the oppreſſion of the late government. Now it appears ſomewhat extraordinary, that ſuicide in one country ſhould be occaſioned by liberty, and in another by the want of it. One of theſe opinions muſt be falſe, and it is ſurely not difficult to diſtinguiſh which.

14 Not owing always to inſanity,

Humanity would in moſt caſes diſpoſe us to conclude, that ſuicide is the effect of inſanity, were there not ſo many inſtances of cool deliberate ſelf-murder. That ſuicide is an unnatural crime, which none but a madman would commit, compaſſion indeed may ſuppoſe; but the murder of a wife, a father, or a child, are alſo unnatural; yet compaſſion does not teach us in all caſes to aſcribe ſuch a crime to madneſs. Paſſion may often ariſe to ſuch a height of outrage as to be ſcarcely diſtinguiſhable from madneſs in its ſymptoms and its effects; yet we always make a diſtinction between that madneſs which ariſes from diſeaſe and that which is owing to a violent perturbation of mind. If a perſon be capable of managing his wordly affairs, of making a will, and of diſpoſing of his property, immediately before his death, or after he formed the reſolution of dying by his own hands, ſuch a man is not to be conſidered as inſane.

Suicide.

15 but often alſo to vicious paſſion.

But though a regard for truth prevents us from aſcribing ſuicide in all caſes to inſanity, we muſt aſcribe it either to inſanity or to vicious paſſion. Theſe two diviſions, we imagine, will comprehend every ſpecies of it, whether ariſing from melancholy, *tædium vitæ* or *ennui*, diſappointment in ſchemes of ambition or love, pride, gaming, or a deſire to avoid the ſhame of a public execution; paſſions which are often increaſed by falſe views of God, of man, and of a future ſtate, ariſing from deiſm and infidelity. If theſe be the cauſes of ſuicide in modern time, what a diſgraceful contraſt do they form to thoſe principles which actuated many of the ancient philoſophers, the Gentoos, the Japaneſe, and the worſhippers of Odin? When they committed ſuicide, they committed it from principle, from a belief of its lawfulneſs, and the hope of being rewarded for what they judged an honourable ſacrifice. But in modern times, we are ſorry to ſay, when it is not the effect of madneſs, it is the effect of vice: and when it is the effect of vice, it proves that the vicious paſſions are then indulged to the higheſt degree; for there is no crime which a man can commit that is ſo ſtrong a ſymptom of the violence of particular paſſions. It is from not attending to this circumſtance, that it has been found ſo difficult to refute the arguments in favour of ſuicide. If the criminality of ſuicide be confined merely to the violent action, many apologies may be made for it; but if it be conſidered ſolely as the effect of vice, as the ſtrongeſt ſymptom of ungoverned paſſion, he who undertakes its defence muſt undertake the defence of what all men will loudly condemn (A).

(A) Several of the heathens entertained a very juſt ſenſe of the atrocity of ſuicide. Quintus Curtius introduces Darius with the following ſpeech, when he had loſt his empire: "I wait (ſays the unfortunate monarch) the iſſue of my fate: you wonder, perhaps, that I do not terminate my own life; but I chooſe rather to die by the crime of another than by my own.

We cannot refuſe ourſelves the pleaſure of preſenting to our readers the following beautiful paſſage upon this ſubject from Fitzoſborne's letters *: "I am perſuaded (ſays this elegant writer) this diſguſt of life is frequently indulged out of a principle of mere vanity. It is eſteemed as a mark of uncommon refinement, and as placing a man above the ordinary level of his ſpecies, to ſeem ſuperior to the vulgar feelings of happineſs. True good ſenſe, however, moſt certainly conſiſts not in deſpiſing, but in managing our ſtock of life to the beſt advantage, as a cheerful acquieſcence in the meaſures of Providence is one of the ſtrongeſt ſymptoms of a well-conſtituted mind. Self-wearineſs is a circumſtance that ever attends folly; and to condemn our being is the greateſt, and indeed the peculiar infirmity, of human nature. It is a noble ſentiment which Tully puts into the mouth of Cato, in his Treatiſe upon old Age; *Non lubet mihi* (ſays that venerable Roman) *deplorare vitam, quod multi, et ii docti, ſæpe fecerunt; neque me vixiſſe pœnitet: quoniam ita vixi, ut non fruſtra me natum exiſtimem.*

* Letter iv.

"It is in the power, indeed, of but a very ſmall portion of mankind to act the ſame glorious part that afforded ſuch high ſatisfaction to this diſtinguiſhed patriot; but the number is yet far more inconſiderable of thoſe who cannot, in any ſtation, ſecure themſelves a ſufficient fund of complacency to render life juſtly valuable. Who is it that is placed out of the reach of the higheſt of all gratifications, thoſe of the generous affections, and that cannot provide for

Suicide.

16 Unneceſſary to enter into the arguments of caſuiſts upon this ſubject.

It is unneceſſary then to enter particularly into the arguments of thoſe caſuiſts who have undertaken the deſpicable office of advocates for the crime of ſuicide. Their talents might ſurely have been employed more uſefully to the world, and more honourably to themſelves, than in pleading for a crime, which, if it were committed by every man to whom their principles would make it lawful, would totally deſtroy ſome of the nobleſt virtues, fortitude, patience, and reſignation; nay, would deſtroy ſociety itſelf, and teach us to deſpiſe the opinion that this world is a ſtate of preparation for another. "I came into life without my own conſent, and may I not quit it at pleaſure?" (ſay the advocates for ſuicide). If, becauſe we came into life without our own conſent, we might quit it at pleaſure, why may we not ſpend our life alſo as we pleaſe? Why may we not rob and murder, and commit every kind of crime, if *mere inclination* is to be the rule of action! Thus upon the principles of ſuicide the highwayman and murderer may reaſon, and every man may find a ſufficient apology for any crime which he is tempted to commit. Or this abſurdity may be otherwiſe anſwered: As we came into life without our own conſent, we muſt have come with the conſent of ſome other being; and logic ſays, that with the conſent of that Being only can we lawfully quit it.

17 Its great criminality and imprudence.

It is ſufficient ſhortly to ſay, that ſuicide is contrary to the ſtrongeſt principle of the human conſtitution, ſelf-preſervation; that it is rebellion againſt God; that it is cruelty to the feelings and reputation, and often takes away the ſubſiſtence of a wife, a child, or a father; that it proves a want of fortitude to brave misfortunes; that it delivers only from imagined to plunge into real evils. We may add, that almoſt every inſtance of ſuicide of which we have heard was raſh, imprudent, and premature, interrupted a uſeful life, or prevented a more honourable death. Had Cato's pride permitted him to yield himſelf to the generoſity of Cæſar, his character and his influence might have contributed to retard the ſlavery of his country, which his death tended to haſten. Had Brutus and Caſſius not executed the fatal reſolution which they had formed, of dying by their own hands in caſe of misfortune, the battle of Philippi might have had a very different iſſue. Had Hannibal ſurrendered himſelf to the Romans, inſtead of ſwallowing poiſon, he would have gained more glory in braving their tortures than he won in the battle of Cannæ; for to die innocently and heroically is the greateſt exertion of human fortitude.

As ſuicide was deemed a crime by the moſt illuſtrious and virtuous of the Greek and Roman philoſophers, it was conſidered as a crime by the laws, and treated with ignominy. By the law of Thebes ſuicides were to have no honours paid to their memory *. The Athenian law ordained the hand which committed the deed to be cut off, and burnt apart from the reſt of the body. The body was not buried with the uſual ſolemnities, but was ignominiouſly thrown into ſome pit. In Cea and Maſſilia (the ancient *Marſeilles*), it was conſidered as a crime againſt the ſtate; and it was therefore neceſſary for thoſe who wiſhed to deſtroy themſelves to obtain permiſſion from the magiſtrates. † Plutarch acquaints us, that an unaccountable paſſion for ſuicide ſeized the Mileſian virgins; from indulging which they could not be prevented by the tears and entreaties of parents and friends: but what perſuaſion and entreaty could not effect was accompliſhed by very different means. A decree was iſſued, "that the body of every young woman who hanged herſelf ſhould be dragged naked through the ſtreets by the ſame rope with which ſhe had committed the deed." This wiſe edict put a complete ſtop to the extraordinary frenzy, and ſuicide was no longer committed by the virgins of Miletus.

Suicide.

18 How puniſhed by the Greeks, Ceans, &c.

* *Petite Comment. in Leges Atticas*, p. 523.

† *Plutarch on the Virtues of Women.*

19 By the Romans.

In the early part of the Roman hiſtory there ſeems to have been ſeldom occaſion for framing any laws againſt ſuicide. The only inſtance recorded occurs in the reign of Tarquinius Priſcus. The ſoldiers who were appointed to make drains and common ſewers, thinking themſelves diſgraced by ſuch ſervile offices, put themſelves to death in great numbers. The king ordered the bodies of all the ſelf-murderers to be expoſed on croſſes, and this put an effectual ſtop to the practice. It is doubtful whether there was any ſtanding law againſt ſuicide during the exiſtence of the republic; but during the reign of the emperors it was thought proper to lay it under certain regulations, though not abſolutely to condemn it as a crime. In Juſtinian's Digeſts there is a law, by which it was enacted, "that if perſons accuſed, or who had been found guilty, of any crime, ſhould make away with themſelves, their effects ſhould be confiſcated." But this puniſhment only took place when confiſcation of goods happened to be the penalty appointed by the law for the crime of which the ſelf-murderer was accuſed or found guilty, and was not inflicted for ſuicide committed in any other circumſtances.

Lib. xlviii. Tit. xxi. par. 3.

20 And by Chriſtians.

When the Chriſtian church had extended its juriſdiction in the Roman empire, it was decreed in the ſixth century, that no commemoration ſhould be made in the euchariſt for ſuch as deſtroyed themſelves: neither ſhould their

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for his own happineſs, by contributing ſomething to the welfare of others? As this diſeaſe of the mind generally breaks out with the moſt violence in thoſe who are ſuppoſed to be endowed with a greater delicacy of taſte and reaſon than is the uſual allotment of their fellow creatures, one may aſk them, whether there is any ſatiety in the purſuits of uſeful knowledge? or, if one can ever be weary of benefiting mankind? Will not the fine arts ſupply a laſting feaſt to the mind; or, can there be wanting a pleaſureable enjoyment, ſo long as there remains even one advantageous truth to be diſcovered or confirmed? To complain that life has no joys, while there is a ſingle creature whom we can relieve by our bounty, aſſiſt by our counſels, or enliven by our preſence, is to lament the loſs of that which we poſſeſs, and is juſt as rational as to die for thirſt with the cup in our hands. But the misfortune is, when a man is ſettled into a habit of receiving all his pleaſures from the mere ſelfiſh indulgences, he wears out of his mind the reliſh of every nobler enjoyment, at the ſame time that his powers of the ſenſual kind are growing more languid by each repetition. It is no wonder, therefore, he ſhould fill up the meaſure of his gratifications long before he has completed the circle of his duration; and either wretchedly ſit down the remainder of his days in diſcontent, or raſhly throw them up in deſpair."

Suicide || Suit.

their bodies be carried out to burial with pſalms, nor have the uſual ſervice ſaid over them. This eccleſiaſtical law continued till the reformation, when it was admitted into the ſtatute code of England by the authority of parliament. As an additional puniſhment, however, confiſcation of land and goods ſeems to have been adopted from the Danes, as we learn from Bracton ‡. At preſent the puniſhment conſiſts in confiſcating all the perſonal property of a *felo de ſe* for the uſe of the crown, and in excluding his body from interment in conſecrated ground. The warrant of the coroner requires that the body ſhould be buried in ſome public highway, and a ſtake driven through it to increaſe the ignominy.

‡ *De Legibus et Conſuetudinibus Angliæ*, Lib. iii. Tract. 11.

21 Difficult to deviſe a puniſhment that would be an effectual preventive.

To inquire into the prevalence and cauſes of crimes, in order to diſcover the moſt judicious methods of preventing them, is the duty of the Patriot and the Chriſtian. Suicide, we find, is a common and an increaſing evil: but it is a difficult matter to find an effectual remedy; for what motives can be held out ſufficient to influence that man's mind who is deaf to the voice of nature ſpeaking within him, and to the voice of nature's God declaring that he is ſtationed at a poſt which it is his duty to maintain? His reputation and property are indeed within the reach of the laws, his body may be treated with ignominy, and his property confiſcated; but this puniſhment will not be a preventive, even if it could be always inflicted; and that it is ſeldom inflicted, though the laws have decreed it, is well known. The humanity of the preſent age diſpoſes us to ſympathiſe with the relations of the deceaſed, inſtead of demanding that the ſentence of the law ſhould be executed. It is a generally received opinion, and a juſt one, that puniſhments decreed by human laws ſhould be directed only againſt ſuch crimes as are injurious to ſociety; but when it is hence inferred, that ſuicide ought not to be ſubject to the cognizance of human laws, every rule of logic is violated. There is no man, however mean in ſtation and in talents, whoſe life may not, on ſome occaſions, be uſeful to the community at large; and to conclude, that a perſon who fancies himſelf uſeleſs may therefore lawfully put a period to his life, is as falſe reaſoning as it would be to conclude, that by killing a poor man, who lives on the public, we ſhould perform an action not only innocent but meritorious, as we ſhould thereby free ſociety from one of its burdens.

SUIDAS, a Greek writer, according to ſome, flouriſhed in the 11th century, under the reign of the emperor Alexius Comnenus; according to others, before the 10th century. He wrote in Greek an Hiſtorical and Geographical Dictionary or Lexicon; a work which, though not always ſtrictly accurate, is nevertheleſs of great importance, as it contains many things taken from the ancients that are nowhere elſe to be found. The beſt edition of Suidas is that of Kuiſter, in Greek and Latin, with notes, printed in 3 vols. fol. which has been much improved by Toup.

LAPIS SUILLUS. See *Swine-STONE*, MINERALOGY *Index*.

SUIT, is uſed in different ſenſes; as, 1. Suit of court, or ſuit-ſervice, which is an attendance the tenant owes to his lord's court. 2. Suit-covenant, where a perſon has covenanted to do ſervice in the court of the lord. 3. Suit-cuſtom, which is where one and his anceſtors have owed ſuit time out of mind. 4. It is uſed for a petition to the king or any perſon of dignity, where a lord diſtrains his tenant for ſuit, and none is due. In this caſe, the party may have an attachment againſt him to appear in the king's court. Suit.

SUIT, in *Law*, the ſame with action. The Romans introduced pretty early ſet forms for actions and ſuits into their law, after the example of the Greeks; and made it a rule, that each injury ſhould be redreſſed by its proper remedy only. "*Actiones*, (ſay the Pandects) *compoſitæ ſunt quibus inter ſe homines diſceptarent, quas actiones ne populus prout vellet inſtitueret, certas ſolemneſque eſſe voluerunt.*" The forms of theſe actions were originally preſerved in the books of the pontifical college as choice and ineſtimable ſecrets, till one Cneius Flavius, the ſecretary of Appius Claudius, ſtole a copy and publiſhed them to the people. The concealment was ridiculous: but the eſtabliſhment of ſome ſtandard was undoubtedly neceſſary to fix the true ſtate of a queſtion of right; leſt, in a long and arbitrary proceſs, it might be ſhifted continually, and be at length no longer diſcernible. Or, as Cicero expreſſes it, "*ſunt jura, ſunt formulæ, de omnibus rebus conſtitutæ, ne quis aut in genere injuriæ, aut in ratione actionis, errare poſſit. Expreſſæ enim ſunt ex uniuſcujuſque damno, dolore, incommodo, calumitate, injuria, publicæ à pretore formulæ, ad quas privata lis accommodatur.*" And in the ſame manner Bracton, ſpeaking of the original writs upon which all our actions are founded, declares them to be fixed and immutable, unleſs by authority of parliament. And all the modern legiſlators of Europe have found it expedient, from the ſame reaſons, to fall into the ſame or a ſimilar method. In England, the ſeveral ſuits, or remedial inſtruments of juſtice, are, from the ſubject of them, diſtinguiſhed into three kinds; actions *perſonal*, *real*, and *mixed*. *Blackſt. Comment.*

Perſonal actions are ſuch whereby a man claims a debt, or perſonal duty or damages, in lieu thereof; and likewiſe whereby a man claims a ſatisfaction in damages for ſome injury done to his perſon or property. The former are ſaid to be founded upon contracts, the latter upon *torts* or wrongs: and they are the ſame which the civil law calls, "*actiones in perſonam, quæ adverſus eum intenduntur qui ex contractu vel delicto obligatus eſt aliquid dare vel concedere.*" Of the former nature are all actions upon debt or promiſes; of the latter are all actions of treſpaſſes, nuiſances, aſſaults, defamatory words, and the like.

Real actions (or, as they are called in the Mirror, *feodal actions*), which concern real property only, are ſuch whereby the plaintiff, here called the *demandant*, claims title to have any lands or tenements, rents, commons, or other hereditaments, in fee-ſimple, fee-tail, or for term of life. By theſe actions formerly all diſputes concerning real eſtates were decided; but they are now pretty generally laid aſide in practice, upon account of the great nicety required in their management, and the inconvenient length of their proceſs; a much more expeditious method of trying titles being ſince introduced, by other actions perſonal and mixed.

Mixed actions are ſuits partaking of the mixture of the other two, wherein ſome real property is demanded, and alſo perſonal damages for a wrong ſuſtained. As for inſtance, an action of waſte; which is brought by him who hath the inheritance, in remainder or reverſion, againſt the tenant for life, who hath committed waſte therein,

Suit || Sulzer.

therein, to recover not only the land waſted, which would make it merely a real action; but alſo treble damages, in purſuance of the ſtatute of Glouceſter, which is a perſonal recompenſe; and ſo both, being joined together, denominate it a *mixed action*.

The orderly parts of a ſuit are theſe: 1. The original *writ*. 2. The *proceſs*. 3. The *pleadings*. 4. The *iſſue* or demurrer. 5. The *trial*. 6. The *judgment* and its incidents. 7. The proceedings in nature of *appeals*. 8. The *execution*. See theſe articles.

SULLY. See BETHUNE.

SULPHATE, in *Chemiſtry*, denotes a compound of ſulphuric acid with ſome baſe.

SULPHUR, a well known inflammable ſubſtance. See CHEMISTRY and MINERALOGY *Index*.

SULPHUR-Wort. See PEUCEDANUM, BOTANY *Index*.

SULPHURIC ACID, the name now adopted for the vitriolic acid. See CHEMISTRY *Index*.

SULPICIA, an ancient Roman poeteſs, who lived under the reign of Domitian, and has been ſo much admired as to be termed the *Roman Sappho*. We have nothing, however, left of her writings but a ſatire, or rather the fragment of one, againſt Domitian, who publiſhed a decree for the baniſhment of philoſophers from Rome; which ſatire is to be found in Scaliger's *Appendix Virgiliana*. She is mentioned by Martial and Sidonius Apollinaris; and is ſaid to have addreſſed a poem on conjugal love to her huſband Calenus, a Roman knight.

SULPICIUS SEVERUS, an eccleſiaſtical writer who flouriſhed about the beginning of the 5th century, and was contemporary with Rufinus and St Jerome. He was the diſciple of St Martin of Tours, whoſe life he has written; and the friend of Paulinus biſhop of Nola, with whom he held an intimate correſpondence. The principal of his works is his *Hiſtoria Sacra*, from the creation of the world to the conſulate of Stilicho and Aurelian, about the year 400; in which his ſtyle is elegant beyond the age he lived in.

SULTAN, or SOLDAN, a title of appellation given to the emperor of the Turks.

Vatner will have the word Turkiſh, and to ſignify *king of kings*; adding, that it was firſt given to the Turkiſh princes Angrolipex and Maſgud, about the year 1055: others will have it originally Perſian, alleging, in proof hereof, an ancient medal of Coſroe; others derive it from *ſoldanus*, *quaſi ſolus dominus*; others from the Hebrew שלט, *ſchalat* or *ſheleth*, "to rule, reign."

It had its riſe under Mahmoud, ſon of Sebecteghin, the firſt emperor of the dynaſty of the Gaznevides, towards the cloſe of the fourth century of the era of the Hegira: when that prince going to Segeſtan to reduce Kalaf governor of that province, who affected the ſovereignty, Kalaf was no ſooner advertiſed of his coming than he went out to meet him, delivered the keys of his fortreſs, and owned him his *ſultan*, that is, his lord or commander. The title pleaſed Mahmoud ſo well, that he aſſumed it ever afterwards; and from him it paſſed to his deſcendants, and to other Mahometan princes. It is chiefly confined to the Turkiſh and Perſian monarchs.

SULZER, M. a celebrated philoſopher, was born at Winterthur, in the canton of Zurich, October 16. 1720. He was the youngeſt of 25 children. His early education did not promiſe much, though it was by no means neglected. He had little inclination for what is called in the ſchools the ſtudy of *humanity*, and made but a ſmall progreſs in the learned languages, which were to prepare him for the ſtudy of theology, for which profeſſion his parents deſigned him. At the age of 16, when he went to the academical ſchool of Zurich, he had not the ſmalleſt notion of the ſciences, or of elegant literature, and conſequently no taſte for ſtudy. The firſt incident that developed a hidden germ of philoſophical genius, was his meeting with Wolfe's Metaphyſics: this was the birth of his taſte for ſcience; but he wanted a guide. The clergyman with whom he lodged was an ignorant man; and the academical prelections were, as yet, above the reach of his comprehenſion. On the other hand, a ſedentary life was not the thing he liked, nor to which he had been acuſtomed; and, moreover, a ſociable turn of mind led him often into company, where he loſt much time in frivolous amuſements, yet without corrupting his morals. Who, that obſerved him at this period, ſays Mr Formey in his *Eulogium*, would have thought that Sulzer would one day be numbered among the moſt knowing and wiſe men of his time? The learned Geſner was the inſtrument of Providence that rendered Sulzer's inclination to ſtudy triumphant over his paſſion for amuſement and company. Animated by the counſels and example of this worthy and learned man, he applied himſelf to philoſophy and mathematics with great ardour, and reſumed the purſuit of Grecian literature and the Oriental languages. The contemplation of nature became his noble and favourite paſſion. An eccleſiaſtical ſettlement in a rural ſcene, that exhibited happy objects and occaſions for this delightful ſtudy, began to render his days happy and uſeful; and he publiſhed, in 1741, Moral Contemplations of the Works of Nature; and the year following an Account of a Journey he had made through the Alps; which ſhowed at the ſame time, his knowledge of natural hiſtory, and the taſte and ſenſibility with which he ſurveyed the beauties of nature and the grandeur and goodneſs of its Author. He afterwards became private tutor to a young gentleman at Magdeburg. This procured him the acquaintance of Meſſrs Maupertuis, Euler, and Sack, which opened to his merit the path of preferment, and advanced him ſucceſſively to the place of mathematical profeſſor in the King's College at Berlin, in 1747, and to that of member of the Royal Academy in 1750.

Sulzer.

In this laſt quality he diſtinguiſhed himſelf in a very eminent manner, enriched the claſs of ſpeculative philoſophy with a great number of excellent memoirs, and was juſtly conſidered as one of the firſt-rate metaphyſicians in Germany. But his genius was not confined to this branch of ſcience. His univerſal Theory of the Fine Arts is a valuable production. A profound knowledge of the arts and ſciences, and a perfect acquaintance with true taſte, are eminently diſplayed in this work, and will ſecure to its author a permanent and diſtinguiſhed rank in the republic of letters. The firſt volume of this excellent work was publiſhed in 1771, and the ſecond in 1774. We ſhall not here give a catalogue of the writings of M. Sulzer; but we cannot help mentioning his remarks on the Philoſophical Eſſays of the late Mr Hume as a work of real merit, which does juſtice to the acuteneſs, while it often detects the ſophiſtry, of the Britiſh Bayle. The moral character of M. Sulzer was amiable and virtuous: ſociability and benefi-

cence

Sulzer ‖ Sumatra.

cence were its characteriſtical lines; and his virtues were animated by that ſacred philoſophy that forms the Chriſtian, ennobles man, and is the only ſource of that heart-felt ſerenity and ſedate fortitude which ſupport humanity, when every other object of confidence fails. His dying moments were calm, humble, and ſublime; and when he expired, the placid and compoſed air of his countenance made his mourning friends doubt, for ſome time, whether it was death or ſleep that had ſuſpended his converſation. He had no enemy; and his friends were numerous, affectionate, and worthy of the tender returns he made them.

The king of Pruſſia diſtinguiſhed him by repeated marks of munificence and favour. But his royal protector had never ſeen him before the end of the year 1777, though he had been member of the academy from the year 1750. The audience, indeed, though late vouchſafed, was honourable to M. Sulzer, with whom the monarch converſed for a long time with great condeſcenſion.

SUM, ſignifies the quantity that ariſes from the addition of two or more magnitudes, numbers, or quantities together.

SUMACH. See RHUS, BOTANY *Index*.

SUMATRA, an iſland of Aſia, the moſt weſtern of the Sunda iſlands, and conſtituting on that ſide the boundary of the Eaſtern Archipelago. Its general direction is nearly north-weſt and ſouth-eaſt. The equator divides it into almoſt equal parts, the one extremity being in 5. 53. N. and the other in 5. 56. S. Lat. Acheen Head, at the north extremity of the iſland, is in longitude 95. 34. eaſt. It lies expoſed on the ſouth-weſt ſide to the Indian ocean; the north point ſtretches into the bay of Bengal; to the north-eaſt it is divided from the peninſula of Malacca by the ſtraits of that name; to the eaſt by the ſtraits of Banca, from the iſland of that name; to the ſouth-eaſt by the commencement of what are called the *Chineſe ſeas;* and on the ſouth by the ſtraits of Sunda, which ſeparate it from the iſland of Java. It is about 900 miles in length, but from 100 to 150 only in breadth. No account had been given of this iſland by any Engliſhman till the year 1778, when Mr Charles Miller (ſon of the late botanical gardener) publiſhed an account of the manners of a particular diſtrict, in the 68th volume of the Philoſophical Tranſactions. Theſe were the Battas, a people who live in the interior parts, called the *Caſſia Country*. They differ from all the other inhabitants in language, manners, and cuſtoms. They eat the priſoners whom they take in war, and hang up their ſkulls as trophies in their houſes. He obſerves, however, that human fleſh is eaten by them *in terrorem*, and not as common food, though they prefer it to all others, and ſpeak with peculiar raptures of the ſoles of the feet and palms of the hands. They expreſſed much ſurpriſe that the white people did not kill, much leſs eat, their priſoners. From this country the greateſt part of the caſſia that is ſent to Europe is procured. It abounds alſo with the camphire trees, which conſtitute the common timber in uſe; and in theſe trees the camphire is found native, in a concrete form. It is remarkable that, in this ſtate, it is ſold to the Chineſe at the price of 250l. or 300l. per cent.; but theſe dexterous artiſts contrive to furniſh the Europeans with it at about a quarter of that price. In 1783, Mr Marſden, who had been ſecretary to the preſident and council of Fort Marlborough, publiſhed a

Brooke's Gazetteer.

Sumatra.

Hiſtory of Sumatra, with very copious particulars of the iſland. He repreſented it as ſurpaſſed by few in the beautiful indulgences of nature. A chain of high mountains runs through its whole extent; the ranges in many parts being double and treble; their altitude, though great, is not ſufficient to occaſion their being covered with ſnow during any part of the year. Between theſe ridges are extenſive plains, conſiderably elevated above the ſurface of the maritime lands. In theſe the air is cool; and from this advantage they are eſteemed the moſt eligible portion of the country, are the beſt inhabited, and the moſt cleared from woods, which elſewhere, in general, throughout Sumatra, cover both hills and valleys with an eternal ſhade. Here too are found many large and beautiful lakes, that facilitate much the communication between the different parts. The heat of the air is far from being ſo intenſe as might be expected from a country occupying the middle of the torrid zone; and it is more temperate than many regions within the tropics; the thermometer at the moſt ſultry hour, about two in the afternoon, generally fluctuating between 82 and 85 degrees. Mr Marſden divides the inhabitants into Malays, Acheneſe, Battas, Lampoons, and Rejangs; and he takes the latter as his ſtandard of deſcription, with reſpect to the perſons, manners, and cuſtoms, of the inhabitants. They are rather below the middle ſtature; ther bulk in proportion; their limbs for the moſt part ſlight, but well ſhaped, and particularly ſmall at the wriſts and ancles; and, upon the whole, they are gracefully formed. Their hair is ſtrong, and of a ſhining black. The men are beardleſs, great pains being taken to render them ſo when boys, by rubbing their chins with a kind of quicklime. Their complexion is properly yellow, wanting the red tinge that conſtitutes a copper or tawney colour. They are in general lighter than the Meſtees, or half-breed, of the reſt of India; thoſe of the ſuperior claſs, who are not expoſed to the rays of the ſun, and particularly their women of rank, approaching to a degree of fairneſs. If beauty conſiſted in this one quality, ſome of them would ſurpaſs our brunettes in Europe. The major part of the females are ugly, many of them even to diſguſt; yet among them are ſome whoſe appearance is ſtrikingly beautiful, whatever compoſition of perſon, features, and complexion, that ſentiment may be the reſult of. Some of the inhabitants of the hilly parts are obſerved to have the ſwelled neck or goitre; but they attempt no remedy for it, as theſe wens are conſiſtent with the higheſt health. The rites of marriage among the Sumatrans conſiſt ſimply in joining the hands of the parties, and pronouncing them man and wife without much ceremony, excepting the entertainment which is given upon the occaſion by the father of the girl. The cuſtoms of the Sumatrans permit their having as many wives as they can purchaſe, or afford to maintain; but it is extremely rare that an inſtance occurs of their having more than one, and that only among a few of the chiefs. This continence they owe, in ſome meaſure, to their poverty. The dictates of frugality are more powerful with them than the irregular calls of appetite, and make them decline an indulgence from which their law does not reſtrain them. Mothers carry their children, not on the arm as our nurſes do, but ſtraddling on the hip, and uſually ſupported by a cloth which ties in a knot on the oppoſite ſhoulder. The children are nurſed but little; are not

confined

Sumatra. confined by any ſwathing or bandages; and being ſuffered to roll about the floor, ſoon learn to walk and ſhift for themſelves. When cradles are uſed, they ſwing ſuſpended from the ceilings of the rooms.

The Sumatrans are ſo fond of cock-fighting, that a father on his death-bed has been known to deſire his ſon to take the firſt opportunity of matching a cock for a ſum equal to his whole property, under a blind conviction of its being invulnerable. When a cock is killed or runs, the other muſt have ſufficient ſpirit and vigour left to peck at him three times on his being held up to him for that purpoſe, or it becomes a drawn battle; and ſometimes an experienced cocker will place the head of his vanquiſhed bird in ſuch an uncouth ſituation as to terrify the other, and render him unable to give this proof of victory.

The wild beaſts of Sumatra are tigers, elephants, rhinoceroſes, bears, and monkeys. The tigers prove to the inhabitants both in their journeys and even their domeſtic occupations moſt deſtructive enemies. The number of people annually ſlain by theſe rapacious tyrants of the woods is almoſt incredible. Whole villages have been depopulated by them; yet from a ſuperſtitious prejudice, it is with difficulty they are prevailed upon, by a large reward which the India Company offers, to uſe methods of deſtroying them, till they have ſuſtained ſome particular injury in their own family or kindred. The ſize and ſtrength of the ſpecies which prevails on this iſland is prodigious. They are ſaid to break with a ſtroke of their fore paw the leg of a horſe or a buffalo; and the largeſt prey they kill is without difficulty dragged by them into the woods. This they uſually perform on the ſecond night, being ſuppoſed on the firſt to gratify themſelves with ſucking the blood only. Time is by this delay afforded to prepare for their deſtruction, either by ſhooting them, or placing a veſſel of water ſtrongly impregnated with arſenic near the carcaſe, which is faſtened to a tree to prevent its being carried off. The tiger having ſatiated himſelf with the fleſh, is prompted to aſſuage his thirſt with the tempting liquor at hand, and periſhes in the indulgence. Their chief ſubſiſtence is moſt probably the unfortunate monkeys with which the woods abound. They are deſcribed as alluring them to their fate by a faſcinating power, ſimilar to what has been ſuppoſed of the ſnake; and, ſays Mr Marſden, "I am not incredulous enough to treat the idea with contempt, having myſelf obſerved, that when an alligator or a crocodile, in a river, comes under an overhanging branch of a tree, the monkeys, in a ſtate of alarm and diſtraction, crowd to the extremity, and, chattering and trembling, approach nearer and nearer to the amphibious monſter that waits to devour them as they drop, which their fright and number render almoſt unavoidable." Theſe alligators likewiſe occaſion the loſs of many inhabitants, frequently deſtroying the people as they bathe in the river, according to their regular cuſtom, and which the perpetual evidence of the riſk attending it cannot deter them from. A ſuperſtitious idea of their ſanctity alſo preſerves them from moleſtation, although, with a hook of ſufficient ſtrength, they may be taken without much difficulty. The other animals of Sumatra are buffaloes, a ſmall kind of horſes, goats, hogs, deer, bullocks, and hog-deer. This laſt is an animal ſomewhat larger than a rabbit, the head reſembling that of a hog, and its ſhanks and feet like thoſe of the deer. The bezoar-ſtone found on this animal has been valued at 10 times its weight in gold; it is of a dark brown colour, ſmooth on the outſide; and the coat being taken off, it appears ſtill darker, with ſtrings running underneath the coat: it will ſwim on the top of the water. If it be infuſed in any liquid, it makes it extremely bitter: the virtues uſually attributed to this ſtone are cleanſing the ſtomach, creating an appetite, and ſweetening the blood. Sumatra.

Of birds they have a greater variety than of beaſts. The coo-ow, or Sumatran pheaſant, is a bird of uncommon beauty. They have ſtorks of prodigious ſize, parrots, dung-hill fowls, ducks, the largeſt cocks in the world, wood-pigeons, doves, and a great variety of ſmall birds, different from ours, and diſtinguiſhed by the beauty of their colours. Of the reptiles, they have lizards, flying-lizards, and cameleons. The iſland ſwarms with inſects, and their varieties are no leſs extraordinary than their numbers. Rice is the only grain that grows in the country; they have ſugar-canes, beans, peaſe, radiſhes, yams, potatoes, pumkins, and ſeveral kinds of pot-herbs unknown to Europe; and here are to be found moſt of the fruits to be met with in other parts of the Eaſt Indies, in the greateſt perfection. Indigo, Braſil-wood, two ſpecies of the bread fruit tree, pepper, benjamin, coffee, and cotton, are likewiſe the produce of this iſland, as well as caſſia and camphire mentioned above. Here alſo is the cabbage-tree and ſilk cotton tree; and the foreſts contain a great variety of valuable ſpecies of wood, as ebony, pine, ſandal, eagle or aloes, teek, manchineel, and iron-wood, and alſo the banyan tree. Gold, tin, iron, copper, and lead, are found in the country; and the former is ſuppoſed to be as plentiful here as in Peru or Mexico. The fineſt gold and gold-duſt are found in the country of *Limong*, immediately contiguous to the preſidency of *Fort Marlborough*, to which the merchants repair annually for the purchaſe of opium, and ſuch other articles as they may be in want of, and give for them gold of ſo pure a nature as to contain little or no alloy. The native indolence of the *Malay* diſpoſition prevents them from collecting more than is ſufficient to ſupply the few and ſimple wants of a race of men as yet unenlightened by civilization and ſcience, and ignorant of the full extent of the advantages of the country inhabited by them. The roads leading to this golden country are almoſt impervious; affording only a ſcanty path to a ſingle traveller, where whole nights muſt be paſſed in the open air, expoſed to the malignant influence of a hoſtile climate, in a country infeſted by the moſt ferocious wild beaſts. Theſe are circumſtances that have hitherto checked curioſity; but perſeverance and ſtudied precaution will ſurmount the obſtacles they furniſh, and ſuch diſcoveries might be made as would amply compenſate for the difficulties leading to them. The gold merchants who come from the neighbouring and leſs rich countries, give us ſuch accounts of the facility of procuring gold as border nearly on the marvellous, and would be altogether incredible, if great quantities of that metal produced by them did not in ſome degree evince the certainty of their accounts. *Aſiatic Reſearches*, vol. i.

This great abundance of gold in Sumatra induces Mr Marſden to ſuppoſe that iſland to be the Ophir of Solomon; a conjecture which, in his opinion, derives no ſmall force from the word *Ophir's* being really a *Malay* ſubſtantive, of a compound ſenſe, ſignifying a mountain containing

Sumatra || Sump.

containing gold. The natives, he confeſſes, have no oral tradition on the ſubject; and we have elſewhere made it probable that Ophir was ſituated in a different quarter of the world (ſee OPHIR). Beſides the metals and different ſpecies of wood which we have mentioned, Sumatra produces ſulphur, arſenic, ſaltpetre, and becs-wax, with edible birds-neſts, which are there commodities of great importance (ſee *BIRDS-Neſts*).

The Engliſh and Dutch have factories on this iſland; the principal one of the former being Fort Marlborough, on the ſouth-weſt coaſt. The original natives of Sumatra are Pagans; but it is to be obſerved, that when the Sumatrans, or any of the natives of the eaſtern iſlands, learn to read the Arabic character, and ſubmit to circumciſion, they are ſaid to become Malays; the term *Malay* being underſtood to mean *Muſſulman*. See ACHEEN.

SUMMARY, in matters of literature. See ABRIDGEMENT.

SUMMER, the name of one of the ſeaſons of the year, being one of the quarters when the year is divided into four quarters, or one half when the year is divided only into two, ſummer and winter. In the former caſe, ſummer is the quarter during which, in northern climates, the ſun is paſſing through the three ſigns Cancer, Leo, Virgo, or from the time of the greateſt declination, till the ſun come to the equinoctial again, or have no declination; which is from about the 21ſt of June till about the 22d of September. In the latter caſe, ſummer contains the ſix warmer months, while the ſun is on one ſide of the equinoctial; and winter the other ſix months, when the ſun is on the other ſide of it. It is ſaid that a froſty winter produces a dry ſummer, and a mild winter a wet ſummer.

SUMMER-Iſlands. See BERMUDAS.

SUMMER Red-Bird. See MUSCICAPA, ORNITHOLOGY *Index*.

SUMMIT, the top or vertex of any body or figure, as of a triangle, cone, pyramid, &c.

SUMMONS, in *Law*, a citing or calling a perſon to any court, to anſwer a complaint or to give his evidence.

SUMMONS, in *War*. To ſummon a place, is to ſend a drum or trumpet to command the governor to ſurrender, and to declare that if the place be taken by ſtorm, all muſt ſubmit to the mercy of the conqueror. See CAPITULATION and CHAMADE.

SUMMUM BONUM, in *Ethics*, the chief good.

SUMP, in *Metallurgy*, a round pit of ſtone, lined with clay within, for receiving the metal on its firſt fuſion from the ore.

SUMP, in the Britiſh ſalt-works, where ſea-water is boiled into ſalt, is the name of a ſort of pond, which is made at ſome diſtance from the ſaltern on the ſea-ſhore, between full ſea and low-water mark. From this pond a pipe is laid, through which, when it is full ſea, the water runs into a well adjoining to the ſaltern; and from this well it is pumped into troughs, through which it is carried to the ciſterns, in order to be ready to ſupply the pans. See SALT.

SUMP, in *Mining*, denotes a pit ſunk down in the bottom of the mine, to cut or prove the lode ſtill deeper than before; and in order to ſlope and dig it away if neceſſary, and alſo to drive on the lode in depth. The ſump principally ſerves as a baſon or reſervoir, to collect the water of a mine together, that it may be cleaned out by an engine or machine.

Sump || Sunda-iſlands.

SUMPTER-HORSE, is a horſe that carries proviſions and neceſſaries for a journey.

SUMPTUARY LAWS (*Leges Sumptuariæ*), are laws made to reſtrain exceſs in apparel, coſtly furniture, eating, &c.

Moſt ages and nations have had their ſumptuary laws; and ſome retain them ſtill, as the Venetians, &c. But it is obſerved, that no laws are worſe executed than ſumptuary laws. Political writers have been much divided in opinion with reſpect to the utility of theſe laws to a ſtate. Monteſquieu obſerves that luxury is neceſſary in monarchies, as in France, but ruinous to democracies, as in Holland. With regard to England, whoſe government is compounded of both ſpecies, it may ſtill be a dubious queſtion, ſays Judge Blackſtone, how far private luxury is a public evil; and as ſuch cognizable by public laws.

The ſumptuary laws of the ancient Locrian legiſlator Zaleucus are famous: by theſe it was ordained that no woman ſhould go attended with more than one maid in the ſtreet except ſhe were drunk: that ſhe ſhould not go out of the city in the night, unleſs ſhe went to commit fornication: that ſhe ſhould not wear any gold or embroidered apparel, unleſs ſhe propoſed to be a common ſtrumpet; and that men ſhould not wear rings or tiſſues except when they went a whoring, &c.

Among the Romans, the ſumptuary laws were very numerous: By the *Lex Orchia*, the number of gueſts at feaſts was limited, though without any limitation of the charges: by the Fannian law, made 22 years afterwards, it was enacted, that more than 10 *aſſes* ſhould not be ſpent at any ordinary feaſt: for the ſolemn feaſts, as the Saturnalia, &c. an hundred aſſes were allowed; ten of which, Gellius informs us, was the price of a ſheep, and a hundred of an ox. By the Didian law, which was preferred 18 years after, it was decreed, that the former ſumptuary laws ſhould be in force, not only in Rome, but throughout all Italy; and that for every tranſgreſſion, not only the maſter of the feaſt, but all the gueſts too, ſhould be liable to the penalty.

The Engliſh have had their ſhare of ſumptuary laws, chiefly made in the reigns of Edward III. Edward IV. and Henry VIII. againſt ſhoes with long points, ſhort doublets, and long coats; though all repealed by ſtatute 1 Jac. I. c. 25. As to exceſs in diet, there remains ſtill one law unrepealed. Under King Henry IV. Camden tells us, pride had got ſo much into the foot, that it was proclaimed, that no man ſhould wear ſhoes above ſix inches broad at the toes. And their outer garments were ſo ſhort, that it was enacted, 25 Edward IV. that no perſon, under the condition of a lord, ſhould from that time, wear any mantle or gown, unleſs of ſuch length, that, ſtanding upright, it might cover the lower part of the trunk of his body.

SUN, SOL, ☉, in *Aſtronomy*, the great luminary which enlightens the world, and by its preſence conſtitutes day. See ASTRONOMY *Index*.

Mock-SUN. See PARHELION.

Sun-Fiſh, a ſpecies of ſhark. See SQUALUS, ICHTHYOLOGY *Index*.

SUN-Flower. See HELIANTHUS, } BOTANY *Index*.
SUN-Dew. See DROSERA, }

SUNDA-ISLANDS, a general name for a cluſter of

Sunda-islands || Superero-gation.

islands in the Indian ocean, between 93° and 120° of eaſt longitude, and between 8° north and 8° ſouth latitude. The particular names of the iſlands are *Borneo*, *Sumatra*, *Java*, *Bally*, *Banca*, &c.

SUNDAY, or the LORD'S-DAY, a ſolemn feſtival obſerved by Chriſtians on the firſt day of every week, in memory of our Saviour's reſurrection. See SABBATH.

In the breviary and other offices we meet with Sundays of the firſt and ſecond claſs. Thoſe of the firſt claſs are, Palm, Eaſter, Advent, and Whitſunday, thoſe of *Quaſimodo* and *Quadrageſima*. Thoſe of the ſecond claſs are the common Sundays. Anciently each Sunday in the year had its particular name, which was taken from the introit of the day; which cuſtom has only been continued to ſome few in lent; as *Reminiſcere*, *Oculi*, *Lætare*, *Judica*.

Some are of opinion that the Lord's day, mentioned in the Apocalypſe, is our Sunday; which they believe was ſo early inſtituted by the apoſtles. Be this as it will, it is certain a regard was had to this day even in the earlieſt ages of the church; as appears from the firſt apology of Juſtin Martyr, where he deſcribes the exerciſe of the day not much unlike to ours.

But it was Conſtantine the Great who firſt made a law for the proper obſervation of Sunday; and who, according to Euſebius, appointed it ſhould be regularly celebrated throughout the Roman empire. Before him, and even in his time, they obſerved the Jewiſh Sabbath as well as Sunday; both to ſatisfy the law of Moſes and to imitate the apoſtles, who uſed to meet together on the firſt day.

By Conſtantine's laws, made in 321, it was decreed, that for the future the Sunday ſhould be kept a day of reſt in all cities and towns; but he allowed the country people to follow their work. In 538, the council of Orleans prohibited country labour; but becauſe there were ſtill many Jews in Gaul, and the people fell into many ſuperſtitious uſes in the celebration of the new Sabbath, like thoſe of the Jews among that of the old, the council declares, that to hold it unlawful to travel with horſes, cattle, and carriages, to prepare food, or to do any thing neceſſary to the cleanlineſs and decency of houſes or perſons, favours more of Judaiſm than of Chriſtianity. See *SABBATH-Breaking*.

SUNDAY-Schools. See *Sunday-SCHOOLS*.

SUOVETAURILIA, an ancient Roman ſacrifice, ſo called becauſe it conſiſted of a pig (*ſus*), a ſheep or rather ram (*ovis*), and a bull (*taurus*). They were all males, to denote the maſculine courage of the Roman people. It was likewiſe called *ſolitaurilia*, becauſe the animals offered up were always *ſolida*, whole or uncut.

SUPERCARGO, a perſon employed by merchants to go a voyage, and overſee their cargo or lading, and diſpoſe of it to the beſt advantage.

SUPERCILIUM, in *Anatomy*, the eye-brow. See ANATOMY, N° 142.

SUPEREROGATION, in *Theology*, what a man does beyond his duty, or more than he is commanded to do. The Romaniſts ſtand up ſtrenuouſly for works of ſupererogation, and maintain that the obſervance of evangelical councils is ſuch. By means hereof, a ſtock of merit is laid up, which the church has the diſpoſal of, and which ſhe diſtributes in indulgences to ſuch as need.

This abſurd doctrine was firſt invented towards the cloſe of the 12th century, and modified and embelliſhed by St Thomas in the 13th: according to which, it was pretended that there actually exiſted an immenſe treaſure of merit, compoſed of the pious deeds and virtuous actions which the ſaints had performed beyond what was neceſſary for their own ſalvation, and which were therefore applicable to the benefit of others; that the guardian and diſpenſer of this precious treaſure was the Roman pontiff; and that of conſequence he was empowered to aſſign to ſuch as he thought proper a portion of this inexhauſtible ſource of merit, ſuitable to their reſpective guilt, and ſufficient to deliver them from the puniſhment due to their crimes.

Superero-gation || Superior.

The reformed churches do not allow of any work of ſupererogation; but hold with the apoſtles, that when we have done our beſt, we are but unprofitable ſervants.

SUPERFETATION, in *Phyſiology*, a ſecond or after-conception, happening when the mother, already pregnant, conceives of a latter coition; ſo that ſhe bears at once two fœtuſes of unequal age and bulk, and is delivered of them at different times. We meet with inſtances of ſuperfetations in Hippocrates, Ariſtotle, Du Laurens, &c.: but they are ſaid to be much more frequent in hares and ſwine.

SUPERFICIES, or SURFACE, in *Geometry*, the outſide or exterior face of any body. This is conſidered as having the two dimenſions of length and breadth only, but no thickneſs; and therefore it makes no part of the ſubſtance or ſolid content or matter of the body.

The terms, or bounds, or extremities, of a ſuperficies, are lines; and ſuperficies may be conſidered as generated by the motions of lines. Superficies are either rectilinear, curvilinear, plane, concave, or convex. A rectilinear ſuperficies is that which is bounded by right lines. Curvilinear ſuperficies is bounded by curve lines. Plane ſuperficies is that which has no inequality in it, nor riſings, nor ſinkings, but lies evenly and ſtraight throughout, ſo that a right line may wholly coincide with it in all parts and directions. Convex ſuperficies is that which is curved and riſes outwards. Concave ſuperficies is curved and ſinks inward. See GEOMETRY.

SUPERFINE, in the manufactories, a term uſed to expreſs the ſuperlative fineneſs of a ſtuff: thus a cloth, a camblet, &c. are ſaid to be ſuperfine when made of the fineſt wool, &c. or when they are the fineſt that can be made.

SUPERFLUOUS INTERVAL, in *Muſic*, is one that exceeds a true diatonic interval by a ſemitone minor. See INTERVAL.

SUPERINTENDANT, denotes an eccleſiaſtical ſuperior in ſeveral reformed churches where epiſcopacy is not admitted; particularly among the Lutherans in Germany, and the Calviniſts in ſome other places.

The ſuperintendant is ſimilar to a biſhop; only his power is ſomewhat more reſtrained than that of our dioceſan biſhops. He is the chief paſtor, and has the direction of all the inferior paſtors within his diſtrict or dioceſe. In Germany they had formerly ſuperintendants general, who were ſuperior to the ordinary ſuperintendants. Theſe, in reality, were archbiſhops; but the dignity is ſunk into diſuſe; and at preſent none but the ſuperintendant of Wirtemberg aſſumes the quality of ſuperintendant general.

SUPERIOR, a perſon raiſed above another in rank, office, or talents.

SUPERIOR,

Superior ‖ Superſtition.

SUPERIOR, in *Scots Law*. See LAW, N° clxiv. 3. clxv. 2. and clxvi.

SUPERLATIVE, in *Grammar*, one of the three degrees of compariſon, being that inflection of adjective nouns that ſerves to augment and heighten their ſignification, and ſhows the quality of the thing denoted to be in the higheſt degree. See GRAMMAR.

SUPERNUMERARY, ſomething over and above a fixed number. In ſeveral of the offices are ſupernumerary clerks, to be ready on extraordinary occaſions.

SUPERPARTICULAR PROPORTION, or *Ratio*, is that in which the greater term exceeds the leſs by unit or 1. As the ratio of 1 to 2, or 2 to 3, or 3 to 4, &c.

SUPERPARTIENT PROPORTION, or *Ratio*, is when the greater term contains the leſs term once, and leaves ſome number greater than 1 remaining. As the ratio

of 3 to 5, which is equal to that of 1 to $1\frac{2}{1}$;
of 7 to 10, which is equal to that of 1 to $1\frac{3}{7}$, &c.

SUPERSEDEAS, in *Law*, a writ iſſued in divers caſes, importing in general a command to ſtay or forbear ſome ordinary proceedings in law, which in appearance ought to be done or purſued, were it not for the cauſe whereon this writ is granted.

Thus a man regularly is to have a ſurety of peace againſt him of whom he will ſwear he is afraid; and the juſtice required hereunto cannot deny it him: yet, if the party be formerly bound to the peace, either in chancery or elſewhere, this writ lies to ſtay the juſtice from doing that which otherwiſe he ought not to deny.

SUPERSTITION, a word that has been uſed ſo indefinitely, that it is difficult to determine its preciſe meaning. From its reſemblance in ſound to the Latin word *ſuperſtes*, "a ſurvivor," it is evidently derived from it, and different attempts have been made to trace their connection in ſignification. Balbus, in the dialogue *De Natura Deorum* of Cicero, ſays, that they who prayed and ſacrificed whole days that their children might *ſurvive* them, were called ſuperſtitious. Lactantius cenſures this etymology, and ſays they were not called ſuperſtitious who wiſhed that their children might ſurvive them (for this we all wiſh), but becauſe they who ſurvived their parents worſhipped their images. Others again ſay, that ſuperſtition is derived from *ſuperſtes*, becauſe it conſiſted in conſidering the dead as if they were alive. But theſe etymologies are ſolely conjectural; and we conſider conjectures as abſurd in philology as we do in ſcience; they may miſlead, but are ſeldom of any benefit. The uſual meaning affixed to the word *ſuperſtition*, both in the Latin and Engliſh languages, is ſo different from *ſuperſtes*, that its change of meaning muſt be owing to ſome accident which it is in vain to inquire after. If we had not known that the word *paganus*, "a pagan," was derived from *pagus*, "a village," becauſe the heathens in a certain period of the Chriſtian hiſtory lived in villages, the whims and fancies of etymologiſts would not have thrown much light on the ſubject.

Without labouring, from the aid of etymology, to define ſuperſtition, which is a word of a very extenſive ſignification, we will conſider to what objects it is applied; and then, by obſerving what is common to them all, we ſhall be enabled to fix with ſome degree of preciſion the meaning of the term. We apply it to the idolatry of the heathens; we apply it alſo to the Jews, who made the will of God of no effect by their traditions, and ſubſtituted ceremonies in place of the religion of their fathers. We ſay alſo that Chriſtians are guilty of ſuperſtition; the Roman Catholics, who believe in tranſubſtantiation and in the efficacy of prayers to ſaints; and thoſe Proteſtants who eſteem baptiſm and the Lord's ſupper, and the punctual performance of other ceremonies, without regard to morality, as ſufficient to enſure ſalvation. Thoſe perſons are alſo reckoned ſuperſtitious who believe, without any evidence, that prophecies are ſtill uttered by the divine inſpiration, and that miracles are ſtill performed. The word is alſo extended to thoſe who believe in witchcraft, magic, and apparitions, or that the divine will is declared by omens or augury; that the fortune of individuals can be affected by things indifferent, by things deemed lucky or unlucky, or that diſeaſes can be cured by words, charms, and incantations.

Superſtition.

Through all the particulars which we have enumerated, there runs one general idea, the belief of what is falſe and contrary to reaſon. From this, however, we muſt not ſuppoſe that whatever is falſe and contrary to reaſon may be denominated ſuperſtition. We think that it is falſe and irrational to ſuppoſe that there ever lived on earth a race of men who walked on one leg, and had their eyes in their breaſt; or that there were giants 90 feet high: yet we do not call the philoſopher who believes theſe chimeras ſuperſtitious, but credulous. Superſtition has always a reference to God, to religion, or to beings ſuperior to man. We do not however diſtinguiſh all falſe and irrational opinions in religion by the name of ſuperſtition. We do not, for inſtance, apply this name to the opinions which ſome of the ancients entertained, that God is the ſoul of the world, and that men are only portions of him ſeparated for a time, or that the ſoul after death lives ſucceſſively in different bodies. If we examine the ſubject with more attention, we ſhall diſcover that the foundation of ſuperſtition is ignorance of the moral attributes of God; for we never ſay a man is ſuperſtitious for entertaining erroneous opinions of the natural attributes of God. Some of the Socinians have denied the preſcience of God; and a French philoſopher has not only rejected the belief that He is a ſpirit, but has preſumed to ſay that he is compoſed of a ſpecies of cryſtals. The firſt of theſe opinions diſcovers very imperfect ideas of God, and the ſecond is the height of impiety and abſurdity; yet the Socinians have not been accuſed of ſuperſtition, nor can this French philoſopher be ſuſpected of it. We do not call every falſe opinion concerning the unity or moral attributes of God by the name of ſuperſtition, as, for inſtance, the opinion which ſome ſceptics have ſupported, that God is not good; for, as was mentioned before, ſuperſtition always involves the idea of credulity. It does not conſiſt in falſely denying that God poſſeſſes any particular moral attributes, but in believing more than what is true concerning them; in forming mean, unworthy ideas of them; in ſuppoſing that he is guided by blind paſſion like mankind, and enjoins upon his creatures commandments which are irrational and abſurd.

As ſuperſtition ariſes from ignorance and credulity in the underſtanding, ſo it has alſo a ſeat in the paſſions. Fear has been commonly conſidered as a paſſion of the human mind from which it chiefly derives its origin;

Superſtition.

and there is no doubt that more ſuperſtition has ariſen from fear united with ignorance and credulity than from any other paſſion. Yet it would certainly be improper to exclude all other paſſions. We cannot account for the ſuperſtition of the Egyptians, without ſuppoſing that much of it aroſe from gratitude. They worſhipped the Nile, becauſe it diſtributed fertility and abundance over the land of Egypt; and they worſhipped ſome animals, merely becauſe they prevented the increaſe of other animals which were noxious. Thus they adored the ibis, becauſe it deſtroyed the eggs of the crocodile.

Having thus endeavoured to analyze the ideas comprehended under the word ſuperſtition, we may ſum them up in a few words. It reſpects God and beings ſuperior to man, and extends to our religious opinions, worſhip, and practices; and may be defined *abſurd opinions and actions ariſing from mean and defective ideas of the moral attributes of God.* Let us apply this definition to the different ſpecies of ſuperſtition already mentioned.

But before entering upon this application, it may be proper to obſerve, that ſuperſtition involves the idea of a blameable inattention to reaſon, or a credulity ariſing from an indolence of underſtanding. We generally make a diſtinction between the imperfect opinions which a ſavage, from the neceſſary effects of his ſituation, forms of the attributes of God, and thoſe which civilized nations entertain. We ſay the ſavage is ignorant, and we aſcribe his ignorance to his ſituation; but we call the Roman Catholic ſuperſtitious, and we blame him for not having thoſe juſt ideas of God which he might have obtained by opening his Bible, or by the exerciſe of his underſtanding in the favourable ſituation in which he is placed. Superſtition then does not originate ſo much from the natural weakneſs of the human underſtanding, as from a miſapplication or a neglect of it (A).

We cannot therefore with any propriety apply the name *ſuperſtition* to polytheiſm in general; for what all the ancient philoſophers, after much ſtudy and reflection, concluded to be true, could never proceed from credulity and inattention, but from their ſituation. We ſpeak very properly, however, when we call idolatry by the name of ſuperſtition; becauſe there is no man ſo devoid of underſtanding as not to be capable of diſcovering, that a piece of metal, or wood, or ſtone, can neither hear nor anſwer petitions. *Superſtition* was a name which the ancient philoſophers gave to thoſe who entertained mean opinions of the gods, or did fooliſh things to obtain their favour. According to Theophraſtus, the ſuperſtitious man is one who, having waſhed his hands, and ſprinkled himſelf all round, leaves the temple with a laurel leaf in his mouth, with which he walks about the whole day. Or, if a weaſel ſhould croſs the road, he will not advance a ſtep till he has thrown three ſtones over the road. If he find a ſerpent in his houſe, he rears a place of devotion on the ſpot. He purifies his houſe often, will not ſit upon a grave, or touch a dead perſon. He is anxious about the interpretation of his dreams, will not offer a ſacrifice unleſs his wife go along with him, or, if ſhe is engaged, he takes the nurſe and the little children. He purifies himſelf with onions; and when he ſees a mad or an epileptic perſon, he ſpits in their boſom. Such was the character of ſuperſtition in the days of Theophraſtus. All theſe whimſical ceremonies were done to prevent miſchief, and to avert the wrath of the gods; and therefore perfectly correſpond with the definition given above.

Theophraſtus's Characters, xvi.

Superſtition.

It is only neceſſary to conſider a little the ſuperſtitious opinions and practices among Jews and Chriſtians, to be ſenſible that they have all ariſen from mean and abſurd ideas of the moral attributes of God; for they have generally entertained noble opinions of his natural attributes. The Jews conſidered God as a partial Being, who had a predilection for their nation in preference to all others, and preferred external homage and ceremony to moral purity. If the Roman Catholics think conſiſtently, they muſt eſteem God as a Being who can be prevailed upon by the importunity of one dead man to aſſiſt another, or as a Being whoſe patience would be fatigued with hearing prayers conſtantly. Hence their practice of praying to ſaints. They in effect believe, however they may deceive themſelves, that God is unjuſt, or they could not believe tranſubſtantiation; for it ſuppoſes that God can give commands directly contrary to thoſe principles of belief with which he has endued the human mind. They conſider a ſtrict adherence to a variety of ceremonies, to forms, to pomp, and ſhow, as eſſential to the worſhip of God: this is treating God as a vainglorious Being. They thought it their duty to extirpate heretics: this was ſuppoſing God a cruel and revengeful Being. Even among Proteſtants, we are ſorry to ſay, a great deal of ſuperſtition remains: we have not yet learned to conſider God as a ſpirit, who is to be worſhipped in ſpirit and in truth, as a pure moral benevolent Being; and hence ariſe all the ſuperſtitious practices which prevail among us.

Beſides thoſe ſuperſtitious opinions and practices which entirely reſpect our duty to God, there are others which may be termed *vulgar ſuperſtitions.* Theſe alſo ariſe from imperfect and mean ideas of the moral attributes of God. To believe vulgar prophecies, which are always the effuſions of madneſs or knavery, is to ſuppoſe that God, who has drawn a veil over futurity, and only delivers prophecies to accompliſh ſome great moral purpoſe, ſometimes gives them for no purpoſe at all, or to gratify idle curioſity, or to diſcloſe ſuch a knowledge of what is to happen as is inconſiſtent with the free agency of man and the moral adminiſtration of the world. Nor is it leſs ſuperſtitious to believe in vulgar miracles. To believe in them, is to believe that God ſuſpends the laws of nature for the moſt trivial purpoſes, or to countenance fraud and worldly ambition: it is to receive the moſt extraordinary facts upon the moſt unſatisfactory evidence. The belief of witchcraft, of apparitions, and the ſecond ſight, may be reſolved into the ſame principle. To ſuppoſe that God would communicate the power of doing miſchief, and of controuling his laws, to any being merely for gratifying their own paſſions, is unworthy of God. The belief of apparitions is equally inconſiſtent with the goodneſs of God (ſee SPECTRE). The

ſame

(A) We do not pretend to ſay that this is the ſenſe in which ſuperſtition is always uſed, becauſe it is often uſed improperly.

Superſtition. ſame objection riſes againſt the ſecond-ſight as againſt the belief of vulgar prophecies, and may alſo be extended to omens, to aſtrology, to things lucky and unlucky, to fortune-telling, &c. As to the different devices and charms for preventing and curing diſorders, they reſemble in every reſpect falſe miracles.

A judicious hiſtory of ſuperſtition would be a curious and entertaining work, and would exhibit the human character in a remarkable point of view. Superſtition is moſt prevalent among men of weak and uncultivated minds; it is more frequent in the female ſex than among men; and abounds more in the rude than in the refined ſtages of ſociety. The general features of it have been the ſame in all ages; but it aſſumes certain peculiarities according to the diverſity of character of different nations. It gained admiſſion into the ſcience of medicine at an early period. He who was endowed with ſuperior genius and knowledge was reckoned a magician. Dr Bartolo was ſeized by the inquiſition at Rome in the laſt century, becauſe he unexpectedly cured a noble-

Manchester Tranſactions, vol. iii. man of the gout. Diſeaſes were imputed to faſcination, and hundreds of poor wretches were dragged to the ſtake for being acceſſary to them. Mercatus, phyſician to Philip II. of Spain, a writer of uncommon accuracy and information, appears ſtrongly inclined to deny the exiſtence of faſcinatory diſeaſes: but he is conſtrained to acknowledge them for two reaſons; 1ſt, Becauſe the inquiſition had decided in favour of their reality; 2dly, Becauſe he had ſeen a very beautiful woman break a ſteel-mirror to pieces, and blaſt ſome trees by a ſingle glance of her eyes.

As the opinions concerning the cauſe of diſeaſes were ſuperſtitious, thoſe concerning the method of curing them were not leſs ſo. In the Odyſſey we read of a cure performed by a ſong. Joſephus relates, that he ſaw a certain Jew, named *Eleazar*, draw the devil out of an old woman's noſtrils by the application of Solomon's ſeal to her noſe in preſence of the emperor Veſpaſian. Many different kinds of applications were uſed for expelling the devil. Flagellation ſometimes ſucceeded admirably; purgatives and antiſpaſmodics were other modes of diſcharging him. Dr Mynſight cured ſeveral bewitched perſons with a plaſter of aſſafœtida. How the aſſafœtida was ſo efficacious, was much diſputed. Some thought the devil might conſider ſo vile an application as an inſult, and run off in a paſſion; but others very ſagely obſerved, that as devils are ſuppoſed to have eyes and ears, it is probable they may have noſes too.

Nor was it only in medicine theſe ſuperſtitious opinions were entertained; they prevailed alſo in natural philoſophy. The pernicious effects in mines, which we now know are occaſioned by noxious air, were confidently imputed to the demons of the mine. Even Van Helmont, Bodinus, Strozza, and Luther, attributed thunder and meteors to the devil. Chemiſts were employed for centuries in ſearch of the philoſopher's ſtone, with which they were to do miracles. It was a common queſtion among philoſophers in the 17th century, whether the imagination could move external objects? A queſtion generally decided in the affirmative.

Though ſuperſtition be generally the mark of a weak mind, ſuch is the infirmity of human nature, that we find many inſtances of it among men of the moſt ſublime genius and moſt enlightened minds. Socrates believed that he was guided by a demon. Lord Bacon believed in witchcraft; and relates that he was cured of warts by rubbing them with a piece of lard with the ſkin on, and then nailing it with the fat towards the ſun on the poſt of a chamber window facing the ſun. Henry IV. one of the moſt illuſtrious of monarchs, was very uneaſy before his aſſaſſination on account of ſome prophecies *. Sully declares, that one of the conſiderations that kept him faithful to his maſter in the moſt unpromiſing ſtate of his affairs, was a prediction of La Broſſe, that Henry would make his fortune †. The aſtrologer Morin directed Cardinal Richelieu's motions in ſome of his journeys ‡. The enlightened Cudworth defended prophecies in general, and called thoſe who oppoſed the belief of witchcraft by the name of *atheiſts*; and the predictions of Rice Evans have been ſupported in the preſent century by the celebrated names of *Warburton* and *Jortin*. Dr Hoffman, the father of the Modern Theory and Practice of Medicine, in a diſſertation publiſhed in the large edition of his works in 1747, ſays, that the devil can raiſe ſtorms, produce inſects, and act upon the animal ſpirits and imagination; and, in fine, that he is an *excellent optician and natural philoſopher* on account of his long experience. Dr Johnſon, the leviathan of literature, is ſuppoſed to have believed the ſecond ſight.

Superſtition ‖ Supine.

* *Memoirs of Sully.*

† *Ibid.*

‡ *Bayle*, art. *Morin.*

With reſpect to the effects of ſuperſtition on the human mind, they are indeed deplorable. It chains down the underſtanding, and ſinks it into the moſt abject and ſordid ſtate, and keeps it under the dominion of fear, and ſometimes of cruelty. Where once it takes poſſeſſion, it has a tendency to become extreme, and generally becomes ſo intolerable, that men of reflection and learning conſpire its deſtruction. The Chriſtian religion gave a violent ſhock to the heathen ſuperſtition; the reformation in a great meaſure demoliſhed the ſuperſtition of the church of Rome; and the ſuperſtition which remained among Proteſtants after their ſeparation from that church has been gradually yielding to the influence of enlightened reaſon, or to the bold and daring attacks of infidelity and deiſm. We behold the proſpect of its ruins with pleaſure, and thank the deiſts for their zeal; but it is from the firm hope that the religion of Jeſus will ariſe in all its beauty and ſimple majeſty, and be admired and reſpected as it deſerves: for mean and contemptible as ſuperſtition certainly is, we would rather ſee men do what they reckon their duty from ſuperſtitious principles, than ſee anarchy and vice prevail, even though attended with all the knowledge and liberality of ſentiment which deiſm and infidelity can inſpire.

SUPERVISOR, a ſurveyor or overſeer.

SUPINATION, in *Anatomy*, the action of a ſupinator muſcle, or the motion whereby it turns the hand ſo as that the palm is lifted up towards heaven.

SUPINE, in Latin grammar, part of the conjugation of a verb, being a verbal ſubſtantive of the ſingular number and the fourth declenſion.

There are two kinds of ſupines: one, called the *firſt ſupine*, ending in *um* of the accuſative caſe, which is always of an active ſignification, and follows a verb of motion; as *abiit deambulatum*. The other called the *laſt ſupine*, and ending in *u* of the ablative caſe, is of a paſſive ſignification, and is governed by ſubſtantives or adjectives; as, *facile dictu*, &c.

They have their name, ſays Probus, and after him Voſſius,

Supine, Supper.

Voſſius, *quod ad inſtar* ſupinorum *et otioſorum hominum omnia habent confuſa:* or, according to Priſcian, *quod naſcantur a participiis paſſivis, quæ* ſupina *appellata ſunt, quia in infimo loco ſita, totam conjugationis molem ſuſcipiant.*

SUPPER, the evening repaſt.—Suppers that are heavy ſhould be avoided, becauſe the ſtomach is more oppreſſed with the ſame quantity of food in a horizontal poſture than in an erect one, and becauſe digeſtion goes on more ſlowly when we ſleep than when we are awake. They ſhould be eaten long enough before bed-time, that they may be nearly digeſted before going to ſleep; and then a draught of pure water will dilute that which remains in the ſtomach.

1 Definition.

SUPPER of the Lord, otherwiſe called the *Euchariſt*, is a ſacrament ordained by Chriſt in his church, of which the outward part is bread and wine, and the inward part or thing ſignified the body and blood of Chriſt, which the majority of Chriſtians believe to be in ſome ſenſe or other taken and received by the faithful communicants. See SACRAMENT.

2 Controverſies about the outward and viſible ſign.

There is no ordinance of the goſpel which has been the ſubject of more violent controverſies between different churches, and even between different divines of the ſame church, than this ſacrament; and though all confeſs that one purpoſe of its inſtitution was to be a bond of love and union among Chriſtians, it has, by the perverſeneſs of mankind, been too often converted into an occaſion of hatred. The outward and viſible ſign, and the inward and ſpiritual grace, have equally afforded matter of diſputation to angry controvertiſts. Many members of the church of Rome condemn the Greek church and the Proteſtants for uſing leavened bread in the Lord's Supper, contrary to the example ſet them by our Saviour; whilſt the Greek church in general, and ſome Proteſtant ſocieties in particular, unite with the church of Rome in cenſuring all churches which mix not the wine with water, as deviating improperly from primitive practice. See EUCHARIST.

That it was unleavened bread which our Lord bleſſed and brake and gave to his diſciples as his body, cannot be queſtioned; for at the time of the paſſover, when this ordinance was inſtituted, there was no leavened bread to be found in Jeruſalem *. For the mixed cup, the evidence is not ſo deciſive. It is indeed true, as we have obſerved under the article EUCHARIST, that the primitive Chriſtians uſed wine diluted with water; and if we may believe Maimonides †, it was the general cuſtom of the Jews, as well at the paſſover as at their ordinary meals, to add a little water to their wine on account of its great ſtrength; but that this was *always* done, or that it was done by our *Saviour in particular*, there is no clear evidence. Origen indeed affirms ‡, that our Lord adminiſtered in wine unmixed; and he was not a man to hazard ſuch an affirmation, had there been in his days any certain tradition, or ſo much as a general opinion, to the contrary. On this account we have often heard with wonder the neceſſity of the mixed cup inſiſted on by thoſe who without heſitation make uſe of leavened bread; for if it be eſſential to the ſacrament that the very ſame elements be employed by us that were employed by our Saviour, the neceſſity of unleavened bread is certainly equal to that of wine diluted by water.

* *Exod.* xii. 15, 19.

† *In Miſhnam.*

‡ *Hom.* 12. *in Hieremiam.*

Supper.

But the mixed cup is ſaid to be emblematical of the blood and water which flowed from the ſide of our Lord when pierced by the ſpear of the Roman ſoldier, while the abſence of leaven is emblematical of no particular circumſtance in His paſſion. This argument for the mixture is as old as the era of St Cyprian, and has ſince been frequently urged with triumph by thoſe who ſurely perceived not its weakneſs. The flowing of the blood and water from our Saviour's ſide was the conſequence either of the ſpear's having pierced the *pericardium*, or more probably of an *aſcites* or *hydrothorax*, occaſioned by his cruel and lingering death (ſee MEDICINE, N° 342, 343). But whatever was the cauſe of it, how can the mixing of wine with water in the ſacrament be emblematical of the flowing of blood and water ſeparately? Such a mixture ſurely bears a more ſtriking reſemblance to the reunion of the *ſerum* and *craſſamentum*, after they had been ſeparated by whatever cauſe. See BLOOD.

We urge not theſe objections to the mixed cup from any diſlike that we have to the practice. It is unqueſtionably harmleſs and primitive; and we wiſh that greater regard were paid to primitive practices than the generality of Chriſtians ſeem to think they can claim: but let the advocates for antiquity be conſiſtent; let them either reſtore, together with the mixed cup, the uſe of unleavened bread, or acknowledge that neither the one nor the other is eſſential to the ſacrament. This laſt acknowledgement muſt indeed be made, if they would not involve themſelves in difficulties from which they cannot be extricated. If either the mixed cup or unleavened bread be abſolutely neceſſary to the validity of the ſacrament, why not wine made from the grapes of Judæa? why not that particular kind of wine which was uſed by our Saviour? and where is that wine to be found?

3 Frivolous.

But the controverſies reſpecting the outward part or ſign of the Lord's Supper are of little importance when compared with thoſe which have been agitated reſpecting the inward part or thing ſignified; and of theſe we haſten to give as comprehenſive a view as the limits preſcribed to ſuch articles will admit.

4 About the thing ſignified.

Our Bleſſed Lord, in the ſame night that he was betrayed, "took bread, and bleſſed it, and brake it, and gave it to the diſciples, and ſaid, Take, eat; this is my body. And he took the cup, and gave thanks, and gave it to them, ſaying, Drink ye all of it; for this is my blood of the new teſtament, which is ſhed for many for the remiſſion of ſins." Such was the inſtitution of the Lord's Supper as it is recorded in the goſpel by St Matthew; and we have the ſame account of it, in almoſt the very ſame words, by three other inſpired writers, St Paul, St Mark, and St Luke. That it was the bread which Chriſt bleſſed and brake that is here called his body, and the wine over which he gave thanks that he ſtyles his blood of the new teſtament, will admit of no reaſonable doubt (A); but in what ſenſe they became ſo, has been the ſubject of many controverſies.

The church of Rome, which holds, that after conſecration,

5 Doctrine of the church of Rome.

(A) Some over-zealous Proteſtants have indeed affirmed, that it was not the conſecrated bread and wine, but thoſe

Supper. cration, Jeſus Chriſt, God and man, is really, truly, and ſubſtantially, contained under the outward appearances of the bread and wine, informs us, that about the middle of the maſs, when the prieſt, taking into his hand, firſt the bread and then the wine, pronounces over each ſeparately the ſacred words of conſecration, the ſubſtance of theſe elements is immediately changed by the almighty power of God into the body and blood of Chriſt; but that all the outward appearances of the bread and wine, and all their ſenſible qualities remain. This more than miraculous change is called TRANSUBSTANTIATION; and is founded on the philoſophy of Ariſtotle, which reſolves all bodies into *matter* and *form* (ſee METAPHYSICS, N° 142—150.); for it is only the *matter* or imperceptible ſubſtance which ſupports the *forms* or ſenſible qualities of bread and wine, that is changed into the *ſubſtance* or matter of the body and blood of Chriſt, ſo that this divine matter, coming into the place of the former earthly matter, ſupports the ſame identical *forms* which it ſupported. Hence we are told, "that Jeſus Chriſt, now preſent inſtead of the bread and wine, exhibits himſelf to us under thoſe very ſame outward *forms* or appearances which the bread and wine had before the change."

Could this doctrine be true, it would be abundantly myſterious; but to add to the myſtery, we are farther informed, that under each kind is contained Jeſus Chriſt whole and entire, his body and blood, his ſoul and divinity; ſo that when a man eats what has the appearance of a wafer, he really and truly eats the body and blood, the ſoul and divinity, of Jeſus Chriſt; and when he afterwards drinks what has the appearance of wine, he drinks the very ſame body and blood, ſoul and divinity, which not a minute perhaps before he had wholly and entirely eaten! The ingenious author from whoſe work we have taken this account of the Romiſh doctrine concerning the real preſence, may perhaps reject our inference that the orthodox members of his church muſt believe the *ſoul* and *divinity* of Chriſt to be *eaten* and *drunk* in the Lord's ſupper; but he cannot deny that, according to his ſtatement of the Catholic faith, the ſoul and divinity are both received whole and entire into the ſtomach of each communicant. He ſays indeed, that "communion conſiſts in receiving Jeſus Chriſt whole and entire, his ſacred body, his precious blood, his bleſſed ſoul, and his adorable divinity, into our *ſouls*;" but that which was formerly bread and wine unqueſtionably goes into the *ſtomachs* of the communicants; and ſince, according to him, it is now the body and blood of Chriſt, the ſoul and divinity muſt go thither with it, for theſe four cannot be ſeparated. This our author himſelf grants. "The Scripture (ſays he) poſitively declares, that *Chriſt riſing again from the dead, dieth no more; death ſhall no more have dominion over him* (Rom. vi. 9.). Conſequently his body, his blood, and his ſoul, ſhall never more be ſeparated from one another; and as the union of his divine and human natures can never more be broken, ſo neither can theſe, his two natures, united in his divine perſon, be ever ſeparated. From this it neceſſarily follows, that wherever the body of Chriſt is, there alſo his blood, his ſoul, and his divinity, muſt of neceſſity be in like manner." Supper.

Now, whether we ſuppoſe, with our author, that the ſoul and divinity of Chriſt directly carry his body and blood with them into the human ſoul, or, truſting, in ſome degree to the evidence of ſenſe, believe that the body and blood carry the ſoul and divinity with them directly into the ſtomach of each communicant—is it credible, is it poſſible, that the high and lofty One, who inhabiteth eternity, and whom the oracles of truth aſſure us that even the heaven of heavens cannot contain, ſhould be *ſubſtantially* received *whole* and *entire* into a finite ſpirit like the human ſoul, or into a body ſo limited as the human ſtomach? Our author ſays it is; declaring that, "by the bleſſed *preſence* of Jeſus Chriſt, *whole and entire within us*, are communicated to our ſouls all the heavenly graces which are the effects of the holy communion: ſuch as the ſanctification of the ſoul by an increaſe of juſtifying grace; the rendering of it more pure, more holy, more beautiful, more agreeable, in the eyes of God; the cleanſing of the ſoul from all thoſe venial ſins and imperfections of which we repent, and preſerving us from falling into mortal ſins; the uniting of us in a moſt intimate manner with Jeſus Chriſt, who comes to us in this holy ſacrament on purpoſe to dwell in our ſouls and abide with us; and the giving us a pledge and earneſt of a glorious immortality, to the enjoyment of which it brings us at laſt, if we perſevere to the end in the grace of God."

The conſequence of the doctrine of tranſubſtantiation is the *ſacrifice of the maſs*, by which, it is ſaid, God's acceptance of Chriſt's ſacrifice on the croſs is obtained for the actual benefit of thoſe perſons in particular for whom the maſs is offered. In the work ſo often quoted, we are told, that "Jeſus Chriſt our redeemer, who is both our high-prieſt and our victim, who, in order to perfect the work of our redemption, and reconcile man with his offended Creator, offered himſelf once in a bloody

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thoſe elements, *together with the whole action* of taking them into his hands, bleſſing them, breaking the bread, and diſtributing the bread and wine to the diſciples, that Chriſt calls his body and blood. This novel and ſingular opinion reſts upon no better foundation than a very childiſh criticiſm. Our Saviour, after bleſſing and breaking the bread, gave it to the diſciples, ſaying, in the original, Λαβετε φαγετε ΤΟΥΤΟ εστι το σωμα μου. Now, ſay our critics, τουτο, in the neuter gender, can never agree with the antecedent αρτος in the maſculine, but muſt refer to all the circumſtances of the action taken together, and conſidered as one complex neuter noun. But this noun, whether complex or ſimple, certainly denotes what could be *eaten*; and to ſuppoſe that our bleſſed Lord deſired his apoſtles to eat *actions*, is as repugnant to human reaſon as any doctrine of the church of Rome. The truth is, that the word τουτο, which is more properly a definite article than a demonſtrative pronoun (ſee GRAMMAR, Chap. II.), refers directly to the thing whatever it was, which our Saviour held in his hand and gave to the diſciples; and the clauſe when completed, is τουτο ον εστι το σωμα μου; this *being*, this *ſubſtance*, *is my body*. There was no neceſſity for characteriſing that ſubſtance by any analogy to ſex, in order that it might be diſtinguiſhed from every other ſubſtance; for the apoſtles could not but ſee it in the hand of their Maſter.

Supper. bloody manner upon the croſs, in order to communicate and apply to the ſouls of individuals thoſe graces, which, by his death, he merited for mankind in general, continues to offer himſelf daily upon the altar in an unbloody manner, by the miniſtry of his prieſts, in the *maſs*. The ſacrifice of the croſs and that of the maſs are both one and the ſame ſacrifice, becauſe in both the victim is the ſame and the high prieſt the ſame, viz. Jeſus Chriſt. The only difference is in the *manner* of offering. On the croſs he offered himſelf in a bloody manner and actually died; whereas on the altar he is offered up to God in an unbloody manner, not *actually* dead, but under the *appearance* of death;" ſo that the communicants not only eat the man Jeſus Chriſt, but even eat him alive (B)!

It is known to all our readers that this doctrine of tranſubſtantiation was one cauſe of the breach between the church of Rome and thoſe various ſocieties which call themſelves reformed churches. The real and ſubſtantial change of the bread and wine into the body and blood of our Lord is rejected by every reformer as a change contradictory and impoſſible, and fraught with the moſt impious conſequences; and volumes have been written to expoſe the weakneſs of thoſe arguments which have ſo often been vainly urged in its ſupport. It has been ſhown to imply numberleſs abſurdities, ſuch as, that the ſame thing can be in a million of different places, *whole* and *entire*, at the ſame inſtant of time; that it is above 1800 years old, and yet may be not more than one minute; that *forms* or ſenſible qualities are real things independent of their ſubject and the ſentient beings who perceive them; that the infinite and eternal God, who created and ſuſtains the univerſe, is himſelf

6 Implies numberleſs contradictions,

wholly and ſubſtantially comprehended by the human ſoul; and that the half, or fourth, or tenth part of the body of Chriſt, is equal to the whole of that body. That theſe are neceſſary conſequences of tranſubſtantiation has been ſo completely proved in various works (C) to which every reader may have acceſs, that it is needleſs for us to repeat arguments ſo hackneyed; but there are two objections to that doctrine, which, as we do not remember to have met with them elſewhere, and as they appear to us abſolutely concluſive, it may be worth while to ſtate in this place.

Supper.

The advocates for the real preſence in the Lord's Supper contend, that every word relating to that ordinance is to be taken in the ſtricteſt and moſt literal ſenſe, and they affect to triumph over the Proteſtants, becauſe their notions of the ſacrament cannot be ſupported without having recourſe to figure and metaphor. This however is a very vain triumph; for we heſitate not to affirm, that ſuppoſing tranſubſtantiation poſſible, and even capable of proof, there is not in the whole New Teſtament a ſingle word or a ſingle phraſe which, if interpreted *literally*, gives the ſlighteſt countenance to that wonderful doctrine. The reader will remember, that tranſubſtantiation, as we have ſtated it from a dignitary of the Romiſh church, and as it is in fact ſtated by the council of Trent (D), conſiſts in a change of the *matter*, *imperceptible ſubſtance*, or *ſubſtratum* of the bread and wine into the *matter*, *imperceptible ſubſtance*, or *ſubſtratum* of Chriſt's body and blood; for all parties agree that the ſenſible qualities of the bread and wine remain, and, according to the Romaniſt, are after conſecration either ſupported by the *matter* of Chriſt's body and blood, or hung upon nothing. But the phraſe τουτο εστι το σωμα μου,

7 is contrary to Scripture,

(B) This whole account of the Romiſh doctrine reſpecting the ſacrament of the Lord's Supper is taken from a work in two ſmall volumes, called *The Sincere Chriſtian inſtructed in the Faith of Chriſt, from the Written Word.* Its author is a man of learning, and great perſonal worth: and as he fills a high ſtation in the church of Rome, we cannot doubt but that he has given a fair view of the doctrine of that church reſpecting this and every other article of which he treats. We are ſorry however that his zeal ſhould have impelled him, in a *popular* work, to write in the manner that he has done of the ſalvation of thoſe who are not members of his church, or who cannot embrace all his opinions; for if his doctrine on this ſubject be implicitly received by thoſe "over whom he has the rule, and for whoſe ſouls he is appointed to watch," they muſt neceſſarily look upon the majority of their fellow-citizens as reprobates doomed to eternal perdition. Let this be our apology for treating ſome of thoſe opinions, which he thinks ſo abſolutely neceſſary to ſalvation, with leſs ceremony than perhaps we ſhould have done, had he leſs poſitively pronounced our damnation for not having it in our power to embrace them. He is not indeed much leſs ſevere on the moſt virtuous heathens, though they never ſaw the New Teſtament, or heard the doctrines of his church preached. But perhaps this ſeverity may be occaſioned by the following queſtion of Cicero: "Cum fruges, *Cererem;* vinum, *Liberum* dicimus, genere nos quidem ſermonis utimur uſitato: ſed ECQUEM TAM AMENTEM eſſe putas, qui illud, quo veſcatur, deum credat eſſe?"—*De Natura Deorum*, lib. iii. cap. 16.

(C) Among other works on this ſubject, we may confidently recommend to the reader a ſmall tract publiſhed by Dr Abernethy Drummond, about thirty years ago, in the form of *A Dialogue between Philalethes and Benevolus.* In that treatiſe, together with a defence of it, which were both printed for Balfour and Drummond, Edinburgh, the abſurd conſequences which we have mentioned are, by arguments unanſwerable, proved to flow from the doctrine of tranſubſtantiation; and the artful ſophiſtry, by which a very acute genius endeavoured to keep theſe conſequences out of ſight, is detected and expoſed on acknowledged principles of the ſoundeſt metaphyſics.

(D) The canon of that council which eſtabliſhes tranſubſtantiation is thus tranſlated by the author of *The Sincere Chriſtian Inſtructed:* "If any man ſhall ſay, that in the bleſſed ſacrament of the Euchariſt the ſubſtance of the bread and wine remains along with the body and blood of our Lord Jeſus Chriſt, and ſhall deny that wonderful and ſingular converſion of the whole ſubſtance of the bread into the body, and of the whole ſubſtance of the wine into the blood, the appearances of the bread and wine only remaining, which converſion the Catholic Church calls *tranſubſtantiation*, let him be anathema."

Supper. μου, if taken in the literal ſenſe, cannot poſſibly denote the conſequence of ſuch a change as this; for every perſon at all acquainted with the Greek language, eſpecially the language of the Peripatetic ſchool, knows that το σωμα μου ſignifies, not the *matter* or *ſubſtratum* of my body diveſted of its ſenſible qualities; but the body of me in its natural ſtate, conſiſting of *matter* and *qualities*, or *matter* and *form united*. Unleſs therefore the *ſenſible qualities*, as well as the *matter* of the bread and wine, give place to the ſenſible *qualities* as well as the *matter* of our Saviour's body and blood, and unleſs he appear glorified on the altar as he appeared on the mount at his transfiguration, the words το σωμα μου muſt be interpreted figuratively. Had the apoſtles underſtood their Maſter's words in the ſenſe in which they are underſtood by the church of Rome, they would have rendered them into Greek, not τουτο εστι το σωμα μου, "this is my *body*," but τουτο εστι ἡ ὑλη του σωματος μου, "this is the *matter* of my body." In like manner, when St John relates* that Jeſus ſaid, "Whoſo eateth my fleſh and drinketh by blood, hath eternal life, and I will raiſe him up at the laſt day," had he underſtood his adorable Maſter to ſpeak of his fleſh and blood in the Euchariſt in the ſenſe in which they are taught to be there by the church of Rome, he would have repreſented him as ſaying, not Ὁ τρωγων μου την σαρκα, και πινων μου το αἱμα, but Ὁ τρωγων την ὑλην μου της σαρκος, και πινων την ὑλην μου του αἱματος, "whoſo eateth the *matter* of my fleſh, and drinketh the *matter* of my blood, hath eternal life, and I will raiſe him up at the laſt day."

* Chap. vi verſe 54.

But further, ſuppoſing this ſingular converſion poſſible in itſelf, it cannot be rendered credible, however ſtated in any language that ever was or ever will be ſpoken by man. At firſt ſight it may appear paradoxical to affirm, that a poſſible fact cannot be ſo related as to obtain credit; but that tranſubſtantiation, if poſſible, is ſuch a fact, will be apparent on the ſlighteſt conſideration.

8 and incapable of proof.

The relation that ſubſiſts between things and words is arbitrary; ſo that what is termed *body* in Engliſh, is σωμα in Greek, and *corpus* in Latin; and the ſame thing might with equal propriety (had the authors of theſe languages ſo pleaſed) have been expreſſed in the firſt by *ſoul*, in the ſecond by νους, and in the third by *anima*. (See LANGUAGE, N° 3, &c.). The conſequences of this are, that there is no univerſal language ſpoken; that the natives of one country underſtand not the ſpeech of thoſe of another; and that different men ſpeaking the ſame language are perpetually liable to miſtake each other's meaning. Between the *ſubſtrata* of bodies and their *ſenſible qualities* there is a relation founded in nature, ſo that the ſenſible qualities which indicate the ſubſtance to which they belong, to be *gold*, for inſtance, in one country, indicate the ſame thing in every other country, and have done ſo from the beginning of time. The ſenſible appearances of bodies therefore are an univerſal language, the language of the Author of Nature, by which he declares to his creature man, that though the ὑλη πρωτη, or primary matter of all bodies, may be the ſame kind of ſubſtance; yet the ὑλη πρωτοτυπος of one body, or the internal combination of its primary parts, differs from that of another; that gold, for inſtance, has a different *ſubſtratum* or *baſis* from iron, lead, or ſilver; that the internal organization or ſtructure of the body of an ox is different from that of a horſe; and that the *internal ſubſtance* or *ſubſtratum* which exhibits the appearances of bread and wine is different from that which ſupports the ſenſible qualities of fleſh and blood (ſee METAPHYSICS, Part I. Chap. I. and Part II. Chap. I. and II.). Suppoſing therefore the doctrine of tranſubſtantiation to be poſſible and even true, it would ſtill be impoſſible, by any ſtatement of it in human language, or by any argument urged in its ſupport, to render that doctrine an object of rational belief; for if it be ſaid that the words τουτο εστι το σωμα μου were ſpoken by a divine perſon, who could neither be deceived himſelf nor intend to deceive us, it may be replied, that the ſenſible appearances of bread and wine, which are confeſſed to remain, are likewiſe the language of a divine perſon, even of the Creator and Governor of heaven and earth; that this language addreſſed to the ſight, the taſte, the touch, and the ſmell, is equally intelligible to all nations; that ſince the creation of the world its meaning has never been miſtaken by the ſcholar or the clown, the ſage or the ſavage, except in this ſingle inſtance of our Lord's fleſh and blood exhibiting the ſenſible appearances of bread and wine; and that it is therefore infinitely more probable that the members of the church of Rome ſhould miſtake the meaning of the words τουτο εστι το σωμα μου, which, though ſpoken by Chriſt, are part of the language of men, and liable to all its ambiguities, than that all mankind ſhould miſtake the language of God himſelf, which is liable to no ambiguities, and which was never in any other inſtance miſunderſtood by a ſingle individual. Should tranſubſtantiation therefore be really true, its truth can never be proved or rendered probable, but by an immediate operation of the ſpirit of God on the mind of man; and he who is conſcious of no ſuch operation on his own mind, may reſt aſſured that the Father of mercies, who knows whereof he is made, will never bring upon him, for his incredulity in this inſtance, any of the anathemas denounced by the church of Rome upon thoſe who place implicit confidence in the univerſal language of Him who created them, in oppoſition to her figurative and contradictory interpretations of the written word. Of the tranſubſtantiation of the elements a viſible miracle would afford no proof. Had the water been changed into wine at the marriage in Cana of Galilee, for the expreſs purpoſe of bearing teſtimony to this ſingular converſion, what muſt have been the conſequence on the minds of thoſe who witneſſed that miracle? Nothing, we think, but ſcepticiſm or diſtruſt of their own faculties; for they would have had the very ſame evidence that *no* ſubſtantial change was wrought on the elements, as that the water was *actually* turned into wine.

Though the reformed churches unanimouſly reject the doctrine of tranſubſtantiation, and of courſe the ſacrifice of the maſs, its inſeparable conſequence, they are far from being agreed among themſelves reſpecting the nature of the Lord's Supper; and the notions of this ordinance entertained by ſome of them appear to us as untenable as any part of the doctrine of the church of Rome. The Lutherans believe, that the body and blood of Chriſt are really and ſubſtantially preſent with the bread and wine; that the body is really and truly eaten, and the blood really and truly drunk, by the communicants; and that whatever motion or action the bread has, the body has the ſame*. According to them, therefore,

9 Doctrine of the Lutherans incredible.

* *Luther. Cogit. MS. 400 Gerhard in Loc. Theol. de Sacra Cœna.*

Supper. therefore, the ſame ſenſible appearances are exhibited by two ſubſtances united in ſome inexplicable manner, which is neither a perſonal union, nor incorporation, nor the incloſure of the body within the bread; nor does it laſt longer than while the ſacrament is celebrating. This union is generally called CONSUBSTANTIATION; but they reject the term, contenting themſelves with aſſerting the real preſence, without preſuming to define the mode by which the body and blood of Chriſt are united to the ſacramental elements.

It would be ſuperfluous to waſte time in replying to this doctrine. Every reader ſees that it implies the poſſibility of the ſame thing's being whole and entire in a million of places at one and the ſame inſtant of time, which has been ſo often urged as an unanſwerable objection to the Romiſh doctrine; and it is fraught with this additional abſurdity peculiar to itſelf, that two bodily ſubſtances may at once occupy the ſame place, which is directly contrary to our notions of ſolidity. It may be obſerved too, that whatever be the real ſenſe of our Saviour's words, he ſays expreſsly, "This is my body"—this thing which I give you, and which you ſee and feel; whereas, had he meant what Luther and his followers teach, he would ſurely have ſaid, "*With* this bread receive my body, *with* this cup receive my blood."

10 Of the early Calviniſts.

The notions of ſome of the early Calviniſts reſpecting the Lord's Supper are very myſterious, and expreſſed in language of which we are not ſure that we underſtand the meaning. In the year 1561 an attempt was made in France to bring the Catholics and Proteſtants to an uniformity of doctrine on this great topic of controverſy; and deputies were appointed by both parties to meet at *Poiſſy*, and debate the queſtion in a friendly manner. The principal managers on the ſide of the Catholics were the cardinals of *Lorraine* and *Tournon;* thoſe on the ſide of the Proteſtants were *Beza* and *Peter Martyr*. After ſeveral meetings, diſputes, and violent ſeparations, the Proteſtant deputies declared their faith in the following words: "We confeſs, that Jeſus Chriſt, in the Supper, does truly give and exhibit to us the ſubſtance of his body and blood by the efficacy of his Holy Spirit; and that we do receive and eat ſpiritually, and by faith, *that very body which was offered and immolated for us*, ſo as to be bone of his bone and fleſh of his fleſh, to the end that we may be enlivened thereby, and receive what is conducive to our ſalvation. And becauſe faith, ſupported by the word of God, makes thoſe things preſent, which it apprehends, and by that faith we do in *deed* and *reality* receive the *true natural* body and blood of Chriſt, by the power of the Holy Spirit; by this means, we confeſs and acknowledge the preſence of his body and blood in the Supper." One of the Catholic delegates expreſſing his diſlike of this laſt clauſe, the Proteſtant miniſters gave the following explanation of their ſentiments: "No diſtance of place can hinder us from communicating of the body and blood of Chriſt, for the Lord's Supper is a heavenly thing; and though on earth we receive with our mouths bread and wine, which are the true ſigns of his body and blood, yet by faith, and the efficacy of the Holy Ghoſt, our minds, which are fed with this food, *are rapt up into heaven*, and enjoy the preſence of the body and blood; and that by this means it may be ſaid that the body is truly joined to the bread, and the blood to the wine; but after the manner of a ſacrament, and not at all according to place or natural poſition *." Supper.

If the reader can diſcover the preciſe meaning of theſe paſſages, his ſagacity exceeds ours. That the Proteſtant deputies believed, or profeſſed to believe, that the *natural* body and blood of Chriſt are by the faithful received in the Lord's Supper, is indeed evident; but their notions reſpecting the manner of this reception are very unintelligible, if not contradictory. In the former quotation, they confeſs that Chriſt's body and blood are really preſent in the ſacrament; that they are m[illegible] preſent by faith (we ſuppoſe the faith of the communicants); and that the *very body* which was offered and immolated for us is eaten *ſpiritually* and by *faith*. In the latter quotation, they ſeem to ſay that Chriſt's body and blood are in heaven, at a great diſtance from the true ſigns of them; that on earth the communicants receive only theſe ſigns, which are bread and wine; but that, by faith and the efficacy of the Holy Spirit, their minds, during actual communion, are rapt up into heaven, where they enjoy the preſence of the body and blood; and that by this means the body and blood are truly joined to the bread and wine through the medium of the mind of the communicant, which is at once preſent both to the ſign and to the thing ſignified. To this myſterious doctrine it is needleſs to urge objections. Every man who is accuſtomed to think, and to uſe words with ſome determinate meaning, will at once perceive that the authors of this declaration muſt have had very confuſed notions of the ſubject, and have pleaſed themſelves with ſound inſtead of ſenſe, ſatisfied that they could not be wrong if they did not ſymbolize with the Lutherans or the Council of Trent.

* *Thuanus* lib. 28. See alſo *Johnſon's Unbloody Sacrifice*, vol. i.

11 unintelligible.

12 Of the churches of Britain.

The churches of England and Scotland, in their eſtabliſhed doctrines reſpecting the Lord's Supper, appear to be Calviniſtical; but the compilers of the Thirty-nine Articles and of the Confeſſion of Faith muſt have been much more rational divines than Beza and Peter Martyr. They agree in condemning the doctrine of tranſubſtantiation as contrary to common ſenſe, and not founded in the word of God; they teach, that to ſuch as rightly, worthily, and with faith, receive the ſacrament, the bread which we break is a partaking of the body of Chriſt, and the cup of bleſſing a partaking of the blood of Chriſt; and they add, that the body and blood of Chriſt are eaten and drunk, not corporally or carnally, but only after a heavenly and ſpiritual manner, by which the communicants are made partakers of all the benefits of his death †. In one important circumſtance theſe two churches ſeem to differ. The Confeſſion of Faith, as we underſtand it ‡, affirms, that in the Lord's Supper there is no ſacrifice made at all. The thirty-firſt article of the church of England likewiſe condemns the Popiſh ſacrifice of the maſs as a *blaſphemous fable* and *dangerous deceit;* but in *the order for the adminiſtration of the Lord's Supper or Holy Communion*, the celebrator "beſeeches God moſt mercifully to accept the alms and *oblations* of the congregation," and again "to accept *their ſacrifice of praiſe* and thankſgiving:" from which petitions many have inferred that, in the Lord's Supper, that church offers a commemorative and euchariſtical ſacrifice. This inference ſeems not to be wholly without foundation. In the order for the adminiſtration of the Lord's Supper, according to the form of the Book of Common Prayer ſet forth by act of parliament

† *Articles of the Church of England*, art. 28. *and Confeſſion of Faith*, chap. 29.

‡ Chap. xxix. § 3.

Supper.

liament in the second and third years of King Edward the Sixth, the elements were solemnly offered to God as a sacrifice of praise and thanksgiving; and though the prayer containing that oblation was, at the review of the liturgy some years afterwards, removed from the prayer of consecration, to which it was originally joined, and placed where it now stands in the post communion service; yet the very act of parliament which authorized that alteration, calls King Edward's "a very godly order, agreeable to the word of God and the primitive church, and very comfortable to all good people desiring to live in Christian conversation."

13 Some English divines hold the Lord's Supper to be a eucharistical sacrifice.

The English church, however, has not positively determined any thing respecting this great question; and whilst she condemns the doctrine of the real presence, with all its dangerous consequences, she allows her members to entertain very different notions of this holy ordinance, and to publish these notions to the world. Accordingly, many of her most eminent divines (E) have maintained that, in the celebration of the Lord's Supper, the elements of bread and wine are offered to God as a sacrifice commemorative of Christ's one sacrifice for the sins of the whole world; that these elements, though they undergo no substantial change, yet receive such a divine virtue by the descent of the Holy Ghost, as to convey to the worthy communicant all the benefits of Christ's passion; that they are therefore called his body and blood, because being, after their oblation, eaten and drunk in remembrance of Him, they supply the place of his body and blood in the feast upon his sacrifice; and that it is customary with our Saviour to give to any thing the name of another of which it completely supplies the place, as when he calls himself the *door* * of the sheep, because there is no entrance into the church or kingdom of God but by faith in him. They observe, that the Eucharist's being commemorative, no more hinders it from being a proper sacrifice, than the typical and figurative sacrifices of the old law hindered them from being proper sacrifices: for as to be a type doth not destroy the nature and notion of a legal sacrifice, so to be representative and commemorative, doth not destroy the nature of an evangelical sacrifice. To prove that, in the celebration of the Lord's Supper, there is a real sacrifice offered to God as well as a sacrament received by the communicants, they appeal to St Paul, who says expresly †, that "Christians have an *altar*, whereof they have no right to eat who serve the tabernacle," and who by contrasting the cup of the Lord with the cup of devils, and the table of the Lord with the table of devils ‡, teaches plainly, that those cups and those tables had the same specific nature. That the *table of devils* spoken of by the apostle was the Pagan altars, and the *cup of devils* the wine poured out in libations to the Pagan divinities, will admit of no dispute; and therefore, say the advocates for the eucharistical sacrifice, the table of the Lord must be the Christian altar, and the cup of the Lord the wine offered to God as the representative of the blood of Christ; otherwise there would not be that *absurdity* which the apostle supposes, in the same person drinking the cup of the Lord and the cup of devils, and partaking of the Lord's table and the table of devils. They observe farther, that in all the ancient liturgies extant there is a solemn form of oblation of the sacramental elements, and that all the Christian writers from the second century downwards treat of the Lord's Supper as a sacrifice as well as sacrificial feast, having indeed no value in itself, but acceptable to God as representing Christ's one sacrifice for the sins of the world. Our limits will not permit us to give even an abstract of their arguments; but the reader who shall attentively peruse *Johnson's unbloody Sacrifice and Altar unveiled and supported*, will discover that their notions are better founded than probably he supposes, and that they are totally irreconcileable with the doctrine of transubstantiation and the Popish sacrifice of the *mass*.

Supper.

14 Others, a mere memorial;

Other English divines of great learning, with the celebrated Hoadley bishop of Winchester at the head of them, contend strenuously that the Lord's Supper, so far from being a sacrifice of any kind, is nothing more than bread and wine reverently eaten and drunk, in remembrance that Christ's body was broken and his blood shed in proof of his Father's and his own love to mankind; that nothing is essential to the sacrament but this remembrance, and a serious desire to honour and obey our Saviour as our head; that the sacrament might be celebrated without uttering one prayer or thanksgiving, merely by a society of Christians, whether small or great, jointly eating bread and drinking wine with a serious remembrance of Christ's death; that St Paul enjoins a man to examine himself before he eat of that bread and drink of that cup, not to discover what have been the sins of his past life in order to repent of them, but only that he may be sure of his remembering Christ's body broken and his blood shed; that, however, it is his duty in that as in every other instance of religious worship to resolve to obey from the heart every precept of the gospel, whether moral or positive; and that to partake worthily of the Lord's Supper is acceptable to God, because it is paying obedience to one of these precepts; but that no particular benefits or privileges are annexed to it more than to any other instance of duty. Bishop Hoadley acknowledges, that when St Paul says *, "The cup of blessing which we bless, is it not the communion of the blood of Christ? The bread which we break, is it not the communion of the body of Christ?" he has been supposed by many learned men to affirm, that all the benefits of Christ's passion are in the Lord's Supper conveyed to the worthy communicant; but this (says he) is an idea which the apostle could not have in his thoughts as at all proper for his argument. The Greek word κοινωνια and the English *communion* signify only a partaking of something in common with others of the same society; and the apostle's meaning (he says) can be nothing more, than that in the Lord's Supper we do not eat bread and drink wine as at an ordinary meal, but as memorials of the body and blood of Christ, in honour to *him* as the *head* of that body of which we are all *members*. That the word κοινωνια is not meant to denote any inward or spiritual part of the Lord's Supper, he thinks evident, because the same word is used with regard to the cup and the table of idols, where no

* *St John* x. 7.

† *Heb.* xiii. 10.

‡ 1 *Cor.* x. 16, &c.

* 1 *Cor.* x. 16.

(E) The archbishops Laud and Wake; the bishops Poynet, Andrews, Bull, and Patrick; the doctors Hickes, Grabe, and Brett; Messrs Bingham, Johnson, Mede, Wheatly, Scandaret, Bowyer, &c.

Supper. spiritual part could be thought of, and in an argument which suppoſes an idol to be nothing †.

† *A Plain Account of the Nature and End of the Lord's Supper.*

To this view of the nature and end of the Lord's Supper, it muſt appear no ſmall objection, that "he who eateth and drinketh unworthily is ſaid to be *guilty of the body and blood of the Lord, and to eat and drink a judgment to himſelf, not diſcerning the Lord's body.*" No doubt it would be ſinful to eat and drink a mere memorial of Chriſt's death without ſerious diſpoſitions; but we cannot conceive how a little wandering of the thoughts, which is all the unworthineſs which the author thinks there can be on ſuch an occaſion, ſhould be a ſin of ſo deep a dye as to be properly compared with the guilt of thoſe who murdered the Lord of life. Other divines, therefore, feeling the force of this and ſimilar objections, ſteer a middle courſe between the mere memorialiſt and the advocate for a real ſacrifice in the holy Euchariſt, and inſiſt that this rite, though no ſacrifice itſelf, is yet a feaſt upon the one ſacrifice offered by Chriſt and ſlain upon the croſs. The moſt eminent patrons of this opinion have been Dr Cudworth, Biſhop Warburton, and the preſent biſhop of Cheſter; and they ſupport it by ſuch arguments as the following: "In thoſe ages of the world when victims made ſo great a part of the religion both of Jews and Gentiles, the ſacrifice was always followed by a religious feaſting on the thing offered; which was called the *feaſt upon, or after the ſacrifice*, and was ſuppoſed to convey to the partakers of it the benefits of the ſacrifice. Now Jeſus (ſay they), about to offer himſelf a ſacrifice on the croſs for our redemption, did, in conformity to general practice, inſtitute the *laſt ſupper*, under the idea of *a feaſt after the ſacrifice;* and the circumſtances attending its inſtitution were ſuch, they think, that the apoſtles could not poſſibly miſtake his meaning. It was juſt before his paſſion, and while he was eating the paſchal ſupper, which was a Jewiſh *feaſt upon the ſacrifice*, that our bleſſed Lord inſtituted this rite; and as it was his general cuſtom to allude, in his actions and expreſſions, to what paſſed before his eyes, or preſented itſelf to his obſervation, who can doubt, when, in the very form of celebration, we ſee all the marks of a *ſacrificial ſupper*, but that the divine inſtitutor intended it ſhould bear the ſame relation to his *ſacrifice on the croſs* which the *paſchal ſupper* then celebrating bore to the oblation of the *paſchal lamb?* If this was not his purpoſe, and if nothing more was intended than a general memorial of a dead benefactor, why was this inſtant of time preferred for the inſtitution to all others throughout the courſe of his miniſtry, any one of which would have been equally commodious? Indeed any other time would have been more commodious for the inſtitution of a mere memorial; for the paſchal lamb and unleavened bread were certainly a ſacrifice; and the words uſed by our Saviour, when he gave the bread and wine to the apoſtles, were ſuch as muſt neceſſarily have led them to conſider that bread and wine as bearing the ſame relation to his ſacrifice that the paſchal ſupper bore to the paſchal ſacrifice. At that Jewiſh feaſt, it was the cuſtom of every father of a family to break the unleavened bread, and to give to every gueſt a portion, ſaying, "This is the bread of affliction, which our fathers did eat in the land of Egypt:" a cuſtom which, we may be ſure, that Chriſt, as father of his family, would religiouſly obſerve. The apoſtles knew well that they were not eating the identical bread which their fathers did eat in Egypt, but the feaſt upon the ſacrifice then offered in commemoration of their redemption from Egyptian bondage; and therefore when they ſaw their Maſter after ſupper break the bread again and give it to each of them, with theſe remarkable words, "This is my body which is given for you, do this in remembrance of me," they muſt have concluded, that his meaning was to inſtitute a rite which ſhould to the end of the world bear the ſame relation to his ſacrifice that the paſchal ſupper bore to the ſacrifice of the paſſover. Supper.

15 and others, a feaſt upon our Saviour's ſacrifice.

This inference, from the circumſtances attending the inſtitution, Biſhop Warburton thinks confirmed by St Paul's mode of arguing with the Corinthians, on their impiety and abſurdity in partaking both of the Lord's table and the table of devils; for "what (ſays he) had the eaters of the ſacrifices to do with the partakers of the bread and wine in the Lord's Supper, if the Lord's Supper was not a feaſt of the ſame kind with their feaſts? If the three feaſts, Jewiſh, Pagan, and Chriſtian, had not one common nature, how could the apoſtle have inferred that this intercommunity was inconſiſtent? *Ye* CANNOT (ſays he) *drink the cup of the Lord and the cup of devils; ye* CANNOT *be partakers of the Lord's table and the table of devils.* For though there might be *impiety* in the promiſcuous uſe of Pagan and Chriſtian rites of any kind, yet the *inconſiſtency* ariſes from their having a common nature, and conſequently, as they had oppoſite originals, from their deſtroying one another's effects in the very celebration. Sacrifices, and feaſts upon ſacrifices, were univerſally conſidered as *federal* rites; and therefore the Lord's table and the table of devils being both *federal* rites, the ſame man could no more be partaker of both, than he could at once engage to ſerve both God and the devil. This is the apoſtle's argument to the wiſe men, to whom he appeals; and we ſee that it turns altogether upon this poſtulatum, that the Chriſtian and Pagan feaſts had the ſame ſpecific nature, or were both feaſts upon ſacrifices. If this be admitted, it is eaſy to ſee why St Paul deemed thoſe who ate and drank unworthily guilty of the body and blood of the Lord; for if the Lord's Supper be a feaſt upon his ſacrifice, it muſt have been conſidered as the means of conveying to the communicants all the benefits of his death and paſſion; and the profanation of ſuch a rite, by rendering his death ineffectual, might be fitly compared and juſtly equalled to the enormous guilt of thoſe by whom his blood was ſhed." In reply to Biſhop Hoadley's remarks upon the word κοινωνια, his brother biſhop obſerves, that "had the apoſtle meant what the learned writer makes him to mean, he would doubtleſs have ſaid κοινωνια ὑμων εις το σωμα, 'your communion in the body—your eating it jointly.' St Paul (continues he) knew how to expreſs himſelf properly, as appears from a paſſage in his epiſtle to the Philippians, where, profeſſedly ſpeaking of the joint participation of a bleſſing, he uſes theſe words, κοινωνια ὑμων εις το ευαγγελιον, 'your communion in the goſpel.' To the other remark, that no ſpiritual part could be thought of in the table of idols, becauſe an idol is ſaid by the apoſtle to be *nothing*, Biſhop Warburton replies, "that by St Paul the Gentiles are ſaid to have ſacrificed to devils, and thoſe who ate of ſuch ſacrifices to have had communion with devils: now the *devil* (continues his Lordſhip) was in St Paul's opinion *ſomething*." But the inference which the

Supper ‖ Suppoſition.

the apoſtle draws from the acknowledged truth, that the cup of bleſſing which we bleſs is the communion of the blood of Chriſt, and the bread which we break the communion of the body of Chriſt, puts his meaning, our author thinks, beyond all doubt. He ſays *, that the partaking of one bread makes the receivers of *many* to become *one body*. A juſt inference, if this rite be of the nature of a *feaſt upon the ſacrifice;* for then *the communion of the body and blood of Chriſt* unites the receivers into one body by an equal diſtribution of one common benefit. But if it be only a general commemoration of a deceaſed benefactor, it leaves the receivers as it found them, not *one body*, but *many ſeparate profeſſors* of one common faith.

* 1 *Cor.* x. 27.

16 The ordinance not generally underſtood.

Thus have we given ſuch a view as our limits would permit us to give, of the principal opinions that have been held reſpecting the nature and end of the Lord's Supper. It is an ordinance which ſeems not to be generally underſtood; though, being intended to ſhow forth the Lord's death till he come, it is ſurely of ſufficient importance to engage the attention of every ſerious Chriſtian. The moſt conſiderable Proteſtant divines who have expreſsly written upon it are, Johnſon in his *Unbloody Sacrifice;* Cudworth in his *Diſcourſe concerning the true Nature of the Lord's Supper;* Hoadley in his *Plain Account;* and Warburton in his *Rational Account*. The notions of Cudworth and Warburton are the ſame, and perhaps they differ not ſo much from thoſe of Johnſon as many readers ſeem to imagine. At any rate, the arguments by which Warburton ſupports his doctrine muſt have ſome force, ſince it is ſaid that Hoadley himſelf acknowledged they would be unanſwerable, if it could be proved that the death of Chriſt was a real ſacrifice.

SUPPLEMENT, in literature, an appendage to ſupply what is wanting in a book. Books of various kinds require ſuch an appendage; but none ſo much as a dictionary of arts and ſciences, which, from the progreſſive courſe of phyſical ſcience, cannot be completed without it.

SUPPORTED, in *Heraldry*, a term applied to the uppermoſt quarters of a ſhield when divided into ſeveral quarters, theſe ſeeming as it were ſupported or ſuſtained by thoſe below. The chief is ſaid to be ſupported when it is of two colours, and the upper colour takes up two-thirds of it. In this caſe it is ſupported by the colour underneath.

SUPPORTERS, in *Heraldry*, figures in an achievement placed by the ſide of the ſhield, and ſeeming to ſupport or hold up the ſame. Supporters are chiefly figures of beaſts: figures of human creatures for the like purpoſe are called *tenants*.

SUPPOSITION, in *Muſic*, is when one of the parts dwells on a note, while another part makes two or more leſſer notes equivalent to it, by conjoint degrees.

Suppoſition is defined by a late author the uſing of two ſucceſſive notes, of the ſame value as to time; the one whereof, being a diſcord, ſuppoſes the other a concord.

The harmony, Mr Malcolm obſerves, is always to be full on the accented parts of the bar or meaſure; but, on the unaccented, diſcords may tranſiently paſs, without any offence to the ear. This tranſient uſe of diſcords followed by concords, make what we, after the French, call *ſuppoſition*.

Concords by ſuppoſition are thoſe where the continued baſe adds or ſuppoſes a new ſound below the fundamental baſs; whence ſuch concords always ſucceed the extent of the octave. Of theſe concords there are three ſorts, all which are concords of the ſeventh: the firſt, when the added ſound is a third below the fundamental ſound; ſuch is the concord of the ninth: and if the concord of the ninth is formed by the mediant, added below the ſenſible concord in the minor mode, then the concord is called the *ſuperfluous fifth*. The ſecond kind is, when the ſuppoſed ſound is a fifth below the fundamental ſound, as in the concord of the fourth or eleventh; and if the concord is ſenſible, and the tonic be ſuppoſed, this concord is called the *ſuperfluous ſeventh*. The third kind is that where the ſuppoſed ſound is below a concord of the diminiſhed ſeventh; if it is a fifth below, i. e. if the ſuppoſed ſound be the mediant, the concord is called the concord of the *fourth* and *ſuperfluous fifth:* if it is a ſeventh below, i. e. if the ſuppoſed ſound be the tonic, the concord is called the *leſſer ſixth* and *ſuperfluous ſeventh*.

Suppoſition ‖ Sur.

SUPPOSITORY, a kind of medicated cone or ball, which is introduced into the anus for opening the belly.

It is uſually compoſed of common honey, mixed up with ſoap or oil, and formed into pieces of the length and thickneſs of the little finger, only pyramidal. To the compoſition is ſometimes alſo added powder of ſcammony, euphorbium, colocynthis, ſalt, aloes, &c. according to the caſe of the patient.

The ſuppoſitory was invented for the convenience of ſuch as have an averſion to clyſters; or to be uſed when the diſeaſe does not allow their uſe.

SUPPRESSION, in *Medicine*, is generally uſed to ſignify a retention of urine or of the menſes.

SUPPURATION, the ſecond way wherein an inflammation terminates; being a converſion of the inſpiſſated blood and the firſt adjacent parts, as the veſſels and fat, into pus or matter; which diſorder, when it has not yet found an opening, is generally called an *abſceſs*.

SUPRACOSTALES, in *Anatomy*. See *Table of the Muſcles* in ANATOMY.

SUPRALAPSARIANS, in *Theology*, perſons who hold that God, without any regard to the good or evil works of men, has reſolved, by an eternal decree, *ſupra lapſum*, antecedently to any knowledge of the fall of Adam, and independently of it, to ſave ſome and to damn others; or, in other words, that God intended to glorify his juſtice in the condemnation of ſome, as well as his mercy in the ſalvation of others; and for that purpoſe decreed that Adam ſhould neceſſarily fall, and by that fall bring himſelf and all his offspring into a ſtate of everlaſting condemnation.

Theſe are alſo called *antelapſaries*, and are oppoſed to ſublapſaries and infralapſaries.

According to the ſupralapſarians, the object of predeſtination is, *homo creabilis et labilis;* and, according to the ſublapſarians and infralapſarians, *homo creatus et lapſus*.

SUPRASPINATUS, in *Anatomy*. See *Table of the Muſcles* in ANATOMY.

SUPREMACY, the ſuperiority or ſovereignty of the king. See SOVEREIGNTY.

SUR, or SHUR, in *Ancient Geography*, a deſert of Arabia Petræa, extending between Paleſtine and the Arabian gulf; into which the Iſraelites, after marching through

Sur, Surat.

through the Red ſea, firſt came (Exod. xv. 22.). Again (Numb. xxxiii. 8.), it is ſaid, that from the ſea they went three days journey into the Wilderneſs of Etham; whence ſome conclude that Etham and Shur are the ſame wilderneſs; or only differ as a part from the whole, Shur being the general name, and Etham that part of it lying neareſt to the place of encampment of the ſame name. We know ſo little of the geography of theſe places, that there is more room for diſputation than for deciſion. As to the route which the Iſraelites followed in their paſſage through the Red ſea, Mr Bryant, we think, has given the moſt ſatisfactory account in his late work on the Plagues of Egypt.—Shur is now called *Corondel*.

SURAT, a city of Indoſtan, belonging to Britain, on the weſtern coaſt of the peninſula, a little to the northward of Bombay, and about 16 miles up the river Tappee. It is but of modern date, and is a moſt remarkable inſtance of the power of trade to bring wealth and population to any ſpot where it can be brought to ſettle. Towards the middle of the 17th century, this place was only the reſort of a few merchants, who, under the ſhelter of an old inſignificant caſtle, laid the firſt foundations of a city now almoſt as large and fully as populous as London within the walls, and containing many fine buildings of Indian architecture, which is partly Gentoo and partly Moriſque. Thoſe of the greateſt note are ſo contrived, that the gateway is defenſible againſt any ſudden irruption of a few armed men. The private apartments lie backwards for the conveniency of the women, of whom the Moors are remarkably jealous. They are fond of having one room, in the midſt of which a fountain keeps playing, and which, by its noiſe, lulls them to ſleep, and refreſhes the room by its coolneſs; but thus a damp is produced, which would be very dangerous to Europeans. They have alſo generally a ſaloon with fountains playing in it, which, with the variegated flower-beds, in which they are very curious, makes a beautiful proſpect. During the intenſe heats of ſummer they have country retirements a little way out of town, where they reſide, or go in parties to amuſe themſelves. The ſtreets are irregularly laid out; but have one property which renders it agreeable to walk in them, viz. that a competent width being left at bottom, the upper ſtories of the houſes project over one another in ſuch a manner, that people may with eaſe converſe from them; by which means the ſtreet is agreeably ſhaded, at the ſame time that a proper ventilation is not impeded, but rather promoted. The ſhops, notwithſtanding the vaſt trade carried on in this great and populous city, have a very mean appearance, owing to the dealers keeping their goods in warehouſes, and ſelling by ſamples.

No place is better ſupplied with proviſions than the city of Surat while its communication with the country remains open. Beſides the unbounded importation, by which every article is brought here in great abundance, the natural productions of the ſoil are excellent, though leſs cheap than in other parts of India, as at Bengal eſpecially; yet in that place, though the cattle and poultry are bought originally at a very low rate, they turn out very dear by the time they are fed for the table. Here, however, all kinds of eatables may be had at a reaſonable price, ready for immediate uſe, and as good as can be found anywhere. The wheat of Surat is famous all over India for its ſingular ſubſtance, whiteneſs, and taſte; and its ſalads and roots are likewiſe of an excellent quality. There are alſo many kinds of wildfowl and other game to be had at an eaſy rate; but for wines and ſpirituous liquors they depend moſtly on importation. Surat.

Surat was ſurrounded with a wall in a ſhort time after it had aſſumed the form of a town. The fortification, however, was meant only to prevent the incurſions of the Mahrattas, who had twice pillaged it; ſo that the place was by no means capable of ſtanding any regular ſiege. Even the caſtle appears but a poor defence, being mounted with cannon here and there, without any order, or without any thing like an attempt towards military architecture.

In this city, before the Eaſt India Company became inveſted with the poſſeſſion of Bombay, was the preſidency of their affairs on the weſtern coaſt. For this purpoſe they had a factory eſtabliſhed there with great privileges by the Mogul government; and even after the preſidency was eſtabliſhed at Bombay, they continued a factory here at one of the beſt houſes in the city; which yet not being ſpacious enough to contain their effects, they hired another at ſome diſtance from it, and nearer the water-ſide, which was called the new factory. In the mean time, the city flouriſhed, and became the centre of all the Indian trade, being much more frequented for the ſake of foreign merchandiſe than for either the natural productions or manufactures of the country, though they alſo made a conſiderable part of its commerce. In ſhort, there was ſcarce any article of merchandiſe but what was to be found at all times in Surat, almoſt as readily as in London itſelf. While the Mogul government was in its vigour, there was ſuch a ſhow of juſtice kept up, as induced merchants of all religions and denominations to take up their reſidence in the city. The Gentoos eſpecially reſorted thither, in order to avoid the oppreſſions of their own government. Great care indeed was taken that no very flagrant acts of oppreſſion ſhould be committed; ſo that, in what ſometimes happened, appearances were at leaſt kept up; and the oppreſſions of government were chiefly owing to the animoſities and rivalſhip of the merchants themſelves. As an inſtance of the great extent to which commerce was puſhed in Surat, we ſhall here quote from Mr Groſe, what is ſaid by Captain Hamilton of a merchant named *Abdulgafour*, viz. "That he drove a trade equal to the Eaſt India Company: for he had known him fit out in a year above 20 ſail of ſhips, between 300 and 800 tons, none of which had leſs of his own ſtock than 20,000l. and ſome of them 25,000l. After that foreign ſtock was ſent away, it behoved him to have as much more of an inland ſtock for the following year's market." On the deceaſe of this merchant, the government ſeized on a million of his money; and his grandſon was not only deprived of all that he poſſeſſed, but barbarouſly murdered through the envy and treachery of his brother merchants, and the rapacity of the governor.

The city of Surat was taken and ruined by the Portugueſe in 1520; and it was not till after this misfortune that it became ſuch a celebrated emporium. All the Indian merchants who had been accuſtomed to trade thither contributed to re-eſtabliſh it; but it was not till near a century after that it became the general ſtaple of Indian

Surat, Surcharge.

Indian and European merchandiſe; when the Dutch appearing in the Indian ocean, had deprived the Portugueſe of all their conqueſts on that coaſt, and almoſt entirely ruined their trade. The Engliſh eſtabliſhed a factory here in 1609, the Dutch in 1616, and the French in 1665. In proceſs of time, the Indian ſeas being greatly infeſted by pirates, a naval officer was appointed by the Mogul to keep them in awe. This officer was named *Siddee* (A) *Muſſoot*, who had been chief of an Ethiopian colony ſettled at Rajapore. Here he had collected ſome veſſels of conſiderable force, and carried on ſome trade, till he was diſpoſſeſſed by the Mahrattas; upon which he repaired to Bombay, and afterwards to Surat, where he was appointed admiral on that ſtation to the Mogul, with a yearly revenue of about 36,000l. ſterling. Though he had no power, independent of the marine, he ſeized on the caſtle, encroached on the town, and appropriated to himſelf a third part of its revenues, under pretence of arrears due in his appointed revenue. Another third was paid to the Mahrattas, to prevent their depredations upon trade in the open country; but they, not ſatisfied with this ſtipulation, watched an opportunity to plunder the town, which was kept in ſubjection by Siddee Muſſoot, till his death which happened in 1756.

Siddee Muſſoot was ſucceeded by his ſon, who ſoon rendered himſelf very diſagreeable to the inhabitants. In 1758, the Engliſh factory was greatly oppreſſed by him, and the black merchants treated ſtill worſe; on which the latter applied to Mr Ellis the Engliſh chief at that time, deſiring him to recommend it to the preſidency of Bombay to take the caſtle by force out of the hands of the uſurper. This propoſal proving agreeable, Admiral Pococke, who was then with his ſquadron at Bombay, readily concurred in ſupporting the expedition. The enterpriſe was conducted with the uſual ſucceſs attending the Britiſh arms; and Captain Maitland the conductor took poſſeſſion of the caſtle with its revenue in name of the Eaſt India Company, who were confirmed in the government by grants from the Mogul.

SURCHARGE OF THE FOREST, is when a commoner puts more beaſts in the foreſt than he has a right to. See FOREST.

SURCHARGE of Common, is a diſturbance of common of paſture, by putting more cattle therein than the paſture and herbage will ſuſtain, or the party hath a right to do. This injury can only happen where the common is appendant or appurtenant, and of courſe limitable by law; or where, when in groſs, it is expreſsly limited and certain; for where a man hath common in groſs, *ſans nombre*, or without ſtint, he cannot be a ſurcharge. In this caſe indeed there muſt be left ſufficient for the lord's own beaſts.

The uſual remedies for ſurcharging the common are by the lord's diſtraining the ſurplus number, or by his bringing an action of treſpaſs, or by a ſpecial action on the caſe, in which any commoner may be plaintiff. The ancient and moſt effectual method of proceeding is by writ of admeaſurement of paſture.

Writ of Second SURCHARGE, *de ſecunda ſuperoneratione*, is given by the ſtatute of Weſtm. 2. 13 Edw. I. cap. 8. when, after the admeaſurement of paſture hath aſcertained the right, the ſame defendant ſurcharges the common again; and thereby the ſheriff is directed to inquire by a jury whether the defendant has in fact again ſurcharged the common; and if he has, he ſhall then forfeit to the king the ſupernumerary cattle put in, and alſo ſhall pay damages to the plaintiff.

Surcharge ‖ Surf.

SURCINGLE, a girdle wherewith the clergy of the church of England uſually tie their caſſocks. See GIRDLE.

SURCOAT, a coat of arms, to be worn over body armour.

The ſurcoat is properly a looſe thin taffety coat, with arms embroidered or painted on it. Such as is worn by heralds, anciently alſo uſed by military men over their armour to diſtinguiſh themſelves by.

SURD, in *Arithmetic* and *Algebra*, denotes any number or quantity that is incommenſurable to unity: otherwiſe called an *irrational number* or *quantity*. See ALGEBRA, Part. I. Chap. IV.

SURETY, in *Law*, generally ſignifies the ſame with BAIL.

SURF, is a term uſed by ſeamen to expreſs a peculiar ſwell and breaking of the ſea upon the ſhore. It ſometimes forms but a ſingle range along the ſhore, and at others three or four behind one another extending perhaps half a mile out to ſea. The ſurf begins to aſſume its form at ſome diſtance from the place where it breaks, gradually accumulating as it moves forward till it gain, not uncommonly, in places within the limits of the trade-winds, a height of 15 or 20 feet, when it overhangs at top, and falls like a caſcade with great force and a prodigious noiſe. Countries where ſurfs prevail require boats of a particular conſtruction very different from the greater part of thoſe which are built in Europe. In ſome places ſurfs are great at high, and in others at low water; but we believe they are uniformly moſt violent during the ſpring-tides.

It is not eaſy to aſſign the cauſe of ſurfs. That they are affected by the winds can hardly be queſtioned; but that they do not proceed from the *immediate* operation of the wind in the places where they happen, is evident from this circumſtance, that the ſurf is often higheſt and moſt violent where there is leaſt wind, and *vice verſa*. On the coaſt of Sumatra the higheſt are experienced during the ſouth-eaſt monſoon, which is never attended with ſuch gales as the north-weſt. As they are moſt general in the tropical latitudes, Mr Marſden, who ſeems to have paid much attention to the ſubject, attributes them to the trade-winds which prevail at a diſtance from ſhore between the parallels of 30 degrees north and ſouth, whoſe uniform and invariable action cauſes a long and conſtant ſwell, that exiſts even in the calmeſt weather, about the line, towards which its direction tends from either ſide. This ſwell, when a ſquall happens or the wind freſhens up, will for the time have other ſubſidiary waves on the extent of its ſurface, breaking often in a direction contrary to it, and which will again ſubſide as a calm returns, without having produced

(A) When the Abyſſinian ſlaves are promoted to any office under the Mogul government, they are called *Siddees*.

Surf ‖ Surfeit.

duced on it any perceptible effect. Sumatra, though not continually expoſed to the ſouth-eaſt trade-wind, is not ſo diſtant but that its influence may be preſumed to extend to it; and accordingly at Poolo Peſang, near the ſouthern extremity of the iſland, a conſtant ſoutherly ſea is obſerved, even after a ſtrong north-weſt wind. This inceſſant and powerful ſwell rolling in from an ocean, open even to the pole, ſeems an agent adequate to the prodigious effects produced on the coaſt; whilſt its very ſize contributes to its being overlooked. It reconciles almoſt all the difficulties which the phenomena ſeem to preſent, and in particular it accounts for the decreaſe of the ſurf during the north-weſt monſoon, the local wind then counteracting the operation of the general one; and it is corroborated by an obſervation, that the ſurfs on the Sumatran coaſt ever begin to break at their ſouthern extreme, the motion of the ſwell not being perpendicular to the direction of the ſhore. This explanation of the phenomena is certainly plauſible; but, as the author candidly acknowledges, objections may be urged to it. The trade-winds and the ſwell occaſioned by them are remarkably ſteady and uniform; but the ſurfs are much the reverſe. How then comes an uniform cauſe to produce unſteady effects?

In the opinion of our author it produces no unſteady effects. The irregularity of the ſurfs, he ſays, is perceived only within the remoter limits of the trade-winds. But the equatorial parts of the earth performing their diurnal revolution with greater velocity than the reſt, a larger circle being deſcribed in the ſame time, the waters thereabout, from the ſtronger centrifugal force, may be ſuppoſed more buoyant; to feel leſs reſtraint from the ſluggiſh principle of matter; to have leſs gravity; and therefore to be more obedient to external impulſes of every kind, whether from the winds or any other cauſe.

SURFACE. See SUPERFICIES.

SURFEIT, in *Medicine*, a ſickneſs with a ſenſation of a load at the ſtomach, uſually proceeding from ſome error in diet, either with regard to the quantity or quality of the food taken. Sometimes, however, a ſurfeit is only a plethora from indolence and full diet: in which caſe perſpiration is defective; and eruptions appear on the ſkin.

Faſting for ſome time, and an attention to temperance afterwards, with ſome briſk purgatives, will generally remove the effects of a ſurfeit, when it is unaccompanied with other more permanent affections.

Surfeit ‖ Surgeon.

SURFEIT, in *Farriery*. See FARRIERY *Index*.

SURGE, in the ſea-language, the ſame with a wave. See WAVE.

SURGEON, or CHIRURGEON, one that profeſſes the art of SURGERY.

In England there are two diſtinct companies of ſurgeons now occupying the ſcience or faculty of ſurgery; the one company called *barbers*, the other *ſurgeons*, which latter are not incorporated.—The two are united to ſue, and be ſued, by the names of maſters or governors and commonalty of the myſtery of barbers and ſurgeons of London. 32 Hen. VIII. c. 42.

No perſon uſing any barbery or ſhaving in London, ſhall occupy any ſurgery, letting of blood, or other matter; drawing of teeth only excepted. And no perſon uſing the myſtery or craft of ſurgery ſhall occupy or exerciſe the feat or craft of barbery or ſhaving, neither by himſelf, nor any other for his uſe. 32 Hen. VIII. c. 42.

By the ſame ſtatute, ſurgeons are obliged to have ſigns at their doors.

The French chirurgeons being refuſed to be admitted into the univerſities (notwithſtanding that their art makes a branch of medicine), on pretence of its bordering a little on butchery or cruelty, aſſociated themſelves into a brotherhood, under the protection of S. Coſmus and S. Damian: on which account, according to the laws of their inſtitution, they are obliged to dreſs and look to wounds *gratis* the firſt Monday of each month.

They diſtinguiſh between a chirurgeon of the long robe and a barber-chirurgeon. The firſt has ſtudied phyſic, and is allowed to wear a gown. The ſkill of the other, beſides what relates to the management of the beard, is ſuppoſed to be confined to the more ſimple and eaſy operations in chirurgery; as bleeding, tooth-drawing, &c.

They were formerly diſtinguiſhed by badges: thoſe of the long gown bore a caſe of inſtruments; the barber, a baſon.

SURGERY.

THE term ſurgery has been uſually employed to ſignify that part of medicine which treats of the diſeaſes of the human body which are to be cured or alleviated by the hand, by inſtruments, or by external applications.

INTRODUCTION.

MEDICINE and ſurgery, formerly regarded as one and the ſame ſcience, were exerciſed by the ſame perſons during the moſt remote ages; and their ſeparation, ſuch as now generally exiſts, is to be conſidered as a modern inſtitution. If we conſider their origin and end, the knowledge which the practitioner of each requires, and the connection which naturally ſubſiſts between the diſeaſes which are ſuppoſed peculiarly to belong to each department, it is probable that the firſt practitioners confounded them with one another; and it is eaſy to conceive how the ſame ideas ſhould have paſſed from one generation to another. At laſt, however, the knowledge of the healing art being greatly enlarged, it became neceſſary to ſeparate it into different claſſes, and to form it into diſtinct departments in practice. Accordingly there were not only ſome who confined themſelves to ſurgery, but there were lithotomiſts, phlebotomiſts, oculiſts, auriſts, dentiſts, &c.

We do not propoſe here to enter into any detail in attempting to ſhow how this ſeparation was made, and ſtill leſs to make mention of the puerile diſputes regarding the pre-eminence of medicine to ſurgery. There

are

Introduction.

are few we believe who in our days do not feel that ſuch a pre-eminence does not exiſt in nature; that medicine and ſurgery are one and the ſame ſcience; that they are coeval with the human race; and to thoſe who are able to appreciate them, they muſt appear of equal utility and importance. The healing art is one, its principles ought to be the ſame throughout, and the exerciſes of its different branches ſuppoſes the ſame fundamental knowledge; but it offers in the detail ſuch a vaſt field for ſtudy, that few men are able to embrace the whole, and to cultivate all the parts with equal ſucceſs. It becomes, therefore, an advantage to ſociety that ſuch parts as can be eaſily ſeparated in practice be exerciſed by different individuals; and that a man who has acquired a general knowledge of the ſtructure, functions, and diſeaſes of the animal economy, practiſe in ſuch departments as he finds his talents and acquirements point out.

Some have oppoſed ſurgery to medicine by qualifying the firſt with the name of art, and in giving to the ſecond that of ſcience. To pretend that ſurgery is nothing but the art of treating diſeaſes by external means or by manual operations, is to rank it among the mechanical profeſſions; and to conſider as a good ſurgeon, the man who can dreſs an ulcer, apply a bandage, reduce a fracture, amputate a limb, or perform ſuch like operations, on the living body. We have already mentioned that the healing art is the ſame in all its branches; the internal organs of the body in a ſtate of health are governed by the ſame general laws, and many of them are analogous in ſtructure to the external parts; and the nature of a local diſeaſe can never be underſtood if we are not acquainted with all the deviations from the natural ſtate, of which the whole animal ſyſtem is ſuſceptible. If a phyſician be called to treat a pleuriſy, he cannot expect to do it with ſucceſs unleſs he have a ſufficiently clear idea of the nature of inflammation, or at leaſt of the principal ſymptoms which characteriſe it; of its conſequences, and of the proper mode of applying the means to remove it. This knowledge is not leſs neceſſary to the ſurgeon who is called to treat an wound, the management of which depends chiefly on the precautions neceſſary to prevent and remove inflammation in the affected parts, without at the ſame time weakening too much the vital powers. The knowledge of the phyſician does not merit more the name of *ſcience*, than that of the ſurgeon who is well acquainted with the functions of the animal economy, with morbid ſtructure, and with the progreſs and termination of diſeaſes.

The ſtudent of ſurgery has therefore to acquire, not only all that knowledge neceſſary for the well educated phyſician, but he has likewiſe to learn the manner of performing ſurgical operations. This, though no doubt an eſſential requiſite to the ſurgeon, is by no means ſo important as a competent knowledge of thoſe diſeaſes and ſtates of diſeaſe which require ſuch means; and the young ſurgeon ſhould endeavour not to cheriſh that love of operating which is obſerved in ſome, and which ariſes from the eclât which a dexterous operator generally receives.

To become an intelligent and expert operator, ſeveral qualifications are neceſſary; and ſome of theſe fall to the lot of few individuals. There are many people, who, though they have acquired an extenſive knowledge of diſeaſes, have not that calmneſs of mind, that collectedneſs of thought, which is neceſſary for a good operator; and there are ſome who are even deficient in that mechanical dexterity, which, though not requiſite in all, is yet neceſſary in ſeveral of the operations in ſurgery. Theſe talents, however, are never given in ſuch perfection as not to require cultivation. An early habit of being preſent, and of aſſiſting at operations, prepares the ſtudent to act for himſelf; and a long and unremitting habit of uſing the knife, and of performing operations on the dead body, gives a facility in all the mechanical part of them, which even experience on the living body does not procure.

Introduction.

Hiſtory of Surgery.

1

THAT ſurgery was coeval with the other branches of medicine, or perhaps antecedent to any of them, will not admit of doubt. The wars and contentions which have taken place among mankind almoſt ever ſince their creation, neceſſarily imply that there would be occaſion for ſurgeons at a very early period; and probably external injuries would for ſome time be the only diſeaſes for which a cure would be attempted, or perhaps thought practicable. In the ſacred writings we find much mention of balſams, particularly the balm of Gilead, as excellent in the cure of wounds; though at the ſame time we are informed that there were ſome wounds which this balſam could not heal.

2

Concerning the ſurgery practiſed among the Egyptians, Jews, and Aſiatic nations, we know little. The art deſcended from the Greeks to us, though they confeſſedly received it from the eaſtern nations. The firſt Greek ſurgeons on record are Æſculapius and his ſons Podalirius and Machaon. Æſculapius flouriſhed about 50 years before the Trojan war; and his two ſons diſtinguiſhed themſelves in that war both by their valour and by their ſkill in curing wounds. This indeed is the whole of the medical ſkill attributed to them by Homer; for in the plague which broke out in the Grecian camp, he does not mention their being at all conſulted. Nay, what is ſtill more ſtrange, though he ſometimes mentions his heroes having their bones broke, he never takes notice of their being reduced or cured by any other than ſupernatural means; as in the caſe of Æneas, whoſe thigh-bone was broken by a ſtone caſt at him by Diomed. The methods which theſe two famous ſurgeons uſed in curing the wounds of their fellow ſoldiers, ſeems to have been the extracting or cutting out the darts which inflicted them, and applying emollient fomentations or ſtyptics to them when neceſſary: and to theſe they undoubtedly attributed much more virtue than they could poſſibly poſſeſs; as appears from the following lines, where Homer deſcribes Eurypylus as wounded and under the hands of Patroclus, who would certainly practiſe according to the directions of the ſurgeons.

> Patroclus cut the forky ſteel away;
> Then in his hand a bitter root he bruis'd,
> The wound he waſh'd, the ſtyptic juice infus'd.
> The *cloſing fleſh* that inſtant ceas'd to glow;
> The wound to torture, and the blood to flow.

3

Till the days of Hippocrates we know very little of what was the practice of the Greek ſurgeons. From him, however, we learn, that the practice of blood-letting, cupping, and ſcarification, was known to them; al-

Hiſtory. ſo the uſe of warm and emollient fomentations, iſſues made with hot irons, peſſaries, injections, fumigations, &c. Hippocrates alſo gives directions with regard to fractures, luxations, ulcers, fiſtulas. He directs the extenſion, reduction, bandages, and ſplints, proper to be uſed in fractures and luxations of different bones, with ſeveral machines to increaſe the extenſion when neceſſary. He directs the laxity and tightneſs of the bandages; the intervals for unlooſing and binding them on again; the poſition and repoſe of the fractured member, and the proper regimen; and he mentions the time when a callus is uſually formed. He treats alſo of fractures of the ſkull, and the method of applying the trepan. In his treatment of ulcers, he ſpeaks of reducing fungous fleſh by means of eſcharotics, ſome of which are alum, nitre, verdigriſe, quicklime, &c.

4 Surgery appears not to have exiſted in Rome, notwithſtanding the warlike genius of the people, for more than 500 years. Archagathus, a Greek, was the firſt profeſſor of the art in that city; and ſo frequently employed the knife, hot irons, and other cruel methods of cure, that he was branded with the opprobrious title of *carnifex*, and expelled the city, where no phyſician or ſurgeon of eminence again made his appearance for 180 years. At this time Aſclepiades undertook the profeſſion of medicine; but ſeems to have dealt little in ſurgery. Neither have we any thing of importance on that ſubject till the time of Celſus, who flouriſhed during the reigns of Auguſtus and Tiberius.—In his work on ſurgery, all the improvements from Hippocrates to his own days are collected; the moſt minute and trifling diſeaſes are not omitted. An eminent ſurgeon, of the moderns, emphatically exhorts every perſon in that profeſſion "to keep Celſus in his hands by day and by night." He deſcribes the ſigns of a fractured ſkull, the method of examining for the fracture, of laying the ſkull bare by an inciſion in the form of the letter X, and afterwards of cutting away the angles, and of applying the trepan, mentioning alſo the ſigns of danger and of recovery. He obſerved, that ſometimes, though very rarely, a fatal concuſſion of the brain might happen from the blood-veſſels within the ſkull being burſt, the bone remaining entire. After the operation of the trepan, ſponges and cloths wetted with vinegar, and ſeveral other applications, were made to the head; and, throughout, ſevere abſtinence was enjoined. In violent fractures of the ribs, he ordered veneſection; low diet; to guard againſt all agitation of the mind, loud ſpeaking, motion, and every thing that might excite coughing or ſneezing. Cloths wetted with wine, roſes and oil, and other applications, were laid over the fracture. The cure of fractures, in the upper and lower extremities, he ſaid were nearly alike; that fractures differ in degree of violence and danger, in being ſimple or compound, that is, with or without a wound of the fleſh, and in being near to the joint. He directs the extenſion of the member by aſſiſtants; the reduction, by the ſurgeon's hands, of the fractured bones into their natural ſituation; and to bind the fractured part with bandages of different lengths, previouſly dipped in wine and oil: on the third day freſh bandages are to be applied, and the fractured member fomented with warm vapour, eſpecially during the inflammation. Splints, if neceſſary, are to be applied, to retain the bones in a fixed poſition. The fractured arm is to be ſuſpended in a broad ſling hung round the neck: the fractured leg is to be Hiſtory. incloſed in a kind of caſe, reaching above the ham, and accommodated likewiſe with a ſupport to the foot, and with ſtraps at the ſide, to keep the leg ſteady: in the fractured thigh-bone, the caſe is to extend from the top of the hip to the foot. He deſcribes the method of treating compound fractures, and of removing ſmall fragments of ſplinters of bones; and the manner of extracting darts. In luxations of the ſhoulder, he mentions ſeveral methods of giving force to the extenſion, and of replacing the diſlocated bone. One method ſimilar to that of Hippocrates was, to ſuſpend the patient by the arm; the fore part of the ſhoulder, at the ſame time, reſting upon the top of a door, or any other ſuch firm fulcrum. Another method was to lay the patient ſupine, ſome aſſiſtants retaining the body in a fixed poſition, and others extending the arm in the contrary direction; the ſurgeon, in the mean time, attempting, by his hands, forcibly to reduce the bone into its former place.

If a large inflammation was expected to enſue after a wound, it was ſuffered to bleed for ſome time, and blood was drawn from the arm. To wounds accompanied with conſiderable hæmorrhagy, he applied a ſponge wet in vinegar, and conſtant preſſure: It neceſſary, on account of the violence of the hæmorrhagy, ligatures were made round the veſſels, and ſometimes the bleeding orifice was ſeared up with the point of a hot iron. On the third day freſh dreſſings were applied. In conſiderable contuſions, with a ſmall wound of the fleſh, if neither blood-veſſels nor nerves prevented, the wound was to be enlarged. Abſtinence and low diet, upon all ſuch accidents, were preſcribed; cloths wet with vinegar, and ſeveral other applications, were to be applied to the inflamed part. He obſerves, that freſh wounds may be healed without compound applications. In external gangrene, he cut into the ſound fleſh; and when the diſeaſe, in ſpite of every effort, ſpread, he adviſed amputation of the member. After cutting to the bone, the fleſh was then ſeparated from it, and drawn back, in order to ſave as much fleſh as poſſible to cover the extremity of the bone. Celſus, though extremely diffuſe in the deſcription of ſurgical diſeaſes, and of various remedies and external applications, treats ſlightly of the method of amputating; from which, comparing his treatiſe with the modern ſyſtems, we might infer that the operation was then ſeldomer practiſed than at preſent. He deſcribes the ſymptoms of that dangerous inflammation the carbuncle, and directs, immediately to burn or corrode the gangrened part. To promote the ſuppuration of abſceſſes, he orders poultices of barley-meal, or of marſhmallows, or the ſeeds of linſeed and fenugreek. He alſo mentions the compoſitions of ſeveral repellent cataplaſms. In the *erysipelas*, he applies ceruſe, mixed with the juice of ſolanum or nightſhade. Sal ammoniac was ſometimes mixed with his plaſters.

He is very minute in deſcribing diſeaſes of the eyes, ears, and teeth, and in preſcribing a multitude of remedies and applications. In inflammation of the eyes, he enjoined abſtinence and low diet, reſt, and a dark room: if the inflammation was violent, with great pain, he ordered veneſection, and a purgative; a ſmall poultice of fine flower, ſaffron, and the white of an egg, to be laid to the forehead to ſuppreſs the flow of pituita; the

History. the ſoft inſide of warm wheat bread dipped in wine, to be laid to the eye; poppy and roſes were alſo added to his collyriums, and various ingredients too tedious to enumerate. In chronic watery defluxions of the eyes, he applied aſtringents, cupped the temples, and burnt the veins over the temple and forehead. He couched cataracts by depreſſing the cryſtalline lens to the bottom of the orbit. Teeth, looſened by any accident, he directs, after the example of Hippocrates, to be faſtened with a gold thread to thoſe adjoining on each ſide. Previous to drawing a tooth, he ordered the gum to be cut round its neck; and if the tooth was hollow, it was to be filled with lead before extraction, to prevent its breaking by the forceps. He deſcribes not only the inflammation, but likewiſe the elongation, of the uvula: he alſo deſcribes the polypus, and ſome other diſeaſes affecting the noſe.

He deſcribes ſeveral ſpecies of herniæ or rupture, and the manual aſſiſtance required in thoſe complaints. After the return of the inteſtines into the abdomen, a firm compreſs was applied to that part of the groin through which they protruded, and was ſecured by a bandage round the loins. In ſome caſes, after the return of inteſtinal ruptures, he diminiſhed the quantity of looſe ſkin, and formed a cicatrix, ſo as to contract over the part, to render it more rigid and capable of reſiſting. He deſcribes various diſeaſes of the genital parts, the hydrocele or dropſy of the ſcrotum, a difficulty of urine, and the manner of drawing off the water by a catheter; the ſigns of ſtone in the bladder, and the method of ſounding or feeling for that ſtone. Lithotomy was at that time performed by introducing two fingers into the anus; the ſtone was then preſſed forward to the perinæum, and a cut made into the bladder; and by the finger or by a ſcoop the ſtone was extracted. He deſcribes the manner of performing this operation on both the ſexes, of treating the patient, and the ſigns of recovery and of danger.

Celſus directed various corroſive applications and injections to fiſtulas; and, in the laſt extremity, opened them to the bottom with a knife, cutting upon a grooved inſtrument or conductor. In old callous ulcers, he made a new wound, by either cutting away the hard edges, or corroding them with verdigriſe, quicklime, alum, nitre, and with ſome vegetable eſcharotics. He mentions the ſymptoms of caries in the bone; directs the bone to be laid bare, and to be pierced with ſeveral holes, or to be burnt or raſped, in order to promote an exfoliation of the corrupted part; afterwards to apply nitre and ſeveral other ingredients. One of his applications to a cancer was auripigmentum or arſenic. He directs the manner of tapping the abdomen in aſcites, and of drawing blood by the lancet and cupping-glaſſes. His cupping-glaſſes ſeem not to have been ſo convenient as the modern: they were made either of braſs or horn, and were unprovided with a pump. He cured varicoſe veins by uſtion or by inciſion. He gives directions for extracting the dead fœtus from the womb, in whatever poſition it ſhould preſent; and, after delivery, to apply to the private parts ſoft cloths wet in an infuſion of vinegar and roſes. In Celſus's works there is a great redundance and ſuperfluity of plaſters, ointments, eſcharotics, collyriums, of ſuppurating and diſcutient cataplaſms, and external applications of every kind, both ſimple and compound: Perhaps, amongſt the multitude, there are a few uſeful remedies now laid aſide and neglected. History.

The laſt writer of conſequence who flouriſhed at Rome was Galen, phyſician to the emperor Marcus Aurelius. His works are for the moſt part purely medical; although he wrote alſo on ſurgery, and made Commentaries on the Surgery of Hippocrates. He opened the jugular veins and performed arteriotomy at the temples; directed leeches, ſcarification, and cupping-glaſſes, to draw blood. He alſo deſcribed with accuracy the different ſpecies of herniæ or ruptures.

In the year 500 flouriſhed Aëtius, in whoſe works we meet with many obſervations omitted by Celſus and Galen, particularly on the ſurgical operations, the diſeaſes of women, the cauſes of difficult labours, and modes of delivery. He alſo takes notice of the dracunculus, or Guinea worm. Aëtius, however, is greatly excelled by Paulus Egineta, who flouriſhed in 640; whoſe treatiſe on ſurgery is ſuperior to that of all the other ancients. He directs how to extract darts; to perform the operation ſometimes required in dangerous caſes of rupture or hernia. He treats alſo of aneuriſm. Galen, Paulus, and all the ancients, ſpeak only of one ſpecies of aneuriſm, and define it to be "a tumor ariſing from arterial blood extravaſated from a ruptured artery." The aneuriſm from a dilatation of the artery is a diſcovery of the moderns. In violent inflammations of the throat, where immediate danger of ſuffocation was threatened, Paulus performed the operation of bronchotomy. In obſtinate defluxions upon the eyes, he opened the jugular veins. He deſcribes the manner of opening the arteries behind the ears in chronic pains of the head. He wrote alſo upon midwifery. Fabricius ab Aquapendente, a celebrated ſurgeon of the 16th century, has followed Celſus and Paulus as text books.

From the time of Paulus Egineta to the year 900, no writer of any conſequence, either on medicine or ſurgery, appeared. At this time the Arabian phyſicians Rhazes and Avicenna revived in the eaſt the medical art, which, as well as others, was almoſt entirely extinguiſhed in the weſt. Avicenna's *Canon Medicinæ*, or General Syſtem of Medicine and Surgery, was for many ages celebrated through all the ſchools of phyſic. It was principally compiled from the writings of Galen and Rhazes. The latter had correctly deſcribed the ſpina ventoſa, accompanied with an enlargement of the bone, caries, and acute pain. In difficult labours, he recommends the fillet to aſſiſt in the extraction of the fœtus; and for the ſame purpoſe, Avicenna recommends the forceps. He deſcribes the compoſition of ſeveral coſmetics to poliſh the ſkin, and make the hair grow, or fall off.

Notwithſtanding this, however, it was not till the time of Albucaſis that ſurgery came into repute among the Arabians, Rhazes complains of their groſs ignorance, and that the manual operations were performed by the phyſicians ſervants. Albucaſis enumerates a tremendous liſt of operations, ſufficient to fill us with horror. The hot iron and cauteries were favourite remedies of the Arabians; and, in inveterate pains, they repoſed, like the Egyptians and eaſtern Aſiatics, great confidence in burning the part. He deſcribes accurately the manner of tapping in aſcites; mentions ſeveral kinds of inſtruments for drawing blood; and has left a more ample and correct delineation of ſurgical inſtru-

History. ments than any of the ancients. He gives various obſtetrical directions for extracting the fœtus in caſes of difficult labour. He mentions the bronchocele, or prominent tumor on the neck, which, he tells us, was moſt frequent among the female ſex. We are alſo informed by this writer, that the delicacy of the Arabian women did not permit male ſurgeons to perform lithotomy on females; but, when neceſſary, it was executed by one of their own ſex.

From the 11th century to the middle of the 14th, the hiſtory of ſurgery affords nothing remarkable except the importation of that nauſeous diſeaſe the leproſy into Europe. Towards the end of the 15th century the venereal diſeaſe is ſaid to have been imported from America by the firſt diſcoverers of that continent.

At the beginning of the 16th century, ſurgery was held in contempt in this iſland, and was practiſed indiſcriminately by barbers, farriers, and ſow-gelders. Barbers and ſurgeons continued, for 200 years after, to be incorporated in one company both in London and Paris. In Holland and ſome parts of Germany, even at this day, barbers exerciſe the razor and lancet alternately.

It is within the laſt three centuries that we have any conſiderable improvement in ſurgery; nor do we know of any eminent Britiſh ſurgical writers until within the laſt 130 years. "In Germany (ſays Heiſter) all the different ſurgical operations, at the beginning even of the 18th century, were left to empirics; while regular practitioners were contented to cure a wound, open a vein or an abſceſs, return a fractured or luxated bone; but they ſeldom or never ventured to perform any of the difficult operations." He alſo ſpeaks of their groſs ignorance of the Latin language.

6 Sixteenth century. The firſt ſurgical work of the 16th century worthy of notice is that of J. Carpus. F. ab Aquapendente, an Italian, publiſhed a Syſtem of Surgery, containing a deſcription of the various diſeaſes, accidents, and operations. Boerhaave pays this author the following compliment: *Ille ſuperavit omnes, et nemo illi hanc diſputat gloriam; omnibus potius quam hocce carere poſſumus.* About the ſame period, A. Parey, a Frenchman, made ſeveral important additions to ſurgery, particularly in his collection of caſes of wounds, fractures, and other accidents which occur during war. The ancients, who were ignorant of powder and fire-arms, are defective in this part of military ſurgery. Parey pretends to have firſt invented the method of tying with a needle and ſtrong ſilk-thread waxed the extremities of large arteries, after the amputation of a member. The ligature of the blood-veſſels is, however, merely a revival of the ancient practice, which had fallen into diſuſe: Throughout the dark ages, the hot iron, cautories, and ſtrong aſtringents, were ſubſtituted in its place. B. Maggius and L. Botellus wrote on the cure of gunſhot wounds. J. A. Cruce wrote a ſyſtem of ſurgery.

In the 17th century, ſurgery was enriched with ſeveral ſyſtems, and with detached or miſcellaneous obſervations. The principal authors are, M. A. Severinus, V. Vidius, R. Wiſeman, Le Clerc, J. Scultetus, J. Mangetus, C. Magatus, Spigellius, F. Hildanus, T. Bartholin, P. de Marchett.

7 Eighteenth century. During the laſt century, ſurgery, like all the other ſciences, made more rapid progreſs toward perfection, than during all the preceding periods. This partly aroſe from the aſſiſtance of governments in the different countries. They being convinced that anatomy is one of the moſt neceſſary ſciences, and the groundwork of the whole healing art, but particularly of ſurgery, in many great cities academies were inſtituted for the cultivation of practical anatomy; and ſchools were alſo eſtabliſhed for the inſtruction of the theoretical and practical parts of ſurgery. History.

Theſe improvements in ſurgery have been chiefly made in England, France, and Germany; and in all theſe countries a number of very eminent men have appeared.

The Engliſh ſurgeons, beſides poſſeſſing an accurate knowledge of anatomy, and great abilities in the operative part of their profeſſion, were the firſt who endeavoured to bring the art to its preſent ſimplicity. They directed alſo their attention, in a particular manner, to the diet of patients; the neglect of which had cauſed the unfortunate iſſue of many operations which had been dexterouſly performed.

Among the ſurgeons of later times, we may firſt mention the name of *Sharp*. He was a ſcholar of Cheſſelden, and one of the beſt ſurgeons of his day. He wrote a Compendium of Surgical Operations, 1746; and alſo a Critical Inquiry into the State of Surgery; both of which works are ſtill in high eſtimation.

In the year 1719, *Dr Monro*, after viſiting the ſchools of London, Paris, and Leyden, where he was a pupil of the great Boerhaave, came to Edinburgh; and this may be conſidered as the date of the foundation of the Edinburgh medical ſchool. He began by giving lectures on anatomy and ſurgery, the firſt which were delivered in Edinburgh; and in the year 1721 he was appointed profeſſor of anatomy and ſurgery to the univerſity. This eminent anatomiſt and ſurgeon, beſides filling his chair with the greateſt reputation, contributed to the advancement of our knowledge in many important parts of anatomy and ſurgery. His works, publiſhed by his ſon, beſides his Treatiſe on Oſteology, which is certainly the beſt deſcription of the bones that has ever been given, will be found to contain many intereſting and valuable obſervations on various ſurgical diſeaſes.

Joſeph Warner, ſurgeon of Guy's Hoſpital, in London, publiſhed his Caſes and Remarks in Surgery, in the year 1754, a work which contains many very important practical remarks. He afterwards publiſhed a very good work, containing a deſcription of the human eye and its adjacent parts, in which he particularly rejects the faſtening of the eye during the operation of cataract. He alſo publiſhed An Account of the Teſticles, their Common Coverings and Coats, &c.

Percival Pott, ſurgeon of St Bartholomew's Hoſpital, may be juſtly conſidered as one of the principal Engliſh ſurgeons of his time. He was not only a ſucceſsful practitioner, but an induſtrious and excellent writer. The merits of Pott are indeed conſiderable. He threw much light on the doctrine of wounds of the head, by his accurate arrangement of the different kinds of injuries to which the head is ſubject. He alſo gives a good account of hydrocele and the other diſeaſes of the teſticle. For the operation of the fiſtula in ano, he made material improvements. He has given many uſeful hints on fractures and diſlocations; and he was a great champion in favour of the operation for cataract by couching. He was the firſt perſon who deſcribed the chimney-

History. sweeps cancer; and on herniæ, polypus, and curvatures of the spine, he has made many judicious pathological and practical observations.

Charles White, surgeon in Manchester, published an excellent practical work in the year 1770, in which he recommends amputation of the foot, a little above the ankle joint, instead of under the knee, as had usually been practised. He also shows the effect of sawing off the ends of bones; and discusses several other interesting points in surgery. In the same year, Mr Else of St Thomas's Hospital, published his treatise on the hydrocele, in which he recommends the use of caustic in the cure of that disease.

In the year 1770, *Mr Dease*, of Dublin, wrote an excellent treatise on the wounds of the head. Mr Bromfield, of St George's Hospital, and Mr Hill, surgeon at Dumfries, also distinguished themselves; Mr Bromfield for his Chirurgical Observations, and Mr Hill for his Observations on Cancers.

In the year 1778, *Mr Benjamin Bell* published the first volume of his System of Surgery. The reputation of this work was soon such, that it was translated into the French and German languages; and it has since gone through several editions in these, and many in English.

This work presented the most complete system of surgery which had ever appeared; and in every part of it there is displayed a talent for practical observation and clearness of thought which must render it ever a useful and valuable present to surgery. Like all such extensive works, it is not without faults, and the language in which it is written is in some places prolix and diffuse; but notwithstanding its errors, it certainly must be considered as the most useful body of surgery that has ever yet appeared in this country.

Besides these, mention must be made of two other eminent surgeons, *William* and *John Hunter;* the former rendered immortal by his splendid work on the gravid uterus, and the latter by his treatise on the venereal disease, and his treatise on the blood, inflammation, and gun-shot wounds.

Many very eminent men arose, both in France and Germany, during the last century. The transactions of their academies leave a lasting monument of their zeal and industry.

In France we have the names of Petit, Arnaud, Garangeot, Morand, Le Dran, Le Cat, Louis, David Levret, Le Blanc, De la Faye, David Chopart, Desfault, Janin, Jourdain, Pouteau, Andrè Lombard Wensel.

In Germany, surgery has been enriched by the works of Vogel, Platner, Albert Haller, Bilguer, Weitz, Seibold, Brambilla, Theden, Smucker, Stork, Plenk, Isenflamm, Rougemont, Conradi, and many others.

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8 Arrangement of surgical diseases.

Most authors who have written systems of surgery have described diseases according to the parts of the body where they are situated; beginning with the head, and describing the parts in succession, according to their situation.

Besides this mode of arrangement being unphilosophical, it has many serious disadvantages. Diseases which have no analogy to each other, are treated of in the same place; and similar diseases are treated of separately, instead of being classed together, and considered in one general point of view. A repetition of what may be considered as the specific characters of the disease, therefore, is constantly occurring. The utility of nosological systems in practical medicine and in pathology, has been very generally acknowledged. Diseases having common characters are thus brought together and arranged under classes, orders, genera, and species. It is to be considered, therefore, as an important step in order to facilitate the knowledge of the diseases of the human body, and to give clear and distinct ideas of them; for it is equally important, to be able to distinguish diseases, as to point out how they should be treated. History.

All nosological writers have not, however, constructed their systems on similar principles; and their efforts have been often frustrated by the false theories and hypotheses with which they have set out.

The world is indebted to the ingenious and celebrated *Bichât*, for the first truly philosophical view of the structure of the human body. The simple division of it into its component parts, which that great anatomist and philosopher pointed out, must be considered as the groundwork of all future anatomical and pathological inquiries.

Bichât demonstrated, that most of the organs of our body are made up of a variety of elementary parts or textures; each of which, in whatever part of the body it is found, uniformly has the same physical properties, and presents the same morbid phenomena. These he considers as the elementary parts; which, by the diversity of their combinations, produce all the modifications of structure and functions exhibited in the different organs of animals. This method of considering organized bodies, accords with every phenomenon with which we are acquainted, and seems to arise from the essential nature of their constitution. We may trace this view of the structure of the body in the observations of many of the older anatomists; and particularly it may be considered as the basis of some of the most ingenious philosophical inquiries of the late ingenious Mr John Hunter.

In order to fix the characters of the elementary textures, Bichât employed various modes of inquiry. He performed numerous experiments on living animals; persevered in tedious and minute dissections; employed chemical reagents to supply the place of the knife; and examined with minuteness all the varieties of morbid structure. Having by these means accomplished his object in tracing the character of each separate texture, he proceeded next to investigate their combinations as they are found in the different organs.

The effects of this mode of investigating the structure of the human body when diseased, must be at once obvious. We learn from it, that diseases at their commencement are generally confined to one texture of an organ; the other textures of which the organ is composed remaining sound.

There is no organ of the body from which this important truth may not be deduced. It may be readily illustrated from considering the diseases of the mucous, serous, and muscular textures, which compose the stomach and alimentary canal; of the cellular texture of the lungs; of the mucous membrane of the bronchiæ, the serous membrane of the pleura, and many others.

But diseases are not solely confined to one individual texture of any organ, as in the cases just mentioned; the symptoms and morbid changes are likewise uniformly the same in textures of a similar structure, in whatever parts

History. parts of the body theſe textures may happen to be found. Thus the ſerous membranes which inveſt the lungs, the brain, the heart, the abdominal viſcera, have one common character when affected with any ſpecific diſeaſe: ſo alſo have the mucous membranes, whether we trace them in the mouth, the noſe, the vagina, the urethra, or covering the eye-ball; and the ſame may be obſerved of every individual texture which enters into the compoſition of our bodies.

Beſides the ſymptoms and morbid changes which are common to all textures whoſe ſtructure is ſimilar in the natural ſtate, there are others which are determined from the particular functions of the organ in which the diſeaſed texture exiſts. For example, when any of the ſerous membranes are inflamed, the nature of the pain, the degree of fever, and the duration of the ſymptoms, are the ſame, in whatever membrane it may have taken place. But to theſe ſymptoms are added, cough, difficulty of breathing, &c. when it happens to be connected with the organs of reſpiration, as in the caſe of pleuritis; coſtiveneſs, ſtrangury, delirium, loſs of viſion, when the inteſtinal canal, the bladder, the brain, or the eye, is involved in the diſeaſe.

This view of the ſubject naturally ſuggeſts a correſpondent diviſion of the ſymptoms. The firſt claſs of ſymptoms is general, and characteriſes a whole genus of textures; the ſecond is in a manner acceſſory, and depends upon the relative ſituation or the particular functions of the organ into the compoſition of which the affected texture enters.

But here we muſt ſet bounds to this theory;—the hiſtory and progreſs of diſeaſes ſhew, that we ought not to confine our obſervations within ſuch narrow limits. The principles which have been ſtated, indeed, account admirably well for the propagation of ſome affections; and for ſome of the ſympathies which ſubſiſt between different parts of the body; but there are other diſorders which advance in a very different manner. In ſome diſeaſes which are termed chronic, for example, the whole ſtructure of an organ becomes gradually altered, although the primary affection was confined to one of its component textures. This is often to be obſerved in cancer, ſcrofula, lues venerea, &c. When cancer attacks the mamma, it is at its commencement generally confined to a ſmall portion of that gland; but if allowed to proceed, it ultimately involves the whole gland, and the adjacent cellular and cutaneous textures, in one maſs of diſeaſe.

Theſe general obſervations will be ſufficient to give an outline of the principles of a pathological ſyſtem, founded on the baſis of anatomical knowledge; and in giving an account of theſe diſeaſes which more properly belong to a ſyſtem of ſurgery, we have ventured to apply theſe principles. We ſhall, in the firſt place, therefore, conſider the diſeaſes of the cellular membrane; the diſeaſes of the ſkin; of the mucous, ſerous, and ſinovial membranes; of bone and cartilage; of the vaſcular and nervous ſyſtems; and of the glands. In the ſecond place, we ſhall treat of diſeaſes which occur only in particular organs, whether from the peculiarity of their ſtructure or functions: ſuch are the diſeaſes of the eyes, ears, noſe, teeth, mouth, and fauces, and the organs of urine and generation. In the third place, we ſhall take notice of malconformations, diſtortions, and protruſions; and in the laſt place, of wounds, fractures, diſlocations, and ſuch operations as are occaſionally neceſſary to be performed on different parts of the body, as amputation, ſutures, &c. History.

CHAP. I.

Of the Diſeaſes of the CELLULAR MEMBRANE.

General Remarks on the Pathology of the Cellular Membrane. 9

THE cellular membrane is diſtinguiſhed from other organs, by the power which it has of throwing out granulations, by its being capable of elongation, of reproduction, and of growth, when it has been divided or cut by any means *.

Suppuration alſo takes place in the cellular membrane, with a rapidity of which we have few examples in other textures. The fluid which is the reſult of this ſuppuration, is well known. Its colour, its conſiſtence, and all its external qualities, have become the criterion by which we form our ideas of *pus*; in conſequence of which, all diſcharges which do not reſemble it, have been commonly conſidered as pus of a bad kind, or as *ſanies*. This opinion, however, is falſe, and has been formed in conſequence of a too ſuperficial view of the different circumſtances attending different kinds of diſcharged fluids. Certainly the pus which is diſcharged from a bone, from a muſcle, from the ſkin in eryſipelas, from the mucous membranes in catarrh, is of a good kind whenever the inflammation runs regularly through its different periods, and notwithſtanding it is quite different in all theſe caſes from the pus produced by ſuppuration of the cellular membrane. As the latter is moſt frequently obſerved, from it we have formed an idea of *laudable* pus, and of *ſanies*. The cutaneous pus, the mucous pus, the oſſeous pus, &c. have all their proper ſanies; which differ from one another as much as the natural ſtructure and functions of the organs from which they are produced.

* *Bichat Anatomie Deſcriptive.*

There are few parts of the body which have a greater number of exhalents than the cellular membrane; and this expoſes it to a number of alterations of ſtructure, ſuch as being preternaturally diſtended by the different ſubſtances which it exhales; theſe preſenting a ſolid appearance, and ſometimes producing a lardy ſubſtance, ſometimes a gelatinous matter, and ſometimes a much firmer and harder maſs. The numerous abſorbent veſſels which are alſo diſtributed on the cellular membrane is another cauſe of various diſeaſes; every ſmall cell being a reſervoir common to the exhalents which terminate in it, and to the abſorbents which ariſe from it.

There are ſome diſeaſes too, which produce a change in the elaſticity and powers of diſtenſion, which the cellular membrane naturally poſſeſſes. In health it has enormous powers of diſtenſion, as may be obſerved in emphyſema and in anaſarca; and whenever theſe cauſes are removed, it regains its natural bulk and form. In inflammations, this property is in part deſtroyed, and it happens alſo in many of the different indurations to which it is liable. Its elaſticity is alſo leſs remarkable in people advanced in life, than in children. When an old man becomes rapidly thin, the ſkin becomes flaccid, and formed

Of the Pathology of the Cellular Membrane.

formed into many folds; but when a young man is emaciated, the skin is applied exactly to the subjacent organ, and preserves its tension.

The cellular membrane, when diseased, becomes sometimes extremely sensible, and the seat of acute pain, though it seems to possess no sensibility in its natural state. When either blood, milk, or lymph, are effused in it, its sensibility is not altered, and these fluids are absorbed. On the contrary, the sensibility is so much altered by the contact of urine, of bile, of saliva, and of the other fluids destined to be thrown out of the body, that often the inflammation which succeeds the effusion prevents their absorption.

As the cellular membrane enters into the composition of every organ, it is often difficult to distinguish in diseases what belongs to it from what is the attribute of the parts with which it is found. These connections, however, become manifest under several circumstances: in acute and chronic diseases it is very susceptible of being influenced by the disease of the organs. We do not speak here of the alterations produced from juxtaposition and continuity, but of those which arise in parts of the cellular membrane which have no known connection with the affected organ.

In acute diseases which affect a particular organ, as the lungs, stomach, intestines, &c. often the cellular membrane becomes sympathetically affected and the seat of inflammation and abscesses, &c. The greater number of critical abscesses arise from this connection which exists between the organ affected and the cellular membrane. In acute diseases too it is commonly the function of exhalation or absorption of the cellular membrane that is affected, and hence the sudden œdema which often accompanies them. In chronic diseases their influence is no less remarkable. It is well known, that in chronic diseases of the heart, of the lungs, of the liver, of the stomach, kidneys, uterus, &c. they have for their symptom during their last stages an anasarca, more or less general, which arises from a debility produced in the cellular system.

We observe, that in all acute diseases, the skin receives with great facility the sympathetic influence of the diseased organ, and that it is alternately moist and dry frequently during the same day. It is by no means improbable that the cellular membrane undergoes alterations analogous to those of the skin; and if we could observe what passes in it, we would discover the cells more or less moist, more or less dry, according as it happened to be influenced: it is also to this that we ought to attribute the different state of the cellular membrane, in patients who have died of acute diseases; these presenting numberless varieties in the serous effusions.

The cellular system is not only influenced by its sympathy with other organs; but it also exercises a sympathy over them. In a phlegmon or inflammation of the cellular membrane, if the tumour is considerable, often various alterations take place in the functions of the brain, of the heart, of the liver, or of the stomach. The sympathetic vomiting, &c. are those phenomena in great phlegmons which are often manifested without being considered as belonging to the disease.

Art avails itself of the influence of the cellular system being affected by other organs, in the use of *setons*. Often in the diseases of the eye and of joints a seton produces an effect which cannot be obtained by a blister: and this probably arises from the connection which exists between the cellular membrane and the eye, being more active than that which exists between that organ and the skin *.

Of the Pathology of the Cellular Membrane.

It ought also to be remarked, in considering the pathology of the cellular system, that there is a manifest difference in the properties of the cellular texture, which is composed of layers and filaments; and in that found exterior to the different mucous surfaces, to the blood-vessels and excretories, which consists of filaments alone. From this difference results the rare occurrence of inflammations and of different kinds of tumors in the latter. It often forms a barrier where the morbid affection of the former stops, and thus protects the organ which it envelopes.

* Vide *Anatomie Descriptive, par Bichât.*

The unfrequency of hemorrhagy when extensive suppurations have laid bare large arteries is a proof of what has been said. We have seen cases where the cellular membrane contiguous to the brachial and femoral arteries has been completely ulcerated, whilst the coats of the arteries remained sound. We have observed the same phenomenon in the urethra and in the intestines. In cases of suppuration of the prostate gland and cavernous bodies of the urethra, the canal has remained untouched; and in a case of femoral hernia, where the hernial sac, and the cellular membrane covering it, all mortified, the protruded gut remained quite sound.

The cellular membrane has also a powerful influence in the production of a variety of tumors and excrescences, forming as it were their base or parenchyma of nutrition. Encysted tumors are met with alone in the cellular texture of different parts of the body, and various kinds of solid tumors and excrescences are formed by the growth of that texture on the part where the tumor is to be developed; afterwards different substances are deposited amongst it, the difference in the nature of which constitutes the difference in the tumors.

These remarks will be sufficient to give a general view of the pathology of the cellular membrane, and will enable us to form a more comprehensive and connected view of those diseases, which may be more properly considered as coming within the province of surgery.

The diseases of the cellular membrane which we shall treat of in this chapter are, 1. Inflammation of the cellular membrane, or phlegmon. 2. Sinuses. 3. Paronychia or whitloe. 4. Carbuncle. 5. Encysted tumors. 6. Steatom. 7. Sarcoma. 8. Oedema. And, 9. Emphysema.

Sect. I. *Of Phlegmon.*

In most accounts which surgical authors have given of *inflammation*, they have taken the description of its general phenomena from inflammation of the cellular membrane.

Inflammation of the cellular membrane, or phlegmon, is characterized by a tumor more or less elevated and circumscribed, visible or not visible, according to the part where it is situated. It is always accompanied with an increased sensibility of the part, and with a lancinating or beating pain, a degree of heat, greater than natural, a bright redness, which becomes more livid as the disease advances, an elevated point; and it gradually

Of Phlegmon.

ly turns ſofter from the centre to one part of the circumference.

Theſe are the ſymptoms which are generally to be obſerved more or leſs remarkable in every ſpecies of phlegmon. When they are ſlight, and when the affected part is not extenſive, or very important from the nature of its functions, it generally has not much influence on the general ſyſtem. But when they are more conſiderable, and the inflammation extends far, the pulſe becomes commonly full, frequent, and hard; at the ſame time, the patient complains of univerſal heat, thirſt, and other febrile ſymptoms.

When by the efforts of nature, or by the application of proper remedies, the pain, the heat, and the tenſion go away, the other ſymptoms, which depend in a great degree or altogether on the firſt which have been mentioned, diſappear alſo, and the patient quickly recovers his health. This termination, which is commonly the moſt deſirable, is called *reſolution*.

But if, notwithſtanding the remedies uſed, the different ſymptoms augment inſtead of diminiſhing, the tumor gradually increaſes in ſize and turns ſoft. A ſmall eminence is obſerved towards the centre of the tumor or at ſome particular point, and its ſurface becomes poliſhed. Soon afterwards the pain diminiſhes, and the febrile ſymptoms abate; and on compreſſing the tumor, the fluctuation of a fluid can be perceived in it, and this conſtitutes the ſecond termination of a phlegmon, or *abſceſs*.

11 *Of the treatment of Phlegmon.*—The principal object which is to be generally kept in view in the treatment of inflammatory tumors, is to obtain their reſolution; this being the moſt prompt and moſt certain mode of cure. There are, however, ſome caſes which are an exception to this general rule; ſuch as ſome inflammatory tumors which precede fevers, and other internal diſeaſes: for it is commonly ſuppoſed that in theſe caſes, ſuppuration is a mode by which nature throws off certain fluids or humours, which are pernicious to remain in the ſyſtem. There are other tumors which ſeem to ariſe from internal cauſes, where it is perhaps better neither to attempt to accelerate their ſuppuration nor reſolution, but to truſt them entirely to nature. Such are inflammatory tumors which occur in ſcrofulous ſubjects. There are few caſes of this kind where ſuppuration ought to be promoted, for their treatment is always embarraſſing whether they are opened naturally or by art. It is well known too, that ſuch tumors often remain a long time without any danger; from whence we may conclude, that it is moſt prudent not to touch them.

In the venereal diſeaſe, we have a ſpecific for its cure; and when buboes are opened, or other inflammatory venereal ſwellings, they generally become very difficult and embarraſſing to treat. It is therefore always moſt prudent to attempt their reſolution.

The principal means to be employed, in order to procure the reſolution of an inflammatory tumor, are local and general blood-letting, the application of heat and moiſture, &c. Leeches is perhaps the beſt mode of bleeding the inflamed part; but ſhould the inflammation take place in any of the extremities, or contiguous to any of the large veins, one or other of theſe may be opened. There is no application which tends ſo much to remove the tenſion and pain of an inflamed part as the uſe of poultices or warm fomentations. Applications of a ſedative nature are recommended by many, ſuch as the different preparations of lead, the ſulphate of zinc, vinegar, &c.; but as far as we have been able to obſerve, the uſe of this claſs of medicines has by no means ſuch powerful effects as emollients, though it has been generally ſuppoſed that emollients haſten ſuppuration. In applying poultices, they ſhould generally be removed three or four times in twenty-four hours, and the part bathed with warm water each time the poultice is changed. When fomentations are to be uſed, many employ warm water alone, whilſt others prefer a decoction of chamomile flowers, or of poppy heads. A piece of flannel of conſiderable ſize, wet with either of theſe in nearly the boiling heat, is to be forcibly wrung out, and applied as warm as the patient can ſuffer it, to the inflamed part. A ſecond piece of flannel is to be prepared in the ſame manner, and whenever that which is firſt applied begins to cool, the ſecond piece is to be employed; and this practice is to be continued for ten or fifteen minutes, and repeated as often as it is found to relieve the patient. The beſt mode of applying the ſedative remedies in external inflammation, is in the form of watery ſolution. Half an ounce of the acetate of lead diſſolved in four ounces of vinegar, with the addition of two pounds of diſtilled water, is a convenient form. In making uſe of this ſolution, it is of conſequence to have the parts affected kept conſtantly moiſt, and cataplaſms prepared with it generally anſwer that intention exceedingly well. But when the inflamed part is ſo tender and painful, as not eaſily to bear the weight of a poultice, pieces of ſoft linen, moiſtened with the ſolution ſhould be employed. Both ſhould be applied cold, or at leaſt with no greater warmth than is merely neceſſary for preventing pain or uneaſineſs to the patient. They ſhould be kept conſtantly at the part, and always renewed before turning dry and ſtiff.

When the part affected with inflammation is not very tender, or lies deep, applications of vinegar are often had recourſe to with conſiderable advantage; and the moſt effectual form in uſing it, is in that of cataplaſm, made with the ſtrongeſt vinegar and crumb of bread. In ſuch caſes, the alternate uſe of this remedy, with the ſaturnine ſolution, has produced more beneficial effects than are commonly obſerved from a continued courſe of any one of them.

In all caſes of inflammation, the whole body, but more eſpecially the diſeaſed part, ſhould be preſerved as free as poſſible from every kind of motion, and the patient ſhould be confined to a low cooling diet, and alſo a total abſtinence from ſpirituous and fermented liquors.

In ſlight caſes of inflammation, a due perſeverance in the mode of treatment which has been mentioned, will be in general ſufficient to accompliſh the intended purpoſes; but when there is likewiſe a full, hard, and quick pulſe, with other ſymptoms of fever, general blood-letting becomes neceſſary; and the quantity of blood taken away is always to be determined by the extent and violence of the diſeaſe, and by the age and ſtrength of the patient. Evacuations, however, ſhould never be carried to a greater height than what is merely neceſſary for moderating the febrile ſymptoms; for ſhould ſuppuration take place after the ſyſtem is too much reduced, its progreſs becomes more ſlow and uncertain; nor

Of Phlegmon.

nor is the patient able to ſupport the diſcharge that enſues. The uſe of gentle laxatives, with a cooling diet, is alſo attended with very good effects.

Beſides theſe different evacuations, it is of great conſequence to procure eaſe and quietneſs to the patient. The moſt effectual remedy for this purpoſe is *opium*, and, when the pain and irritation are conſiderable, as in extenſive inflammations very frequently happens, it ſhould never be omitted. In all ſuch caſes, the opium ſhould be given in full doſes, otherwiſe, inſtead of proving ſerviceable, it ſeems rather to have the contrary effect, a circumſtance which is perhaps the chief reaſon for opiates having been by ſome very unjuſtly condemned in every caſe of inflammation.

By a proper attention to theſe different circumſtances, a reſolution of the tumor will generally begin to take place in the courſe of three or four days, and ſometimes in a ſhorter time; at leaſt before the end of that period, it may be for the moſt part known how the diſorder is to terminate. If the heat, pain, and redneſs, and other attendant circumſtances abate, and eſpecially if the tumor begins to decreaſe, it is probable that, by a continuance of the ſame plan, a total reſolution will be finally effected.

But, on the contrary, if all the different ſymptoms rather increaſe, and eſpecially if the tumor turns larger, and ſomewhat ſoft, with an increaſe of throbbing pain, we may with tolerable certainty conclude that ſuppuration will take place; and we ſhould therefore immediately deſiſt from ſuch applications as were judged proper while a cure was thought practicable by reſolution, and endeavour to aſſiſt nature as much as poſſible in the formation of pus, or what is called the *maturation* of the tumor. To effect this, nothing is more uſeful than warm fomentations and cataplaſms; and ſhould theſe not have been employed during the former ſtage, the cold ſaturnine applications ſhould be given up, and recourſe had to the emollient remedies.

Dry cupping, as it is termed, viz. uſing the cupping glaſſes without the ſcarificator, applied as near as poſſible to the part affected, is frequently had recourſe to in promoting the ſuppuration of tumors. It is only, however, in thoſe in which there ſeems to be a deficiency of inflammation, that it can ever be either neceſſary or uſeful; but in all tumors of an indolent nature, and where there is ſtill ſome probability of a ſuppuration, no remedy is more effectual. By theſe different applications, continued for a longer or ſhorter time, according to the ſize of the tumor, its ſituation and other circumſtances, a complete ſuppuration may generally be at laſt expected.

Whilſt an abſceſs is forming, it extends according as the quantity of purulent matter is augmented in the cavity in which it is contained; and this extenſion takes place towards that ſide where there is leaſt reſiſtance. It is on this account that where an abſceſs is deep, or covered by an aponeuroſis, it extends in the interſtices of the neighbouring parts, and diſſects, as it were, the tendons, the muſcles, and the bones, whilſt in common caſes it makes its way towards the ſkin. When matter is collected very near to the ſurface of the body, and is only covered by the common integuments, it ſpeedily makes its way externally; but when it is deep, and ſurrounded by parts which make great reſiſtance, purulent matter inſinuates itſelf until it arrives at ſome place where there is nothing to oppoſe its exit; and it is obſerved making its eſcape after having made, in ſome caſes, a very great circuit. It is generally towards the inferior parts of the body that purulent matter, in conſequence of its weight, makes its route. On this account we ſee large abſceſſes open themſelves moſt frequently at their inferior part, and from thence the advantage which is found by waiting till they open of themſelves, or that they indicate the place moſt convenient for the opening to be made. Thus, we ſee abſceſſes formed under the temporal muſcles open themſelves in the mouth, and thoſe of the loins making their appearance near the ring, or upon the anterior part of the thigh. Deep abſceſſes, in certain parts of the body, proceed rather towards the interior than towards the ſurface, becauſe the purulent matter finds leſs obſtruction in its paſſage. Thoſe, for example, which form on the ſurface of the lungs, find great reſiſtance from the ribs and other parts forming the thorax, whilſt they eaſily make their way through the ſpongy ſubſtance of the lungs, and open in the ramifications of the bronchiæ. For the ſame reaſon, abſceſſes formed in the cavity of the abdomen ſometimes diſcharge themſelves into the ſtomach or inteſtines; but as the parietes of the belly yield more eaſily than thoſe of the cheſt, we alſo ſee abſceſſes of the different organs contained in the belly, diſcharge their contents through its parietes.

When matter is fully formed in a tumor, a remiſſion of all the ſymptoms takes place. The throbbing pain, which before was frequent, now goes off, and the patient complains of a more dull, heavy, and conſtant pain. The tumor points at ſome particular part, generally near to its middle, where, if the matter be not deep ſeated, a whitiſh yellow appearance is obſerved, inſtead of the deep red that formerly took place; and a fluctuation of the fluid underneath is, upon preſſure, very evidently perceived. Sometimes, indeed, when the abſceſs is thick, and covered with muſcle and other parts, though from concurring circumſtances there can be little doubt of there being a very conſiderable collection of matter, yet the fluctuation cannot be readily diſtinguiſhed. It does not, however, often happen that matter is ſo very deeply lodged as not to be diſcovered on proper examination.

This, however, is a circumſtance of the greateſt conſequence in practice, and deſerves more attention than is commonly paid to it. In no part of the ſurgeon's employment is experience in ſimilar caſes of greater uſe to him than in the preſent; and however ſimple it may appear, yet nothing more readily diſtinguiſhes a man of extenſive obſervation than his being able eaſily to detect deep-ſeated collections of matter; whilſt nothing, on the contrary, ſo materially affects the character of the ſurgeon as his having, in ſuch caſes, given an inaccurate or unjuſt prognoſis.

In addition to the ſeveral local ſymptoms of the preſence of pus already enumerated, may be mentioned the frequent ſhiverings to which patients are liable on its firſt formation. Theſe, however, ſeldom occur ſo as to be eaſily diſtinguiſhed, unleſs the collection is conſiderable; but it is a ſymptom conſtantly obſerved in all large abſceſſes; and when it takes place, along with other ſymptoms of ſuppuration, it always contributes to point out the true nature of the diſeaſe.

Of the opening of Abſceſſes.—When abſceſſes come to

Of Abſceſſes.

complete maturity, the integuments gradually become thinner over the more prominent part of the tumor; and they become ulcerated in one or more points through which the pus is evacuated. In many caſes it is adviſable to wait for the ſpontaneous rupture; but, on the other hand, it is often more prudent, and is indeed abſolutely neceſſary, to give vent to the matter by an artificial opening. It is a general rule not to have recourſe to ſuch means before ſuppuration is completely formed; for if an abſceſs be opened before this period, and a conſiderable hardneſs remain around, the treatment afterwards becomes very embarraſſing and difficult. It is, however, neceſſary in ſome caſes to depart from this general rule, and to open an abſceſs much ſooner; above all, thoſe which are critical, and thoſe which are the conſequence of lingering fevers.

In many caſes there is neither ſafety nor convenience to be expected from the ſpontaneous opening of the integuments. In abſceſſes ſituated in any of the joints, or upon either of the cavities of the breaſt or abdomen, and more eſpecially when they ſeem to run deep, they ſhould always be opened as ſoon as the leaſt fluctuation of matter can be diſcovered; for when the reſiſtance is on either ſide equal, it juſt as readily points inwardly towards the cavity, as outwardly towards the ſkin; and the conſequence of a large abſceſs burſting into either of the large cavities, is moſt frequently fatal.

Abſceſſes are ſometimes formed about the face, which point externally, and theſe ſhould be opened in the inſide of the mouth, in order to prevent any deformity. Whenever the fluctuation is ſenſible, this ſhould be immediately done. They cicatriſe very rapidly, and require no dreſſings.

Abſceſſes confined under an aponeuroſis, and in general under thoſe parts which are not capable of being extended without much difficulty, ought to be opened early. Such are abſceſſes which are formed under the temporal muſcles or faſcia lata of the thigh, or thoſe which frequently happen in the extremity of the fingers, under the arch of the palate, round the maxillary bones, behind the ear, above the maſtoid proceſſes, &c. All theſe ought to be opened very ſpeedily, and in particular thoſe laſt mentioned, on account of the danger of a caries of the bone in which they lie being produced.

It is alſo particularly neceſſary to open without delay abſceſſes in the neighbourhood of the anus, or near the urethra. This ought alſo to be done in large abſceſſes of the extremities, and in particular thoſe which are the conſequence of violent inflammation, occupying the whole member, as the thigh, the arm, &c. If in ſuch caſes the matter be allowed to remain too long, the greater part of the cellular membrane is detached from the ſubjacent aponeuroſis, and there often follow large gangrenous ſloughs, which in ſeparating themſelves lay open extenſive ſurfaces, and often form large bags of pus, which become as many ſeparate abſceſſes; and often the diſorder is ſuch that the whole of the integuments of the member ſphacelate and fall off. It is alſo neceſſary not to delay the opening of abſceſſes formed among the large muſcles, the interſtices of which are filled up with cellular texture; ſuch are thoſe of the thigh, the back leg, and under the arm-pit. In theſe ſituations the matter is very apt to ſpread, and to form ramifications of the abſceſs in various directions, which, if not treated with much care, are very tedious to heal.

With the exception of thoſe caſes which have been mentioned, it ought to be obſerved as a general rule not to open an abſceſs until ſuppuration be complete; for if it be true, as it is ſaid, that pus is always ſufficiently prepared to be evacuated, it is alſo the caſe, that the more we favour its formation before giving it vent, the more we are ſure of diminiſhing and of reducing the hardneſſes which exiſt in the neighbourhood, and facilitating the cicatrization of the ulcer.

Of Abſceſſes.

Of the different Methods of opening Abſceſſes.

There are three different modes of opening abſceſſes; viz. by cauſtic, inciſion, or ſeton. 13

1. *By Cauſtic.*—The uſe of cauſtic is recommended in caſes where ſuppuration has been ſlow, and has not occupied the whole tumor; in thoſe where the integuments have ſuffered much, and where it was neceſſary to wait long before opening it, on account of ſome affection of the bottom of the abſceſs; and in general in all caſes of the ſuppuration of glands.

But though there are circumſtances which may render it neceſſary to employ the cauſtic rather than the inciſion, yet the latter generally deſerves the preference. The pain which it occaſions laſts only a moment, whilſt that of cauſtic continues many hours; and when the inflamed part has acquired a morbid degree of ſenſibility, the pain is very violent. The ſurgeon alſo can never limit preciſely the extent of the action of the cauſtic; and whatever attention be paid to it, it often extends too far, and penetrates too deep.

To open an abſceſs with cauſtic, an adheſive plaſter ſpread on leather is to be applied over the tumor, with a ſlit in it of a ſize ſomewhat leſs than what is intended to be made in the ſkin by the cauſtic. The ſlit is to be filled with the cauſtic reduced into powder, mixed with a ſmall quantity of ſoap, and wetted, ſo as to make it operate more quickly. Another adheſive plaſter is then to be laid over it, and the whole ſecured with a firm compreſs and bandage. The time neceſſary to allow the cauſtic to make a ſufficient opening will depend on the thickneſs of the ſkin and ſtrength of the cauſtic, but generally it requires two, three, or more hours. When the eſchar is made, and the matter has not eſcaped, we ought to aſſiſt its exit with the end of a probe, or the point of a biſtoury; and the ſeparation of the eſchar is to be promoted by emollient applications.

2. *By the Inciſion.*—The tumors which are not very extenſive, may generally be opened by making a longitudinal inciſion with the lancet, ſee Plate DXIII. fig. 1. For this purpoſe, when the ſituation of the abſceſs permits it, the ſurgeon is to apply one hand on the baſe of the tumor, and preſs the pus towards the ſkin, by doing which there is no riſk of wounding any artery, or important part at the bottom of the tumor, and the lancet penetrates into the cavity of the abſceſs with more certainty and eaſe, and with leſs pain. With the other hand an inciſion of the integuments is to be made in ſuch a direction, that it may terminate at the moſt depending part of the tumor; and ſhould be made of ſuch length as may appear neceſſary, in order that the matter may be allowed freely to eſcape. It is in general ſuppoſed ſufficient, in caſes of ſmall abſceſſes, that the inciſion extend two-thirds of the length of the tumor. Some authors have adviſed, that when the integuments are much diſtended, an inciſion ſhould be made through the whole length of the tumor, even 14 Plate DXIII. fig. 1.

where

Of Abſceſſes.

where it is of a large ſize; but this practice ought to be rarely adopted. The irritation and conſequent inflammation, produced from ſuch an operation, muſt always be very conſiderable; and as it ſcarcely ever happens that the integuments are ever ſo much extended as entirely to loſe their contractile power, there is always reaſon to hope that they will recover their natural dimenſions. In all very large abſceſſes, it is the ſafeſt practice to make at firſt a ſmall inciſion ſufficient to allow the contents to be diſcharged; for whenever this is done, the extent of the cavity rather diminiſhes; and ſhould it be found afterwards neceſſary to make a more extenſive opening, this can now be done with much advantage. When an abſceſs has been opened by either of theſe methods, it is reduced to the ſtate of a ſimple wound or ulcer, and ought to be treated accordingly.

The mode by inciſion ought to be preferred to that of cauſtic, when the matter is collected deep; when it is in the neighbourhood of important nerves or blood-veſſels; when it is neceſſary to make the opening large; when the ſkin which is to be opened has a natural appearance; and, above all, when the ulcer is wiſhed for to be healed rapidly up, and leave little deformity.

Although ſurgeons generally agree in preferring the inciſion to the cauſtic, it has nevertheleſs its inconveniences. Whenever the inciſion is made, the matter contained in the tumor is ſuddenly evacuated; from whence it happens, when the collection is conſiderable, that the patient faints, or has ſome other diſagreeable ſymptoms; but the principal diſadvantage of this method is, that it gives free acceſs to the air over a large extent of the ulcerated ſurface; a circumſtance which is followed by very pernicious effects, particularly in large abſceſſes. A total change takes place in the nature of the matter; a laudable pus is transformed into an ichorous indigeſted fluid; the pulſe becomes quick; colliquative ſweats and other ſymptoms of fever come on, and commonly the patient dies in a ſhort time. Surgeons have too often occaſion to obſerve the dangerous effects which probably are altogether produced by the admiſſion of the air; for we ſee a great number of patients have for a long time after a termination of inflammatory diſeaſes conſiderable abſceſſes, where the pus is perfectly formed, without ſhewing at the ſame time any ſymptom of hectic fever. But when theſe abſceſſes exceed a certain ſize, and if a large inciſion be made into them, there always follow ſymptoms of fever, generally in forty-eight hours from the time that the abſceſs had been opened. Theſe accidents, which we have frequently obſerved in private practice, are ſtill more frequent in great hoſpitals, where the air is impregnated with putrid exhalations.

13 3. *By the Seton.*—From the obſervations which have been already made, it appears neceſſary that as much precaution as poſſible ſhould be taken to prevent the contact of the air with the internal ſurface of the abſceſs. The ſeton, therefore, has the advantage, not only of being attended with little pain, and emptying the abſceſs in a gradual manner, but it completely prevents the acceſs of the air. When patients are otherwiſe in good health, there is another advantage in employing the ſeton; for frequently a cure is obtained at a period much ſhorter than that which is uſually neceſſary when the inciſion has been adopted. On the other hand, if we have reaſon to wiſh to keep up for a long time a certain degree of irritation and ſuppuration in the affected part, the ſeton ought to be preferred to every other means. There have been various inſtruments contrived for introducing the ſeton, and it may eaſily be done by a lancet and common probe, or by the inſtruments repreſented in Plate DXIII. fig. 15. and 16. One of theſe being threaded with glovers ſoft ſilk or with cotton, ſhould be introduced into the upper part of the tumor; but if the blunt one be employed, it will be neceſſary to have the aſſiſtance of the lancet. The inſtrument is then to be brought out at the under part of the tumor, and the matter allowed to run gradually along the threads. The ſeton ſhould be changed forty-eight hours after it has been introduced, and as much of it ſhould be pulled out at the under part as is ſufficient to allow the removal of that which was ſhut up in the abſceſs. The abſceſs is to be dreſſed in this manner every day as long as circumſtances ſeem to require.

By means of the ſeton, we obtain a regular and ſlow diſcharge of the matter contained in the abſceſs; the ſides of the abſceſs are allowed to contract in a gradual manner; the preſence and friction of the ſeton on the ſurfaces, excites a ſlight inflammation which contributes to unite them, and to complete an adheſion, much more readily than by any other method. In proportion as the diſcharge diminiſhes, the thickneſs of the ſeton ought to be leſſened; and this is eaſily done by taking out ſome of the threads of the cotton every two or three days. It ought to be entirely taken out when no more matter is diſcharged than what would be produced by the irritation of the ſeton alone; and by compreſſing gently the parts for ſome days after it has been withdrawn, with a compreſs and bandage, we can in general depend upon a complete cure.

When ſpeaking of the mode of introducing the ſeton, we recommended that this ſhould be done from above downwards, becauſe, if the firſt opening be made at the baſe of the tumor, a great quantity of matter immediately eſcapes. Thus the boundaries of the abſceſs at the upper part become effaced, and the paſſage of the director along the abſceſs is much more difficult than when the abſceſs is opened according to the manner we have pointed out. In that way the under part of the tumor is left completely diſtended till the laſt moments, and only a very ſmall quantity of matter eſcapes by the ſuperior orifice. Another advantage is, that the part of the ſeton left for the future dreſſings, is eaſily kept clean and dry.

The method of opening abſceſſes by the ſeton has been found particularly uſeful in ſuppurations of the joints, and in all thoſe glandular parts where the admiſſion of the air is followed by very pernicious effects. Thus, when it is thought neceſſary to open a ſcrofulous tumor, we may generally be able to obtain a more prompt and eaſy cure from the uſe of the ſeton, than by making a larger inciſion. Venereal buboes, too, when come to maturity, have been ſaid to get well much ſooner by this than by any other method, when the integuments have not become too thin by great diſtenſion long continued. On the other hand, this mode is not without its inconveniencies, for in adopting it we cannot be well aſſured of the ſtate of the bottom of the abſceſs, which it is often important to know.

Whatever advantages theſe different methods of opening abſceſſes may poſſeſs over one another, yet there is not one of them which deſerves the preference in all caſes, although the cauſtic, as already mentioned, be the means

Of Sinuſes. to which we ought moſt rarely to have recourſe. However troubleſome it may be, the action of the air on the interior ſurface of the abſceſs is not always equally pernicious; and when by properly applied dreſſings, care is taken not to allow purulent matter to form in any particular cavity, and to prevent the acceſs of cold air on the ſurface of the wound, and above all when the ſurrounding air, as that in hoſpitals, is contaminated with putrid exhalations, daily experience ſhews, that the method by inciſion is accompanied with moſt ſucceſs. On the other hand, we have ſeen the ſeton extremely uſeful in gradually diſcharging, and without exciting much inflammation, large abſceſſes.

Theſe are the general principles we have to obſerve in the treatment of abſceſſes, in whatever part of the body they are found. There are, however ſome modifications, ſome particular details of practice, which ought to be kept in view, when the diſeaſe is ſeated in particular organs, as the eyes, the mammæ, the cavity of the cheſt, the groin, the ſcrotum, &c. Mention will be made of theſe in giving an account of the diſeaſes of the particular organs.

Sect. II. *Of Sinuſes* (Fiſtulæ).

16 When an abſceſs, inſtead of healing continues to diſcharge purulent matter, and when this takes place through a ſmall orifice, it obtains the name of a *fiſtula*. The orifice has ſmooth and callous edges, and the fiſtula commonly communicates with one or more cavities of different dimenſions, ſituated in the cellular membrane, between the common integuments and the muſcles, or between the interſtices of the muſcles themſelves.

Theſe different cavities, which are generally known by the name of *ſinuſes*, ſerve as reſervoirs, both for the matter which is formed in the body of the ulcer, and for that furniſhed by their own ſides. It is thus that when by compreſſion, the matter contained in the ſinuſes is preſſed out through the ulcers, theſe diſcharge a much greater quantity than what might have been expected, by conſidering the extent of their ſurface alone.

This deſcription of a fiſtulous ulcer indicates the moſt ſimple form of the diſeaſe; but when it has laſted for a long time, the whole internal ſurface frequently becomes hard and callous, acquiring the properties and ſtructure of a *mucous* ſurface.

The moſt frequent cauſe of the formation of ſinuſes is, when an abſceſs burſts, that the purulent matter, inſtead of being all diſcharged, remains ſhut up in ſome part of the cavity. Remaining there, it naturally falls to the lower part, and gradually inſinuates itſelf among the layers of the cellular membrane, which, from its ſoftneſs, gives little reſiſtance; it advances by degrees among the interſtices of the more ſolid organs, which are connected by that ſubſtance alone; and at laſt it makes its appearance on the ſurface of the body, or penetrates into one of the cavities. Both recent and old fiſtulous ulcers are generally curable, provided that the ulcer be ſituated in ſuch a manner, that the neceſſary remedies can be applied to it, and that the conſtitution be otherwiſe free from diſorder. But when the diſeaſe has been of very long duration, and, above all, when the ſinuſes open into any articulating cavity, or are placed in ſuch a manner, that one cannot practiſe any operation, the treatment then becomes extremely difficult, and the event very doubtful. There is no diſeaſe which reſiſts more frequently all the efforts of art than certain ſpecies of fiſtula, and particularly ſome of thoſe about the anus and perinæum. Of Sinuſes.

Of the treatment of Fiſtulæ.—There are ſeveral different modes which have been propoſed for the treatment of this diſeaſe, all of which may be uſeful in particular caſes.

17 Injections, ſuppoſed to have a cicatrizing quality, have been propoſed by ſome; and theſe are no doubt uſeful in particular caſes, in diminiſhing the quantity of the diſcharge, and in preventing the extent of the ſinus from increaſing. When the diſeaſe is far advanced, and the edges become perfectly callous, injections of an eſcharotic quality have been employed; but theſe remedies have ſeldom, if ever, produced any good effects; and their too frequent uſe has even rendered ſinuſes hard and callous, which were of a more benign nature. By injection.

18 In ſome caſes, particularly when the diſeaſe is recent, great advantage may be derived from the proper application of a compreſs and bandage. In applying theſe, the compreſs ſhould be placed in ſuch a manner, and made of ſuch a form, as to make a firm preſſure from the bottom of the ſinus towards its orifice; and care ſhould be taken that no preſſure be made towards the orifice itſelf, in order that any matter which is formed may not be allowed to collect, but be diſcharged from it. Indeed in whatever mode we treat ſinuſes, the object to be held in view, is to allow any matter which is formed to be immediately diſcharged. By compreſſion.

Some have adviſed, that, in all fiſtulæ of long ſtanding, their cavities ſhould be laid open from one end to the other, and all the parts ſhould be diſſected out which have become hard, and thus to convert the whole into an ulcer, and treat it in the ordinary manner. There is no doubt, but that by ſuch an operation, it will often be poſſible to obtain a cure; but independent of the great pain, and of the large and diſagreeable cicatrix which muſt always follow, the practice is not without danger. It cannot anſwer, for inſtance, in thoſe fiſtulas which extend far up the rectum. No practitioner ſurely would adviſe the adoption of ſuch a method in the caſe of fiſtulas which penetrate very deep, and extend, as often happens, underneath the blood-veſſels, the tendons, and the nerves; and even although this practice was without danger, it ought to be adopted in no caſe, as we are enabled, by an operation more ſimple, and much leſs painful, always to obtain a cure with as much certainty as by a total deſtruction of the parts.

19 In the treatment of fiſtulas, it is neceſſary to procure an agglutination of the edges of the ſinuſes, ſo as to obliterate the cavity. The means moſt efficacious to fulfil this indication are, to make firſt an opening, ſo as to allow the exit of the matter; and to excite a certain degree of inflammation on the internal ſurface of the cavity, ſo as to produce an adheſion between its ſides. By inciſion.

Both of theſe indications may, in ſome caſes, be fulfilled in the moſt convenient manner, by introducing into the orifice of the ulcer a ſeton which will follow the whole courſe of the ſinus as far as its oppoſite extremity. The ſeton ſhould be of a ſize proportioned to that of the ſinus; and it may be diminiſhed by degrees as the cure advances, by taking away ſome of the threads day after day. At laſt, when the cavity of the ſinus is nearly

Of Sinuſes.

nearly filled up, and conſequently the diſcharge much moderated, the ſeton ought to be withdrawn. Afterwards a bandage is to be firmly applied over the part, which ſhould be allowed to continue a convenient time, in order to obtain a complete cure. In all caſes, therefore, we ought to diſcover the direction of the ſinus, which can commonly be done by introducing a probe, or by obſerving the place in which the matter collects, when it has been allowed time to accumulate, and by marking the place from whence it comes, the preſſure is to be made on the affected part. A ſeton ought then to be introduced into each ſinus.

Another means of procuring the obliteration of ſinuſes is, by a longitudinal inciſion along the whole cavity. In caſes where the fiſtula extends to parts which it is not dangerous to cut, and where the ſeton has inconveniences which render it inadmiſſible, we ſhould not heſitate to have recourſe to this means. Indeed, the longitudinal inciſion of the ſinus is to be conſidered in all caſes, as the only means which can be adopted with certainty in the cure of the diſeaſe; and though in many caſes it may be proper to attempt the cure by the milder means which have been mentioned, yet they often fail, and the mode by inciſion ought always to be held in view.

We may obſerve here, that this part of ſurgery owes much to the celebrated Mr Pott, he having rendered much more ſimple and ſucceſsful the treatment of fiſtulas, particularly thoſe ſituated in the perinæum and anus. When a fiſtula is to be laid open, the firſt thing to be done, is to determine the extent of the inciſion. The exact extent of the ſinus ſhould be accurately aſcertained with a probe, and it is neceſſary to lay it open to the extreme point, in order completely to ſecure the filling up of the cavity. The operation may be performed by introducing a director (fig. 9. and 12.), along the whole courſe of the ſinus, and cutting on it with a common ſcalpel (fig. 1.); or the ſharp-pointed biſtoury (fig. 4.) may be introduced along the groove of the director, the point of the inſtrument puſhed through at the bottom of the ſinus, and then, by withdrawing the director, the inciſion may be ſpeedily completed with the biſtoury.

Plate DXIII.

A ſtill better method is one we have often adopted in caſes of ſinus with the greateſt advantage. It conſiſts ſimply in putting a ſmall bit of wax, about the ſize of a pin head, upon the end of a ſharp-pointed biſtoury, introducing the point of the inſtrument thus defended along the ſinus; and when it arrives at the bottom of it, the point may be puſhed through the ſkin, and diſplace the wax with very little preſſure. When the point has been brought through the ſkin, the inciſion may afterwards be completed with one quick motion of the knife. In laying open ſinuſes in this manner, it is particularly neceſſary to form an exact idea of the direction of the ſinus, and of the extent of the inciſion to be made, before attempting to introduce the biſtoury. For as a very ſlight degree of preſſure is ſufficient to diſplace the wax on its point, any untoward motion upon the ſide of the abſceſs would thus expoſe the point of the inſtrument, and render the operation more tedious and difficult, and always more painful.

The principal advantages of this mode of laying open ſinuſes are, that the operation can be much more ſpeedily performed, and that it coſts much leſs pain to the patient. The introduction of the director through a ſmall fiſtulous opening, and the tedious proceſs of cutting through the integuments with a ſcalpel, cannot fail of creating much diſtreſs, whereas a thin biſtoury can be introduced without giving almoſt any uneaſineſs; and after the operator has conducted its point to the bottom of the ſinus, it may be puſhed through the integuments, and the ſinus cut open with a *coup de main*.

Of the Whitloe.

All ſinuſes ſhould be laid open in this manner, which can be detected by a careful examination with the probe; and if the edges of the fiſtulous ſore are found to have acquired a great degree of calloſity, it is alſo ſometimes adviſeable to cut them entirely away.

The ſinuſes are now to be dreſſed by placing between the edges portions of caddis dipped in oil, or ſimple ointment; and great care ſhould be taken that no portion of newly divided parts be allowed to come into contact, as there will be great riſk of an adheſion taking place between them, thus fruſtrating the very objects of the operation. After the pledgets have been introduced between the edges of the wound, it is commonly directed that the whole wound be covered up with a piece of linen ſpread with ointment. In place of the ointment, we have generally found a poultice anſwer better. The poultice, by its moiſture, prevents any agglutination of the lips of the wound; and it has the power of diminiſhing the inflammation more than any other application. The wound is afterwards to be treated on the principle of the common ulcer *.

* See *Ulcers.*

Sect. III. *Of the Whitloe* (Paronychia).

20 The whitloe is a painful inflammatory ſwelling, occupying the extremities of the fingers, moſt frequently at the root of the nails. Several varieties of the diſeaſe have been deſcribed by authors; but theſe differences only conſiſt in the depth the diſeaſe is ſuppoſed to have been ſeated. From what we have been able to obſerve, it appears to be ſituated chiefly in the cellular membrane immediately underneath the ſkin, and in the ſtructure connected with the nails; though at the ſame time the pathology of this diſeaſe is not yet well underſtood.

The firſt ſymptom of the whitloe is an uneaſy burning ſenſation over the point of the finger, or root of the nail. The part becomes tender and painful to the touch; and a ſlight degree of ſwelling takes place, reſembling œdema, attended by little diſcolouration. A tranſparent effuſion takes place below the epidermis, and forms a veſication round the root of the nail. A purulent diſcharge takes place round the edge of the nail, and the nail always ſeparates. The peculiarity in this diſeaſe is, that it generally affects ſeveral fingers, one after the other, and ſometimes all the fingers of both hands.

In the more ſevere forms of the diſeaſe, the inflammation extends to the cellular membrane underneath the ſkin, and even to the tendinous aponeuroſis and perioſteum of the fingers, producing caries. In ſuch caſes the whole hand generally ſwells, and the ſwelling even extends up the arm and affects the axillary glands.

Whitloes ſometimes ſucceed a blow or injury of the finger; but they moſt uſually make their appearance without any known cauſe.

21 *Treatment.*—In the treatment of whitloe, two ſets of remedies

Of the Carbuncle.

remedies have been employed. Some uſe fomentations, poultices, and leeches; whilſt others apply ardent ſpirits, vinegar, cold water, and aſtringents.

Local bleeding and emollients do not ſeem to give the ſame relief in this as in other ſpecies of inflammation. When, however, the inflammatory ſymptoms and pain are violent, it is always neceſſary to take away ſome blood; and this may be beſt done at the bend of the arm. The affected part ſhould be afterwards immerſed in ſtrong brandy, ſpirit of wine, or alcohol or ſtrong vinegar. We have alſo ſeen the inflammation much abated by immerſing the hand, on its firſt commencement, in a very large veſſel of cold water.

It is only, however, in the firſt ſtages of this affection that remedies of this kind can prove uſeful: for, when effuſion has actually taken place, and ſuppuration begun, that ſtate of the diſeaſe is produced which theſe remedies were intended to prevent. Emollient remedies ſhould now be employed; and whenever the preſence of a fluid can be aſcertained, it ſhould be diſcharged with a lancet.

The wound is afterwards to be treated as a common abſceſs; but we may remark, that here, more than in any other part of the body, it is of the greateſt importance to lay open freely every ſinus, which a patient uſe of the probe can detect. Sinuſes, ſituated here, never heal; and, when allowed to ſpread, are always attended with miſchief. They deſtroy ligaments and tendons, or at leaſt produce a thickening of the parts around the joints, ſo as afterwards to interrupt their free motion.

Sect. IV. *Of the Carbuncle.*

23

The carbuncle (*anthrax*) may be conſidered as a ſpecies of phlegmon, attended with a remarkable degree of malignity, and is one of the ſymptoms of the plague, where that diſeaſe rages, or of typhus fever in this country. It conſiſts in a deep-ſeated very hard ſwelling, attended with an intenſely painful ſenſe of burning in the part, and conſiderable diſcolouration of the ſkin.

The carbuncle is often ſudden in its appearance. It is of a duſky red colour at its centre, but much paler and variegated at its circumference. Veſications appear on its ſurface, and when theſe are ruptured they diſcharge a dark-coloured ſanies. The diſeaſe ſometimes commences with ſymptoms of general inflammation; but moſt commonly it is attended with rigors, ſickneſs, great reſtleſſneſs and depreſſion of ſtrength, fainting, delirium, &c. A miliary eruption, or even petechiæ, are alſo ſometimes found diſperſed in different parts of the body.

When ſuppuration takes place, ſeveral openings generally form in the ſkin, a thin ichorous fluid is diſcharged, and a dark yellow ſlough is obſerved at the bottom of the ſore.

The carbuncle moſt frequently takes place about the back, neck, and ſhoulders, and is generally ſolitary. They are uſually two or three inches in diameter, though ſometimes they acquire an enormous ſize.

The cellular membrane and ſkin ſeem to be the principal textures affected in this diſeaſe; a great part of the former is always deſtroyed by the formation and ſeparation of very large ſloughs, and that of the latter by the extenſive ulceration.

In the treatment of this diſeaſe great attention is neceſſary, not only to the local applications, but alſo to the general remedies.

Of Encyſted Tumors.

23

Emollient poultices, and warm anodyne fomentations, ought to be employed during the firſt ſtages of the diſeaſe; and when ulceration of the ſkin has taken place, the application of an ointment, compoſed of a conſiderable quantity of the powder of opium, we have found to relieve very much the pain which the ulcerative proceſs generally creates. The uſe of rags, wet with diluted nitrous acid, or a ſolution of lunar cauſtic, has been found of great uſe in promoting the ſeparation of the ſlough, and the granulation of the cavities which remain.

When the conſtitutional ſymptoms are inflammatory in their commencement, it may be neceſſary to employ general blood-letting; but the fever being commonly of a typhoid form, wine, bark, and opium, ought to be freely adminiſtered. It will be alſo proper to preſcribe a generous diet, and to pay great attention to keep the bowels regular.

Sect. V. *Of Encyſted Tumors.*

24 General obſervations on tumors.

The word *tumor* has been the origin of much confuſion in the arrangements of diſeaſes adopted by the moſt celebrated noſologiſts; they have employed it as a term to characteriſe a *claſs*, and alſo as expreſſing merely a *ſymptom* of diſeaſes. A vaſt variety of diſeaſes have been thus included under the claſs of tumors, diſeaſes which are totally diſſimilar, and have no analogy whatever. Anaſarca, bubo, encyſted tumors, ſcrofulous and ſcirrhous tumors, warts, &c. have all been included under this claſs, theſe being as different from one another as any diſeaſe with which we are acquainted, having only one common ſymptom, which is that of ſwelling.

Mr Abernethy has lately made a very laudable attempt to arrange tumors from their anatomical ſtructure; but, like thoſe who preceded him, he has claſſed diſeaſes together, among which no analogy can be diſcovered. He divides tumors into ſarcomatous, encyſted, and oſſeous. Under the ſarcoma he includes the ſteatom (adipoſe ſarcoma), medullary ſarcoma, and others, all of which have no reſemblance to each other in their hiſtory or ſymptoms.

The word *tumor* ought therefore to be expunged from noſology, and be no longer employed to characteriſe a claſs of diſeaſes. Its uſe ſhould be ſynonymous with that of ſwelling, and be confined to expreſs merely an enlargement of any organ of the body, or a new growth; whilſt all thoſe diſeaſes, which have been formerly claſſed among tumors, ſhould be arranged either according to their ſpecific nature, or to the texture of the body in which they ariſe. Thus tumors, connected with *lues venerea* or *ſcrofula*, ſhould be included under theſe general names. The *ſteatom*, being a growth of fat, and being always formed in the cellular membrane, ought to be treated of among the diſeaſes of that texture. Encyſted tumors, being alſo formed in the cellular membrane, ought to be arranged among its diſeaſes; and warts, corns, and other tumors being diſeaſes of the ſkin, will be with propriety claſſed among them: and the ſame may be ſaid of all other diſeaſes which have uſually received the general appellation of

tumor.

Of Encyſted Tumors.

tumor. We ſhall, therefore, in this ſection, treat of thoſe tumors only which are formed in the cellular membrane.

Under the claſs of encyſted tumors (*tumeurs enkyſties*, *loups cystides*), are comprehended all thoſe tumors of preternatural formation, the contents of which are ſurrounded by a bag or cyſt.

25 Of Encyſted tumors.

Encyſted tumors are generally formed in the cellular membrane, immediately underneath the common integuments, they are moveable, circumſcribed, commonly indolent, without heat or any change of colour in the ſkin; and they are very ſlow in their formation and progreſs. They contain a matter more or leſs thick in conſiſtence; and, according to the nature and conſiſtence of this matter, they are diſtinguiſhed by different names. They have been denominated *atheroma*, from the contents being of a ſoft cheeſy conſiſtence; *meliceris*, when they contain a matter of the conſiſtence of honey; and *ſteatoma*, when formed of fat. The ſteatom, however, ought not to be claſſed among the encyſted tumors, as the thin cellular covering in which it is contained has no analogy in its ſtructure to the *cyst* of the other tumors.

It ought to be obſerved, that the conſiſtence of the matter contained within the cyſt varies in every ſpecies of encyſted tumor. In the *atheroma* and *meliceris* they have ſometimes the conſiſtence and firmneſs of new cheeſe, and at other times they are ſofter than the moſt liquid honey. Theſe varieties depend on the length of time which the fluids have remained in the cyſts, and in the proportion of coagulable lymph and ſerum, which have been ſeparated and abſorbed, and alſo from their having been inflamed or not, and on the extent to which this inflammation may have proceeded. Sometimes an encyſted tumor is compoſed of different cyſts, each of which contains a ſubſtance of a different nature. Theſe different circumſtances render in general the diagnoſis in the varieties of encyſted tumors very difficult; and happily this diſtinction is not neceſſary in practice, and perhaps ought alſo to be omitted in our noſological arrangements. The ſac of an encyſted tumor is generally pretty firm, and compoſed of concentric lamellæ. We have obſerved ſome of the cyſts which were nearly as firm as cartilage, having ſmall chalky concretions formed in many parts between each layer. When the contents of the tumor are waſhed out, the internal ſurface of the ſac generally appears ſmooth and poliſhed; but, in others, ſome of the matter adheres firmly to the ſurface of the ſac. In ſome caſes the tumor very much reſembles the hydatids found in the liver and other organs; for, beſides the firm ſac, there is ſometimes formed within it, and apparently having no adheſion with it, a thin and very eaſily torn whitiſh bag, which contains the fluid.

Encyſted tumors are very ſmall at their commencement, and grow by almoſt inſenſible degrees. They vary a good deal in their form and ſize. Thoſe which are formed in the hip, are generally round and ſmooth; commonly of the ſize of a nut, and acquire rarely the bulk of a large egg. Thoſe which are ſeated in other parts of the body are more irregularly formed, and ſometimes become of a prodigious ſize, ſome having been found which weighed 10, 15, and even 20 lbs. They are never painful, at leaſt at their commencement, and the ſkin preſerves, for a long time, its natural colour; but when they become very large, the veins of the ſkin are large, and become varicoſe; and the ſkin on their upper part becomes poliſhed, and acquires a reddiſh colour, ſimilar to that of a part inflamed. They ſeldom give pain or uneaſineſs, except when they receive a blow. Inflammation and pain then eaſily come on, and the cyſt becomes ruptured, if it is not previouſly opened by an inſtrument.

Of Encyſted Tumors.

Such is the uſual progreſs of encyſted tumors; and although they do not come to a rapid termination, yet this ſometimes happens more readily under certain circumſtances, and even before they have acquired a large ſize. In the hip, for example, we perceive the integuments become tender and very thin, and open before the tumor has acquired any conſiderable ſize. But on other parts of the body, and particularly the back, ſhoulders, and thighs, the integuments preſerve their natural appearance, even when the tumor has acquired a large bulk. This appears to ariſe from the ſkin being more looſe in theſe parts.

The ſituation of encyſted tumors alſo contributes much to determine the degree of adheſion which they have contracted with the neighbouring parts. In ſome ſituations they are ſo detached, eſpecially while they continue ſmall, that they readily alter their ſituation by very ſlight degrees of preſſure; but in others, particularly when covered by any muſcular fibre, they are more firmly fixed from their commencement. The attachment of encyſted tumors is alſo influenced by their remaining more or leſs free from inflammation; for they never become inflamed, even in the ſlighteſt manner, without ſome degree of adheſion being produced between the cyſts and contiguous parts.

26 Mode of their formation.

It has been generally ſuppoſed that the membrane which forms the cyſt of this ſpecies of tumor is not a new formation in this part, but that it is formed by a collection of fluid in one of the cells of the cellular membrane, which by its increaſe dilates the cell, and brings it in cloſe contact with the adjacent cells, ſo as finally to obliterate them, and increaſe the thickneſs of its own coats.

The ingenious Bichât* has ſhown that this opinion ſo generally adopted is without foundation, and that the formation of encyſted tumors more probably depends on laws, analogous to thoſe which regulate the growth of the different parts of our bodies. He has alſo ſhown that there is a great analogy between theſe cyſts and the *ſerous* membranes.

* Vide *Anatomie Generale.*

The cyſts, like ſerous membranes, form a ſpecies of ſac without an opening; they contain the fluid which they exhale, and they have a ſmooth and poliſhed ſurface contiguous to the fluid, whilſt the other ſurface is unequal, and connected with the adjacent cellular membrane.

The cyſts have a ſimilar ſtructure to ſerous membranes; maceration, &c. proving them both to be compoſed of a cellular texture. In the natural ſtate neither of them have any ſenſibility, but when inflamed they both become extremely ſenſible. The cyſts alſo are evidently ſecretory organs, exhaling the fluid with which they are filled, and their power of abſorption is alſo very manifeſt from the ſpontaneous cures of ſome encyſted dropſies.

Theſe conſiderations led Bichât to conclude that there exiſts a perfect reſemblance between the cyſts of the

Of Encyſted Tumors.

the encyſted tumors and the ſerous membranes. An important queſtion here preſents itſelf, to know how theſe cyſts are formed, how a membrane which did not exiſt in the natural ſtate can be produced, can grow, and even acquire a conſiderable developement under certain circumſtances? The mechanical explanation of theſe phenomena which has been already mentioned, though it at firſt ſight may appear ſimple and ſatisfactory, yet it is by no means conformable to the uſual proceedings of nature. How does it happen that as the cyſts and ſerous membranes are analogous, that theſe membranes are formed in a different manner, the ſerous membranes being never formed from a compreſſion of the cellular membrane? How is it, if the cells are applied and compacted with one another ſo as to form a ſac, that the neighbouring cellular membrane does not diſappear, or even diminiſh, whilſt the ſac acquires a large bulk? Theſe reflections would lead us to believe with Bichât, that the common manner of explaining the formation of cyſts is eſſentially different from the manner in which nature generally follows in all her operations.

Bichât ingeniouſly remarks that all tumors which vegetate externally, or appear internally, are formed and grow in the ſame manner as the cyſts, there being no difference between theſe two morbid productions but in the form in which each of them appears. Moſt tumors throw out upon their external ſurface the fluid which they ſeparate. The cyſt, on the contrary, exhales that fluid from its internal ſurface, and preſerves it in its cavity. "Suppoſe a fungous tumor in ſuppuration (ſays Bichât), transformed in a moment into a cavity, and the ſuppuration to be tranſported from the external ſurface to the ſides of the cavity, that cavity will then become a cyſt.—Reciprocally, ſuppoſe a ſuperficial cyſt, the cavity of which is obliterated, and of which the fluid is exhaled from its external ſurface, you will then have a tumor in ſuppuration.

"If therefore the form alone eſtabliſhes the difference between tumors and cyſts, how does it happen that the formation of the latter is not analogous to that of the firſt? or has ever any one attempted to attribute the formation of external or internal tumors to compreſſion? We ought therefore to conceive the production of cyſts in the following manner: they begin to be formed in the cellular membrane by laws analogous to thoſe which regulate the general growth of our bodies, and which appear to be deviations of theſe fundamental laws of which we are ignorant. When the cyſt is once formed, exhalation begins to take place, and though at firſt in a ſmall degree, it at laſt augments in proportion to its progreſs. The increaſe of the exhalent organ then always precedes the accumulation of the exhaled fluid, in ſuch a manner that the quantity of the ſuppuration of a tumor is always directly in proportion to its bulk *."

* Vide *Anatomie Generale.*

This mode of explaining the formation of cyſts appears much more conformable to the laws of nature than that which has been formerly mentioned and generally received. But it ſtill remains to determine the preciſe mechaniſm of the origin and growth of cyſts, and conſequently of all other tumors. We ought to ſtop where the firſt cauſes commence; and as we do not know the mechaniſm of the natural growth of our organs, how ought we to gueſs at that of morbid productions which depend upon the ſame laws. It is a great deal in the economy of our organs to point out analogies, and to ſhow the uniformity of a phenomenon not underſtood with one in regard to which all the world agree. Much would be done for the benefit of ſcience, if in all its branches we could demonſtrate that principle on which depends ſuch a great number of effects, that nature, avaricious in her means, is prodigal in her reſults; that a few cauſes preſide over a multitude of effects, and that the greater number of thoſe regarding which we are uncertain, depend on the ſame principles as many others which appear to us evident.

Of Encyſted Tumors.

Of the treatment of Encyſted Tumors.—Encyſted tumors, though not dangerous, are often inconvenient from their ſize, ſituation, and from the deformity which they produce, ſo that whenever their removal becomes neceſſary, this can be done alone by a ſurgical operation. 27

If the tumor be of the thin or *meliceris* kind, which for the moſt part will be the caſe when a diſtinct fluctuation is perceived in it, it ought to be treated as a common abſceſs. If the tumor be ſmall, the matter may be diſcharged by laying open the moſt dependent part of it with a common lancet, and treating it in the ordinary way till the ſides of the cavity come in contact by adheſion, or by the proceſs of granulation. But when the tumor is more conſiderable, the free admiſſion of air into the interior of its cavity is always dangerous; and we ought to be attentive to prevent its effects by making the opening in ſuch a manner, that the wound be expoſed as little as poſſible. When treating of abſceſſes, we have recommended the paſſing of a ſeton or cord through them, as the beſt method of opening them when they are of a large ſize. This method is alſo very convenient in the caſe of encyſted tumors, which contain a matter of a liquid conſiſtence. It will only be neceſſary here to obſerve, that the ſeton ſhould tranverſe the whole tumor, from the ſuperior part of it to the moſt dependent point, and that the inferior opening ſhould be ſufficiently large for allowing the matter to be freely diſcharged. This method often anſwers extremely well; and cures have been performed by it which could not have been obtained in ſo ſhort a time in following the ordinary method of treatment by inciſion. But this method cannot be employed, except in thoſe caſes in which the contents of the tumor are ſo liquid as to be eaſily diſcharged by a ſmall opening. When it is of too firm a conſiſtence to admit of the ſeton, the contents muſt be emptied, either by making an extenſive opening into the cyſt, or the cyſt and its contents may be diſſected out. 28 By the ſeton.

When an encyſted tumor adheres ſo firmly to the contiguous parts, as to render its removal tedious and difficult, it is often better not to undertake the operation. In ſuch a caſe it will be ſufficient to lay open the tumor its whole length, and to cut away any portions of the cyſt which can be eaſily detached. The contents of the tumor will in this manner be completely removed, and the cure will be effected, either by keeping the wound open till the cavity of the cyſt is filled with granulations; or it may be attempted by drawing the divided edges of the ſkin together, and applying moderate preſſure, ſo as to produce adheſion with the ſides of the cavity. It ſometimes happens, however, that from the adheſion being complete, the remaining portion

tion

Of Encysted Tumors.

tion of the cyst forms as it were the nucleus of a new tumor.

29

Operation.—When it is determined upon to remove the cyst completely, the first step of the operation is to make a free incision through the integuments covering the tumor with a common scalpel *. If the tumor be not very large, a longitudinal incision will answer the purpose; but should the tumor be of such a size, that the whole integuments covering it are too large to lie neatly upon the wound, it is much better to remove an oval portion of them †. The size of this portion must be left entirely to the judgment of the operator, who should always take care that a sufficient quantity is left, so as completely to cover the wound. After the skin is divided, the cellular membrane should be dissected back, so as distinctly to expose the surface of the sac; and as the sac will be generally found loosely attached to the adjacent parts, it may be easily separated by a very simple dissection. In removing encysted tumors, it is particularly necessary to cut fairly down upon the sac; for if this be not done, instead of the tumor being readily turned out of the sheath of loose cellular membrane which surrounds it, it can only be removed by a very tedious process of dissection. Some surgeons have recommended that the contents of the tumor should be removed, before attempting to dissect out the sac; but if the incision of the integuments be made sufficiently large, this may be generally avoided. We have often observed the operation of extirpating encysted tumors, and indeed tumors of every description, rendered extremely tedious by a want of proper attention to this step of the operation. We would therefore particularly recommend, that in the extirpation of all tumors, the incision of the integuments extend both above and below the tumor a considerable way, proportioned in all cases to its bulk and easy access.

* See Plate DXIII. fig. 1.

† See *the tumor represented in* Plate DXIII. fig. 19.

In some cases it is advisable to open the cyst, and remove its contents, before an attempt be made to dissect it out. This practice will only be necessary in cases where, either from the shape or situation of the tumor, it is impracticable to pass the knife round it, and where, from the situation of important parts at its base, the dissection is rendered very nice and delicate. We remember a case of encysted tumor closely attached to the capsule of the knee joint, where great assistance was derived from operating in this manner. Whilst the tumor remained distended, it was impossible to separate it, without running great risk of cutting, either into it, or into the cavity of the knee joint. When, however, its contents were removed, the tumors could be readily dissected from one another, without the smallest risk of injury.

After an encysted tumor is extirpated, if any artery bleed very profusely, it ought to be secured by a ligature; but this should always be avoided as much as possible, as ligatures are apt to interfere with the adhesion of the lips of the wound. At the same time it is always necessary that the bleeding be completely stopped before the wound is dressed; for should any hemorrhagy take place after the dressings have been applied, it is very apt to displace the edges of the wound, and prevent them from adhering by adhesion.

The edges of the wound are to be placed accurately together, and kept in contact with adhesive plaster, a compress and proper bandage being applied over it. The wound is to be treated in the usual manner, removing the dressings whenever they become soiled, and the application of the adhesive plaster continued till a complete cicatrization has taken place.

Of Encysted Tumors.

Sect. VI. *Of the Steatom* or *Fatty Tumor* (B).

30

This species of tumor consists of a mere accumulation of cellular membrane and fat in a particular part of the body. They occur frequently, and are formed most commonly on the front or back part of the trunk of the body, and sometimes in the extremities. They generally grow in a slow and progressive manner, and the blood-vessels are neither large nor numerous. They have always a thin capsule of common cellular substance; and this capsule seems merely to be the effect of that condensation of the surrounding cellular substance which the pressure of the tumor occasions. "As the growth of adipose tumors is regularly and slowly progressive, and as nothing like inflammation in general accompanies their increase, their capsules afford a striking instance of an investment acquired, simply by a slight condensation of the surrounding cellular structure, unaffected by inflammation *." When the capsule, which is extremely thin, and which adheres but slightly to the tumor, is removed, the tumor within consists of a mere piece of fat, more or less compacted according to its situation in the body, and the length of time which it has remained.

* *Abernethy's Surgical Observations*, p. 27.

31

Of the treatment of the Steatom.—When a steatom is small, when it causes little deformity, and when it does not seem to injure the functions of any organ, it is most prudent to allow it to remain. They sometimes, however, acquire a very large bulk, and from their situation are extremely inconvenient and unseemly, and they then become an object of medical treatment. No external application was ever known to be useful in discussing tumors of this kind; and the only means to be employed for removing them is by an operation. There is indeed no species of tumors that can be dissected out with so much celerity, or with such apparent dexterity. In some cases, however, if inflammation has been induced, the capsules even of these tumors are thickened, and adhere so as not to be separated without difficulty from their surface.

In dissecting out a tumor of this kind, the same general rules may be followed as we mentioned when treating of encysted tumors. The external incision should be made very free, and it is also of great importance to cut completely down to the capsule of the tumor, before attempting to dissect it out.

Sect. VII. *Of the Sarcoma* or *Fleshy Tumor.*

32

Our knowledge of the pathology of tumors of the cellular membrane is yet too limited to be able to arrange them in any systematic form; and it would be foreign to our purpose to attempt in this place the investigation

(B) Steatoma, *adipose arcoma* of Mr Abernethy.

Sarcomatous Tumors.

veſtigation of the ſubject. We have adopted the term *ſarcoma* as very general; and include under it all thoſe ſwellings or wens of a fleſhy feel, which occur in the cellular membrane throughout the body.

The baſis of theſe tumors, as we before mentioned, is the cellular membrane; and the difference in the qualities of the ſubſtances depoſited in the cells gives the peculiar appearance to the tumor.

The veſſels which pervade them are either larger or ſmaller, and more or leſs numerous. They are alſo diſtributed in their uſual arborecſcent manner, without any deſcribeable peculiarity of arrangement.

When tumors of this kind have attained a conſiderable ſize, the ſuperficial veins appear remarkably large. They have little ſenſibility, enduring a rough examination.

This kind of tumor generally grows till the ſkin is ſo diſtended that it ulcerates, and expoſes the new formed ſubſtance, which ſloughs away. In this manner does the diſeaſe occaſionally terminate; but ſuch is the conſtitutional irritation attending this proceſs, and the diſguſting fœtor and frightful appearance of the part, that the ſurgeon generally recommends its removal. In ſome inſtances ſarcomatous tumors are compoſed of a number of irregular-ſhaped maſſes, which from their reſemblance to the pancreas have been called by Mr Abernethy the *pancreatic ſarcoma*, and conſidered as a diſtinct ſpecies. "This new-formed ſubſtance is made up of irregularly-ſhaped maſſes, which in colour, texture, and ſize, reſemble the larger maſſes compoſing the pancreas. They appear alſo to be connected to each other like the portion of that gland, by a fibrous ſubſtance of a looſer texture." Other ſarcomatous tumors are compoſed of a number of cyſts, containing ſometimes a tranſparent and ſometimes a dark fluid; and have been called by Mr Abernethy, the *cyſtic ſarcomas*.

33 The *Mammary* and *Tuberculated Sarcomas* are alſo other two ſpecies enumerated by Mr Abernethy. In the firſt the ſtructure of the tumor has been ſuppoſed to reſemble the natural ſtructure of the mamma, and in the ſecond the tumor "conſiſts of an aggregation of ſmall, firm, roundiſh tumors of different ſizes and colours, connected together by a kind of cellular texture. The ſize of the tubercle is from that of a pea to that of a horſe-bean, or ſometimes larger; the colour of a browniſh red, and ſome are of a yellow tint (c)."

Theſe different terms employed to characterize the various kinds of ſwellings which form in the cellular membrane, are by no means adequate; and tumors will be daily met with which it is impoſſible to aſſign to one or other of theſe ſpecies. This ſubject therefore ſtill remains open for the inveſtigation of future inquiry. And it is probable, that when the ſubject is better underſtood, the ſurgeon will not on all occaſions be obliged to have recourſe to the knife; and that he will be able to diſtinguiſh thoſe which may be allowed to remain, or as harmleſs treated by external applications, from thoſe whoſe nature is more malignant, and require an early extirpation.

Sarcomatous Tumors.

Treatment.—When ſarcomatous tumors are painful and tender to the touch, advantage may be had by local blood-letting, either by leeches or cupping. Fomenting the parts with a decoction of chamomile flowers or poppy heads, and applying a ſolution of muriate of ammonia or of vinegar, and acetate of lead, are alſo uſeful in diminiſhing their bulk. Frictions with unctuous ſubſtances, as mercurial ointment and camphor; camphorated ſpirits, aqua ammonia and oil; tincture of cantharides—have been uſed for the diſcuſſion of indolent ſwellings: Soap and mercurial plaſters have been alſo much commended by ſome; but of all theſe remedies perhaps there is none more uſeful than friction with the dry hand. The mode by which this practice is to be conducted is particularly mentioned under *Swellings of the Joint*. While we employ theſe applications to the tumor, we ought alſo to preſcribe purgative medicines every ſecond or third day, enjoin an abſtemious diet and reſt. An alterative courſe of medicine is alſo ſuppoſed to be uſeful. Small doſes of calomel or corroſive ſublimate are given for this purpoſe. The extract of hyoſcyamus and calomel, or calomel and the extract of cicuta, has been much extolled by ſome. 34

By cauſtic.—Some ſurgeons (and it is a favourite practice with all itinerants) have attempted to remove tumors with cauſtic; and though this mode is much more painful and more clumſy than the knife, yet there are ſome caſes, where, either from the tumor being ſo ſituated, or from the patient being timorous, this practice may be reſorted to. 35

Where a tumor is to be removed by cauſtics, the common cauſtic potaſs will anſwer the purpoſe extremely well. This is to be placed over a ſufficient bulk of the ſkin, and allowed to remain longer or ſhorter according to the depth of the tumor, and the portion of it intended to be removed. After the dead portion has ſeparated by the aſſiſtance of poultices, &c. the cauſtic may be again renewed until the whole maſs is deſtroyed. Equal parts of red precipitate and burnt alum forms a very active cauſtic, and is uſed by ſome; but it creates great pain. By mixing opium with the cauſtics, the pain has been alleviated.

By inciſion.—When a ſarcomatous tumor is to be removed by inciſion, the ſurgeon ſhould always keep in remembrance, that whilſt the tumor is growing, the contiguous cellular membrane is generally condenſed, and is formed into a kind of capſule. A knowledge of this not only renders the extirpation of the tumor much eaſier, but tumors may be cut out from a depth, and from connexions, apparently dangerous. The integuments are to be freely divided, and the inciſion carried down to the capſule of the tumor, before we attempt to diſſect it from the contiguous parts; if this be not done, the diſſection becomes more tedious and difficult, and more blood is loſt than what was neceſſary, from veſſels being divided which might have been ſaved; and if the tumor happen to be deeply ſeated, its extirpation even becomes impracticable. The general directions given for the extirpation and after treatment of encyſted tumors may alſo be applied to the ſarcomatous tumors. 36

SECT.

(c) Another ſpecies of ſarcoma has been termed the *oſteo ſarcoma*, from bony matter being formed in the tumor.

Sect. VIII. *Of Oedema.*

37 Oedema conſiſts in the effuſion of a watery fluid in the cellular membrane of any part of the body.

The ſwelling in œdema is not circumſcribed. The ſkin of the ſwollen part retains its natural colour, and ſometimes becomes paler than natural, having a gloſſy hue. The part has a cold feeling; and preſſure made by the point of the finger forms an impreſſion or dimple, which remains for ſome time after the finger is removed, and diſappears ſlowly. There is no acute pain, but there is an uneaſineſs or ſenſe of weight and tightneſs in the part. If a limb be œdematous, the magnitude of the ſwelling is always increaſed or diminiſhed, according as it is placed in a depending or horizontal poſture. Oedema always ariſes from the want of proper balance in the functions of the exhalent and abſorbent ſyſtems, and it appears both in a conſtitutional and local form. Contuſions, ſprains, the long uſe of relaxing poultices and waſhes, are often local cauſes of œdema. More or leſs œdema is conjoined with eryſipelatous inflammation, and this ſometimes terminates in gangrene. A part which has been acutely inflamed often remains œdematous for ſome time afterwards. It is alſo often owing to ſome impediment which prevents the return of the blood to the heart. Preſſure of the gravid uterus on the iliac veins often renders the lower extremities œdematous. Aneuriſms and other tumors, by compreſſing the veins of the extremity, often produce this affection. It alſo accompanies *aſcites*, *hydrothorax*, &c. &c.

38 *Treatment.*—As an œdematous ſwelling is generally the effect of ſome other diſeaſe, the cure muſt depend upon the original diſeaſe being removed.

If the limb be the part affected, it ſhould be kept in a horizontal poſition. Frictions made on the part with flannel, and a moderately tight roller, applied from the toes upwards, have a powerful effect in diminiſhing the ſwelling. The operation of theſe means is to be aſſiſted by giving purgatives and diaphoretics. See Medicine.

If the tumor become ſo tenſe as to create much pain and inflammation of the ſkin, theſe are better moderated by the diſcharge of the fluid by means of a ſmall puncture, than to allow the integuments to burſt. A puncture is, however, not void of danger, for wounds in dropſical conſtitutions generally excite a great degree of inflammation, and are apt to become gangrenous. The puncture ſhould be made upon the moſt prominent parts of the ſwelling with the point of a lancet; and as the fluid which oozes out is apt to create great irritation of the tender ſkin over which it flows, it is a proper and very uſeful precaution to keep the ſkin always covered with ſome unctuous adheſive ſubſtance. For this purpoſe the *unguentum reſinoſum* is very well calculated.

Sect. IX. *Of Emphyſema.*

39 Emphyſema is an effuſion of air into the cellular membrane of any part of the body.

The ſwelling is without pain, and colourleſs; and it is eaſily diſtinguiſhed from œdema by the noiſe and particular feeling it has when preſſed upon. It then makes a crackling noiſe, and reſembles the feeling created by preſſing a dry thin bladder half filled with air. The ſwelling is not heavy. At its commencement, it only affects one part; but it ſoon ſpreads over the body, and diſtends the whole ſkin. Oedema.

Emphyſema generally ariſes from a wound of the lungs; often from a ſpicula of a broken rib *. It has alſo been known to ariſe from an ulceration in the lungs; but this ſeldom happens, as the inflammation attending the formation of the matter condenſes the contiguous veſicles, and produces adheſions between the lungs and cavity of the thorax.

* See *Wounds of the Thorax*, under Wounds.

Emphyſema has alſo been ſometimes obſerved in ſome putrid diſeaſes. Dr Huxham has recorded a caſe of this kind in a ſailor who was attacked with putrid fever and ſore throat †.

† *Medical Obſervations and Inquiries*, vol. i.

A partial emphyſema has alſo been obſerved in caſes of gangrene. Dr William Hunter has mentioned a caſe of that kind.

The treatment of emphyſema muſt always depend on the nature of the original diſeaſe. It may be here, however, remarked, that the effuſed air is readily abſorbed, and creates no inflammation or any change in the cellular ſtructure where it had been effuſed.

Chap. II.

Of the Diſeaſes of the Skin.

General Remarks on the Pathology of the Skin.

40 There are a conſiderable number of diſeaſes which ariſe in the different parts which compoſe the ſkin; and there are others which ſeem to be the effect of that ſympathy which the ſkin has with moſt organs of the body.

Of the diſeaſes which attack the ſkin, there are five claſſes. In the firſt, the papillæ are affected; in the ſecond, the cellular membrane contained in the areolæ of the ſkin; in the third, the rete mucoſum or capillary net-work, from which the exhalents ariſe; in the fourth, the cutis vera or chorion; and in the fifth, the epidermis or ſcarf ſkin.

1. Under the diſeaſes of the firſt claſs, or thoſe of the papillæ, may be conſidered all thoſe in which an alteration in the ſenſibility of the ſkin takes place. Whenever inflammation affects the ſkin, this alteration of ſenſibility is perceptible; and in ſome of the nervous diſeaſes of women it is very remarkable; for on touching the ſkin a little roughly, convulſions are produced. It is alſo well known the effect of titillation on the ſkin; and perhaps an application of this knowledge might be extremely uſeful in the treatment of ſome diſeaſes.

2. We have examples of the ſecond claſs of diſeaſes of the ſkin, where the areolæ of the cellular membrane of the cutis vera becomes inflamed, in boils and perhaps alſo in ſmallpox, and in ſome of thoſe tumors commonly called pimples of the ſkin.

3. The rete mucoſum, from its vaſcularity, is probably the ſeat of eryſipelas, meaſles, ſcarlatina, and that multiplicity of eruptions to which the ſkin is ſubject.

4. In elephantiaſis, cancer, &c. and in general in all chronic cutaneous diſeaſes, the cutis vera is affected; it appears, however, to be ſeldom primarily affected in acute diſeaſes.

5. The epidermis is paſſive in all the diſeaſes of the ſkin, and is only affected by its continuity. Its ſenſibi-

Diſeaſes of the Skin.

lity is never increaſed, nor is it ſuſceptible of being inflamed, and conſequently it never forms adheſions. Its internal ſurface, too, raiſed by a bliſter or any other means, and applied to the parts below, never reunites. The excreſcences which form on it, ſuch as corns, &c. are dry and inert, and without circulation; if they are painful, it ariſes alone from their preſſure on the nerves of the ſubjacent parts.

From all theſe different affections of the ſkin, a number of ſympathetic affections ariſe which it is worth while here to remark, though only a few of the diſeaſes of this organ come properly within the limits of a ſyſtem of ſurgery.

41 1. Every time that the papillæ are much excited in irritable people, as in titillation, various organs are ſympathetically affected by it. Sometimes it is the heart; hence follows fainting. Sometimes the ſtomach, and in two caſes mentioned by Bichât, the perſon vomited. Sometimes it is the brain, as is obſerved in people, where tickling brings on laughter, and even violent convulſions.

* *Bichât Anatomie Generale*, tom. iv. p. 730.

"Medical men," ſays Bichât*, "are often aſtoniſhed at the extraordinary effects which quacks produce on the body from the knowledge they have acquired of the ſympathies of the ſkin produced by titillation. But how ſhould we be more aſtoniſhed at this, than by vomiting produced by diſeaſes of the womb, than by diſeaſes of the liver being brought on from an injury of the brain, or by headaches ariſing from a diſordered ſtate of the gaſtric viſcera?" The influence of titillation of the ſkin may be of much uſe in the treatment of ſome diſeaſes. In hemiplegia, &c. would not the excitement of the ſoles of the feet, which have ſo much ſenſibility, as every one knows, anſwer much better repeated ten or twelve times a day, than the application of a bliſter, the irritation of which continues only during a ſhort time?

From this ſympathy which the ſkin has with the diſtant organs, we may be perhaps able to explain ſatisfactorily the influence which friction has been lately found to have in ſome diſeaſes. Mr ———, an ingenious ſurgeon at Oxford, has employed this remedy to a very great extent in diſeaſes of the joints; and he has experienced from it the beſt effects†.

† *Treatment of the White Swelling of the Joints.*

2. Whenever the exhalents of the ſkin, or the exterior capillary ſyſtem from whence they ariſe, are affected in any manner, a number of other parts participate, and thence ariſes a ſecond order of ſympathies of the ſkin.

There are few organs which have more ſympathy with the ſkin than the ſtomach. The bath, which acts upon the ſkin, during digeſtion affects ſympathetically the ſtomach, and diſturbs it functions. When that organ is ſpaſmodically affected, it often is reſtored to a ſtate of health, by the influence it receives from the bath. Bichât mentions a caſe of a woman who was troubled with conſtant vomiting, in conſequence of ſuppreſſed menſes; and who was immediately relieved by the warm bath after other remedies had failed.

The action of cold on the ſkin produces a variety of ſympathetic effects; above all when that action takes place during perſpiration. It is alſo well known what a number of phenomena reſult from a ſudden diſappearance of many eruptions of the ſkin.

3. When the cellular membrane contained in the areolæ of the ſkin, becomes inflamed, as in boils, puſtules, &c. a number of ſympathies enſue, which may be referred to the cellular ſyſtem in general. Diſeaſes of the Skin.

4. The diſeaſes of the cutis vera and epidermis being all of a chronic nature, their ſympathetic affections have the ſame character, little more being known of them.

We have alſo mentioned, that beſides diſeaſes of the ſkin, ariſing from a change of ſtructure in that organ, there were alſo others which aroſe from the ſympathy it has with other organs. Whenever a cold body enters the ſtomach whilſt there is a perſpiration on the ſkin, the perſpiration inſtantly ſtops. The entry of warm drinks into the ſtomach, and an augmentation of the cutaneous exhalation, are two phenomena which coincide at the ſame moment, in ſuch a manner, that one cannot attribute the ſecond to the abſorption of the drink, to its paſſage to the venous blood through the lungs, and then to the arteries. The production of perſpiration is, therefore, analogous to the ſuppreſſion of it in the former inſtance. Hence will be found a great variety of phenomena in different diſeaſes, ariſing from the ſympathy exiſting between the ſkin and the other organs, various degrees of dryneſs, of moiſture, and of perſpiration. Sometimes theſe phenomena are chronic. In many organic diſeaſes, different kinds of tumors are formed on the ſkin, in the ſame manner as we obſerve *petechiæ*, miliary eruptions, &c. &c. produced in acute fevers; the difference being merely in the duration of the periods of the ſympathetic affections.

The diſeaſes of the ſkin form a very important claſs in a ſyſtem of noſology. There are, however, only a few which ought properly to be conſidered in a ſyſtem of ſurgery.

It is the ſeat of all eruptions, as ſmallpox, meaſles, and a vaſt number of other diſeaſes. It is liable to inflammation, ſuppuration, and gangrene. It is alſo ſubject to diſeaſes and injuries from its expoſure to the action of external bodies, and from ſerving as a defence to the internal parts. It is alſo ſubject to cancer, warts, and other excreſcences, the treatment of which more properly belong to the ſurgeon.

Sect. I. *Of the Eryſipelas*, or *the Roſe.*

42

The roſe is ſometimes a local diſeaſe; at other times it is merely a ſymptom of ſome other affection. It differs from all other inflammations in the peculiar ſhade of red colour, and it is alſo remarkable for the diſorder which it generally creates throughout the whole ſyſtem. The part of the ſkin which is affected becomes of a bright ſcarlet colour, with a tinge of yellow; and towards the termination of the complaint, the yellow becomes more diſcernible. Beſides the difference in the ſhade of red, the ſwelling is neither ſo hard, ſo elevated, nor ſo circumſcribed as that of phlegmon. The ſkin has a gloſſy ſmooth appearance, a burning heat, and on its being touched with the finger, the ſcarlet colour diſappears where the preſſure is made, leaving a white ſpot, which, however, is almoſt immediately replaced when the finger is removed. The pain attending the diſeaſe is ſometimes very great; there is alſo always more or leſs ſwelling of the parts affected and thoſe in the immediate vicinity; and this ſeems chiefly to ariſe from a watery effuſion in the cellular membrane.

The roſe is very apt to ſpread rapidly to a great extent;

Eryſipelas. tent; and it frequently changes its ſituation, growing gradually well in one ſide, and extending itſelf on the other. Sometimes it diſappears entirely at one place, and attacks ſome other. As the diſeaſe gets well, the cuticle peels off from the affected part.

Eryſipelas may be combined with phlegmon (eryſipelas phlegmonoides), in which caſe the inflammation is of a deeper red colour; the ſwelling is alſo greater and deeper, and the pain is more acute. There is alſo a throbbing in the part, and the pulſe is full and hard.

There is alſo a particular ſpecies of eryſipelas called *St Anthony's fire*, in which ſmall veſicles are formed on different parts of the ſkin. Theſe burſt, and diſcharge a thin fluid which forms a ſcab, and beneath the ſcab ſuppuration ſometimes takes place.

The true eryſipelatous inflammation ſeldom ſuppurates, but generally terminates by reſolution; very violent caſes ſometimes cauſe gangrene.

When eryſipelas is accompanied with inflammation of the cellular membrane, as there are no diſtinct limits of the diſeaſe, the matter which is formed in thoſe caſes which advance to ſuppuration, often extends very far in every direction, and ſometimes produces very conſiderable ſloughing, not only of the cellular ſubſtance, but of the faſciæ and tendons beneath the ſkin. Eryſipelas is generally accompanied with all the ſymptoms of general fever, and theſe occur in a very conſiderable degree, even where the external inflammation is extremely ſlight. Languor, laſſitude, wearineſs in the limbs, headach, loſs of appetite, oppreſſion about the ſtomach, precede the appearance of the local complaint. The moſt violent form of eryſipelas is moſt frequently ſeen attacking the face, producing a great deal of general fever, often accompanied with delirium; and in a few caſes we have known it to proceed ſo far as to inflame and ſuppurate the membranes of the brain. Eryſipelas ſeems to be intimately connected with the ſtate of the general conſtitution. Perſons in the habit of drunkenneſs and other ſpecies of intemperance, and who, when in a ſtate of intoxication meet with local injuries, often have eryſipelatous inflammation in conſequence of theſe. In general, eryſipelas has its principal ſource in a diſordered ſtate of the chylopoetic viſcera, and the wrong ſtate of the bilious ſecretion. It ſeems alſo to be often connected with a ſuppreſſion of perſpiration, for it never recedes until that ſymptom is relieved.

83 *Of the treatment of Erysipelas.*—The mild eryſipelas is to be relieved by the exhibition of gentle diaphoretics. A few doſes of nitre, in order to promote the ordinary evacuations, and the general attention to the antiphlogiſtic regimen.

It is alſo of great importance to attend to the ſtate of the bowels, and to give purgative medicines, both with a view of removing any feculent matter contained in them, and as a general evacuant.

When the caſe is conjoined with phlegmon, and when there are ſtrong ſymptoms of inflammatory fever, veneſection becomes neceſſary; and this is particularly the caſe when the face is the ſeat of the diſeaſe. Copious bleeding, however, is generally hurtful, and no blood ought ever to be taken away when the functions of the abdominal viſcera are much diſordered.

When the patient has a very foul tongue, a bitter taſte in his mouth, and a propenſity to vomit; if theſe ſymptoms cannot be removed, purgatives and emetics become neceſſary. Indeed, in almoſt all ſevere caſes, Eryſipelas. an emetic is indicated, and ought even to be repeated, ſhould the ſymptoms remain ſevere.

There has been a great variety of opinions with regard to the external treatment of eryſipelas; ſome recommending the part to be kept dry, of a moderate warmth, and excluded from the air: others have uſed warm or cold moiſt applications. The practice of Deſſault is perhaps the moſt judicious. In thoſe caſes of eryſipelas which were produced from an internal cauſe, no topical application is to be employed, except, perhaps, duſting the part with flour; but when any ſpecies of eryſipelas ſucceeds a contuſion, a wound or an ulcer, the regimen and internal medicines are inſufficient, if proper topical remedies are not at the ſame time employed to alleviate the local irritation. In this point of view Deſſault employed poultices, the good effects of which in theſe ſort of caſes were confirmed by numerous obſervations. He conſidered it, however, as an eſſential precaution not to extend this topical application further than the bruiſed part, or the edge of the wound or ulcer. If any application is made to the eryſipelatous ſurface, it ought to conſiſt merely of a weak aſtringent ſolution: that which was always employed at the Hotel Dieu, conſiſted of a ſcruple of the extract of lead in a pint of water.

Sect. II. *Of the Furunculus* or *Boil.* 44

The furunculus appears to be an inflammation of the cellular membrane of the areola of the chorion; the other inflammations of the ſkin and cutaneous eruptions being ſeated on the *corpus reticulare.* The furunculus is a circumſcribed, very prominent, and hard tumor, of a deep red colour; and they vary, from the ſize of a pea to that of a pigeon's egg. They are extremely painful, and are ſeldom attended with fever. They are alſo moſt frequent in young people. Boils generally paſs into a more or leſs perfect kind of ſuppuration; a ſmall white ſpot is formed on the apex of the tumor, which, when it has reached the ſkin, diſcharges but a ſmall quantity of pus in proportion to the bulk of the ſwelling. Before the tumor begins to ſubſide, a yellow ſlough, formed by a portion of dead cellular membrane, comes out.

As ſwellings of this kind almoſt always ſuppurate, and as induration conſtantly remains after an incomplete reſolution of them, we ought to promote ſuppuration by uſing emollient applications. Emollient poultices are beſt for this purpoſe. When a quantity of matter is collected, it is ſometimes advantageous to open the boil with the point of a lancet, then to allow it to remain until the ſkin ulcerates. Gentle aperients and antiphlogiſtic regimen ought not to be omitted.

Sect. III. *Of the Chilblain.* 45

The chilblain is a painful, and very often an extremely itchy ſwelling of the ſkin of an extreme part of the body, in conſequence of expoſure to extreme cold, or ſudden change from a very cold to a warmer atmoſphere.

Chilblains are moſt frequent in young people of ſcrofulous conſtitutions, and in this country the diſeaſe is moſt prevalent during the winter months. It appears moſt

Chilblain. moſt commonly on the toes and heels, and ſometimes alſo on the fingers, and parts where the circulation is moſt languid.

The firſt ſymptoms of the diſeaſe are a paleneſs of the part, which is quickly ſucceeded by more or leſs redneſs, a very troubleſome itching, and ſometimes pain. The ſkin gradually acquires a purple hue; the part ſwells, and the cuticle ſeparates from a ſerous effuſion which takes place below it. Beneath the cuticle an ulcer appears of a very irritable appearance, and accompanied with great pain. This ulcer ſpreads rapidly, has very acute edges, and its ſurface is of a dark or rather dirty yellow colour. Sometimes the ulceration penetrates as low as the tendons, or even expoſes the ſurface of the bones, producing a ſphacelation of an extremity.

In the treatment of chilblains, before the ſkin has ulcerated, the principal attention ought to be paid in keeping the affected part of an equal temperature, and to rub it over with ſtimulating applications. Camphorated ſpirit, ſpirit of turpentine, &c. have been generally recommended for this purpoſe; but we have found the tincture of cantharides, properly diluted, to be much more efficacious. A drachm of this tincture to an ounce of the tincture of ſoap, will be generally found to anſwer extremely well; and this is to be rubbed on the part once or twice a day.

When veſications begin to appear, and ulceration has taken place, emollient poultices ſhould be employed; but after this proceſs has gone on a certain time, and the pain and irritation abated, much benefit will be experienced by the application of the red precipitate ointment to the ulcers. Under this treatment we have repeatedly obſerved large ulcers of this kind heal with unuſual rapidity.

Reſt and a plain nouriſhing diet will be commonly beſt ſuited to people with chilblains; and ſhould ſymptoms of debility and a ſloughing of the ſore enſue, it may be even neceſſary to give freely wine and bark.

46

Sect. IV. *Of Cancer of the Skin.*

The ſkin is frequently attacked with cancer. That of the face is more particularly expoſed to it; and this no doubt ariſes from its delicacy, from the great number of veſſels which penetrate it, and perhaps alſo from its more frequent expoſure than any other part of the body to external irritations. Cancer, however, is not confined to the ſkin of the face; it frequently appears on the back of the hands, and on the feet. Wiſeman has ſeen it on the cranium, Gooch on the inſide of the thigh, Richter at the umbilicus; and we have ſeen an example of it in the ſkin above the pubes.

When cancer affects the ſkin, it begins in the form of a ſmall, hard, and dark-coloured wart, which increaſes very ſlowly in ſize; the contiguous ſkin becomes hardened, forming a ſtool or button around the wart. The progreſs of the diſeaſe in the ſkin has been always obſerved to be more ſlow than cancer in any other part; ſo that it often remains in the form of a black ſcab for many years. The ſcab at laſt ſeparates, and then an ulcer of the ſkin is expoſed, having all the characters of the true cancerous ſore. It has a pale colour, ragged hard edges, and unequal ſurface; and it gradually extends in an irregular manner along the ſkin; the hard tumor which forms its baſis, at the ſame time increaſing in ſize. Inſtead of pus, the ulcer diſcharges a thin ichor, which reddens and excoriates the adjacent ſkin. The diſeaſe which, when in the form of a ſcab gave little uneaſineſs, now becomes painful; and the patient feels more or leſs frequently ſharp lancinating pains darting through the tumor, and extending from it to the adjacent ſoft parts. Cancer of the Skin.

When a cancerous affection of the ſkin is examined after it is removed from the body, it has all the leading characters we have deſcribed in our general obſervations on cancer *. The great degree of hardneſs of the morbid maſs, is produced from the formation of the hard fibrous-looking matter obſerved in all ſchirrous tumors; and the direction of its fibres will be generally found extending from the baſe of the tumor to the ſurface of the ſkin. * See chap. *on Cancer.*

Cancer of the ſkin follows the ſame progreſs as cancerous affections of other textures; the contiguous glands become enlarged and ulcerate; and both the ulcers which theſe form, and the primary one, ſpread over whatever parts they meet, till they deſtroy the patient.

Treatment.—The ſucceſs which has been attributed 47
to various medicines, particularly to arſenic and ſtrong corroſive applications, in the cure of cancer, has been chiefly from the uſe of theſe medicines in cancerous affections of the ſkin. From the diſeaſe being obſerved in the ſkin before it has far advanced, from its ſlow progreſs in that part, and the ready application of remedies, it affords better opportunities of experiment than other parts of the body when affected with that diſeaſe. Paſt experience, however, leaves us but little room to hope for a cure of cancer in the ſkin by any external application with which we are as yet acquainted; and we know of no remedy to be truſted to but the complete exciſion of the diſeaſed parts.

The more early the diſeaſed ſkin is removed, the greater is the chance of a permanent cure of the diſeaſe. And in whatever part of the body the ſkin is affected, it is of the utmoſt importance to remove every part where there is the leaſt ſuſpicion of contamination. In the face, we have often obſerved the ſurgeon too anxious to ſave ſkin, with a view of leſſening the blemiſh of an extenſive ſcar; but in a diſeaſe ſo deplorable as cancer, no object of this kind can in any degree compenſate for being expoſed to the ſmalleſt riſk of its return; the more ſo, eſpecially as we have often remarked that a ſecond operation is ſeldom if ever attended with permanent advantage. The ſurgeon, therefore, ought to lay it down as a general rule, to include in his inciſion a conſiderable portion of the ſound ſkin ſurrounding the diſeaſed parts.

The particular caſes wherein an operation is adviſable, muſt be left entirely to the judgment of the ſurgeon. The operation may be performed in all caſes where the diſeaſed parts appear to be within the reach of the knife; or if there are any glands affected, if theſe can be ſafely removed, it may be even under theſe circumſtances undertaken, though no doubt the chance of a return of the diſeaſe in ſuch caſes is greater.

Whenever the periоſteum and parts ſurrounding any of the bones is affected, there is little chance from any aſſiſtance of art, except when the diſeaſe occurs in the extremities of the body, as in the hands or feet; for in ſuch caſes, amputation of the whole member may be performed.

When

Cancer of the Skin.

When cancerous ſores appear about the eyelids, and ſpread along the *conjunctiva*, covering the eyeball, it is the only ſafe practice to remove the whole contents of the orbit. The different parts which compoſe the eyeball and its appendages, ſeem to have ſuch a cloſe connection with one another, that it is difficult, perhaps impoſſible, to mark the boundaries of the diſeaſed action which is going on; and as the loſs of any part of the organ prevents the others from performing their functions, it becomes no material object to ſave any particular part.

It is generally remarked, that the lips are particularly ſubject to cancer, at leaſt in men; and that the under lip is more ſo than the upper one. The diſeaſed part may be removed in this part of the body with great neatneſs upon the general principles of the operation of harelip. This can only be done when the diſeaſed portion is ſmall, and may be included by two inciſions forming an angle, inclining towards the chin. See HARELIP. When, however, the diſeaſe has ſpread over a conſiderable portion of the lip, ſo as to prevent the ſound parts from being united: after the diſeaſed parts have been removed, all that can be done is to remove the parts affected, ſecure the bleeding veſſels, and dreſs the ſore like any other recent wound.

By a little ingenuity and contrivance, much may be ſometimes done in making the inciſion in ſuch a manner as to allow the ſound parts to be afterwards brought together and united; ſo that in all caſes of extenſive diſeaſe, the ſurgeon ſhould conſider of all the different modes by which the diſeaſed parts may be removed with moſt advantage.

The operation is performed by ſome with a common ſcalpel, by others with ſciſſars. When the ſcalpel is uſed, the lip is to be held firmly with forceps by an aſſiſtant, and the ſecond inciſion made along their edge; but when the diſeaſe extends beyond the adheſion of the lip to the jaw, no forceps are neceſſary.

The ſciſſars are, however, the preferable inſtrument; they divide the lip with much leſs pain, and with a mathematical preciſion. When they are uſed for this purpoſe, it is neceſſary they be made thick and ſtrong; and as in ſome people the lip is extremely thick, and apt to ſlip through the blades, inſtead of being divided. Giving the cutting edge of the blades a circular form will be found to be an improvement on the common ſtraight edge. It is evident, however, that the ſciſſars can only be employed in thoſe caſes where the forceps could be uſed to aid the knife. All wounds of the lip heal beſt and moſt accurately with the twiſted ſuture; ſo that the edges ſhould be brought together in the ſame manner as has been recommended in the caſe of harelip, and the ſame mode of after-treatment is alſo to be purſued.

48 SECT. V. *Of Warts.*

There are two kinds of warts which grow upon the ſurface of the body; the one ſpecies is connected with the ſkin by a broad baſe; is of a hard, firm texture, unequal in the ſurface, and free from pain. Warts of this deſcription are frequent in young people, and are generally found on the hands.

The other ſpecies of wart is attached to the ſkin by a ſlender pedicle; they have a very unequal ſurface, appearing as if compoſed of an aggregate of ſmall tumors. Warts of this kind ſeldom attain any very conſiderable ſize, the largeſt ſcarcely exceeding that of a pea. They are ſeldom troubleſome; but in ſome ſituations they become extremely irritable, and produce, eſpecially when injured, very diſagreeable ſenſations. Warts.

This ſpecies of wart is moſt frequently met with on the prepuce and glans of the penis; on the labia; around the anus, and alſo frequently upon the hairy ſcalp. In theſe ſituations they ſometimes acquire a very large ſize, numerous warts ariſing over the whole ſurface, and forming a maſs of a cauliflower appearance. They are moſt frequent in people advanced in life, and are often connected with the venereal diſeaſe.

Beſides theſe, there are varieties of ſmall warts which occur in different parts of the body, which have not been accurately deſcribed by authors. There is one variety where a number of ſmall, whitiſh tumors appear in ſome parts of the face of children; theſe contain an opaque white fluid, which when diſcharged, and allowed to remain upon the contiguous ſkin, contaminates it, and produces warts of the ſame deſcription.

Of the treatment of Warts.—A variety of local remedies have been applied, both by medical men and the vulgar, for the curing of warts; and theſe generally poſſeſs a corroſive quality. 49

Lunar cauſtic is one of thoſe which generally anſwers beſt, and is moſt eaſily managed for deſtroying the firſt ſpecies of warts which we have deſcribed. A ſaturnine ſolution applied to the warts three or four times a day, or *aqua ammoniæ*, and tincture of cantharides, have alſo been found beneficial in promoting their abſorption.

In the ſecond ſpecies, when the excreſcences are very large, they ſhould always be removed along with a portion of the adjacent ſkin, by the knife. In thoſe caſes where the warts are very numerous, and where, from their ſituation, it becomes impoſſible to remove them with the knife, equal portions of *ærugo æris* and ſavine powder, or ſavine powder alone, will be found ſometimes to ſucceed in removing them. In ſome caſes, particularly where the warts are ſituated about the glans of the penis, we have found a ſaturated ſolution of the muriate of mercury in ſpirit of wine, completely anſwer the purpoſe. In thoſe caſes connected with ſyphilis, beſides local applications, it is neceſſary to uſe mercury. Sometimes, indeed, the warts drop off whenever the mercury begins to affect the conſtitution.

50 SECT. VI. *Of Corns.*

A corn is a peculiar hardneſs of the epidermis, which ſometimes extends to the ſubjacent ſkin. In the firſt caſe, the diſeaſed part is removeable; in the ſecond caſe it is more fixed. It frequently elevates itſelf above the ſkin, and is not unlike one ſpecies of wart. It is hard, dry, and inſenſible, except when preſſed upon the contiguous parts; and it reſembles in colour and appearance the thickened cuticle on the hands of workmen. Corns commonly are formed on the toes and ſides of the feet, and they are generally owing to the wearing of tight ſhoes. Sometimes corns do not occaſion the leaſt inconveniency; but in other inſtances they occaſion ſo much

Corns. much pain, that the patient can walk with difficulty. Corns are generally more painful in warm than in cold weather. The pain ſeems to ariſe from an inflamed ſtate of the parts in the circumference of the corn, which ſtate is excited and kept up by the preſſure of the induration, and not from any ſenſibility in the corn itſelf. They are more painful in dry than in moiſt weather, becauſe they become much more hard and dry.

51 *Treatment of Corns.*—The pain and difficulty of walking produced by corns, may be alleviated by immerſing them in warm water, and with a ſharp inſtrument cutting off their external layers; much relief will alſo be found by covering the part with a piece of adheſive plaſter, and by being careful not to wear ſhoes which are too tight. But what we have found a moſt complete cure for corns, is the application of one or other of thoſe corroſive ſubſtances which were mentioned for the treatment of warts. The lunar cauſtic, or the ſaturated ſolution of muriate of mercury in ſpirit of wine, ought to be preferred. They may be applied once every ſecond or third day, until the abſorption of the corn be completed; and, before uſing them, it will be found proper to pare off ſome of the external hard layers of the corn.

Some corn-operators extirpate the corn by a ſharp inſtrument; but this only proves a palliative treatment, for ſooner or later a hard ſubſtance is again depoſited.

52 SECT. VII. *Of Nævi Materni.*

Nævi materni are thoſe marks which frequently appear upon the bodies of children at birth, and which are ſuppoſed to originate from impreſſions made on the mind of the mother during pregnancy. They are of various forms; their colour is likewiſe various, though moſt frequently reſembling that of claret or port-wine. Many of theſe marks are perfectly flat, and never riſe above the level of the ſkin: theſe do not require the aſſiſtance of ſurgery; but in ſome caſes they appear in the form of ſmall protuberances, which frequently increaſe to a great ſize in the courſe of a few months. They appear to be ſoft and fleſhy; of a cellular texture, the cells containing liquid blood. They may be removed with little danger when not involving any important organ. They are ſupplied indeed more plentifully with blood than moſt other tumors are; and even ſometimes they appear to be entirely formed of a congeries of ſmall blood-veſſels; but the arteries which ſupply them may be, for the moſt part, eaſily ſecured by ligature. An operation ſhould never be long delayed; for as the ſize of the veſſels correſponds with that of the tumor, they ſometimes are ſo large as to throw out a good deal of blood before they can be ſecured. In performing it, the tumor is to be cut out, the arteries taken up, and the remaining ſkin brought as well together as the nature of the part will allow, and kept ſo by adheſive plaſter or ſuture.

If the whole tumor be removed, little hæmorrhagy generally follows; but if the ſmalleſt portion of the diſeaſed veſſels remain, not only a troubleſome bleeding follows, but the tumor is quickly reproduced by an increaſed exuberance. Tumors of this kind have been alſo removed by ulceration excited by the application of corroſive ſubſtances; and a knowledge of this circumſtance might be in ſome caſes of practical application.

Diſeaſes of the Mucous Membranes.

CHAP. III.

On the Diſeaſes of MUCOUS MEMBRANES.

General Remarks on the Pathology of the Mucous Membranes. 53

THOUGH at firſt ſight it may appear that the mucous membranes are very conſiderable in number, yet when they are viewed more generally, they appear much more limited; and we will find that in whatever part of the body they be found, they are ſubject to the ſame morbid alterations of ſtructure.

The ingenious Bichât has ſhown that there are two *general* mucous ſurfaces, of which the others are all portions. The one penetrates into the interior of the mouth, the noſe, and the anterior ſurface of the eye. After lining theſe two firſt cavities, it is prolonged into the excretory ducts of the parotids, and ſubmaxillary glands. It paſſes into all the ſinuſes, forms the conjunctiva, enters the lachrymal points, the naſal canal, the lachrymal ſac, and is continued into the noſe. It lines the pharynx and euſtachian tube, the trachea and bronchiæ. It goes down the œſophagus into the ſtomach, and paſſes along the whole inteſtinal canal till it joins with the ſkin at the extremity of the rectum. This he calls the *gaſtro-pulmonary mucous ſurface.*

The other general mucous ſurface, the *genito-urinary*, begins in the male at the urethra; paſſes along that canal into the bladder, lines the bladder, veſiculæ ſeminales, and vaſa deferentia, along with their numerous branches. It alſo extends into the excretories of the proſtate gland, the ureters, and the pelvis of the kidneys.

In the female it begins at the vulva, penetrates the ureter, and paſſes as in the male over the urinary organs. It alſo enters the vagina, lines the womb and fallopian tubes, and is then continued with the peritoneum. This is the only example of a communication eſtabliſhed between the mucous and ſerous ſurfaces.

This view of the extenſion of the mucous membranes is ſtrongly exemplified by an examination of their diſeaſes; for it will appear that there is not only an analogy between the different portions of the firſt, by an affection of the whole parts over which it extends, but there is alſo a line of demarkation between the two, from the one remaining ſound whilſt the other is affected throughout. This laſt circumſtance is confirmed in the hiſtory of many epidemic catarrhs; one of theſe membranes having been obſerved affected throughout, whilſt the other remained unchanged. The epidemic obſerved at Paris in the year 1780 had this character. "This epidemic (ſays Pinel*) which was very general in Paris, and with which I was myſelf attacked, was remarkable; for it affected almoſt the whole mucous membranes, that of the trachea and bronchiæ, the conjunctiva, the pituitary membrane, the palate, the pharynx, and the alimentary canal." The epidemic catarrh of 1752, deſcribed in the Memoirs of the Medical Society of Edinburgh, is an example of the ſame kind; for in all theſe, the mucous membrane lining the urinary and genital organs remained unaffected.

* *Noſographie Philoſophique*, tom. ii. p. 208.

We alſo obſerve that an irritation of any part of a mucous membrane frequently creates a pain on a part of the membrane which was not irritated. Thus a calculus

Inflammation of Mucous Membranes.

culus in the urinary bladder produces the chief pain at the point of the penis, and the preſſure of worms in the inteſtines produces an itching at the noſe.

Among theſe phenomena, which are purely ſympathetic, it is ſeldom that a partial irritation of one of the mucous ſurfaces produces pain in any part of the other. The ſingular connection which ſubſiſts between the membranes of the uterus and bronchiæ in mucous hæmorrhagies, however, is an example of this kind. If the blood accidentally ceaſe to flow from the one during menſtruation, the other frequently ſupplies the functions of the firſt, and exhales it. In caſes of ſtricture, or thickening and diſorganization of the mucous membranes of the urethra, the ſtomach is ſometimes affected: this may alſo ariſe from the ſympathy of the two mucous membranes.

Mucous membranes, from being conſtantly expoſed to the action of the external air, or to the contact of extraneous ſubſtances, do not ſuffer, when diſplaced, like other parts of the animal economy. In a prolapſus of the uterus or rectum, their mucous ſurfaces ſerve all the purpoſes of ſkin; and ſurrounding bodies do not produce more pain on them than on common ſkin. This is very different from the effects produced on opening a *ſerous* cavity or a capſule of any joint. The cellular, muſcular, nervous, glandular, and other ſyſtems, when laid open, preſent alſo very different phenomena.

The mucous membrane, like the ſkin, is organiſed in ſuch a manner as to endure with impunity the contact of external bodies; theſe merely producing an increaſed ſecretion of thin mucus. A ſound introduced and retained in the bladder produces no alteration in the ſtructure of the mucous membrane of the urethra; and for the ſame reaſon, a ſtyle or tube can be kept in the lachrymal duct without cauſing any irritation.

Moſt of the diſeaſes of mucous membranes come within the province of the ſurgeon; the others have been already treated of under the article MEDICINE.

SECT. I. *Inflammation of Mucous Membranes.*

54

The contact of extraneous and irritating ſubſtances, acrid vapours, or the ſudden expoſure to cold air of any mucous ſurface, is often followed by ſome degree of inflammation.

A preternatural degree of redneſs is a conſtant ſymptom of inflammation in moſt parts of the body; but the moſt remarkable character of inflammation in mucous membranes, and that which diſtinguiſhes it from all others, is the ſecretion of a puriform fluid. The mucus, which in the natural ſtate is nearly tranſparent, and merely moiſtens the ſurface, becomes of a yellow colour, and the quantity is ſo abundant as to form a purulent diſcharge. It is from the ſuſceptibility of the mucous glands to be acted upon by any irritation which is applied to the extremities of their ducts, that the ſtone or any tumor of the bladder, polypi of the noſe or vagina, are always accompanied by a profuſe diſcharge.

The inflammation is accompanied with a more or leſs degree of thickening of the membrane; and ſometimes this remains after all the inflammatory ſymptoms ceaſe. The abatement of the inflammation is marked by an increaſe in the thickneſs of the diſcharge and a diminution in its quantity.

Gonorrhœa.

We have an example of inflammation affecting the mucous membrane of the noſe in coryza, the ear in otitis, the urethra and vagina in gonorrhœa, the bladder in a catarrhus veſicæ, and the eye in the puriform ophthalmia, the lachrymal ſac or duct in fiſtula lacrymalis. In all theſe diſeaſes the ſymptoms have a ſtriking analogy, and are varied only from the difference in the functions of the particular organ, the mucous covering of which has been affected.

During life, mucous membranes become gangrenous much more ſeldom than the ſkin. This is proved from the conſequences of catarrh, compared with thoſe of eryſipelas. There are, however, caſes where this texture dies, whilſt thoſe adjacent continue to live; as in malignant angina.

SECT. II. *Of the Inflammation of the Mucous Membrane of the Urethra.*

55 Gonorrhœa (*Ecoulement Muceux*).

The term gonorrhœa is employed to ſignify a diſcharge of puriform matter from the orifice of the urethra or prepuce in men, and from the vagina in women; whether it proceed from a ſyphilitic or any other irritating cauſe.

The gonorrhœa may be defined a diſcharge of a contagious, puriform fluid, which comes from the mucous glands of the urethra, and membrane which lines that canal; or from the glans in men, and the interior of the genital organs in women. The diſeaſe ſeems to be produced by a *virus ſui generis*.

This diſeaſe generally makes its appearance in three or four days, ſometimes in ſix, but rarely later, after impure coition, with the following ſymptoms. The patient finds a particular itching and diſagreeable ſenſation at the point of the yard, and a ſort of ſlight itching alſo at the part of the urethra placed immediately under the frenum. This laſts one or two days, and on the following days the orifice of the urethra becomes ſenſible and red; it alſo ſwells, and a limpid matter of a clear yellow colour flows from it, which tinges the linen. Whilſt the flow of this matter continues, the titillation becomes ſtronger and more painful, particularly in making water; for this leaves a burning impreſſion and ſharp pain in the affected part. In ſome individuals the firſt ſymptom preſenting itſelf is the diſcharge of a thick mucus. In theſe caſes the patient feels from the commencement a burning and painful ſenſation in making water. Theſe ſymptoms generally increaſe in three or four days. Sometimes, however, that does not ſenſibly happen till after eight or twelve days. The glans acquires a deep red livid colour; the diſcharge through it increaſes, and the matter becomes of a yellow, or greeniſh yellow colour, reſembling pus diluted. The ſwelling of the glans, and alſo of the whole penis, becomes conſiderable; the patient has frequently a deſire to make water, and he finds, particularly when he has remained for ſome time in bed lying on his back, frequent and involuntary erections, and ſo painful that they diſturb his ſleep, and oblige him to riſe out of bed.

Such is uſually the progreſs of the diſeaſe when the inflammation is ſimple, ſlight, and ſuperficial; but in many caſes the inflammation extends farther and penetrates more deeply, affecting the reticular ſubſtances of the

Gonorrhœa. cavernous bodies of the urethra. Then the pain becomes exceſſive during erections, and the frenum of the glans is drawn downwards as by a cord, in ſuch a manner that the body of the penis is forced upwards by the violence of the erection. It is this which is called *cordee*. It ſometimes happens, that in this ſtate the veſſels of the urethra are torn, and thus occaſion conſiderable hæmorrhagy. At other times, the diſcharged matter is mixed with ſtreaks of blood; the prepuce is alſo ſo much inflamed and ſwelled that it cannot be pulled back over the glans, or if it has been pulled back, it cannot be again brought forwards. In ſome caſes the ſtrangulation which accompanies this laſt accident, produces a mortification of the glans, and even occaſions the death of the patient; this, however, ſeldom happens.

In ſome perſons one or more of the inguinal glands ſwell, become painful, and are attended with ſymptomatic fever. Often the glands of the penis ſwell alſo, a cord or knots can be felt on the back of the penis, and the ſkin is alſo ſwelled and painful. Beſides theſe ſymptoms, the patient often feels, either from his own fault, or on account of bad treatment, a particular uneaſy aching ſenſation, with tenſion and ſwelling of the ſpermatic cord and teſticles, accompanied with a diminution, or even a complete ſuppreſſion of the diſcharge by the urethra. In other caſes the diſeaſe makes greater progreſs; the irritation and inflammation ſtretching along the canal of the urethra. All the ſymptoms then become more violent, the pain which is felt in the perinæum or behind it, in making water, is ſo violent, that the patient is afraid to make the attempt, at the ſame time that he is frequently ſolicited by the fatiguing titillation at the neck of the bladder and anus. There is a perpetual deſire to let off the water, whilſt he can make no more than a few drops at a time with a burning pain. The whole canal of the urethra is ſwelled, and in a ſtate of tenſion; the patient has frequent erections, and lancinating pains along the whole length of the canal, through the perinæum and anus. He cannot lie down for a long time, nor can he reſt ſeated. In this ſtate the ſwelling of the glands of the urethra, and the ſpaſmodic contraction of its internal membrane, obſtruct the free paſſage of the urine, and allow it to flow in a very thin bifurcated ſtream, or drop by drop; and if at the ſame time the diſcharge diminiſh conſiderably, or totally ſtop, a complete ſuppreſſion of urine ſometimes ſucceeds, occaſioned by the inflammation and ſtricture of the neck of the bladder, or by the inflammation and ſwelling of the proſtate gland and adjacent parts.

It ſometimes happens that the inflammation of the urethra becomes ſo violent, that its internal ſurface, and the orifices of the glands which line it, ſecrete nothing; the ſame as we obſerve ſometimes happens in inflammation of the mucous membrane of the noſe and of the lungs. It is this ſtate of the diſeaſe which ſome authors have deſcribed under the name of *gonorrhœa ſicca*.

After theſe ſymptoms have continued with more or leſs violence, or when they have increaſed during one, two, or three weeks, or even during ſix or ſeven, according to the treatment employed, they begin gradually to diminiſh. The difficulty and the frequent deſire to make water ceaſe; the erections are no longer painful; the matter acquires more conſiſtence, and forms into threads between the fingers, and at laſt the diſcharge entirely diſappears. In other caſes, and theſe the moſt frequent, the inflammatory ſymptoms diſappear by degrees; but the diſcharge remains during weeks, months, or even years. It is this form of the diſeaſe which is called *gleet*, or ſimply *blennorrhœa*. Gonorrhœa.

Sometimes the inflammatory ſymptoms diſappear by degrees, and leave behind them in the urethra an ulcer, from which there is a malignant and purulent diſcharge, and which occaſions an affection of the ſyſtem. This is what has been called *gonorrhœa complicata* or *ulceroſa*; but it occurs rarely.

In other caſes a contraction remains in the urethra; ſometimes a paraphymoſis continues, and ſometimes there is a tumor of the teſticles, a hardening of theſe parts or of ſome of the glands of the urethra, an inflammation of the proſtate gland, with a more or leſs complete ſuppreſſion of urine; at other times, though very rarely, the diſcharge, when ſuppreſſed, produces ſuddenly a perfect deafneſs, or moſt violent ophthalmia *.

* *Traité de Maladies Venerieus par Swediaur.*

The exciting cauſe of ſyphilitic gonorrhœa is always the application of the ſpecific virus to ſome part of the mucous membrane lining the urethra. The contagious fluid, applied to any part of the body of a ſound perſon, acts with more or leſs difficulty, according to the difference in the ſtructure, the greater or leſs debility of the part, and alſo according to the particular conſtitution of the individual; for we ſee people who are expoſed to every danger of infection, without ever having the diſeaſe even during their whole life. Perhaps alſo the more or leſs violence of the action of the virus depends ſometimes on the greater or leſs degree of acrimony of the virus itſelf.

The ſeat of gonorrhœa, when it immediately proceeds from impure coition, is always at a ſmall diſtance from the orifice of the urethra, under the frenum, at that part of the canal where we obſerve a dilatation, called *foſſa navicularis*. All gonorrhœas which are ſituated more anteriorly on the cuvature of the penis, in the *veru montanum*, the neck of the bladder, or in the bladder itſelf, ariſe from bad treatment, or from ſome cauſe which has ſtopped or ſuppreſſed the primary diſcharge.

Sometimes by the natural progreſs of the diſeaſe, and more frequently from faults committed by the patient, or by the effects of improper remedies, the inflammation and irritation are apt to change their place. They often occupy the orifice of a mucous gland which opens at the firſt turn of the penis. At other times they affect the two glands of Cowper. Sometimes they occupy the protuberances which cover the orifices of the ſeminal veſicles; and they alſo ſometimes take place in the proſtate gland, or in the neck of the bladder.

In ſome rare caſes the contagious virus does not penetrate during the inflammation into the urethra, but applied to the extremity of the penis, it fixes itſelf upon the corona of the glans, and irritating the excretory ducts of the ſebaceous glands there, produces a diſcharge which has been called the *gonorrhœa of the glans*.

When the urethra of a perſon who has laboured under gonorrhœa is laid open, no ulcer is almoſt ever found upon the ſurface of the internal membrane; and in thoſe who have ſuffered much in conſequence of the diſeaſe, there is merely a thickening and contraction of one or more

parts,

Gonorrhœa. parts of the urethra. Sometimes, though very rarely, exereſcences are formed within it. The ducts of the mucous glands are obliterated, and the proſtate gland and bladder changed in their ſtructure.

It has been a matter of great diſpute among thoſe who have written on the venereal diſeaſe, whether the gonorrhœal and venereal virus are the ſame. In this controverſy a number of very futile arguments have
56 been brought forward. It is a ſtriking fact, however,
Specific nature of the virus. which the practical man muſt have always in view, that the venereal diſeaſe is never cured without mercury; whilſt a gonorrhœa, however virulent, never requires that remedy. This difference in the treatment of the diſeaſes ſome authors have attempted to explain, from the difference in the ſtructure of the parts affected. It is remarkable, however, that the matter from the gonorrhœa never affects the ſkin, producing chancre; but that when its virus is applied to the vagina, or to the urethra of another perſon, gonorrhœa is the conſequence. When it affects the prepuce too, it produces, in place of chancre, a morbid diſcharge from the ſebaceous glands of that organ. It is alſo a ſtriking fact, in the hiſtory of gonorrhœa, that however long it may remain, it never produces any conſtitutional affection. All theſe circumſtances in the hiſtory of the diſeaſe, in its progreſs and ſymptoms, and in its cure, being ſo diſſimilar to thoſe of the venereal diſeaſe, are ſurely ſufficient grounds to conſider gonorrhœa and ſyphilis as two diſtinct morbid affections, and different from one another as much as any two diſeaſes of the animal economy.

Treatment.—All the forms of the venereal diſeaſe,
57 when they are left to themſelves, undermine and deſtroy the conſtitution; but gonorrhœa ceaſes without the reſources of art, particularly if during its courſe the patient live a ſober and regular life. The irritability of the urethra, the conſtitution of the patient, the faults in his diet, and his exerciſe and choice of remedies, and perhaps alſo the nature of the virus itſelf, which is more or leſs acrid, and of which the action will be more or leſs violent, often renders gonorrhœa a very ſevere diſeaſe. Experience confirms, that the ſooner proper remedies are applied, and the ſooner the patient is cured, the leſs he ſuffers; and the more certainly he avoids the diſagreeable accidents which are ſo often the conſequence of that diſeaſe. From this conſideration, it is evidently of importance, either to prevent the diſeaſe entirely, or deſtroy it in its beginning. Two means have been propoſed to accompliſh theſe ends; one is, to remove the virus before it can act on the parts expoſed to it; the other deſtroys and alters its nature, and prevents theſe effects from the moment that it gives the firſt ſigns of its action.

Different practitioners have tried and recommended various prophylactic remedies. Some have applied mercurial ointment upon the ſurface of the glans and prepuce, immediately after coition, and others different kinds of lotions and injections, as cauſtic alkali, lime water, alcohol diluted with water: theſe preparations being injected ſeven or eight times a-day, for ſeveral days after the commencement of the diſcharge.

By the uſe of injections the irritation is diminiſhed, and the progreſs of the inflammation ſtopped; and when the diſcharge becomes thicker during their uſe, they ought to be continued eight or ten days after it has diſappeared; for if we were to give up too ſoon the uſe of Gonorrhœa
theſe injections, the inflammation and diſcharge would increaſe. In this caſe it is neceſſary to make the injection ſtronger, and to uſe it more frequently. The advantages to be derived from this practice do not ſeem, however, to be altogether confirmed; and it is to be wiſhed that enlightened and prudent practitioners would make ſome deciſive experiments to determine whether injections are uſeful or hurtful in the commencement of gonorrhœa.

When inflammation has taken place, and when the diſcharge and other ſymptoms of gonorrhœa are completely formed, a different mode of treatment ought to be purſued. Repoſe, abſtinence from all kinds of irritating food, ſpiceries, wine, &c. will contribute much to allay the irritation.

In order to defend the irritable parts againſt the acrid matter, and to moderate the ſymptoms of inflammation, authors have recommended the uſe of mucilaginous, oily, and ſedative applications. That which renders the urethra in man ſo violently affected by gonorrhœa, and ſo different from catarrh, is not from the difference of ſtructure in the organ, which has been ſuppoſed to be more irritable than the mucous membrane of the noſe and other parts of the body. It is the ſalts of the urine paſſing along the urethra, which keeps up the irritation produced by the virus. It has been propoſed, in order to remedy this ſource of irritation, to give gum arabic or the infuſion of linſeed internally; but theſe, when taken in the neceſſary quantities, generally injure the ſtomach. An infuſion of hemp has been found by Swediaur to anſwer all the purpoſes, and not to be ſubject to the inconveniences of the others. This remedy may be rendered more agreeable to take, by adding a little ſugar to it; and in ſome caſes a weak decoction of ſarſaparilla may be advantageouſly added. All theſe drinks ſhould be taken cold, or at leaſt nearly milk-warm, and in ſmall doſes frequently repeated.

The antiphlogiſtic regimen muſt alſo be purſued in the treatment of gonorrhœa. The patient ought to avoid all exerciſe, or high-ſeaſoned food. Lint, wet with a ſaturnine ſolution, ſhould be kept conſtantly applied to the penis; and the patient ſhould keep his bowels open with ſaline purgatives. When the ſymptoms of inflammation are conſiderable, and the pulſe hard and frequent, bleeding becomes neceſſary, either general or topical: the conſtant application of fomentations and emollient poultices is alſo uſeful. Swediaur has adviſed, that camphor and the nitrate of potaſh ſhould be given internally, and this ſhould be continued according to its effects. Camphor alone, taken in the form of emulſion with ſugar or freſh egg, is an efficacious remedy in allaying the pain and *ardor urinæ*. The uſe of camphor has alſo been recommended externally, with a view to allay the cordee.

Theſe remedies ought to be continued as long as the pain and ſymptoms of inflammation in the urethra continue. After they are abated, the patient may be allowed a better diet, in order to prevent the urethra from being affected with a chronic gonorrhœa or gleet. Injections made of the extract of opium with acetate of lead, applied frequently from the commencement of the diſeaſe, contribute much to ſhorten it, and allay the accompanying pain. Sometimes, however, even the moſt mild injections do harm, from a particular irritable ſtate of the

Gonorrhœa. urethra. Great advantage has alſo been obtained by ſome, in very aggravated caſes of the diſeaſe, by frictions of mercurial ointment on the perinæum, and along the courſe of the urethra, or by mercurial fumigations applied to the genital organs, and even by the injection of mercurial ointment into the urethra.

On the other hand, when the ſymptoms of eryſipelatous inflammation prevail; when the patient is feeble, and of an irritable temperament; when he feels better after dinner; when the diſcharge is clear and profuſe, accompanied with ſharp pain, often lancinating throughout the whole urethra; and if the pulſe is feeble and frequent, it is more adviſeable to give him a leſs rigid diet; to allow him the moderate uſe of wine, and in ſome caſes to give him opium and bark internally. We are ſometimes ſurpriſed at the ſudden changes which theſe remedies in ſuch caſes produce. The uſe of opium alſo contributes much to prevent cordee; and in all caſes this ought to be avoided as much as poſſible, by fixing the penis downwards, and in making the patient lie on his ſide upon a mattreſs, which anſwers better than lying upon the back, and in a feather bed.

If in conſequence of the violence of the inflammation the diſcharge ſtops, and the poſterior parts of the urethra begin to be affected, we ſhould have recourſe to the warm bath, or apply vapours to the part, by placing the patient upon a veſſel containing boiling water, and this ſhould be repeated three or four times a-day; the patient ſhould keep his bed, and an emollient cataplaſm applied upon the penis, which ſhould be renewed every hour. All kinds of injections in ſuch caſes are hurtful. The ſame treatment is alſo applicable when the diſcharge is ſtopped by the uſe of acrid and aſtringent injections, or by injections improperly uſed, or by the improper uſe of turpentine and balſams.

When the proſtate glands and the neck of the bladder are affected, and the patient of a plethoric habit, it becomes neceſſary to bleed profuſely, either at the arm, or by applying a number of leeches to the perinæum. In all theſe caſes, a ſedative clyſter repeated every ſeven or eight hours, and a general or local warm bath uſed twice a-day, are the beſt remedies which can be uſed. Sometimes a bliſter applied to the perinæum is alſo uſeful.

The ſwelling of the lymphatic glands of the groin which ſometimes takes place, is purely ſympathetic, and diſappears along with the inflammatory ſymptoms of the urethra.

In all caſes of gonorrhœa the patient ſhould wear a ſuſpenſory bandage whilſt the diſeaſe continues *. It is alſo uſeful to perſons who are obliged to take exerciſe, to wear a convenient bandage round the penis, which may be united to the ſuſpenſory in ſuch a manner, that the penis may be encloſed in a kind of caſe, and thus defended from external injuries, from cold, and from friction; this bandage being kept conſtantly clean, by often changing the caddis, which is placed in its cavity. For this purpoſe, a hole ſhould be left in the bag, covered by the caddis, which the patient can take away each time he makes water. Another general precaution which it is uſeful to make, is never to keep the penis bound up high, but to keep it low, in order that the matter may flow out freely, and may not paſs backwards along the urethra.

* Plate DXIV. fig. 12.

The gonorrhœa which takes place in the glans and prepuce is generally eaſily cured, by injecting frequently warm milk between the glans and prepuce, and by keeping the penis in an emollient poultice. In thoſe caſes where the prepuce is ſo ſwelled that it cannot be pulled back, we ought to have recourſe to ſedative injections. Gonorrhœa.

It is a uſeful general rule, which ought to be obſerved in all caſes of gonorrhœa, to touch the parts affected as little and as ſeldom as poſſible; and every time that it is touched, to waſh the hands immediately afterwards, and with the greateſt care, fearing that, by carrying them unintentionally upon the eyes, noſe, &c. theſe organs might be inoculated with the diſeaſe.

58 In women.

Gonorrhœa in women is ſeldom followed by ſo violent ſymptoms, or by ſo ſevere and dangerous conſequences as in men. In ſome caſes the ſymptoms are ſo ſlight, that they conceive the diſcharge, particularly at its commencement, to be nothing but the whites, to which diſeaſe a great many are ſubject, eſpecially in the large towns of Europe.

The gonorrhœa in women has been ſuppoſed by many authors to have its ſeat in the cavities of the urethra. This, however, will not be found to be the caſe. The diſeaſe is ſeated, either upon the clitoris, or on the orifice of the urethra; upon the nymphæ, or in the cavity of the vagina; or even upon the inferior commiſſure.

59 Treatment.

With regard to the treatment, we have the ſame indications to fulfil in gonorrhœa in women as in men, with this difference, that one can ſee the change of ſtructure in theſe parts, and thus, from the ſeat of the diſeaſe, employ proper injections and lotions from the beginning.

Precautions in uſing Injections.—The ſyringe uſed in men for this purpoſe ought to have a ſhort point of a conical form and of a thickneſs proportioned, that not more than its extremity may paſs into the orifice of the urethra *. The body of the ſyringe ſhould be perfectly cylindrical, and the piſton ought to play very accurately; for if the piſton does not fit the body of the ſyringe, the injection, inſtead of paſſing into the urethra, regurgitates between the piſton and the ſyringe. From the unſteadineſs of the motion of the piſton, the point of the ſyringe is apt to move ſuddenly on the urethra, and injure its thin and delicate membrane. To prevent any injury of this kind, we have employed with great advantage, particularly if the mouth of the ſyringe is made of metal, a ſmall ſtrip of caddis wrapped in a ſpiral manner round the mouth of the ſyringe, ſo as nearly to expoſe its point. If the diſeaſe is ſeated near the point of the urethra, the patient ſhould be attentive to compreſs with one hand the urethra above the arch of the pubis, where the ſcrotum commences, whilſt with the other hand he holds and guides the ſyringe. The liquid ſhould be thrown in gently, and ſo as ſlightly to diſtend the urethra; the liquid is to be kept for a minute or two, and the ſame operation repeated two or three times in ſucceſſion.

* Plate DXIV. fig. 12.

The liquid employed ſhould always be uſed warm, which may be eaſily done by filling a cup with the neceſſary quantity, and placing the cup in a baſon of boiling water.

It often happens, particularly in young people, that after

Gleet. after having uſed injections ſome time with advantage, they become leſs attentive in uſing them, and neglect them even for a day. This omiſſion is always followed with bad conſequences, the diſcharge returning with double force; and the patient is obliged to continue the injections during ſome weeks more than would have been neceſſary, if the uſe of the remedy had not been interrupted.

In order, therefore, to prevent the danger of a relapſe, it is always prudent to adviſe patients to inject three, four, or even ſix times a-day, if the circumſtances demand it, and to continue the ſame two or three times a-day regularly for at leaſt ten or fifteen days after the diſcharge has entirely ceaſed.

For women the canula ought to be larger and longer. A canula of ivory, an inch in diameter, and two or three inches in length, fixed to a bottle of elaſtic gum, is the moſt convenient form of a ſyringe *.

* Plate DXIV. fig. 13.

Of Gleet.

60 It very often happens, that after the ſpecific inflammation of the urethra is removed, from which gonorrhœa is ſuppoſed to originate, a diſcharge ſtill continues. This diſcharge is not attended with pain, nor can it be communicated from one perſon to another. The matter which eſcapes is generally of a tenacious conſiſtence, and of a yellow colour, appearing to be compoſed of globules, mixed with a mucous fluid. When a cure cannot be formed, either by the uſe of injections, or by bougies, it has ſometimes been propoſed to inject liquids capable of exciting irritation and inflammation in the affected part of the urethra. It is probably from this principle that ſome gleets have been cured by violent exerciſe on horſeback, or a long journey. There have alſo been examples of ſimilar caſes cured by coition; but this is a cure not to be recommended, as there always may be a riſk of communicating the diſeaſe to the women. A bliſter, applied externally to the part affected, or to the perinæum, has alſo been found uſeful. The cold bath has often been recommended in obſtinate gleets, from which good effects often reſult; but there are other caſes in which it ſeems to increaſe the diſcharge.

It is alſo proper to change the injection; for it is obſerved that an injection leſs ſtrong ſometimes produces a good effect, after a ſtrong one has been employed without ſucceſs, and *vice verſa*. In many caſes it is uſeful to combine the uſe of internal medicines with external means. The chief of theſe are mercurial preparations, balſamic and reſinous ſubſtances, and tonics. Swediaur has uſed, with much ſucceſs, in gleets, pills made of turpentine and oxide of mercury. Among the reſinous ſubſtances which are employed, the moſt common is the balſam of copaiba. The beſt way of taking this remedy is to give the patient thirty or forty drops in a ſmall glaſs of cold water morning and evening, or from fifty to eighty drops for one doſe in the middle of the day, and afterwards to take, in a ſmall glaſs of water, twenty drops of the elixir of vitriol, which renders the balſam leſs diſagreeable to the ſtomach. Half a dram of turpentine, of the balſam of Tolu, or of the balſam of Canada, anſwers the ſame end. Swediaur mentions the caſe of a young man, who, having been for a long time diſtreſſed with a very obſtinate gleet, ſwallowed at once between two and three ounces of the balſam of copaiba, and was cured. Coryza.

Sometimes the balſams, combined with tincture of guaiac, or with kino, produce a deſireable effect.

Among the corroborant or tonic remedies, the kino, which we have already mentioned, is one of the moſt uſeful; the cinchona alſo in powder or infuſion in red wine, or, which is ſtill better, in lime water; tormentilla in powder, or in extract, in the form of pills, joined, according to circumſtances, with preparations of iron. Glauber's ſalts are uſeful and efficacious remedies. The tincture of cantharides, given in a doſe from twenty to thirty drops, has often been found very beneficial. It is one, however, which ought to be given with precaution, as it might do much harm to people of a delicate and irritable temperament.

There are, however, caſes, where all our efforts to cure a gleet are fruitleſs; and we ſometimes ſee, that nature alone can in time ſucceed, after we have uſeleſsly tried all the reſources of art.

There ſometimes remains a ſpecies of cordee or curvature of the penis after all the other ſymptoms of gonorrhœa have diſappeared. Frictions, with mercurial ointment, with camphorated oil, ſpirituous lotions, or electricity applied to the part, are moſt appropriate remedies in ſuch caſes.

In all caſes of obſtinate gleet, which are ſituated far back in the canal of the urethra, the ſtate of the proſtate gland ſhould be carefully examined; for they often ariſe from a diſeaſe in that part. When the proſtate is found ſwelled and hard, Swediaur has ſeen inſtances where, after a mercurial treatment, the repeated application of cupping-glaſſes to the perinæum, and the uſe of large doſes of the *conium maculatum*, has ſucceeded, other remedies having failed.

The gonorrhœa of the proſtate is a morbid diſcharge of mucus from that gland, mixed ſometimes with the liquor of the ſeminal veſicles; and it takes place principally through the day, without any venereal deſire. This diſeaſe is ſoon followed by feebleneſs and general debility, with emaciation of the whole body, and even with death; particularly if the patient has not employed proper remedies.

The remedies moſt efficacious are the cold bath, injections of metallic ſalts, fomentations of hemlock, bliſters to the perinæum, and internally tonic medicines, with a well-regulated diet.

61

SECT. III. *Of Inflammation of the Mucous Membrane of the Noſe.* Coryza.

Inflammation of the mucous membrane of the noſe is generally preceded by dryneſs in the noſtrils, with an itching feeling, and with a weight over the forehead. It is alſo accompanied with ſneezing and an increaſed flow of tears. The ſecretion of mucus from the noſe is at firſt diminiſhed, and afterwards becomes very abundant. At firſt it is limpid and irritates the ſound ſkin of the upper lip, over which it paſſes, and becomes afterwards opaque, of a yellowiſh white colour, and a diſagreeable odour. This ſtate is ſometimes accompanied by fever, and it continues for a longer or ſhorter period. Moſt commonly it ceaſes at the end of a few days. It ſometimes, however, becomes chronic and indetermined, in which caſe it is often intermittent, and re-appears at regular

Otitis. regular periods. Coryza, like all other inflammations of the mucous membranes, terminates by reſolution. It ſometimes paſſes into the ſtate of chronic catarrh, and it alſo occaſions an ulceration of the mucous membrane of the noſe; but this is extremely rare.

Coryza is frequently accompanied with inflammation of the mucous membrane of the eye, it alſo ſpreads in many inſtances along the euſtachian tube, producing deafneſs, and it is very apt alſo to paſs down the trachea and affect the lungs.

The noſe is ſometimes affected with a diſcharge of thick viſcid mucous, when there is very little apparent redneſs or pain. Such inſtances are often connected with the formation of polypi: but we have obſerved ſeveral caſes, where no other ſymptom than the mucous diſcharge appeared, and where the diſeaſe had very much the general character of ſome diſcharges from the urethra.

62 *Treatment.*—Coryza is commonly an affection ſo ſlight, and of ſuch ſhort duration, that it is ſeldom neceſſary to employ any means to produce an abatement of its ſymptoms. Sometimes, however, the ſymptoms go to a very high degree, and it is then that emollient vapours directed into the naſal cavities are particularly indicated. If much ſymptomatic fever accompanies the diſeaſe, it may be adviſeable to draw ſome blood from the arm, and in all caſes a briſk purgative will be found to relieve the fullneſs and uneaſineſs in the head. When the inflammation ſpreads along the mucous membrane of the trachea, it becomes the more neceſſary to uſe every means to alleviate the inflammatory ſymptoms, and to prevent the inflammation affecting the mucous membrane of the bronchi.

Patients labouring under this diſeaſe, feel remarkable relief from living in a warm atmoſphere; and the ſymptoms of inflammation of the noſe and trachea will be much alleviated by the internal exhibition of opium.

When the inflammation and the diſcharge are of a chronic nature, aſtringent injections, or a doſſel dipt in ſimilar ſolutions, kept in the noſe during the night, are in ſuch caſes the moſt uſeful applications. They gradually diminiſh the quantity of the diſcharge, and render it more thick and tenacious; and the ſenſe of ſmelling, which is commonly deſtroyed, is gradually reſtored.

If the diſcharge be fœtid, and occaſionally mixed with blood, in all probability it originates from the formation of an abſceſs or ulcer, connected with a carious bone.

63 SECT. IV. *Of the Inflammation of the Mucous Membrane of the Ear* (Otitis).

In inflammation of the ear, there is the ſame characters deduced from analogy of ſtructure, as in other mucous membranes. The principal cauſes of this diſeaſe are ſudden changes in the atmoſphere; above all, the change from heat to cold, or from dryneſs to moiſture; coldneſs of the nights, north winds, ſuppreſſion of any regular diſcharge, the criſis of acute diſeaſes, metaſtaſis, the preſence of an irritating body in the ear, or the imprudent application of oily or ſpirituous ſubſtances.

The inflammation ſometimes takes place in the *meatus auditorius*; and in other caſes it is confined to the cavity of the tympanum and euſtachian tube. In the firſt caſe, Otitis. there is more or leſs pain, and buzzing in the ears, and afterwards a diſcharge of thin reddiſh yellow matter. This matter gradually becomes white and opaque, and increaſes in conſiſtence till the termination of the diſeaſe; when it differs in nothing from the wax of the ear, but in its white colour. This affection generally laſts twelve or fifteen days. It ſometimes ſpreads to the external parts of the ear, and often paſſes into a chronic ſtate.

When the inflammation is confined to the cavity of the tympanum, it produces an obſcure tingling ſenſation, and a feeling of tenſion, which the patient ſupports without much inconvenience; but moſt frequently the inflammation is propagated from the cavity of the tympanum along the euſtachian tube. In this caſe, the pains become more violent and extend along the contiguous mucous ſurfaces; they paſs from the interior of the ear into the throat; there is great difficulty in ſwallowing, and the food, when paſſing through the pharynx, gives a ſenſation as if the ſkin had been eroded. The motions of the neck alſo become uneaſy, and the ſmalleſt attempt to cough, to ſneeze, or blow the noſe, produces a painful ſenſation in the ear. The patient alſo complains of a ſtoppage in the noſe, of a frequent dry cough, and of pain in the head, and more or leſs fever in the evening. The ear alſo feels hard and diſtended, and there is generally deafneſs, particularly towards the end of the diſeaſe. Soon all theſe ſymptoms diminiſh except the hardneſs in the ear, which augments continually till the fifteenth or twentieth day.

Moſt commonly after this period, a quantity of fœtid matter is ſuddenly diſcharged into the external ear, or into the throat, and then all the ſymptoms diſappear. This diſcharge generally diminiſhes daily, and in a ſhort time ceaſes altogether. At other times, particularly in young people, it continues, and becomes chronic.

Treatment.—When the inflammation is confined to the 64
external meatus, the diſeaſe is generally ſo ſlight that it may be allowed to run through its common periods, and it is merely neceſſary to keep the patient warm. When the inflammation is very conſiderable, the mildeſt injections give pain, and in place of moderating the ſymptoms, they increaſe the irritation. We ought therefore to do nothing, except, perhaps, to allow ſome warm vapour to paſs into the ear, and to purſue the antiphlogiſtic regimen. About the twelfth or fifteenth day, it may be uſeful to apply tonic medicines, ſuch as aromatic alcohol dipped in a piece of cotton. When the inflammation is in the tympanum, or the euſtachian tube, beſides emollients, it will be alſo neceſſary to give ſome briſk purgative, or to employ local or general blood-letting. If the membrane of the drum is much diſtended, and accompanied with violent pains, it has been even propoſed to make an opening through the tympanum *. When the matter has been diſcharged from the tympanum either ſpontaneouſly or artificially, little more is required to be done, unleſs the diſeaſe aſſumes a chronic form. This is more frequent in children. We often ſee the purulent diſcharge continue in them for many months, and ſome of the ſmall bones of the ear become carious, and are diſcharged along with the matter. In ſuch caſes ſmall doſes of calomel, for ſome time repeated, bliſters applied behind the ear, and injections of lime water

* *Noſographie Philoſophique par Pinel.*

Angina. water combined with muriate of mercury, acetate of lead and the like, ſhould be employed.

65 SECT. V. *Of Angina.*

The parietes of the mouth, trachea, and larynx, are often inflamed in catarrhal affections, and preſent ſymptoms which vary according to the intenſity of the diſeaſe, and particular ſeat of the affected membrane.

Angina has therefore been diſtinguiſhed according to its ſeat in the tonſils, the trachea, the pharynx, and larynx.

When the patient has great difficulty in ſwallowing his food, and when the pain ſtretches in chewing, to the ear along the euſtachian tube, by a ſort of crepitation, and if, on inſpection of the throat, the amygdalæ and edge of the palate appear much inflamed, along with an abundant excretion of mucus, the angina has its ſeat principally in the amygdalæ.

Angina affects the pharynx when deglutition is difficult or impoſſible, and the food is returned by the noſe, reſpiration at the ſame time not being impeded. This inflammation is alſo viſible by examining the bottom of the mouth.

But if the deglutition is difficult; if no redneſs is perceived at the bottom of the throat, and if the patient has great difficulty in reſpiring, a ſharp pain in the motions of the larynx, the voice acute but weak, and the ſpeech ſhort, we may then conclude that the inflammation has attacked the larynx, or upper part of the wind-pipe. An affection of this kind, though a few caſes have been known to take place in adults, generally attacks children under twelve years of age. It is known by the name of *croup*.

When the inflammation affects the amygdalæ, inhaling ſteams of warm water and vinegar will often be found to give great relief. A poultice, too, applied to the outſide of the throat, aſſiſts in leſſening the tenſion of the inflamed parts. Though in many caſes the inflammation ſeems to be confined to the mucous covering of the glands, yet in others it ſpreads into the glandular ſubſtance, where it generally advances to ſuppuration and abſceſs. In ſuch caſes, the early diſcharge of the matter gives great and immediate relief; and though no matter has been formed, puncturing the inflamed part with a ſharp inſtrument often produces an alleviation of all the ſymptoms. The inſtrument delineated in Plate DXIV. fig. 14. is well calculated for theſe purpoſes. By altering the poſition of the ſcrew in the handle, the depth of the cutting part of the inſtrument may be regulated. When it is to be uſed, the fore finger of the left hand is to be introduced down the mouth, and the perforator concealed in the canula introduced as a director. When the extremity of the canula reaches the inflamed part, the perforator may be then ſafely puſhed into it, of a ſufficient depth, which had been previouſly regulated.

When the inflammation affects the pharynx, relief will alſo be obtained by inhaling the ſteam of warm water, and by employing antiphlogiſtic remedies. In croup, calomel has been found to have a ſpecific effect; and it is aſtoniſhing the quantity that has been given to infants for the cure of that diſeaſe. See MEDICINE.

When the effuſion which takes place in croup, is chiefly confined to the upper part of the larynx, and produces ſymptoms of ſuffocation, it has been propoſed to make an artificial opening into the trachea below where the matter is effuſed, in order to ſave the life of the patient. See BRONCHOTOMY.

Of the Catarrh of the Bladder.

SECT. VI. *Of the Catarrh of the Bladder.* 66

The ureters, the bladder, and the urethra, are all liable to be affected with catarrhal affections from general cauſes, the ſame as thoſe affections of the mucous membranes which have been already mentioned; and beſides, the ſurfaces of the mucous membranes of theſe parts are expoſed to the action of particular cauſes, namely, the ureters and the bladder to calculi, and the urethra to the venereal virus.

The catarrh of the bladder is more frequent among men than among women; and old people are more ſubject to it, than thoſe at any other period of life. It is often produced by the internal uſe of cantharides, by acrid diuretics, and by the progreſs of hemorrhagy from the urethra. The ſudden expoſure to cold, ſuppreſſed perſpiration, the diſappearance of different diſeaſes of the ſkin, of rheumatiſm, and of gout, are followed almoſt ſuddenly by this catarrh. Other circumſtances may alſo give riſe to the chronic catarrh of the bladder. The preſence of a calculus or any foreign body, the continual application of bougies, a ſwelling of the proſtate gland; and above all, ſtrictures of the urethra.

This diſeaſe is marked by pains of the bladder, and at the point of the urethra, both before, and whilſt making water. The injection of the urethra is more or leſs difficult, according to the action of the bladder, and of the freedom of the paſſage of the urethra. The hypogaſtric region is tenſe, and the urine preſents variety of colours; it is ſometimes whitiſh, or reddiſh, or of a deep yellow colour; it is muddy, and it exhales an odour of ammonia, which becomes more ſenſible a ſhort time after it has cooled. It alſo forms, in moſt common caſes, a mucus, which mixes and comes away with the urine in the form of glary filaments, and which is afterwards depoſited at the bottom of the veſſel in the form of the tenacious glary ſubſtance, reſembling ſomewhat the white of egg.

The chronic inflammation of the mucous membrane of the bladder, may be accompanied with an ulceration of the kidneys or bladder; the mucus diſcharged then becomes of a greeniſh yellow colour, ſometimes mixed with ſtreaks of blood. It is depoſited ſlowly, is mixed eaſily among the urine, and in water; it has little viſcidity, or fœtor, and does not coagulate by ebullition. The other ſymptoms which accompany this excretion, as fever, pain, waſting of the fleſh, ſufficiently diſtinguiſh this double affection of the bladder. The chronic catarrh is ſubject to return with intolerant pain in the region of the pubis and perinæum, accompanied with reſtleſſneſs and anxiety. Theſe intermiſſions are irregular, and may remain ſome weeks.

67 *Treatment.*—The matter which exiſts in the mucous membrane of the bladder, and that of other membranes of the ſame name, is ſufficient to point out the means which are to be employed in its treatment. The warm bath, and mucilaginous drinks, are particularly indicated at the beginning of the acute catarrh; but the tendency which it has to become chronic, ought to make us cautious

Strictures. tious in not profecuting debilitating remedies too far. Opium ſhould be employed with great prudence, notwithſtanding the intenſity of the pain; and as this is often the reſult of the diſtenſion of the bladder, from the accumulation of urine, it is ſometimes neceſſary to have recourſe to the introduction of the catheter.

The chronic catarrh of the bladder is generally difficult to cure, and the more ſo, if it occur in old age: if it ariſes from the preſſure of a ſtone in the bladder, there is no cure but the operation of lithotomy; if it ariſes from metaſtaſis, rheumatiſm, or any other diſeaſe, we ought to employ remedies to the ſkin and inteſtinal canal, and pour tonic injections into the bladder. The uva urſi has alſo been found a uſeful remedy. Exerciſe, dwelling in dry and elevated places, the uſe of woollen clothes next the ſkin, contribute often more to the cure of this diſeaſe, than the uſe of medicines, and they ought always to be combined.

The conjunctiva covering the eye-ball, eye-lids, and lacrymal paſſages, are alſo ſubject to inflammation; but theſe will be treated of among the diſeaſes of the eye and its appendages.

68 SECT. VII. *General Remarks on Strictures.*

The term ſtricture has been uſually applied to a contraction of the urethra; generally ariſing from a thickening of the mucous membrane lining that canal. This change of ſtructure is not, however, confined to the mucous membrane which lines the urethra; the ſame morbid alteration takes place in the œſophagus, in the euſtachian tube and meatus externus, in the maxillary ſinus, in the bladder, in the lacrymal paſſages, and in all canals lined by mucous membranes. Strictures, however, occur much more frequently in the urethra, and are there more pernicious than in any other part. They appear alſo ſometimes in the upper part of the œſophagus. A ſimilar change has been obſerved in the internal part of the bladder. Bichat found the membrane lining the maxillary ſinus ſeveral lines in thickneſs, and alſo the canals of the tympanum much thickened*; and reaſoning from analogy, and from what we may obſerve by an attentive examination of the ſymptoms of many caſes, of what is uſually called fiſtula lacrymalis, there is little doubt but a contraction and thickening often take place of the mucous membrane lining the lacrymal ſac and duct, and produce that diſeaſe.

* *Anatomie Generale*, tom. iv. p. 431.

This change in the ſtructure of mucous membranes is always the conſequence of inflammation; and when the membrane is thus altered, the diſcharge, inſtead of being healthy mucus, is generally a puriform fluid, apparently a mixture of pure mucus and globules of pus.

69 SECT. VIII. *Of Strictures in the Urethra.*

The treatment of the diſeaſes of the bladder and urethra has always been conſidered a difficult branch of ſurgery, as their true nature is often obſcure, and as it is by no means eaſy to direct the proper means of relief.

Of the great variety of cauſes which diſturb the functions of theſe organs, ſtrictures in the urethra are perhaps the moſt frequent, and moſt ſerious. They prevent the free evacuation of the bladder; greatly diſturb, if not entirely deſtroy the function of generation; and often give origin to conſtitutional ſymptoms which ſometimes increaſe to an alarming degree, and even prove fatal. Strictures of the Urethra

That the urethra ſhould be ſubject to many morbid changes, we may infer, not only from our knowledge of the functions it performs, but alſo from its delicate and no leſs complicated ſtructure.

One part of this ſtructure is intended for the evacuation of the urinary bladder, the other for the tranſmiſſion of the ſeminal fluid; and as in the exerciſe of this laſt function, the urethra ſympathiſes, in a greater or leſs degree, with the whole ſyſtem, and alſo with the mind itſelf, it muſt have a connection with many of the other organs of the body.

Accordingly, we find that patients who have obſtructions in the urinary canal, have at the ſame time other complaints, which get well when the obſtruction is removed. And, on the other hand, diſeaſes of other parts bring on morbid affections of the urethra, which are cured along with the original complaint.

The whole extent of the urinary canal is lined by a delicate membrane, which is conſtantly covered with a viſcid fluid, ſecreted by numerous glands, whoſe ducts open on its internal ſurface by orifices which are called lacunæ.

It is highly vaſcular, and is endowed with ſo much nervous ſenſibility, that irritating bodies applied to it often affect, or even derange the whole ſyſtem.

It has a conſiderable degree of contractility, is evidently elaſtic, and perhaps may poſſeſs a muſcular power, although no muſcular coat has yet been demonſtrated; but to whatever cauſe this contractility be owing, it is well known it does not contract upon irritation.

As a proof of this contractile power, a remarkable caſe is mentioned by Mr Cline in his lectures, where a ſtone was lying in the membranous part of the urethra one evening, which during ſleep had been expelled and was found among the bed-clothes the following morning.

The contraction which forms a ſtricture in the urethra may take place round the whole circumference of the canal; it may ariſe chiefly at a particular point of the circumference; or, it may extend along a conſiderable extent of its ſurface, and thus produce obſtructions of different forms.

The ſtricture once begun, continues no longer than the cauſe which firſt produced it continues to operate. But if the parts are kept long in this ſtate of contraction they generally are attended with a degree of inflammation; the membrane of the urethra acquires a morbid degree of thickneſs; the ſurrounding parts are altered in ſtructure; and this change of form and appearance remains after the cauſe which originally produced them has ceaſed to operate.

That ſpaſmodic ſtrictures do exiſt appears from the impreſſions made on bougies which have been paſſed through them, and from the examination of the parts after death; for although complete obſtructions to the bougie were found when alive, yet not the ſmalleſt remains can be obſerved on diſſection. This contraction is peculiarly violent, and from what we have ſeen more frequent, at the foſſa navicularis than at any other part of the canal.

A gentleman, after many attempts to make water during the night, was not able to paſs a drop, and he applied for relief in the morning. A bougie was introduced, and met with a complete obſtruction at the glans, which

Strictures. which yielded in a few ſeconds after the bougie was in cloſe contact with it; on being withdrawn the urine flowed freely, and the complaint has never ſince returned.

Contractions at this place are ſometimes ſo violent as for a long time to interrupt the entrance of the bougie; and in one caſe it was ſo ſtrong as nearly to cut the inſtrument through, after it was introduced. What is remarkable, this happened repeatedly with the ſame patient.

70 Appearances on diſſection. When there has been a permanent ſtricture, the natural ſtructure of the urethra is changed, and the morbid alterations it has undergone may be ſeen on diſſection. There is commonly a contraction at one particular part of the canal; and the appearance of it has been compared to that which would have been given had a packthread been tied round it, or in ſlight caſes it is a mere narrowing *.

* See Plate DXIV. fig. 6. and 7.

When a ridge is formed projecting into the cavity of the canal, it is found to be a doubling of the inner membrane, with the cellular ſubſtance lying between the fold. The internal membrane itſelf is diſeaſed; it aſſumes a whitiſh colour; becomes much harder, ſometimes as hard as cartilage; and in ſome caſes this change is confined to the doubling of the ſtricture itſelf, whilſt in others it extends into the cavernous bodies. Theſe ridges or folds often form over one another, ſo that the intermediate portion of urethra becomes preternaturally contracted alſo; but it never becomes ſo narrow as at thoſe parts where the original ſtrictures were formed. Inſtead of a diſtinct curtain or fold, it happens alſo in ſome caſes that the urethra has the appearance of a cone gradually converging before the ſtricture, and diverging in the ſame manner behind it.

The contraction is generally round the whole of the circumference of the urethra; but it ſometimes happens that it is only at one ſide, and in ſuch caſes the urethra does not form a uniform tube, but it becomes ſerpentine and contorted in various directions.

When one ſtricture is formed, that portion of the urethra anterior to it is liable to ſuffer ſome changes, and theſe probably ariſe from its not meeting with the ordinary diſtenſion, the ſtream of urine being diminiſhed. It is by no means uncommon, therefore, to find in thoſe caſes where the original ſtricture has been formed near the bladder, another ſtricture anterior to it, ſo that when an obſtruction is found at the glans or four inches and a half from it, another is generally met with at ſeven inches, or at the bulb.

71 Situations of ſtricture. From the peculiarity in the form of the urethra, ſome parts are ſubject to ſtrictures much more frequently than others.

In the adult, and in the relaxed ſtate, the urinary canal is about nine inches long, and nearly of the ſame diameter as a common quill; but its ſize varies at three different points, and there ſtrictures moſt frequently ariſe. Theſe contractions are at the glans, the bulb, and the proſtate gland (ſee fig. 5. Plate DXIV.) The narroweſt part is juſt below the bulb, and here ſtrictures moſt frequently occur.

The natural contraction renders it, in almoſt every caſe of ſtricture, the ſeat of the diſeaſe. This part of the canal ſeems alſo to poſſeſs an uncommon degree of irritability, as it is here that the contraction takes place in caſes of ſtrangury. When ſtrictures continue long, and the violence of the ſymptoms increaſe, diſeaſes ariſe in other parts. Strictures

The urethra between the ſtricture and bladder, from the obſtruction the urine has to overcome, enlarges, and is ſometimes attacked by inflammation.

As in moſt caſes the ſtricture is attended with a gleet, the glands ſituated about the neck of the bladder become diſeaſed. The bladder becomes extremely thickened, and its capacity diminiſhed. From the ſtrong exertions it is neceſſary to make in order to overcome the obſtruction, and as it cannot contain much urine, the ureters alſo become dilated.

When the diſeaſe advances ſtill farther, ſo that it is impoſſible to evacuate the bladder, the obſtruction being complete, the urine eſcapes by ſome new channel; for as in ſuch caſes the parts between the bladder and obſtruction make leſs reſiſtance than its coats, both on account of their natural ſtructure, and as theſe parts are generally inflamed or ulcerated, they give way, and the urine takes a new courſe. When this change has once taken place, ſo that no urine paſſes through the meatus urinarius, the other ſymptoms will differ according as the aperture has been formed by ulceration of the inner membrane of the urethra, or by a ſudden rupture. For when the membranous part of the urethra has been eroded, a ſuppurating cavity muſt have formed in the contiguous cellular ſubſtance, and as the urine cannot ſo eaſily be diffuſed in the ſurrounding parts, it makes its way without difficulty through the integuments.

But when a ſudden rupture or ulceration of the inner membrane of the urethra takes place, as the urine meets with no obſtruction in inſinuating itſelf into the cellular membrane, it effuſes itſelf in a ſhort time over the perinæum, ſcrotum, and adjacent parts; extenſive abſceſſes are formed where the urine was diffuſed; and as theſe burſt in numerous places, fiſtulous openings are formed, which have either a direct or indirect communication with the bladder, and through which the urine continues to paſs till the original obſtruction is removed.

Symptoms.—Often this complaint does not become of 72
ſuch importance as to give alarm to the patient till many months, or even years, after the original cauſe has been forgot. At other times, a few months after a gonorrhœa has been cured, the urine, inſtead of coming away with the accuſtomed eaſe, begins to be paſſed with ſome difficulty. The ſtream, in place of being full and even, diminiſhes and becomes unequal; ſometimes it comes in drops after much ſtraining and exertion, has a forked appearance, or ſcatters in all directions. From the irritable ſtate of the parts, the ſmalleſt quantity collected in the bladder, brings on a deſire to make water, and a continual uneaſineſs all along the courſe of the canal, about the perinæum, anus, and lower part of the abdomen. In moſt caſes there is a diſcharge of matter from the urethra. The gleet is always more ſevere after any debauch or venereal act. It comes on immediately after ſuch exceſs, and gradually diminiſhes or diſappears. It is alſo not unfrequent to find ſtrictures accompanied with that profuſe diſcharge of mucus from the bladder called *catarrhus veſicæ*. The irritation communicated to the bladder in conſequence of the diſeaſe of the urethra, brings on inflammation, which is followed by a profuſe diſcharge of mucus from the whole of its internal ſurface, and this mucus comes away with the urine, and

Strictures. is depoſited, and firmly adheres at the bottom of the pot in the form of a tough tenacious maſs.

Nocturnal emiſſions are ſometimes the only ſymptoms which lead us to ſuſpect the exiſtence of ſtricture; for in ſome caſes the diſeaſe is neither attended with any fixed pain in the urethra, nor is there any diſcharge of matter.

Fiſtulas in the perinæum, and along the courſe of the penis, often derive their origin from an obſtruction of the urinary canal.

When, either from irritating injections, bougies, or any other cauſe, inflammation comes on, the urethra is completely ſhut at the place of the ſtricture, and the internal membrane giving way, the urine is effuſed in the cellular membrane, which gives riſe to abſceſſes and fiſtulous openings, through which the urine continues to paſs, till the ſtricture is removed.

The inflammation in ſome caſes ſpreads to the ſurrounding parts; the mucous glands inflame, ſuppurate, and burſt; and hemorrhoidal tumors often form at the extremity of the rectum.

Beſides theſe, the more uſual ſymptoms of ſtricture, there are others which accompany that complaint, and ariſe from conſtitutional cauſes.

The moſt frequent of theſe is a febrile attack, in the form of a complete paroxyſm; but it differs from the common intermittent fever, in its ſhort continuance, its irregularity, and in the violence of its termination. It happens moſt frequently to thoſe who have been in warm climates; but it is by no means confined to them alone.

People of weak conſtitutions have often ſickneſs at ſtomach, nauſea, and vomiting, and ſometimes an uneaſy ſtate of irritability about the ſtomach, which gets better when the ſtricture is relieved.

Gout, epilepſy, hydrocele, ſciatica, eryſipelas, ſwellings in the perinæum, occaſional ſuppreſſions of urine, have all been found connected with ſtricture; but ſuch caſes rarely occur.

There are other diſeaſes of theſe organs which have ſo many ſymptoms in common with ſtricture, that it is neceſſary to inquire with much attention into the hiſtory and ſtate of all the ſymptoms, before we can judge of the true nature of the complaint; and when there is any reaſon to ſuſpect that an obſtruction exiſts, it is aſcertained only by the introduction of a bougie; but the mode of doing this will be explained when ſpeaking of that inſtrument.

73 Diagnoſis. There are diſeaſes that ought to be mentioned as being liable to be miſtaken for ſtricture, and always kept in view in forming the diagnoſis. An irritable ſtate of the urethra, proceeding from gonorrhœa, is one that is very frequent.

In ſuch a caſe there is a diſcharge of matter and a pain in making water. The urine flows in a ſmall ſtream at the commencement, but before it is all evacuated it is of the natural ſize. The ſymptoms come on a few hours after coition, but abate in a ſhort time, and whenever the irritating cauſe is repeated, they return.

The bladder alſo, when irritated, brings on diſeaſes of the urethra, as theſe parts ſympathize ſo ſtrongly with one another; but when the primary affection is in the bladder, there are always ſymptoms which aid us in diſcovering the true complaint.

Strictures. Enlargements of the proſtate gland are by far the moſt apt to miſlead our judgement. Scrophulous and ſchirrous enlargements of that organ were at one time ſuppoſed to be very frequent cauſes of retention; it is now generally believed that they occur ſeldom, and are chiefly confined to people advanced in life.

It will be afterwards mentioned how ſwellings of the valvular proceſs of the proſtate are apt to be miſtaken for ſtricture when a bougie or catheter is introduced. The obſtruction in ſuch a caſe is always at a diſtance, as the canal has increaſed in length from the enlargement of the parts.

If attention be paid to this remark, and if the gland be at the ſame time examined from the rectum, little doubt will remain of the nature of the diſeaſe.

It is often difficult to draw off the water when the proſtate gland has become thus diſeaſed: to do this, much benefit will be found in uſing a catheter longer than ordinary, as the common curve cannot reach the extremity of the urethra from the increaſed length of that canal. Pouches or irregularities are alſo apt to form from the unequal growth of the gland; and as the ducts of the ſeminal veſicles and mucous glands become enlarged, the inſtrument ought to be of a large diameter to avoid being entangled by them.

74 Cauſes of ſtrictures. From the idea we have of the manner in which ſtrictures are formed, we infer that many ſubſtances of an irritating nature, whether applied immediately to the parts themſelves, or to thoſe connected with them, may, under particular circumſtances, produce this diſeaſe. The ſtone irritating the bladder, numerous diſeaſes of that organ and proſtate gland, irritations in conſequence of gonorrhœa, long and repeated erections or other ſtimulants, and the natural diſpoſition which the urethra has to contract in ſome conſtitutions, are the common cauſes of ſtricture. In whatever manner this irritation is produced, the ſymptoms and changes obſerved in the ſtructure of the urethra, make it probable that there is always a certain degree of inflammation ſubſequent to or accompanying it. Obſtructions in the urethra were ſuppoſed by Daran, and others about his time, to originate from cauſes very different from thoſe now mentioned. They conceived that the diſcharge from gonorrhœa proceeded from internal ulcers, and that the cicatrices and indurations they left behind were the moſt common cauſes of ſtricture. But ſince the nature of the diſcharge from gonorrhœa is found very rarely, if ever, to be purulent, and as ulcers occur very ſeldom, they cannot be conſidered as a common cauſe of the diſeaſe in queſtion.

Caruncles were alſo ſuppoſed to be frequent cauſes of obſtruction in the urethra; but theſe are rarely met with. One preparation of ſuch a caſe may be ſeen in the muſeum of St Thomas's Hoſpital. Drs Hunter and Baillie have ſeldom met with them. Indeed, ſince the internal membrane of the urethra ſo much reſembles that which lines the cavities of the noſe, mouth, and œſophagus, and as ulcers in theſe parts are more diſpoſed to form ſkin and heal, than to produce fungi, few caſes of obſtruction can be aſcribed to ſuch tumors.

The other cauſes which prevent the free diſcharge of the urine, are thoſe which are attended with no morbid change in the ſtructure of the urethra itſelf.

Such are tumors or indurations of the proſtate gland, of the veſiculæ ſeminales, or parts compoſing the body

of

Strictures. of the penis, or of the mucous glands along the course of the canal.

By far the most common of these, is an obstruction into the entrance of the bladder, from a diseased prostate gland.

This proceeds from a new form which the canal has assumed in consequence of an enlargement of its parts.

Its cavity becomes deeper from the growth of its sides, and the posterior extremity or valvular process forms a projecting tumour into the cavity of the bladder, which interrupts the passage of the urine, or the entrance of a catheter.

From the frequency of this appearance in diseased prostate glands, it is probable that it is the cause of diseases of that organ being often mistaken and treated as strictures of the urethra, and has in numerous instances not only prevented the introduction of a bougie into the bladder, but has been the cause of the formation of artificial passages through the substance of the gland.

75 *Treatment of Stricture.*—From the erroneous ideas that the older surgeons formed of the nature of strictures, it was not to be expected that the means of cure they employed were either founded on just principles, or attended with much success.

They made use of various external and internal remedies; they prescribed long and tedious courses of mercury, and gave many medicines which were supposed to have peculiar virtues in curing diseases of these organs.

They sometimes introduced into the canal mechanical instruments in order to dilate it; and when that was impracticable, a new passage was made by force, or the diseased parts were dissected away, and a new canal formed in the sound parts.

76 Wiseman's practice. Wiseman, so far back as the beginning of the last century, exploded many of these rude and dangerous practices, and introduced into use the *waxed candle* or *bougie*, by means of which he said he "crushed the carunculi to pieces." He met with cases, however, where this could not be done; that is to say, cases where it was impracticable to pass small bougies into the bladder; and this led him to adopt another mode of treatment. He consumed them by stimulating applications in the following manner. The wax at one end of the candle was scraped away, and the wick dipped in plasters composed of alum, red precipitate, calcined vitriol, ærugo, and other such substances, and then it was applied to the caruncle.

77 The use of caustic proposed by him. "But (says he), if after doing this you cannot pass the caruncle, you may well conclude it callous; in which case you may pass a canula into the urethra to that caruncle, and whilst you hold that there steady, you may convey a grain of caustic into the canula, and press the caustic to it; and whilst you hold it there, you will perceive its operation by the pressing forward of the caustic. The caruncle thus consumed, cast in a lenient injection daily; and if you take notice of his urine, you may see the separation of the sloughs as rags in it. After which you may with the common medicated candles wear away the remainder, and with the injections cicatrize it."

After Wiseman, Daran introduced into use a kind of bougies, the particular composition of which was kept secret. They were supposed to possess very great medical virtues; and it was from these qualities that their superior efficacy was supposed to proceed. Other surgeons soon began to imitate them, and they found that those they made had the same qualities as those of the original inventor. This led them soon after this to alter their opinion of their mode of action; and, instead of supposing that all the beneficial effects proceeded from the medicines in their composition promoting suppuration, cicatrization, &c. they explained their action on the principle of a simple wedge. Strictures.

But however successful their practice might have been in alleviating, if not in curing strictures, yet many cases occurred where the obstruction was so complete as altogether to prevent the bougie being introduced. They were therefore obliged to continue forcing past the obstruction, till the mode of treatment described by Wiseman was renewed, and held out as an original invention. The practice, indeed, generally followed by modern surgeons is founded entirely on what Wiseman has written; but since these have been better understood, from the progress of pathological investigation, it has been considerably modified and improved.

When we consider the effects of these modes of practice, and try to reconcile them with the ideas we have formed of the causes producing the stricture, it would appear that those very means employed for their removal belong to the same class of bodies as those originally producing the complaint.

As this cannot be denied, yet it will appear neither surprising nor improbable, when we reason from analogy, and observe the effect of similar applications to other diseased parts, and similar phenomena in other organs. It may be here observed, that the action of any part depends not only on the kind of the stimulus applied, but also on its degree of violence. We know that a slight pressure on the skin produces uneasiness or tickling, whilst to a stronger degree it passes unnoticed. A certain degree of light produces distinct vision, but a more intense one destroys it. The upper part of the throat is thrown into violent action by a slight irritation, but a more powerful one has no effect. Similar phenomena take place in disease; or slight irritations sometimes occasion violent morbid action, whilst those that are more powerful not only produce a lesser degree of disease, but are even employed to remove such as are brought on from a slighter cause. We see this opinion strongly confirmed in ulcers, attended with much local or constitutional irritation. The most emollient applications in such cases, if they do not increase the sufferings of the patient, bring no relief; whilst strong stimulating ones, such as a solution of lunar caustic, or diluted nitrous acid, seldom fail to diminish the pain and promote the cure of the disease *.

In toothach, the irritation produced by the external air on the exposed nervous surface excites much pain and even symptomatic fever; but the application of caustic or acid destroys these sensations.

The same we will find to take place when we consider the nature and the mode of treating strictures of the urethra; and if we can prove that strictures have all that variety of character which an ulcer or many other diseases have, we will be better able to judge of the comparative merit of the different modes of treatment, and be able in some degree to account for their mode of action.

* See *Home's Observations on Strictures.*

Strictures.

Of the Bougie.

78 When ſurgeons attributed all the beneficial effects of bougies to their mechanical qualities, the principal deſideratum was to have them ſufficiently pliable to take the curvature of the urethra, firm and elaſtic to make reſiſtance, and mild ſo as to produce no irritation. But however ſimple ſuch inſtruments might be in their compoſition, yet it will appear probable that their ultimate effect is not the ſame as that which a wedge produces on inanimate matter. That bougies cannot act by their mechanical powers in removing ſpaſmodic ſtricture, appears from thoſe caſes where the mere introduction of the inſtrument into the urethra, and its contact with the obſtruction, removes at once all ſpaſm.

The ſame thing is obſerved in thoſe caſes of permanent ſtricture which are attended with occaſional ſpaſm. In ſuch caſes it frequently happens that a bougie finds a complete obſtruction on its firſt introduction, but after being allowed to remain for ſome time in the canal it paſſes readily without force. A remarkable caſe of this kind happened, where there was not only a ſtricture in the urethra, but fiſtulous openings in the perinæum and ſcrotum, through which moſt of the urine was diſcharged. After much trouble, a very ſmall-ſized elaſtic catheter was paſſed into the bladder, and as it gave no pain it was allowed conſtantly to remain. For the firſt five days the urine flowed through the inſtrument, but afterwards it began to paſs along its ſides; and gradually as the urethra dilated, larger inſtruments were introduced with ſimilar good effect.

The ſilver ſtiles uſed by Mr Ware ſeem to act, in removing obſtructions of the lacrymal paſſages in fiſtula lacrymalis, on the ſame principle as the catheter appears to have done in the above example. The ſtile when firſt introduced, fills up completely the lacrymal duct; but in a ſhort time the tears begin to flow along the ſides, and paſs into the cavity of the noſe. In theſe examples it is difficult to explain the action of bougies on mere mechanical principles; it ſeems much more probable that they produce their good effects, either by a change of action of the living body, or by ſome alteration in the ſtructure of the diſeaſed parts. Says Hunter, "Preſſure produces action of the animal powers, either to adapt the parts to their new poſition or to recede by ulceration."

79 Mode of introducing the bougie.

When ſpeaking of the ſymptoms of ſtricture, it was obſerved, that in order to determine with certainty their preſence, it was neceſſary to introduce a bougie. To do this, either with a view of aſcertaining the ſtate of the urethra, or in order to remove a ſtricture, a good deal of caution and nicety is required; for as the urethra is generally tender, painful, and eaſily thrown into ſpaſmodic action, any aukwardneſs might entirely prevent the poſſibility of aſcertaining the nature of the complaint, or of affording the means of relief.

When, therefore, the operation is to be performed, in order to diſcover the kind of obſtruction, bougies ought to be provided of different ſizes, of a ſoft conſiſtence, and of a cylindrical form *. One of the ſize of a common gooſe quill, or even larger, generally paſſes eaſily, and is leſs apt to meet with obſtructions before it comes to the ſtricture, than one of leſs diameter. Being of a ſoft conſiſtence, it readily takes an impreſſion of the ſtricture, and its blunt point prevents its being entangled by any accidental irregularity.

* See Plate DXIV. fig. 2.

Strictures.

As it ought always to be rubbed over with oil before being uſed, it generally paſſes with little more force than its own weight, till it comes to the contracted part, where it ſtops. After changing with much caution the direction of the point, by elevating or depreſſing the other extremity of the bougie, and perhaps bringing it a little backwards and then forwards, ſo as to be ſatisfied of the ſituation of the ſtricture, the inſtrument may be allowed to remain in cloſe contact with it for a few ſeconds and receive its impreſſion, ſo that when it is withdrawn, a preciſe knowledge is obtained of its ſituation and form.

Some patients are often ſo irritable, that any foreign body touching the urethra excites much irritation and pain. In ſuch caſes it is the more neceſſary not to employ the ſmalleſt force, and to uſe an application of opium, or ſuch medicine, to the perinæum, to prevent theſe inconveniences as far as poſſible.

When the ſtricture lies near the extremity of the urethra next the bladder, the point of the bougie ought always to be conſiderably bent previous to its introduction, ſo that it may readily accommodate itſelf to the curve of the urethra; for as a large inſtrument does not bend eaſily, it is apt to preſs on one of the ſide of the canal, and give riſe to the ſuſpicion of a ſtricture.

It is alſo of conſiderable importance that the point of the inſtrument be not conical *. When once we are well acquainted with the ſtate of the parts, ſuch formed inſtruments may be uſed with much advantage, as the ſmall point enters the ſtricture, and by puſhing the bougie forward it is dilated by the baſe of the cone.

* See Plate DXIV. fig. 2.

It may be alſo here remarked, that in ſome inſtances a catheter can be eaſily introduced when no bougie can be made to paſs; we ought therefore to make uſe of that inſtrument before finally deciding on the nature of the obſtruction (D).

When a ſtricture is diſcovered, and when bougies are to be uſed with a view of curing it, the firſt thing we are to attempt is to paſs one through it. As the bougie we employ is moſt frequently of a very ſmall ſize, we muſt attend particularly to the irregularities in the canal which may entangle the point of ſuch a ſmall inſtrument and the occaſional bendings it may make, while it is ſuppoſed it is paſſing forwards towards the bladder. As the mouth of the lacunæ are chiefly ſituated on the ſuperior part of the canal, the point of the bougie ought to glide along its inferior ſurface to avoid them.

The bending of the bougie is only to be prevented by a forbearance in uſing force, and in directing properly the point; but as the common bougies are apt to do this, it is often extremely uſeful to have catgut ones for this purpoſe; and it is neceſſary to have them very ſmall.

In order to overcome the obſtruction when the bougie reaches it, the ſituation of the point ought to be changed by ſhifting it backwards and forwards, and from

(D) The ſilver balls repreſented in Plate DXIV. fig. 4. have alſo been found uſeful in aſcertaining the nature of ſtrictures by Mr Charles Bell.

Strictures. from side to side, and even employing a little pressure, till it passes forwards, provided the surgeon has a clear and distinct idea of the direction of the urethra.

As the introduction of the bougie almost always brings on spasm to a greater or less degree on the first attempt, it is often necessary to persevere some time before it can be made to pass the stricture; and we must continue in our endeavours a long time before we declare it impracticable.

Blisters on the perinæum or loins, fomentations of warm water and spirits, turpentine glysters, dipping the feet or glans in cold water, anodyne applications, and the internal use of camphor, opium, or tincture of iron, all assist in alleviating the spasmodic symptoms when they occur, and may be selected for use according to the judgement of the surgeon.

Attention ought to be paid to the composition of the bougie; for those made of elastic metal, catgut, or elastic gum, often give pain, while those made of soft plaster are mild and harmless.

The time which a bougie ought to remain in the urethra, must depend greatly on the peculiarities of the case, for there are no diseases which appear under more various forms than stricture. In most cases bougies can be introduced with little pain, and can remain for some minutes without inconvenience; but there are others where the introduction not only produces general irritation, but the pain is so violent, as hardly to allow them to enter the canal, and sometimes they give rise to constitutional symptoms. In the first case, from the little pain the patient suffers, their use has been abused, and they have been allowed to remain not only when asleep, but they have been worn during the patient's daily employments.

It is found, however, that bougies have a more powerful effect when retained for a short time, and often repeated, than when they are longer continued, but seldomer used; so that in no case, however little pain they may produce, ought they to be allowed to remain for a long time. Many indeed think that all their good effects are obtained after they have remained twenty or fifteen minutes, while others allow them to remain for one or more hours.

In cases of stricture accompanied with much irritation, whatever pain the bougie may bring on, it ought not to be thrown aside, but it should be introduced repeatedly whenever there is the least abatement of the symptoms. This practice should be continued for weeks before we despair of success, as afterwards the pain, from daily habit, will be diminished, and the patient will be gradually more and more able to bear it. Whilst we continue the use of the bougie, it ought gradually to be increased in size as the stricture gives way, and be introduced once or perhaps twice a-day till the obstruction is no longer felt, and till the urine flows in a full, even, and natural stream.

When this happens we are not to consider the cure as altogether complete; for it is very generally found, that if the use of the bougie is at this time given up, the parts soon begin to contract again, as they have still a disposition to return to their former situation, and the disease in a short time is completely renewed. It will therefore be proper to continue using them at distant intervals, some time after the cure appears complete, and give them up in a very slow and gradual manner. Strictures.

It may be here mentioned, that it is not necessary to retain the point of the bougie in the cavity of the bladder, but merely to allow it to pass the stricture.

Of the Caustic.

In speaking of the use of bougies, we have supposed that it has been practicable to pass one through the stricture; but it is well known, that cases do often occur, where, from the tortuous form the canal has assumed, the smallest bougie is prevented from entering the bladder.

In such cases, pressure was employed on the diseased parts, in order to produce ulceration to destroy the obstruction; but as this mode was found in many cases to be followed with violent inflammation, and attended with great pain, it was not often performed.

Laying open the sinuses, and dissecting out the diseased parts, was also a painful and no less difficult operation, so that no easy mode was ever adopted till Wiseman employed lunar caustic.

From the delicate structure of the urinary canal, it was not without much caution, and in very urgent cases, that this remedy was first employed; but since its action was found not to be so violent, it has been freely used by many surgeons, and its application not confined to the more advanced stages of the complaint.

From the time of Wiseman to that of Mr J. Hunter, we find little worthy of remark in surgical writers regarding the use of caustic. The latter of these authors, however, again introduced it into practice, and applied it to all those cases where he could either do no good with bougies, or when he could not pass them through the stricture. In his first trials he met with success; and as he soon improved the mode of its application, he was able to employ it with considerable advantage.

Mr Hunter's mode of applying caustic was first adopted by Wiseman; but as the silver canula which he employed, not only gave much pain, but could not be introduced as far down the urethra as a common bougie in many instances, and as the caustic could not be applied directly to the centre of the obstruction, a new mode was invented. A piece of caustic was fixed in the extremity of a common bougie, and covered with the plaster except at the extremity, where a part was exposed, but so small as merely to form the apex of the conical point of the bougie. In this manner it is found possible to apply it to almost all cases, and when in dexterous hands, may be used with considerable safety. When it is to be applied to a stricture, it is necessary that some previous knowledge of the case has been obtained from the introduction of a soft bougie. When this has been done, the armed bougie must be introduced rather quickly, but steadily, till it meets the stricture, which we know both from the feel, and from the situation previously determined. When brought into contact with the stricture, it is perhaps better merely to touch it with the caustic the two or three first applications, and afterwards it may be retained longer. When the bougie is to be withdrawn, it ought to be done cautiously; for as it has become soft, and the caustic not so firmly fixed in it, it may fall out, and be left behind in the urethra. Although this

Strictures. this mode has advantages over the silver canula formerly employed, yet there is a way which we think may be attended with considerable superiority, as it not only requires less dexterity on the part of the surgeon, but is less apt to do mischief.

It is evident, that when the armed bougie is passed to a stricture, it will unavoidably touch several parts of the side of the canal in its passage; and as often its introduction brings on a spasm, which lasts some seconds, or even minutes, a considerable portion of caustic may be dissolved on the sound membrane.

The frequency of the application of the caustic must be determined by the particular circumstances of the case. It should never be repeated till after the effects of the first application have ceased; in general, every second day will be found to be enough, but in some instances it may be applied daily.

After the use of the caustic, the patient ought to be kept quiet; he should not make any exertions to empty the bladder, nor take any violent exercise. In general the pain from the caustic lasts but a few minutes; and the day following, when the slough separates, a rawness is felt on making water.

81 Bad effects of caustic. The application of caustic to the urethra is, however, often followed by a train of very alarming symptoms; instead of a mere burning heat in the parts, the patient is seized with violent pain, followed by retention of urine, swelling of the testicles and perinæum, hæmorrhagy, and sometimes, a complete febrile paroxysm.

From the sympathy that exists betwixt the urethra and testicles, it is not unfrequent to find diseases of the former produce morbid affections of the latter.

Stone of the bladder and the use of common bougies often bring on swelling on one or both of the testicles; and in one case the irritation of a bougie brought on an inflammation, which terminated in a hydrocele of the vaginal coat. It is a frequent effect of caustic, but soon disappears when its use is given up.

82 Strangury. Strangury has often followed the application of caustic after any imprudence on the part of the patient; and it generally happens in those cases where it has been applied near the bladder. This may happen not only from the great susceptibility this part of the canal has to contract; but it may arise from the bougie passing a part of the urethra where caustic had been formerly applied, and which remained still tender. This retention of urine in general does not continue long, and in most cases it is relieved by the introduction of a bougie, or the application of a blister.

83 Hæmorrhagy. When caustic has not only destroyed the stricture, but its action extended to the sound parts, blood is often poured out into the canal, or is effused into the cellular texture of the penis. The hæmorrhage is sometimes very profuse, and seems to proceed from an erosion of the spongy bodies; but as it has, in every case hitherto published, ceased of itself, no particular means have been found necessary to stop it. Keeping the parts cool, and giving cold acid drinks, quietness, and caution against all causes of irritation, should be attended to. The tumor composed of effused blood generally gives little inconvenience, and like an ecchimosis on any other part, it may be removed by the topical application of stimulants.

By far the most serious and most alarming symptom which arises from the use of caustic is an ague or febrile fit. It begins with a severe cold stage, which continues from fifteen minutes to an hour. This is followed by another fit, which lasts sometimes several hours, and is succeeded by a very profuse perspiration, which is much greater than what happens in common ague. These paroxysms do not return at the same periods, and seldom occur more than two or three times. When repeated, they become more and more severe, and every future application of the caustic brings on one six or twelve minutes after. Patients attacked in this manner become extremely debilitated; and three instances have come under our immediate knowledge where it proved fatal. When such a symptom occurs, the caustic ought to be immediately laid aside, emollients applied to the urethra, and the patient supported by cordials. Strictures. 84 Febrile fit.

85 Falling out of the caustic. The caustic too has been sometimes known to fall out of the bougie, and dissolve in the urethra. When such an accident happens, if it be not immediately removed, it may produce a slough of almost the whole extent of the canal, and bring on very alarming symptoms.

86 Mode of applying the caustic. In place, therefore, of fixing a large piece of caustic in the bougie, take such a quantity as is intended to be dissolved on the stricture; reduce it into a fine powder, and stick it on the point of the bougie, by pressing them on one another. When this is done, it may be dipped in warm wax, and receive a thin covering of it.

A bougie prepared in this manner may be introduced down to the stricture without any risk of injuring the sound membrane; for as the thin layer of wax which covers the caustic, prevents it being immediately dissolved, it is not till it has been kept some time in contact with the stricture that it begins to act. By following this plan we not only avoid injuring the internal membrane, but we dissolve no more of the caustic on the diseased parts than what is wished for, and there is no risk from a portion of caustic being left behind.

There are, however, cases where a soft bougie cannot be so easily introduced as a metallic instrument: in them, a silver catheter, or one made of Smith's elastic metal, may be used with much advantage.

Instead of the holes being made at the sides of the instrument, it ought to be perforated at the extremity, and this hole filled with caustic, and fixed in that situation with adhesive plaster. Or, what answers equally well, the catheter may be introduced down to the obstruction, and an armed bougie passed through it.

Comparative advantages of the Bougie and Caustic. 87

Thus far we have mentioned the manner in which the bougie or caustic are to be employed; we now come to consider the peculiar merits of those two modes of practice, and to point out those cases where the one is to be employed in preference to the other.

Notwithstanding the zealous advocates which have lately introduced caustic as a general remedy for strictures, we have no hesitation in declaring it as our opinion, that the simple bougie is the instrument to be preferred in the generality of cases of this disease, and that in all cases where the cure can be accomplished by its means, it should be adopted. Caustic, however, is a remedy by no means less beneficial, though its use ought to be much more circumscribed; for we certainly believe that

that by its proper application many of the worſt caſes of ſtricture, caſes indeed which are quite incurable by the bougie, may be benefited by its application.

In thoſe caſes of ſpaſmodic ſtricture where the common bougie either cannot paſs the ſtrictured part, or where it has no effect in relieving the ſymptoms, cauſtic may be uſed with advantage.

It may be alſo employed whenever the ſtricture is attended with much pain and irritation or conſtitutional ſymptoms; and in caſes where the contraction of the urethra is ſuch, as entirely to cloſe up the canal, and the urine to come through fiſtulous openings in the ſcrotum and perinæum, the uſe of cauſtic is attended with the beſt effects. We have met with caſes, where during a ſucceſſion of years, urine has drilled through fiſtulous openings in the ſcrotum, in which ſix, eight, or ten applications of the cauſtic bougie have opened a free paſſage into the bladder, and allowed all the fiſtulas to heal up.

From the rapidity of the cures performed by cauſtic in compariſon to thoſe of the bougie, the former a few years ago came into very general uſe, and was tried by different ſurgeons all over this iſland in every poſſible variety of the diſeaſe. In this extenſive field of experiment the merits of cauſtic have been fairly balanced, and its exaggerated good effects have fallen into diſrepute, whilſt the calumnious reports of its fatal and dreadful conſequences in the hands of experienced men, have been ſhown to be without foundation. Thus in the midſt of medical rancour and diſpute, cautious and intelligent men have become acquainted with the good qualities of a moſt active application; and an unprejudiced mind has laid open before it a vaſt field of obſervation on a diſeaſe which deeply intereſts a conſiderable number of men.

83 SECT. II. *Of Strictures in the Oeſophagus.*

The mucous membrane lining the œſophagus, like that of the urethra, is liable to become contracted, forming a ſtricture. Theſe contractions may be formed at any part of the canal; but it is obſerved that there is one ſpot more liable than any other to become affected with it. The part alluded to is immediately behind the cricoid cartilages of the larynx, where the fauces may be ſaid to terminate, and the œſophagus begin. The diſeaſe appears, on diſſection, to conſiſt of a tranſverſe fold of the internal membrane of the œſophagus, filling up in different degrees the aperture of the canal.

This part of the œſophagus is alſo liable to two other diſeaſes, whoſe ſymptoms are nearly alike, and therefore may be miſtaken for ſtricture. One of theſe is a thickening of the coats of the œſophagus, which extends to the ſurrounding parts, and in the end moſt commonly degenerates into cancer. The other is an ulcer of the lining of the œſophagus, which is commonly ſituated a little below the ordinary place of ſtricture, and upon the poſterior or vertebral portion of the canal. Both of theſe complaints produce a difficulty in deglutition, and in their early ſtages are only to be diſtinguiſhed from ſtricture, by an examination with a bougie. Stricture appears to be a diſeaſe more frequent in the early periods of life; while the two other diſeaſes are more commonly met with at an advanced age.

With a view to aſcertain the true nature of the diſeaſe, it is always neceſſary to introduce a bougie. The beſt mode of doing this, is that recommended by Mr Everard Home. The patient is deſired to puſh the tongue as far as poſſible out of the mouth, thus bringing the orifice of the ſtricture as nearly as poſſible in a line with the middle of the pharynx. The bougie being oiled or covered with mucilage, is then to be thruſt down into the œſophagus. When the bougie paſſes down to the diſtance of eight inches, meaſuring from the cutting edge of the front teeth in the upper jaw, the ſurgeon may be ſatisfied that it has gone beyond the uſual ſeat of ſtricture; and if it is brought back without any reſiſtance, he may conclude that the aperture of the œſophagus conſiderably exceeds the ſize of the bougie which has been uſed. But if the bougie ſtops at ſix inches or even lower, he is to retain it there with a uniform ſteady preſſure for half a minute, ſo as to receive on its point an impreſſion on the ſurface to which it was oppoſed. If the end of the bougie retains its natural form, or nearly ſo, and there is an indentation like the mark of a cord on its ſide, whether all round or only partially, he may decide that the diſeaſe is a ſtricture. But if, on the other hand, the bougie paſſes without any difficulty to the diſtance of ſeven inches and a half, and when brought back the point has an irregular jagged ſurface, it is equally clear that the diſeaſe is an ulcer on the poſterior ſurface of the œſophagus.

When ſtrictures of the œſophagus have been of long continuance, ulceration takes place on the ſide of the ſtricture next the ſtomach. When ſuch ulceration takes place, the character of the original diſeaſe is loſt; and when the ulceration extends upwards, the ſtricture itſelf is deſtroyed. A bougie paſſed under ſuch circumſtances, will, in general, have its point entangled in the ulcer; and when ſo ſkilfully directed as to go down into the œſophagus, it will meet with a difficulty while it is paſſing from the ſound œſophagus to the ulcer, and again when it leaves the ulcer and reenters the ſound canal below; and in its return there will alſo be two parts at which a reſiſtance is felt. This may miſlead the moſt accurate obſerver, and create a belief that there are two ſtrictures, whereas in fact there is none but an ulcer of ſome extent, and a power of contraction in the upper and lower extremities of the œſophagus where they terminate in the ulcer.

Treatment.—The treatment of ſtricture in the œſophagus is to be conducted on the ſame general principles as ſtricture in the urethra. 84

Bougies which are made much longer and of larger dimenſions than thoſe for the urethra, may be uſed with the greateſt ſafety. At firſt, indeed, they ſometimes create a good deal of irritation and a febrile attack; and in ſuch caſes they muſt be employed with the greateſt caution. Once in twenty-four or forty-eight hours, according to the nature of the caſe, will be ſufficiently often to introduce them; and they may be diſcontinued in proportion to the alleviation of the ſymptoms. The uſe of cauſtic in this ſpecies of ſtricture has alſo been not only propoſed, but adopted; a practice which is more a proof of the boldneſs of its inventor than of his prudence *. It is not to be denied, that ſome deſperate caſes of the diſeaſe may occur, where every remedy proves uſeleſs, and that in theſe, the cauſtic bougie,

* *Home on Strictures.*

Strictures.

bougie, introduced and applied to the ſtricture with much dexterity, may be beneficial. But theſe caſes are ſo rare, and there are ſo few able to uſe this active remedy properly, that we cannot help thinking it can never be very generally introduced into practice.

90 SECT. III. *Stricture of the Rectum.*

As far as we know, there is no author who has given any accurate account of the various morbid appearances of the extremity of the rectum. Under the general name of *hæmorrhoids*, a variety of tumors very different from one another have been claſſed; whilſt under the name of *ſchirrus*, have been conſidered all caſes where the diameter of the lower part of the inteſtinal canal has been diminiſhed. In a practical point of view, theſe obſervations are of the greateſt importance, as they lead the ſurgeon to diſcriminate between thoſe caſes which are likely to be aided by the uſe of medicines, and thoſe which are beyond the reach of art, or which the ſame mode of treatment might tend more to aggravate than to alleviate.

In many caſes of the true ſcirrhus, or cancerous affection of the inteſtine, the diſeaſe firſt appears by the formation of one or more griſtly tumors on the internal ſurface of the canal; and theſe by increaſing in number and in ſize, and by involving the adjacent parts, contract the canal, and at laſt ulcerate, forming true cancerous ſores. But there is another claſs of caſes, in which the diameter of the inteſtines becomes narrowed by a thickening of its coats, and which, were we to reaſon from analogy, might be compared to that thickening which forms ſtricture in the other mucous ſurfaces, as in the œſophagus and urethra. It is the ame caſes that we ſuſpect Deſſault treated with ſo much ſucceſs by the uſe of bougies*; and from the good effects of this mode of treatment in caſes of ſtricture in other parts of the body, it is reaſonable to expect benefit from their uſe in ſtrictures of the rectum. Deſſault, however, wiſhes it to be underſtood that the practice is to be employed in the true ſchirrus; but the two caſes which are given in detail by Bichât in his edition of Deſſault's works, in illuſtration of the practice in ſchirrus, are by no means concluſive. The firſt is a caſe of tumors of the internal membrane, which were much alleviated by the compreſſion of a bougie; whilſt the ſecond was a caſe which ſhows the relief to be obtained by the uſe of bougies in caſes of ſchirrous contraction in the diſcharge of the fæces, but by no means in the cure of the diſeaſe.

* *Oeuvres Chirurgicales.*

In caſes, therefore, of contraction of the rectum which are not of a ſcirrhous nature, beſides the ſtrict attention to keep the bowels regular, and render the fæces as liquid as poſſible by the uſe of laxatives and emolient injections, bougies made of a proper ſize may be uſed with relief; and, as we have mentioned in another place, the practice is alſo highly ſerviceable in ſome caſes of tumors which grow from this part of the inteſtine.

91 SECT. IV. *Of Polypi.*

When the mucous membrane of any part of the body becomes elevated above its natural level, ſo as to form a circumſcribed ſwelling, the diſeaſe is called a *polypus*.

Of Polypi.

Polypi have been found on all the different mucous ſurfaces; in the noſe, frontal and maxillary ſinuſes, pharynx, gullet, mouth and gums, meatus externus, conjunctiva, ſtomach, inteſtines, rectum, uterus, vagina, bladder, and urethra.

There are four different kinds of polypi, varying from each other in their ſtructure. 1ſt, The *mucous;* 2d, the *fleſhy*, 3d, the *carcinomatous;* and 4th, the *encyſted* polypi.

The *mucous* polypi have a ſlippery ſurface, and are conſtantly covered with a quantity of mucus. They are of a greyiſh or dull white colour, and have a demi-tranſparent appearance, reſembling, particularly at their extremities, a piece of ſoftened glue. They are eaſily torn and bleed freely; they are neither painful nor ſenſible to the touch; they ſuffer remarkable alterations from changes in the ſtate of the atmoſphere, extending prodigiouſly in cold and moiſt, and contracting in a dry and warm air. They are of an irregular and angular ſhape, and often ſeem to take the particular form of the cavity in which they grow. They are commonly attached by a narrow neck, and are quite moveable.

The *fleſhy* or carcinomatous polypi are of a bright red colour, their ſurface is ſmooth and regular. They are of a rounded form, and are attached by a narrow neck. They are firmer and are not ſo eaſily torn, nor do they bleed ſo readily as thoſe of the mucous kind.

The *carcinomatous* polypi are of a darker red or more purple colour than thoſe of the fleſhy kind, and ſometimes they are of a livid hue. They are ſupplied by a great number of blood-veſſels, which makes them bleed profuſely even when ſlightly injured, or gives them a diſpoſition to bleed of themſelves. They are of a very hard firm ſtructure; ſome of them are as hard as cartilage. They are more or leſs painful, and are very ſenſible to the touch. Sometimes the pain is of that ſtinging lancinating kind which carcinomatous tumors have in other parts of the body. Their ſurface ſometimes ulcerates, and the ulcer aſſumes all the characters of a cancerous ſore. They are commonly attached by a firm broad baſis.

The *encyſted* polypi occur leaſt frequently. Richter ſays that they reſemble a reticular ſac, which contains fluid ſometimes reſembling mucus; at other times it is of a thick conſiſtence. In one caſe we found the mucous membrane covering the ſuperior ſpongy bones extended, but not much thickened; and between its folds there were ſeveral round ſemitranſparent veſicles, containing a thick glairy fluid.

SECT. V. *Of Polypi of the Noſe.* 92

All the four different kinds of polypi have been found growing from the mucous membrane lining the cavity of the noſe; we have alſo ſeen the ſuperior ſpongy bone ſo increaſed in bulk, as to form a tumor reſembling the fleſhy polypus.

The firſt ſymptom of a polypus in the noſe is a preternatural degree of redneſs of its mucous ſurface. It becomes ſpongy and callous, and there is an increaſed ſecretion of mucus. The patient has ſome interruption in breathing, and the voice is rendered more or leſs indiſtinct; he feels as if ſtifled, and he tries to get quit

Of Polypi.

of ſomething which incommodes him by blowing his noſe, for the ſame reaſon as a perſon does who labours under a common catarrh; the ſenſe of ſmell becomes impaired, and all theſe ſymptoms are more troubleſome in wet than in dry weather.

The ſymptoms increaſe till the extenſion of the mucous membrane increaſes to ſuch a degree, as to form a diſtinct circumſcribed tumor; and the progreſs of the complaint is generally ſo ſlow, that its nature is frequently not ſuſpected till it gets this length.

By degrees the breathing through the noſe and the ſenſe of ſmell are entirely deſtroyed from the mechanical obſtruction of the tumor; and the patient himſelf finds, that by a violent expiration or inſpiration, the tumor can be puſhed forward or backward in the noſe.

The preſſure which a *polypus* ſometimes makes on the naſal duct prevents the tears from flowing freely into the noſe, and is the cauſe of a watery eye.

When the tumor is large, the ſeptum of the noſe is frequently preſſed on, and puſhed to the oppoſite ſide, and then the reſpiration is oppreſſed in both noſtrils. Sometimes the tumor deſcends, and part of it projects through the noſtril; when this takes place, the ſurface of the part expoſed to the air becomes like common ſkin. This indeed happens when any mucous ſurface is expoſed. We have obſerved it in the vagina when it was inverted, and in the eyelid when the palpebral membrane was turned outwards, from a tumor, or any other cauſe.

Morgagni takes particular notice that the natural poſition of the ſeptum is apt to be miſtaken for diſeaſe, as it very frequently divides the naſal cavity into two unequal portions.

More frequently polypi extend backward into the pharynx, and can be felt by introducing the finger behind the velum pendulum palati. In one rare inſtance, we have known a polypus ſo large, as to deſcend along the œſophagus into the ſtomach, and in another to fill up the whole cavity of the mouth, and produce ſuffocation.

It happens alſo that polypi growing from an extenſive baſe, ſeparate, diſplace, and produce an abſorption of the bones which ſurround them. The bones of the noſe are puſhed upward; the maxillary bones and the palate bones are diſjoined, and carried outward; the arch of the palate depreſſed; the inferior margins of the orbits are preſſed upward, and puſh the eyes out of their orbits.

Polypi are found to ariſe from every part of the naſal cavity; but moſt frequently from the inferior ſpongy bones. Many ſurgeons have conceived that polypi aroſe from general diſeaſes of the conſtitution, as ſcrofula, ſyphilis, &c.; but it will in general be found to be a mere local diſeaſe, and probably to ariſe from whatever tends to produce a continued or repeated attack of inflammation in the part.

93 *Treatment.*—If polypi are attached to the upper ſpongy bones, their removal will be more dangerous, as the inflammation excited by an operation will be readily conveyed to the brain. When they are attached to the inferior ſpongy bones, they can be removed with perfect ſafety.

The moſt celebrated ſurgeons have never adviſed any operation when the tumor is ſmall and gives no diſtreſs; but whenever it becomes of ſuch a ſize as to fill up the cavity of the noſtril, diſturb reſpiration, and aſſume a malign aſpect, it ought to be removed. Of Polypi.

As long as polypi continue ſmall, or when the mucous membrane acquires that appearance which indicates the commencement of the diſeaſe, tonic and aſtringent remedies are generally recommended, as decoction of oak bark, with alum; ſtrong ſolutions of white vitriol, ſaccharum ſaturni, or muriate of mercury, ardent ſpirits, and vinegar. Either of theſe ſolutions, which may be ſelected, ought to be thrown up a little warm into the naſal cavity with a ſyringe, retained there half a minute or more, and repeated four or five times daily; or a piece of charpee wet with them may be put into the noſe with a probe, and applied to the diſeaſed ſurface. Kino, galls, white vitriol, &c. ſabine in the form of powder, ſnuffed up into the noſe, as ſtrong as the patient can ſuffer it, are alſo uſeful in ſtopping the progreſs of the diſeaſe. Mercury has been found rather to make them worſe; cauſtic and other corroding applications have been of uſe in the ſofter kind, though they have never produced a cure. Bougies have been recommended by Mr B. Bell, and are ſaid to have been uſeful; and when the polypus is ſmall, they may act on the ſame principle as bougies do on tumors of the rectum, a practice ſo ſucceſsful in the hands of Deſſault.

Polypi may be removed either by tying a ligature round their neck, by tearing or twiſting them, or by cutting them out with a knife or ſciſſars.

Operation.—Profeſſor Richter of Gottingen, and ſeveral eminent practitioners of this country, uſe, in general, the forceps; and in thoſe caſes where the polypus is attached to the inferior ſpongy bones, or to any of the inferior parts of the naſal cavity, this mode of operation is much more eaſily performed, and has the beſt chance of ſucceſs. 94

From the ſoft ſpongy texture of the ſuperior ſpongy bones, and ethmoid bone, with which they are connected, there is a conſiderable riſk of tearing and injuring more parts than is neceſſary for the removal of the polypus; and, as any inflammation excited on theſe may ſpread to the membranes of the brain, it is more adviſeable to remove polypi attached to theſe parts by the ligature.

When polypi are completely within the reach of the knife, adhering towards the external opening of the noſtrils, they may be eaſily cut away.

In performing any operation, or even making an examination of the ſtate of the noſe, it is of conſiderable importance to attend to the poſition of the forehead, and to employ a proper light.

The head ſhould be bent backwards; and in order to enlarge the external noſtril, an aſſiſtant, on whoſe breaſt the head of the patient reſts, ought, with the fore-finger of his right hand, to preſs upward the point of the noſe; whilſt, with a probe in his left, he ſpreads out the alæ.

Of removing Polypi with the Forceps.—Forceps for this purpoſe ought to be ſix inches or ſix inches and a half long, and the axis at two-thirds of their length diſtant from the extremity of the handle; ſo that the operator may have the advantage of a long lever. See Fig. 1. Plate DXV. 95 Plate DXV. fig. 1.

The points of them ought to be blunt, rounded on the outſide, perforated, and a concavity, made rough, extending

Of Polypi.

extending to near the axis. The two blades ought to be separated at their union, when closed, and not to become parallel till they are opened to a considerable distance, in order that the polypus may be held very firmly. The blades should be strong, and pretty broad.

Even this form of forceps is not always sufficient; and it is useful to have a pair of such as has been recommended by Richter *. They are intended to be employed in those cases, where the polypus is so large as completely to fill the nostril, and so hard, that the upper part of the blades of the common forceps cannot sufficiently dilate to allow their extremity to pass down the nostril, and reach the bottom or neck of the tumor.

* See Plate DXV. fig. 2.

It is of great importance to fix the forceps as near the root of the polypus as possible; for, when that is accomplished, the whole mass may be at once removed: and the hæmorrhagy is never so great as if the polypus was torn through the middle.

Often, however, it happens, that the polypus is so large as to distend the nostrils in such a manner, that it is impossible to discover the root till the extremity is removed. We must, in such a case, remove as much as we are able, and even although the bleeding is profuse, persevere in the operation as long as we can pull any away with safety.

When the operation is to be performed, the patient ought, by his own efforts, to push the body as far forwards as possible; then the surgeon, with a pair of small forceps in his left hand, seizes the point of the polypus, and having kept fast hold of it, he cautiously introduces the polypus forceps on the outside of the others. The more time that is bestowed on this step of the operation, the more the polypus becomes elongated and thinner, the more room is given for the forceps, and therefore the higher up can the polypus be grasped. After it is completely secured between the blades of the forceps, it is to be twisted slowly round, and at the same time pulled outwards. If only a portion of the polypus is removed, what remains is to be extracted in the same manner. The hæmorrhagy is generally profuse, but seldom requires the assistance of art to stop it.

96 *Of Removing Polypi by the Ligature.*—The ligatures consist of wire, catgut, silk or cord; and different methods have been employed for passing them round the root of the polypus. In order to remove a polypus, the anterior part of which is situated in one of the nostrils, a ligature (*a*) † is to be introduced through a double canula (*b*), and one end fixed round the ring (*c*); whilst the other end (*d*) being loose, allows the noose at *a*, to be increased or diminished, according to the size of the polypus. The polypus is to be grasped by a pair of forceps put through the noose, and drawn forwards. The ligature is then to be carried to the root of the polypus, either by means of the forked probe (fig. 4.), or by one of the porte-nœuds (fig. 5.), taking care to tighten the wire gradually, the further the instrument is introduced. When the noose reaches the root of the polypus, the ligature is to be firmly drawn, and secured by being twisted round the ring of the canula. If the polypus hang down behind the velum pendulum palati, the doubled wire is to be slowly insinuated through the nostril into the throat. The finger of the surgeon is to be introduced into the mouth, and by opening its doubling the noose passed over the extremity of the polypus, and conducted to its root, by gradually tightening the ligature, and then it is to be firmly fixed. The ligature should be tightened once or twice a-day, until the tumor entirely separates. As there is generally a considerable degree of swelling and inflammation of the tumor before this takes place, if it be so situated as to disturb respiration, it may even be necessary to perform bronchotomy as a preliminary step. Should any part of the polypus remain, it may be destroyed by caustic, or the actual cautery, if practicable.

† Plate DXV. fig. 3

Of Polypi.

Besides this, which is the common and most simple mode of applying the ligatures, there are others which are well adapted for particular cases. The apparatus employed by Deffault is extremely ingenious and well-suited for its purpose, but is more particularly useful in polypi of the vagina and uterus.

97 Deffault's apparatus.

When this apparatus is to be used, two porte-nœuds (*a a*) ought to be procured, and having pushed the cylinder over the branches of the stalk, so as to shut the rings (*d*) completely, a ligature of waxed thread, catgut, or silver wire, is to be passed through them (*k*), and the extremities may be either held along with the canula or secured at *e* *.

* See Plate DXV. fig. 5.

The two canulas, thus armed, are introduced parallel to one another between the tumor and parietes of the cavity in which it lies; and when they reach its base, one is held firm, and the other carried round the base, crossed over the other, forming a noose round it.

The ligature being pulled tight by an assistant, the two ends are to be put through the hole (*g*) of the other canula, and fixed to the axis at *h*.

The extremity (*g*) is then to be slipt along the ligature close to the polypus; and the ligature being firmly fixed to the other extremity, the two porte-nœuds may be at once removed, by allowing the ring to divide and the ligature to escape.

This being done, nothing remains to complete the operation. The ligature is kept round the polypus till it drops off, and as the parts begin to give way, it ought to be retained always perfectly tight; and this may be easily accomplished by turning the screw at *h*.

The apparatus, too, (fig. 6. Plate DXV.) may also be sometimes useful, from the flexibility of the canula, which conveys and directs the ligature.

2. *Of the Polypus of the Rectum.*

98

Polypi of the rectum differ considerably from the common *hæmorrhoidal* tumor, in their symptoms and appearances. They resemble the fleshy polypi in other parts of the body, in their colour and external form, and they are also sometimes ulcerated on the surface. On cutting through a large tumor of this kind, we found it composed of a vast number of cells, some of them very large, and all of them filled with blood. Their progress is slow, and we have seen them grow as big as a large walnut. They do not alter their size at different times, as is observed in the hæmorrhoidal tumor, except that they are apt to swell, when allowed to remain long external to the anus. They are most commonly situated in the rectum, close to the anus; so that when the patient goes to stool they are pushed downwards,

Of Polypi. downwards, and appear externally. When very large, they are alſo apt to come through the anus by the leaſt exertion in walking. They are generally attended with more or leſs pain or uneaſineſs on going to ſtool; and when they become ſo large as to come through the anus in walking, the diſeaſe becomes very diſtreſſing. They are often accompanied with a diſcharge of mucus. Sometimes, too, hæmorrhoidal tumors are formed contiguous to the polypus; but the latter is generally pointed out by the patient as the original ſwelling, and that which gives moſt pain. Theſe tumors may alſo be readily diſtinguiſhed from one another by their difference in colour and general form.

99 *Treatment.*—Aſtringents, with opium, and bougies, may alleviate the ſymptoms; but as they ſeldom give permanent relief, the moſt complete and ſafeſt mode of cure is removing them with the knife, if they can be readily reached; if not, the ligature is preferable, although it gives much more pain; for it ſometimes happens, that a very profuſe bleeding follows after they have been cut away. The hæmorrhoidal tumors which accompany the polypus diſappear after its removal.

When they are tied with a ligature, this can be done in moſt caſes by ſimply tying a ſtrong ſilk thread firmly round the baſe of the tumor. Often the baſe is larger than the apex, and then it is neceſſary to paſs through the middle of the tumor a curved needle with two ligatures, one to tie each half of it. To prevent any miſtake, and accelerate the operation, ſurgeons make one of the ligatures of black, and the other of white thread. Whilſt the mortified part is ſeparating, great attention is neceſſary to keep the ſurrounding parts from excoriating; and this is to be done by frequently waſhing with warm water, or a ſaturnine ſolution, and anointing them with ſaturnine ointments, or the unguentum reſinoſum. Fig. 7. Plate DXV. gives an outline of tumors of this kind.

100 ### 3. *Polypi of the Gums*

Moſt frequently are connected with a carious tooth, or of the alveolar proceſſes of the jaw bone; ſometimes, however, not. They are generally of a firm fleſhy texture, rounded form, poliſhed ſurface, and are very apt to bleed; and they ſometimes grow to a very large ſize, and become malignant. They are beſt removed by the knife; and, as they bleed profuſely, it is often neceſſary to uſe the actual cautery to reſtrain it. If the bone is found carious, the diſeaſed part ſhould, if poſſible, be be removed, or means uſed to aſſiſt and promote its exfoliation; and when this has taken place the polypus often diſappears without any operation.

101 ### 4. *Polypus of the Frontal Sinus.*

This is a very rare diſeaſe, and it produces the ſame dreadful conſequences as that of the antrum. Art can perhaps venture to do little, as the cloſe connection to the brain would render any attempt to remove it dangerous.

102 ### 5. *Polypus of the Antrum Maxillare.*

The ſurgeon is ſeldom aware of the preſence of this diſeaſe until it is far advanced, and has begun to diſtend the bony cavity in which it is formed. It ſometimes acquires a prodigious bulk, ſeparating and rendering carious the bones of the face, puſhing the eyeball out of the orbit, and filling up the cavity of the mouth. If the nature of the complaint is early ſuſpected, by removing a portion of the external parietes of the antrum with a trephine, the polypus may perhaps be removed from its attachments; but if that is impracticable, ſtrong aſtringent applications, cauſtic or the actual cautery, or removing portions by the knife, may arreſt the progreſs of the diſeaſe. Of Polypi.

103 ### 6. *Polypi of the Urethra.*

Theſe are what have been called caruncles, and were ſuppoſed to be the moſt common cauſe of ſtricture. It is now, however, well known that they occur ſeldom. If their growth is not checked by the uſe of a bougie, and if they are not near the meatus urinarius, it may be neceſſary in ſome caſes to cut in upon the urethra, in order to get them extirpated; but that muſt happen rarely.

104 ### 7. *Polypi of the Bladder*

Are beyond the reach of the ſurgeon, but they occur very rarely; and the diſtreſſing ſymptoms which attend this diſeaſe, can only be alleviated by thoſe internal medicines which dilute the urine and allay the irritability of the bladder.

105 ### 8. *Polypi of the Ear.*

They ſometimes grow from the membrana tympani, but they generally ariſe from the cavity of the tympanum, after the membrana tympani has been doſtroyed by ulceration. They reſemble the common mucous polypi in ſtructure; and they are moſt frequently accompanied by a diſcharge of puriform matter and a total loſs of hearing. They may be removed with a ligature in moſt caſes very eaſily; or they may be torn out with forceps; and it is always neceſſary to touch the part to which they adhered repeatedly with cauſtic, and to uſe ſtrong aſtringent waſhes, in order to prevent their future growth.

106 ### 9. *Polypus of the Conjunctiva.*

We have never obſerved them on the conjunctiva covering the eyeball; but they are formed on the inner membrane of the eyelids, and moſt frequently on the upper one. They are ſoft pendulous maſſes, which, being looſe, float between the eyelid and ball, and ſometimes even paſs beyond the edge of the lids. They are of the red colour of the inflamed mucous membrane; but thoſe portions which are expoſed to the external atmoſphere become dry, and often drop off. They are often formed in conſequence of the membrane being inflamed by the abſceſs burſting internally. They are eaſily removed by the knife; and they are prevented from being regenerated, by ſlight ſcarifications or the application of lunar cauſtic to the baſe.

107 ### 10. *Of the Polypus of the Uterus.*

Theſe polypi are found to grow either from the fundus, the lower edge of the os uteri, or from the inſide of the cervix. The firſt is the moſt, and the ſecond the leaſt frequent. The ſhape of the uterine polypi is generally pyriform, having a very narrow neck. They are commonly of the ſarcomatous kind; though it often happens that polypi are formed in uteri affected with

Of Aphthæ.

cancer. Polypi protruding into the vagina are apt to be miſtaken for prolapſed uteri; and this miſtake is more likely to take place in ſome caſes where the polypus acquires a large bulk in the uterus, and is ſuddenly protruded into the vagina, and ſtrangulated by the os tinci. Caſes, too, of prolapſed uteri have been miſtaken for, and treated as polypi.

The ſafeſt mode of removing uterine polypi is with the ligature. When it is ſituated in the uterus, this operation is impracticable; but when it deſcends into the vagina, it may be very readily done by the apparatus of Deſſault (Plate DXV. fig. 5.).

108

Sect. VI. *Of Aphthæ.*

The formation of aphthæ, when they are examined with care in their different degrees, may probably extend our views of the intimate ſtructure of the mucous membranes. Boerhaave conſidered them as ſmall ſuperficial ulcerations, and Stahl regarded them as tubercles or puſtules. From the preſent ſtate of our knowledge it is difficult to determine whether aphthæ ariſe from the chorion of the mucous membrane, in its papillæ, or in its mucous follicles.

Aphthæ are formed on the lips, the gums, the interior of the mouth, the tongue, the palate, the amygdalæ, the œſophagus, and alſo in the ſtomach and inteſtines. They are moſt frequent in children and old people, and they have been obſerved in people who inhabit places where the air is tainted, and who live on unwholeſome food.

The aphthæ of the adult may be conſidered as a collection, more or leſs agglomerated or inſulated, of white ſuperficial rounded tubercles, each about the ſize of a millet ſeed. Theſe tubercles diſcharge a ſerous humour; the pellicle which covers the mucous membrane is detached, and is progreſſively formed in the different parts of the mouth, and even in the reſt of the alimentary canal. They are ſometimes diſſeminated in ſolitary puſtules over the tongue, the angles of the lips, or the back part of the mouth, with a benign character. At other times they are formed and ſeemingly propagated from the interior of the œſophagus; paſs the back part of the mouth, forming a white, thick, and ſtrongly adhering cruſt; and theſe are often dangerous from a complication of typhus fever.

The aphthous tubercles vary in colour. Sometimes they are tranſparent; at other times they are white, with a certain degree of thickneſs; they are alſo ſometimes of a deep yellow colour, and ſometimes they are livid or blackiſh, a ſymptom which always indicates a greater degree of danger.

Aphthæ may alſo be frequently obſerved in people who have taken many courſes of mercury. In theſe caſes, the repeated action of the mercury on the mouth appears to leave on that organ a degree of ſenſibility or weakneſs which diſpoſes it to the diſeaſe. It happens not unfrequently that theſe aphthæ are conſidered as venereal ſores, in conſequence of the venereal diſeaſe not having been properly cured; on this ſuppoſition a new mercurial courſe is employed, which only augments the diſpoſition to aphthæ, and makes the ſores ſpread more rapidly.

The aphthæ of children are preceded by a profound ſleep, by agitation of the muſcles of the face and lips, difficulty of reſpiration, proſtration of ſtrength, feebleneſs of the pulſe, and vomiting. In the mild form of the diſeaſe, white ſuperficial ſpots appear in different parts of the mouth, which are ſeparated from one another, and the interſtices are neither red nor inflamed. The bottom of the mouth has often been diſcoloured, and the heat immoderate; there is no difficulty in ſwallowing, and the child can readily ſuckle; the ſleep is natural, and there is a ſlight diarrhœa. The ſpots during the firſt days preſerve their whiteneſs and tranſparency; they afterwards become a little yellow, exfoliate in flakes, and go away entirely about the ninth or tenth day, particularly when the child has a nurſe.

Of Hæmorrhagy from Mucous Membranes.

The confluent or gangrenous aphthæ have other characters. The ſmall puſtules are contiguous to one another, and ſpread not only over the lips, the gums, the tongue, and the interior of the cheek; but we alſo ſee them at the bottom of the throat. The mouth of the child is burning; the lips are with difficulty applied to the nipple, and ſometimes it is excoriated by their contact. Deglutition is very difficult, and the moſt ſimple drinks given in ſmall quantities, and with precaution, do not enter into the ſtomach but with pain. There is a conſtant purging of greeniſh matter, which inflames and excoriates the ſkin round the anus; the child is very feeble and heavy, and the eyes are ſunk and ſhut, and the child ſcreams. The whole interior of the mouth from the lips to the throat becomes at laſt lined with a white thick cruſt, reſembling coagulated milk. This cruſt becomes yellow, and forms a ſlough, which, after it falls off, expoſes gangrenous ulcers of a dark browniſh yellow colour.

Treatment.—In the benign form of the diſeaſe in children, it is of great conſequence to get the child a good nurſe; and the affected parts may be waſhed over five or ſix times a-day with a piece of caddis dipped in a little water gruel, to which has been added a few drops of ſulphuric acid. Borax, either in powder or ſolution, has alſo been conſidered by ſome as a uſeful application. When the cruſt has ſeparated, if the remaining ulcer be painful and irritable, its ſurface may be rubbed over with nitrate of ſilver, or any other cauſtic application. Sometimes very malignant looking ulcers remain in the adult, after the ſeparation of the cruſt. In theſe caſes, cauſtic may be employed; and we have often ſeen them heal rapidly by touching their ſurfaces once a-day with a weak ſolution of corroſive ſublimate or muriatic acid. For the treatment of the confluent aphthæ, ſee Medicine. 109

Sect. VII. *General Remarks on the Hæmorrhagy from Mucous Membranes.* 110

All the mucous ſurfaces are particularly ſubject to hæmorrhagy; and this may ariſe either from a rupture of the veſſels, or the blood may be poured out by the exhalents.

The ſuperficial poſition of the veſſels, and conſequently their want of firmneſs and ſupport, expoſes them much to rupture by very ſlight concuſſions. We have examples of this in the bronchiæ, brought on by coughing; in the noſe, by ſlight blows on the head, or by violent ſneezing; and in the rectum, by ſtraining on going to ſtool. The effects of ſtones or gravel on the mucous membrane lining the urinary organs are the ſame; and

even

Of Hæmorrhagy from Mucous Membranes.

even the moſt cautious introduction of a ſound or bougie into the urethra, often cauſes bleeding; or the ſlighteſt friction of polypi of the noſe and gums, or the introduction of a probe into the lachrymal paſſages. When conſidering the diſeaſes of the ſkin, we mentioned, that in ſome diſeaſes, particularly ſome peſtilential fevers, the exhalents of the ſkin poured out red blood. The ſame thing happens among the mucous membranes. We often ſee blood come from the noſe, from the bronchiæ, ſtomach, and inteſtines, urinary bladder and kidneys, where there has been no reaſon to ſuppoſe ulceration previouſly to have taken place, or any thing to cauſe a rupture of any of the veſſels.

111 1. *Hæmorrhagy from the Noſe.*

Hæmorrhagy from the noſe ariſes from a variety of cauſes. We often obſerve it after fevers, and then it has been conſidered as critical. In young people it occurs very frequently, and from very ſlight cauſes; and it has been ſometimes known to take place at the menſtrual period.

Hæmorrhagy from the noſe is generally preceded by ſymptoms of an increaſed quantity of blood to the head, pulſating motion of the temporal arteries, feeling of weight about the head, ſymptoms which are preceded or accompanied by other changes in more diſtant parts; ſuch as ſpontaneous laſſitude, pains about the belly.

When the means mentioned for this complaint in the article MEDICINE have failed, recourſe muſt be had to compreſſion. Doſſils of lint introduced into the noſtrils are ſometimes effectual; or the gut of ſome ſmall animal, tied at one end, then introduced by a probe into the noſe as far as the pharynx, and filled with cold water, or water and vinegar, and ſecured by a ligature, by adapting itſelf to all the parts, and preſſing equally on them, has been attended with advantage. When theſe remedies likewiſe fail in their effect, a piece of catgut or wire may be introduced through the noſe into the throat, and brought out at the mouth; a piece of ſponge, or a bolſter of lint of a ſize ſufficient to fill the back-part of the noſtril, is then to be fixed to it; the ſponge is next to be drawn back and properly applied. Another is to be applied to the anterior part of the noſtril and ſecured. The ſame may be done to the other noſtril, if it be neceſſary; or the ſponge may be of ſuch a ſize as to fill the ends of both noſtrils at the ſame time. By this contrivance the blood not finding an outlet, will ſoon coagulate, and prevent any farther evacuation.

112 2. *Hæmorrhagy from the Rectum*, or *Fluxus Hæmorrhoidalis.*

The diſcharge of blood from the rectum is a diſeaſe chiefly confined to thoſe advanced in life. It is often occaſioned by full living, change from an active to a very ſedentary life, the abuſe of purgatives, particularly aloes; violent paſſions, or habitual melancholy. The ſymptoms which precede and accompany this diſeaſe, are bearing down pains, and a ſenſation of weight in the back and loins, ſometimes a numbneſs in the limbs, and a contracted pulſe, thirſt, diminution of urine, flatulency, and ſometimes a diſcharge by ſtool of a white mucus. The diſcharge returns commonly in a periodical manner once a month, and thus becomes neceſſary for the preſervation of health; for if it be ſuppreſſed, or if it ſtops ſpontaneouſly, it occaſions a variety of nervous affections, ſuch as ſpaſmodic tightnings about the cheſt, colic and vertigo.

Of Hæmorrhagy from Mucous Membranes.

Treatment.—When the hæmorrhoidal diſcharge has become habitual like the menſtrual diſcharge, we not only ought not to attempt curing it, but if it be from any cauſe ſuppreſſed, it ought to be reſtored. If it be the effect of general plethora, it is to be removed by a vegetable diet and moderate exerciſe. In order to moderate the diſcharge, the patient ought to lie in the horizontal poſture on a hard bed, avoid all exerciſe, keep the belly open by cooling laxatives, or even to take acids if the bleeding is exceſſive, and apply cold to the loins and perinæum. As a ſudden ſuppreſſion of the hæmorrhoidal diſcharge is the cauſe of many diſeaſes, it is of much importance to reproduce it. To effect this, leeches applied to the anus, and warm fomentations, are the moſt efficacious remedies.

3. *Hæmorrhagy from the Bladder* (Hematuria). 113

Hæmorrhagy from the bladder is a diſeaſe moſt frequent in old people; it is often occaſioned by a ſuppreſſion of the hæmorrhoidal diſcharge, or any other accuſtomed diſcharge of blood. It is ſometimes the conſequence of exceſs in living and drinking, and of a ſedentary life followed by great exereiſe. It alſo ariſes from a plethoric ſtate of the ſyſtem, violent exerciſe on horſeback, the internal uſe of cantharides, a contuſion in the region of the kidneys, or from ſtone in the bladder.

Treatment.—The treatment to be employed is the ſame as in hæmorrhagy in general. Every thing ought to be avoided which might tend to irritate the kidneys or the urinary bladder. Laxatives, acid drinks, the application of ice to the lumbar region, hypogaſtrium, and perinæum, or to the inſide of the thighs, is of great importance. Under the articles MEDICINE and MIDWIFERY, we have conſidered the hæmorrhagies from the lungs and uterus. We may here remark the connection and ſtrong ſympathy which ſubſiſts between theſe organs, and alſo between them and the other organs of the body; for a minute acquaintance with theſe may often lead to a ſucceſsful mode of treating their diſeaſes. When the menſes are ſuppreſſed, there is often a hæmorrhagy from the mucous membrane of the lungs; and there are alſo many caſes of obſtruction in the bowels which bring on hæmorrhagy both from the lungs and uterus; a hæmorrhagy which never ceaſes until the primary affection be removed.

SECT. VIII. *General Remarks on the Ulceration of Mucous Membranes.* 114

Simple inflammation of a mucous ſurface ſeldom, if ever, terminates in ulceration, moſt ulcers of theſe parts having a ſpecific character. The venereal inflammation rapidly terminates in ulceration; and aphthæ have the ſame tendency, forming often what are called phagadenic ſores.

The mucous membrane of the noſe is peculiarly ſubject to ulceration; ulcers alſo occur in the different parts of the mouth and gums, in the inteſtinal canal, and alſo, though very ſeldom, in the urethra. It is the

Of the Diſeaſes of Serous Membranes.

the firſt of theſe only which are to be treated of in this place.

Of Ulcers of the Noſe, or *Ozæna*.

115 This ſpecies of ulcer ſometimes appears in the noſtrils, and ſometimes in the frontal or maxillary ſinus. It generally ſucceeds a violent coryza. It alſo ſometimes ariſes from blows on the noſe, or from the application of very acrid ſubſtances. Ozæna is often accompanied with inflammation, hæmorrhagy, pains, caries of the bones which ſometimes deſtroys the palate bones, cartilages of the noſtrils; and by hindering more or leſs the free paſſage of the air, it alters the tone of the voice.

Treatment.—In the ſimple ozæna, much benefit generally ariſes from the uſe of aſtringent waſhes, ſuch as a decoction of oak-bark and alum, ſolutions of ſulphate or acetate of zinc, or the acetate of lead. The beſt mode of uſing theſe is to inject them a little warmed, with a common ſyringe, into the affected noſtril, three or four times a day; and when the quantity of diſcharge diminiſhes and becomes of a better quality, an ointment compoſed of the flowers of zinc or the like, ſpread on a piece of lint, ſhould be introduced once or twice a day into the noſtril.

When the ozæna is of a more virulent nature, and the bones affected with caries, there is generally great reaſon to ſuſpect a venereal taint. This can only be determined by the hiſtory of the complaint and the conſtitutional ſymptoms of the venereal diſeaſe being preſent. In ſuch caſes mercury is the only remedy, and along with its internal uſe the injection of mercurial lotions, and the uſe of fumigations, will be ſerviceable. In ſuch ulcers as are obſtinate, and which do not partake of any venereal taint, a liniment, with an eighth part of the red precipitate of mercury, or a ſmaller proportion of the acetate of copper, has been recommended by Mr Bell as an uſeful application. In ſome caſes, too, where, after the venereal taint is deſtroyed by a proper mercurial courſe, there remains an obſtinate ſore, the above liniment may be uſeful, and it has alſo been found in ſuch caſes of much advantage, a courſe of ſarſaparilla or cinchona.

Chap. IV.

Of the Diſeaſes of Serous Membranes.

116

General Remarks on the Pathology of Serous Membranes.

The phenomena of the diſeaſes of ſerous membranes are very different from any of thoſe of the other textures which have been mentioned. When they are attacked with inflammation, the ſerous ſurfaces often adhere together, or if ſuppuration takes place, it is never accompanied with ulceration or eroſion of their ſubſtance. However abundant theſe purulent collections may be, the membranes always remain ſound, with only a little additional thickneſs; the purulent fluid rejected from them, being like the natural fluid formed by exhalation.

The ſerous cavities are alſo ſubject to hæmorrhagy, and to preternatural collections of the exhaled fluid.

Under the article Medicine we have treated of inflammation of the pleura, membranes of the brain and peritoneum, and alſo of hæmorrhagy from theſe organs. In this place we ſhall conſider dropſy and hæmorrhagy from the vaginal coat of the teſtes, as the only diſeaſes belonging to ſurgery.

Of Aſcites.

Sect. I. *Dropſy of the Peritoneum*, or *Aſcites*.

117

When water collects in a conſiderable quantity within the cavity of the peritoneum, the ſkin becomes dry and ſcurfy, and the ſuperficial veins varicoſe. In one caſe they appeared like large tubes half filled with blood, the anterior part of the canal thin and dry, and the poſterior portion hard and unyielding. The ſkin at the umbilicus is ſometimes much diſtended, and the water ſeen ſhining through it as in a common bliſter. The water varies much in its appearance; moſt frequently it is yellow or browniſh. We have ſeen it as thick and dark coloured as coffee grounds. In one caſe it was viſcid and tenacious, reſembling the white of an egg; and in other inſtances it reſembled milk and water, with the milk partly curdled. Aſcites is generally accompanied with a diſeaſe of ſome of the abdominal viſcera, and moſt frequently the liver.

It is not confined to any particular period of life, but has been obſerved more frequently in men than in women.

The ſymptoms of aſcites are, 1. The ſwelling and ſenſe of tightneſs over the belly. 2. Laborious and difficult breathing, eſpecially in the horizontal poſture. 3. The diſtinct feeling of fluctuation, upon applying one hand to one ſide of the belly, and ſtriking it with the other hand on the oppoſite ſide. 4. The urine is in ſmall quantity, and of a dark red colour. There is alſo thirſt, a dry ſkin, often a feeling of heat, and very frequently œdema of the inferior extremities.

118 Operation.

Paracenteſis.—When the ſwelling becomes large, and internal medicines have no effect in diminiſhing it, it is adviſeable to diſcharge the water by an artificial opening, an operation which ſeldom cures the diſeaſe, but is always attended with temporary relief, and may be repeated as often as the water is found to collect. Smucker has performed it ſeventy times, and protracted the patient's life for many years. The operation is to be performed by introducing a trocar* at the linea alba, as in a hydrocele, about two or three inches below the umbilicus. Many ſurgeons now prefer this place, as it prevents all riſk of wounding the epigaſtric artery, or any other important part. It was formerly the common practice to introduce the inſtrument on the left ſide of the abdomen, half way between the umbilicus and anterior ſuperior ſpinous proceſs of the ileum, in order to avoid the liver and epigaſtric artery. But thoſe who laid down this rule were not aware of the change in the relative ſituation of parts when diſeaſed; and it has ſeveral times happened to Mr Cline and other eminent ſurgeons, in performing the operation at this place, that they have wounded the epigaſtric artery, and the patient has died of hæmorrhage. The diſſection of the abdominal muſcles in patients who have died of dropſy, ſhows how much the *recti* are extended in breadth, and the ſituation of the epigaſtric artery changed.

* See Plate DXIV.

The place for entering the trocar being determined, and marked with ink, the patient ſhould be placed in the horizontal poſture, and in ſuch a ſituation that the water

Of Hydrocele.

water can be run off readily into a veſſel proper to receive it. But as patients are very apt to faint if the water is ſuddenly removed, and no preſſure applied to ſupport the belly as it is emptied, it is neceſſary to make an equal preſſure during, and after the operation. From neglecting this in ſome caſes, dangerous ſymptoms have ariſen, and in one inſtance the patient died three days after the operation from this cauſe.

A piece of flannel as broad as the belly, and divided into ſeveral pieces at each end, and theſe drawn acroſs each other by aſſiſtants, or the bandage *, anſwers for this purpoſe. By either of theſe modes the belly may be gradually compreſſed as the water is let out, and the compreſſion continued for ſeveral days after the operation. Sometimes the water does not come out readily, by a portion of omentum or inteſtine coming in contact with the end of the canula; but the diſcharge may be aſſiſted by introducing within the canula a blunt probe, or a leſs canula within the firſt, having ſmall perforations at the extremity and edges. After all the water is diſcharged, a piece of plaſter ſhould be applied to the wound, and every caution taken to exclude the admiſſion of the external air. The bandage ſhould alſo be kept applied, and it may be worn for ſome time.

* Plate CXIV.

119 SECT. II. *Water collected in the cavity of the Vaginal Coat, or Hydrocele.*

The effuſion of water in the tunica vaginalis, frequently accompanies hernia, the ſcrophulous ſchirrus, venereal and other enlargements of the teſticle; but in ſuch caſes, it is merely to be conſidered as a ſymptom accompanying theſe diſorders. Mr Home mentions caſes where it was a ſymptom of ſtricture. It occurs alſo during the abatement of inflammation of the teſticle; and ſometimes more or leſs of the water remains after the inflammatory ſymptoms have diſappeared. In caſes of this kind the tunica vaginalis is generally found thickened, and there is an effuſion of lymph over its ſurface and over the ſurface of the albuginea. In many caſes, the water is collected where there is no apparent alteration in the ſtructure of the parts. The diſeaſe in ſuch caſes moſt probably ariſes either from a diminiſhed abſorption or from an increaſed exhalation. If the diſeaſe has been of long duration, the tunica vaginalis is generally thickened, to a great degree ſometimes; and particularly in old people it becomes hard or cartilaginous. We have ſeen ſeveral preparations where it was converted into a ſhell of bone. We have met with two caſes where a round ſubſtance reſembling cartilage was found floating looſe in the water of a hydrocele. It is not uncommon to find the veſſels alſo of the ſpermatic veins become more or leſs varicoſe. Collections of water of a very conſiderable ſize form ſometimes after birth (*wind rupture*); but in old people they are moſt frequent. The water is uſually collected only in one cavity; but it ſometimes happens, that in conſequence of adheſions between the tunica vaginalis and teſticle, ſeveral irregular ſhaped bags are formed in which it is contained. The water uſually collects in one ſide of the ſcrotum, ſometimes alſo in both. The water is generally clear and ſtraw-coloured, ſometimes it is coloured with blood, ſometimes yellow or brown, and ſometimes thick, and like coffee grounds. See Morgagni, Ep. xxxviii.

The quantity of water varies. In the Act. Erud. Lipſienſis 1725. p. 492, there is mention made of a caſe which contained forty pounds of fluid. Doight ſaw one which contained four pounds. There are ſometimes alſo hydatids found along with the water. Richter has met with four caſes of this kind.

Symptoms.—1. The ſcrotum is commonly of a pyramidal form, and the corrugations of the external ſkin are deſtroyed in proportion to the bulk of the ſwelling. The ſhape of the tumor however varies; in ſome caſes, it is very globular, and in others it appears like two ſwellings joined. It is even altered from the manner in which it is ſuſpended; if a bag truſs has been worn it is uſually oblong. 2. The ſwelling generally begins at the lower part of the ſcrotum, and as its bulk increaſes, it gradually aſcends towards the abdominal ring. 3. It appears pellucid when held between the eye and a candle; but this is not a certain prognoſtic, as the tranſparency is deſtroyed when the tunica vaginalis is thick and hard, or when the water is turbid and dark. 4. It gives the diſtinct ſenſation of fluctuation. In ſome caſes, however, the degree of thickening of the tunica vaginalis renders the fluctuation obſcure or imperceptible, and alſo deſtroys its tranſparency. 5. The tumor cannot be made to recede or change its ſituation from preſſure or change of poſture of the body. 6. The teſticle is involved in the ſwelling, and can be diſtinguiſhed like a firm unyielding maſs at the poſterior part of it. In caſes where adheſions have been formed, the poſition varies; but the patient generally knows where it lies, and preſſure applied to the part of the ſwelling where it is ſituated gives pain. Sometimes the teſticle is placed at the under part of the ſwelling, ſometimes in the middle. Mr Bell felt it twice forwards. Sometimes along with the water there are hydatids floating in the cavity of the vaginal coat. Somering ſays, that he has often obſerved this appearance. 7. The ſpermatic cord can be readily diſtinguiſhed unaltered. 8. The tumor gives little or no pain, and the patient ſuffers merely from its bulk. 9. The growth of the ſwelling is generally very ſlow, and ſometimes years elapſe before it becomes a great inconvenience; ſometimes, however, it forms rapidly. When it grows very large, the integuments become thick, and the veins varicoſe; if the ſwelling extends up to the inguinal ring, the cord cannot be felt, and the penis is ſometimes ſo much involved in the tumor, that it appears like an umbilicus or piece of corrugated ſkin. 120

Treatment.—In children, the water generally diſappears in a ſhort time, by the application of ſtrong aſtringent or diſcutient applications. In ſome caſes, the diſeaſe advances ſo ſlowly, that it is ſufficient to wear a ſuſpenſory bandage. Richter mentions a caſe where it was twenty years old before it was neceſſary to remove the water. When the ſwelling becomes ſo large as to render it neceſſary to diſcharge the water, the operation may be either *palliative* or *radical*. The object of the firſt is merely to remove the water, after which the diſeaſe commonly returns; and by the ſecond, an adheſion is intended to be produced between the ſurface of the vaginal coat and albuginea, and conſequently the cavity in which the water was collected entirely obliterated. In making choice of theſe modes of treatment, 121

it

Of Hydrocele.

it is neceſſary to attend to the following rules. 1. When the hydrocele is large, it is ſafer to perform the palliative operation; and afterwards when it has again collected in leſs bulk, the radical one may be employed. 2. When the ſtate of the teſticle is not accurately aſcertained, it is better firſt merely to diſcharge the water, which allows it to be completely examined. 3. The palliative operation ſhould be employed in all caſes where the diſeaſe is connected with a morbid ſtate of any contiguous organ. 4. In all other caſes, the radical operation is preferable.

122 *Palliative Operation.*—The matter may be diſcharged either by a puncture made with a lancet or by a ſmall trocar.

* See Plate DXIV. When the trocar * is to be introduced, the poſterior part of the tumor ſhould be firmly graſped in the left hand, ſo that the fluid is puſhed to the anterior and inferior part of it. A puncture is to be made, with a lancet, through the integuments at the moſt prominent part of the ſwelling, large enough to admit readily the trocar, taking care to avoid any large ſuperficial vein. The trocar is then to be puſhed through the coats of the tumor perpendicularly; but when it has entered the cavity, which is known by the feeling of a ſudden want of reſiſtance, the point ſhould be directed upward, and carried forward a ſufficient way; ſo that the ſurgeon is aſſured of its being within the cavity ſo far that there is no riſk of its falling out.

After all the matter has been allowed to flow out, and the canula withdrawn, the wound ſhould be covered with a piece of ſticking plaſter, and the ſcrotum ſupported by a ſuſpenſory bandage. If the operation is to be done with a lancet, an inciſion ſhould be firſt made through the ſkin, rather larger than what is neceſſary into the cavity. Then a puncture is to be made through the tunica vaginalis, which will allow the water to flow out; and the diſcharge may be aſſiſted by the introduction of a probe, director, or hollow tube, into the opening. The trocar ſhould always be employed for this operation, except when the hydrocele is ſo ſmall that the teſticle would be in danger of being wounded by it, or when there is any enlargement of the teſticle accompanying the hydrocele, which is not well underſtood, or if the tunica vaginalis is extremely thick and the fluctuation not diſtinct.

123 *Radical Operation.*—An obliteration of the tunica vaginalis may be produced either by an infuſion of *lymph* on the ſurfaces of the tunica vaginalis and albuginea, or by the proceſs of *granulation*. The firſt is effected by injecting into the cavity a ſtimulating fluid to produce inflammation and adheſion; the ſecond is by laying open the cavity to produce inflammation and ſuppuration, and to allow it to fill by granulation.

124 *By Injection.*—Dr Monro *primus* firſt propoſed and adopted this ingenious, yet ſimple mode of cure; and it is now that which is moſt generally practiſed in all caſes not attended with any peculiarity or puzzling ſymptom. The fluid contained in the tunica vaginalis, is to be diſcharged by a trocar, in the manner recommended in the *palliative* treatment. The trocar for this purpoſe ſhould be of a rounded form, which is either altogether cylindrical, or only a ſmall ſlit at its extremity; for that of *Andrè*, which is flat and ſlit up at both ſides, is apt to allow the fluid to be effuſed into the cellular membrane of the ſcrotum; an accident which we have ſeen repeatedly happen, and always fruſtrates the object of the operation.

Of Hydrocele.

The fluid is then to be injected through the canula either by a ſyringe (Plate DXIV.), which has a moveable *ſtop-cock*, that it may be filled as frequently as is neceſſary, or by an elaſtic bottle, which has a valve in its pipe, ſo as to allow the fluid to paſs forward, but to prevent its exit. It is not neceſſary to inject as much fluid, as there was water in the hydrocele; it anſwers well to fill the cavity moderately, and by gentle ſtrokes on the ſcrotum agitate it over the whole ſurface. The fluid moſt commonly employed is *port wine*. Some recommend it to be diluted, but it is better to uſe it pure, and allow it to remain a longer or ſhorter time according to the degree of pain it excites, and the general irritability of the patient. In hoſpitals, other fluids are uſed, as being leſs expenſive. Mr Cline of St Thomas's hoſpital employs a ſolution of the ſulphate of zinc ʒi. ad lbi. From five minutes to a quarter of an hour is in moſt caſes a ſufficient length of time to allow the wine to remain. If it excite ſevere pain in the teſticle or cord, it may be detained more or leſs time. A conſiderable degree of uneaſineſs is always to be wiſhed for in order to ſecure ſucceſs in the operation. After the wine is withdrawn, the wound ſhould be covered with a piece of ſticking plaſter or caddis; the ſcrotum well ſupported with either pillows or a truſs, and the patient put to bed. The operation excites more or leſs ſwelling in a longer or ſhorter period. The medium effect on the teſticle is to cauſe it to ſwell about the bulk of a turkey's egg in four or five days; and the ſurgeon ſhould, by purſuing the antiphlogiſtic regimen, moderate as far as in his power the inflammatory ſymptoms to that pitch, and by an oppoſite treatment bring them up to that degree ſhould they be too mild. Low diet, local or even general blood-letting, purging, the horizontal poſture and fomentations, are the moſt powerful means to arreſt inflammation; but if the patient has little pain, he ſhould live on a nouriſhing diet, and ſome local ſtimulant may be applied over the ſcrotum until a ſufficient degree of inflammation comes on. If the inflammatory ſymptoms abate, the ſwelling diſappears; and it is adviſable to wear always afterwards a bag truſs to ſupport the whole ſcrotum. In ſome caſes the water again collects, and then the operation ſhould be repeated; but it requires caution, as the relative ſituation of parts is ſometimes altered from ſome partial adheſions having formed between the tunics.

We have ſeen frequently caſes where it was thought that the water has been regenerated a few days after the operation, which ſwelling afterwards diſappeared. This probably ariſes from an effuſion in the cellular membrane, but it requires no particular treatment.

125 *By Inciſion.*—After graſping the tumor firmly, an inciſion is to be made through the ſkin with a ſcalpel, from its ſuperior to its inferior part. A puncture is to be made towards the upper part, with a lancet, large enough to admit the point of the fore finger; the fluid is allowed gradually to eſcape through the opening; and the tunica vaginalis is to be laid open its whole extent with a probe-pointed biſtoury in the ſame direction as the inciſion through the integuments. Pledgets of lint dipped in oil,

Of Hydrocele.

oil, or covered with ſimple ointment, are to be put between the lips of the wound, down to the bottom of the cavity, one on each ſide of the teſticle; and the edges of the ſcrotum are to be brought together either by ſtraps or ſuture. A ſingle ligature put through the integuments oppoſite the teſticle, anſwers beſt, and prevents the teſticle from being puſhed without the edges of the wound in conſequence of the degree of ſwelling the operation occaſions. The whole ſhould be covered with a pledget of ointment, and ſuſpended in a tight bandage.

In three or four days after the operation, the external dreſſings ſhould be removed; and in one or two days more, the pledgets interpoſed between the tunica vaginalis and teſticle may be taken away and renewed. The ligature ſhould be cut out whenever the ſwelling of the parts begins to abate, or at any time when it appears to create irritation. During the cure, great care ſhould be taken, firſt, by the introduction of ſlips of plaſter, to prevent the union but from the bottom; ſecondly, to guard againſt the collection of matter in any cavity; thirdly, to prevent the lips of the wound ſeparating far, thus expoſing the teſticle and protracting the cure; and fourthly, to lay open freely any ſinuſes which may form. The cure goes on much more rapidly by perſevering in the horizontal poſture, and keeping the ſcrotum well ſupported. The bowels ſhould be always kept open and regular, and when ſuppuration has begun, the patient's ſtrength ſhould be ſupported by a nouriſhing diet and bark or port wine, if neceſſary. The cure takes from three to eight weeks in moſt caſes. This mode of operating is the moſt eligible when there is any ambiguity in the caſe, as it allows the teſticles to be accurately examined, and caſtration performed if neceſſary. It ought alſo to be performed when the tunica vaginalis is much thickened and hardened, and it is ſometimes neceſſary, even to cut away ſome of the hardeſt portions. The modes of curing hydrocele by a *ſeton*, *cauſtic*, &c. are now generally given up.

126 When to be adopted.

127 SECT. III. *Dropſy of the Thorax*, or *Hydrothorax*.

The fluid is ſometimes confined to one, and ſometimes affects both ſides of the cheſt. It is commonly of a brown or yellow colour; ſometimes it is reddiſh from a mixture of blood. Its chemical qualities are thoſe of ſerum. When it is accumulated in a large quantity, the lungs are more or leſs compreſſed. Dr Baillie has ſeen a lung not larger than the cloſed fiſt. It is alſo in ſome inſtances accompanied with adheſions between the ſurface of the lungs and pleura.

The exiſtence of water is known by the following ſymptoms. Reſpiration is ſhort and difficult; and the patient cannot reſt in bed, except the head and trunk be elevated from the horizontal poſture. The ſleep is often interrupted by alarms and diſagreeable dreams, and the patient ſuddenly ſtarts from it with a ſenſe of ſuffocation: he is unable to ſtoop much forward, or raiſe any thing from the ground. There is ſometimes a teaſing cough, with little expectoration. During the progreſs of the diſeaſe, the pulſe is very variable; but it is generally irregular. The countenance is pale, and the lips and cheeks of a purple hue. The urine is diminiſhed in quantity, and of a high colour. The bowels are generally conſtipated. The feet and legs are commonly anaſarcous. The undulation of a fluid may be heard by the patient himſelf, and moving the body by ſudden jerks will ſometimes aſſiſt in diſcovering the diſeaſe. The affected ſide has in ſome caſes been obſerved to be enlarged.

Of Hæmatocele.

This diſeaſe is treated by the exhibition of internal medicines, where the quantity of water is ſmall; but when it collects in ſuch a quantity as to threaten ſuffocation, it ought to be diſcharged by an opening made into the cavity of the thorax. The inciſion ought to be made between the fifth and ſixth ribs, half way between the ſternum and ſpine; two inches in length through the ſkin. The ſubjacent parts ought to be cautiouſly divided; and the inciſion ſhould be directed rather towards the upper part of the ſixth rib, to avoid wounding the intercoſtal artery and nerve, which creep along the inferior edge of the fifth rib. The pleura, which is diſtinguiſhed by its bluiſh colour, ſhould be carefully cut with the point of the knife; ſo, that, in caſe of adheſion, the lung is not wounded: and if the water flows out, a canula ſhould be introduced into the opening. If it does not, in conſequence of adheſion, another inciſion muſt be made. Great care ſhould be taken to prevent the admiſſion of air, and for that purpoſe, the opening ſhould be made valvular, by pulling up the ſkin which is to be cut through. If the quantity is very great, it may be drawn off at two different intervals; or if it is collected in both cavities of the thorax.

128 SECT. IV. *Dropſy of the Pericardium.*

Water is ſometimes found in the *pericardium* when there is none in any other cavity of the thorax, but it is generally accompanied with a collection of water in ſome of them. The ſymptoms of this diſeaſe are nearly ſimilar to thoſe of hydrothorax; and we find that Deſſault and other very eminent ſurgeons have not been able to diſtinguiſh them. Dr Baillie ſays, "that the feeling of oppreſſion is more accurately confined to the ſituation of the heart; and the heart is more diſturbed in its functions in dropſy of the pericardium than in hydrothorax." It is alſo ſaid, that a firm undulatory motion can be felt at every ſtroke of the heart.

If the exiſtence of this complaint is aſcertained, and if the quantity of water is ſuſpected to be great, it may be perhaps adviſable to diſcharge it, as practiſed in one caſe by Deſſault, by making an opening between the ſixth and ſeventh ribs of the left ſide, oppoſite to the apex of the heart.

129 SECT. V. *Blood effuſed in the Tunica Vaginalis.* (Hæmatocele).

The effuſion of blood within the cavity of the vaginal coat is characteriſed by the ſudden appearance of the tumor, by its wanting the tranſparency of a hydrocele, by its greater weight, and by its being moſt commonly occaſioned by ſome accident. It is uſually produced by the trocar uſed in performing the *palliative* operation wounding a veſſel which pours its blood into the vaginal cavity; it is ſtill more apt to happen when a lancet is uſed and a varicoſe veſſel punctured. It alſo takes place from the rupture of a varicoſe veſſel by the ſudden depletion of a large hydrocele.

If the ſwelling is ſmall, it may diſappear by the local

Of Ganglions.

uſe of diſcutients and ſtimulants, ſuch as ſolutions of ſaccharum ſaturni, or that of alum, vinegar, &c. If it does not yield to theſe, and if it has acquired a conſiderable bulk, the blood ſhould be diſcharged by an inciſion; and any bleeding veſſel either ſecured by a ligature, or by ſtrong ſtimulants, and the wound afterwards treated as in common hydrocele.

Chap. V.

Diſeaſes of the Sinovial Membranes.

130 Sect. I. *General Obſervations on the Pathology of Sinovial Membranes.*

The diſeaſes of the ſinovial membranes are much more limited and leſs underſtood than thoſe of the textures which we have examined. They do not appear to be ſympathetically affected in the diſeaſes of other parts. In the acute diſeaſes of the important viſcera, the ſkin, the mucous ſurfaces, the cellular membrane, the nerves, &c. are more or leſs ſympathetically affected, whilſt all the ſinovial membranes remain undiſturbed. In this reſpect they reſemble the bones, cartilages, and fibrous membranes. Neither is the ſinovial fluid ſubject to the different alterations, which we obſerve of the ſerous fluid. We never find any preternatural membranes formed on the articulating ſurfaces; and the preternatural collections of ſinovia never contain any of the white floculent matter ſo frequent in ſerous collections.

The ſinovial membranes are ſubject to inflammation, and are probably the ſeat of many of thoſe pains about the joints which are ſo frequent. Their fluids are alſo ſometimes increaſed to a preternatural quantity, and chalky or earthy depoſitions are alſo occaſionally found in them.

131 Sect. II. *Of Ganglions.*

An increaſe of the ſinovial fluid in the burſæ, or tendinous ſheaths, forms a ſpecies of dropſy called a *ganglion*. It is not, however, probable that theſe tumors are always formed in a natural ſinovial capſule: moſt commonly they are accidental, and are formed in the cellular membrane; for they are frequently found in parts where no natural capſule exiſts. They are moſt frequently met with over the tendons upon the back of the wriſt, and often likewiſe about thoſe of the ankle and other parts of the extremities. When preſſed, they are found to poſſeſs a conſiderable degree of elaſticity, from which, and from their ſituation, they may generally be diſtinguiſhed from other encyſted tumors. They ſeldom arrive at any great bulk, are not often attended with pain, and commonly the ſkin retains its natural appearance. On being laid open, they are found to contain a tough, viſcid, tranſparent fluid, reſembling the glaire of egg, which is alſo ſometimes of a reddiſh colour.

They are generally produced by ſprains or contuſions of the joints, or by rheumatiſm. In many inſtances, they go off inſenſibly, without any aſſiſtance from art; but as this is often not the caſe, means ought to be uſed for removing them. For this purpoſe, friction frequently repeated, or gentle compreſſion applied to them by means of thin plates of lead and bandages, ſometimes remove them. In ſome inſtances they have been removed by the application of bliſters; but the moſt certain method is, to make a ſmall puncture into the ſac, or to draw a cord through it; or, after the puncture is made, to preſs out the contents, and then inject ſome gently ſtimulating fluid, as port wine and water heated blood-warm.

Of Collections in the Joints.

132 Sect. III. *Of Collections within the Capſular Ligaments of the Joints.*

Collections here may conſiſt of ſerum, blood, or pus and ſynovia combined. They are moſt frequently met with in the joint of the knee, and may be produced either by internal or external cauſes. Theſe kinds of collections may in general be diſtinguiſhed from each other.

Watery effuſions, commonly called *dropſical* ſwellings of the joints, ariſe chiefly in conſequence of ſevere rheumatic complaints; and when the tumor is not very large, the fluctuation of the fluid may be felt by preſſure. When a large effuſion appears immediately after a violent bruiſe, it is probable that it conſiſts chiefly of blood: but when it ſucceeds a violent ſprain, attended with great pain, inflammation, and ſwelling, terminating in an effuſion, there is every reaſon to think that the contained fluid conſiſts of pus mixed with ſynovia.

Swellings of the joints are moſt apt to be confounded with collections in the burſæ mucoſæ, or with matter effuſed in the adjacent cellular ſubſtance. From the firſt of theſe they are generally diſtinguiſhed by the contained fluid paſſing readily from one ſide of the joint to the other, and from its being diffuſed over the whole of it; whereas, when it is contained in the burſæ, the tumor is confined to a particular part, and is ſeldom attended with much pain.

When ſuch collections can ſafely be allowed to remain, the capſular ligament ought never to be opened, as they can often be removed by diſcutients. Even conſiderable collections ariſing from rheumatiſm may commonly be diſcuſſed by friction, fomenting the parts with warm vapour, keeping them conſtantly moiſt with ſaturnine ſolutions, covering them properly with flannel, and applying bliſters. When theſe fail, ſupporting the part with a laced ſtocking, or with a roller, has frequently been of ſervice. But whether a rheumatic tumor can be diſcuſſed or not, it ought not to be opened; for the inconvenience attending it is more tolerable than the pain and inflammation which may enſue. But when the matter would do miſchief by lodging, it ſhould be diſcharged. Effuſed blood and matter which ſucceed high degrees of inflammation are of this kind. Blood is frequently extravaſated among ſoft parts without much detriment; but when in contact with cartilage or bone, it ſoon injures them. The matter ought to be diſcharged ſo as moſt effectually to prevent the admiſſion of air into the cavity of the joint. For this purpoſe the opening ſhould be made with a trocar; and the ſkin, previouſly drawn tight to the upper part of the tumor, ſhould be pulled down immediately on withdrawing the canula. A piece of adheſive plaſter ſhould be immediately laid over the opening, and the whole joint ſhould be firmly ſupported by a flannel roller carefully applied. If the patient be plethoric, he ſhould be blooded to ſuch an extent as his ſtrength will bear; he ſhould

ſhould be put upon a ſtrict antiphlogiſtic regimen, and in every reſpect ſhould be managed with caution; for inflammation being very apt to enſue, we cannot too much guard againſt it.

133 SECT. IV. *Of Moveable Bodies which are found within the Sinovial Capſules.*

Moveable bodies have been found in many of the ſinovial capſules of the human body. But they are moſt frequent in the knee joint; and it is there only where they require ſurgical aſſiſtance. Theſe bodies are generally compoſed of cartilage in the form of lamellæ, and there is often an oſſeous concretion in their centre. The cauſe of their formation is not known; but it is probable that they are formed by a gradual depoſition of the cartilaginous matter on the articulating ſurface. They have been often met with, attached by narrow necks to the ſinovial cavity; ſo that when this attachment is deſtroyed, they float looſe in the cavity, and undergo perhaps but little future change.

When they occur in the knee joint, and acquire ſuch a bulk as to obſtruct or derange the motions of the joint, it then becomes neceſſary to remove them. This ought to be done by bringing the moveable body to the outer part of the joint, and making a valvular inciſion of ſuch a ſize as to admit of its extraction. Sometimes much inflammation ſucceeds this operation, which ought to make us careful in chooſing a proper time for performing it, and in uſing every endeavour to repreſs any inflammatory ſymptoms afterwards.

134 SECT. V. *Of the Spina Bifida.*

Spina bifida is a tumor which ſometimes appears upon the lower part of the ſpine in new-born children. A fluctuation is diſtinctly perceived in it, and the fluid it contains can in ſome meaſure be preſſed in at an opening between the vertebræ. In ſome caſes this opening is owing to a natural deficiency of bone; in others, to the ſeparation of the ſpinous proceſſes of the vertebræ.

The diſeaſe proceeds from a ſerous looking fluid collected within the coverings of the ſpinal marrow. It is always fatal. Children labouring under it have been known to live for two or three years; but, in general, they linger and die in a few weeks. All that art has been able to do is to ſupport the tumor by gentle preſſure with a proper bandage. When a tumor of this kind is laid open or burſts, the child generally dies in a few hours. A tumor nearly of the ſame nature with this is ſometimes met with upon different parts of the head in new-born children: it is formed by a fluid lodged beneath the membranes of the brain, which have been forced out at ſome unoſſified part of the ſkull. What we have ſaid with reſpect to the former is exactly applicable to this diſeaſe.

CHAP. VI.

Of the Diſeaſes of the BONES.

135 SECT. I. *General Remarks on the Pathology of the Bones.*

THE diſeaſes of bones are remarkable for their ſlow progreſs, in compariſon with what is obſerved in the other organs. Inflammation proceeds extremely ſlowly, and callus is remarkable when compared with the cicatrization of other parts, for the length of time neceſſary for its formation; the origin and progreſs too of an exoſtoſis is very different from a tumor of the ſoft parts, as we obſerve in phlegmon. Suppuration too, which requires only a few days in other organs, takes months before the ſame proceſs is completed in bones. There is alſo a ſtriking difference between a gangrene of the ſoft parts and a caries or necroſis of the bones. In the natural ſtate the bones have no ſenſibility, but when diſeaſed, they are often the ſeat of acute pain; we obſerve this in the *ſpina ventoſa*, in caries, necroſis, &c. Beſides the changes to which the bones are ſubject from inflammation and various accidents, they alſo ſuffer alterations in their hardneſs and ſoftneſs. Preternatural growths alſo form upon them; and they are liable to abſorption.

SECT. II. *Of Particular Diſeaſes of the Bones.* 136

The bones, as well as the ſofter parts, are liable to be ſwelled, either throughout their whole length, or to have tumors formed on particular parts of them. 137

Exoſtoſis. Exoſtoſis is one ſpecies of tumor of the bone. According to Mr Bromefield, no ſwelling ſhould be called ſo, but an excreſcence continued from a bone, like a branch from the trunk of a tree. Under this head therefore is ranked the *benign node*, which may be produced by external injury, ſuch as contuſions and fractures: it can hardly be called a diſeaſe, as pain ſeldom ſucceeds, but rather a deformity.

Tophus. 138 There are riſings or tumors obſervable on the bones which are often the conſequents of venereal virus, and are termed *tophi*, *gummi*, or *nodes*.—Tophus is a ſoft tumor in the bone; and ſeems to be formed of a chalky ſubſtance, that is intermediate between the oſſeous fibres. Theſe cretaceous extravaſations are ſometimes found on the ligaments and tendons, as well as on the bone; and may ſometimes be taken out by the knife. We have many inſtances where chalk ſtones in gouty people make their way out through the ſkin of the fingers and toes.

Gummi. 139 Gummi is a ſoft tumor on the ſurface of the bone, between it and the perioſteum; and its contents reſemble gum ſoftened, from whence it has taken its name.

Venereal node. 140 The confirmed venereal node has the appearance of a divarication of the oſſeous fibres. When the perioſteum is thickened, but the bone not affected, a courſe of mercury will often produce a perfect cure: but when the bone itſelf is diſeaſed, this method will often fail. But here the diviſion of the extended perioſteum has been known to give perfect eaſe.

The uſual method, formerly, was to apply a cauſtic equal to the extent of the node, which being laid bare, required exfoliation before it could be cicatrized. If the inciſion is made early, that is, before matter be formed under the inveſting membrane, it ſeldom requires exfoliation; and, as we often find that the bone itſelf is not affected, but only the perioſteum thickened, we may be deceived even after a careful examination: it is therefore proper that the patient ſhould be pretty far advanced in a courſe of mercurial unction before even the inciſion is made; for, ſhould the tumor decreaſe, and the pain abate during the courſe, chirurgical aſſiſtance, with the knife, moſt likely may become unneceſſary.

Of the Diſeaſes of the Bones.

A bone may become carious firſt in its internal parts; and that from external injury, as well as from a vitiated ſtate of the animal fluids. Authors ſeem not to agree as to the technical term for this kind of diſeaſe of the bones; ſome calling it *cancer* or *gangræna oſſis*; others, *ſpina ventoſa*, from the pointed extuberances uſually attendant on this diſorder of the bone; and ſome again, *teredo*, from the appearance of the carious bone, like wood that is worm-eaten.

141 Carus.

142 Abſceſs.

It is univerſally allowed, that this diſeaſe takes its riſe from matter being formed either in the diploe, or in the marrow: whenever obſtruction is begun in the veſſels expanded on, or terminating in, the medullary cyſts, the conſequence will be inflammation, and, if not early removed, matter will form; for this reaſon this caſe may be called *abſceſſus in medulla*. Whenever, then, a patient complains of dull heavy pain, deeply ſituated in the bone, conſequent to a violent blow received on the part ſome time before, though the integuments appear perfectly ſound, and the bone itſelf not in the leaſt injured, we have great reaſon to ſuſpect an abſceſs in the medulla. Children of a bad habit of body, though they have not ſuffered any external injury, will often become lame, and complain of the limb being remarkably heavy; and though not attended with acute pain, yet the dull throbbing uneaſineſs is conſtant. If rigors happen during the time the patient labours under this indiſpoſition, it generally implies that matter will be formed within the ſubſtance of the bone. If the extremities of the diſeaſed bone ſwell, or if it becomes enlarged throughout its whole extent, it may be known to be an abſceſs in the medulla, or the true ſpina ventoſa, as it is called: if neither of theſe ſymptoms take place, the great inſenſibility of the bone in ſome ſubjects will prevent that acuteneſs of pain uſual in other parts where matter is formed, though the acrid matter is eroding the bone during the whole time it is contained within it. This matter at length having made its way through, arrives at the perioſteum, where it creates moſt violent pain. The integuments then become ſwelled and inflamed, and have a ſort of emphyſematous feel. On being examined by preſſure, the tumor will ſometimes be leſſened, from part of the matter retiring into the bone: from this appearance to the touch, moſt likely the name of *ventoſa* was added to the term *ſpina*.

When we are aſſured of matter being under the perioſteum, we cannot be too early in letting it out, as it will ſave a conſiderable deal of pain to the patient, though probably it may not be of any conſiderable advantage in reſpect to the carious bone; for, where the fluids in general are vitiated, no chance of cure can be expected from topical remedies; but where the conſtitution is mended, nature will ſometimes aſtoniſh us in her part, as the carious bone will be thrown off from the epiphyſes, or the teredines will be filled up by the oſſific matter that flows from the parts of the bone where ſome of the ſpinæ have come away.

If proper medicines are given, the children well ſupported, and the parts kept clean and dry, patience and perſeverance will frequently give great credit to the ſurgeon. In caſe it ſhould have been thought adviſeable to apply a trephine, to give free diſcharge to the matter, the waſhing it away, as well as the ſmall crumblings of the carious bone, by means of deterſive and drying injections, has been known to contribute greatly to the curing this kind of caries, after the habit of body in general had been mended.

Of the Diſeaſes of the Bones.

Beſides thoſe above mentioned, the bones are liable to two oppoſite diſeaſes; the one termed *friabilitas*, the other *mollities*; the former peculiar to adults, the latter more frequent in infants, though ſometimes ſeen in adults, from a vitiated ſtate of their juices.

143 Rickets.

From repeated ſalivations, the bones in old people have been rendered extremely brittle; inſomuch that in many ſubjects they have been fractured merely from their weight and the action of the muſcles: but in ſuch caſes, this is not owing to the friability of the bones, but to the loſs of ſubſtance, from the eroſion of the bone by an acrimonious humour thrown on it: to which cauſe perhaps may be attributed the diſeaſe called *rickets* in children. The effects of ſcorbutic humour in rendering the bones ſoft in many inſtances, have often been remarked.

By proper diet, gentle friction, exerciſe, and cold bathing, rickety children will frequently get their conſtitution ſo much changed, as that, by the time they arrive at the age of 20 years, there ſhall not remain the leaſt veſtige of their former diſeaſe. The epiphyſes are generally moſt affected in this ſpecies of the diſorder. For want of early attention to invalids of this ſort, we find that their bones not only become ſoft, and yield to the powers of the muſcles, but remain diſtorted during the reſt of life, though they have acquired a perfect degree of ſolidity. In ſuch caſes, therefore, the aſſiſtance of a ſkilful mechanic is neceſſary both to ſupport the parts improperly acted on, and to alter the line of direction of the diſtorted oſſeous fibres.

Though the curvature of the extremities, or thickneſs of the ends of the bones near their articulations, may give the firſt alarm to thoſe who are conſtantly with children, yet there are other ſymptoms that give earlier notice; which if they had been timely diſcovered, it is highly probable that the curvature of the limbs in many children might not have happened. The belly generally becomes larger in this diſeaſe, from the increaſed ſize of the contained bowels; the head then becomes enlarged; then a difficulty of breathing ſucceeds, which is generally ſuppoſed to be the effects of taking cold. The ſternum is elevated and ſharp, and the thorax becomes contracted; the ſpine is protruded in ſeveral parts; the pelvis altered, according to the preſſure of the parts within, and habitual inclination of the patient to obtain that line of direction in which the perpendicular from the centre of gravity may fall within the common baſe of the body, the extremities of the cylindrical bones, and the ends of the ribs next the ſternum, become enlarged; ſoon after this the bones in general become ſoft and flexible, yielding in ſuch directions as the ſtrongeſt muſcles determine.

Where the affection of the meſenteric glands is evident, Mr Bromefield aſſerts, that after a doſe or two of the pulvis baſilicus to empty the inteſtines thoroughly, the purified crude quickſilver is by much the moſt efficacious medicine to remove obſtructions in thoſe glands. When the belly begins to ſoften and ſubſide, the chyle paſſes without interruption, and the child begins to get fleſh; then the cold bath becomes truly ſerviceable, and the decoction or cold infuſion of the Peruvian bark is a

proper

the Diſeaſes of the Bones.

proper reſtorative; but the cold bath uſed too early, or the bark given before there is a free circulation of chyle through the lacteals, would be very injurious.

144 Palſy of the lower extremities.

Among the diſeaſes of the bones we may likewiſe take notice of that *palſy of the lower extremities* which takes place, as is generally ſuppoſed, in conſequence of a curvature in ſome parts of the ſpine. To this diſtemper both ſexes and all ages are liable. When it attacks an infant of only a year or two old or younger, the true cauſe of it is ſeldom diſcovered until ſome time after the effect has taken place. The child is ſaid to be uncommonly backward in the uſe of his legs, or it is thought to have received ſome hurt in the birth. When the child is of an age ſufficient to have already walked, and who has been able to walk, the loſs of the uſe of his legs is gradual, though in general not very ſlow. He at firſt complains of being very ſoon tired, is languid, liſtleſs, and unwilling to move much or at all briſkly. Soon after this he may be obſerved frequently to trip and ſtumble, though there be no impediment in his way; and whenever he attempts to move briſkly, he finds that his legs involuntarily croſs each other, by which he is frequently thrown down without ſtumbling; and when he endeavours to ſtand ſtill in an erect poſture without ſupport, even for a few minutes, his knees give way and bend forward. As the diſtemper advances, it will be found that he cannot, without much difficulty and deliberation, direct either of his feet exactly to any one point; and very ſoon after this, both legs and thighs loſe a good deal of their natural ſenſibility, and become quite uſeleſs. In adults, the progreſs of the diſeaſe is much quicker, but the ſymptoms nearly the ſame.

Until the curvature of the ſpine is diſcovered, the complaint generally paſſes for a nervous one; but when the ſtate of the back bone is adverted to, recourſe is almoſt always had to ſome previous violence to account for it. That this might have been the caſe in ſome few inſtances might be admitted; but in by far the greateſt number ſome prediſpoſing cauſe muſt be looked for.

Mr Pott, who has written a treatiſe upon this diſeaſe, recommends it to our obſervation, that though the lower limbs are rendered almoſt uſeleſs, or even entirely ſo, yet there are ſome circumſtances in which it differs from a common nervous palſy. The legs and thighs, though ſo much affected, have neither the flabby feel of a truly paralytic limb; nor have they that ſeeming looſeneſs at the joints, nor the total incapacity of reſiſtance, which allows the latter to be twiſted almoſt in all directions: on the contrary, the joints have frequently a conſiderable degree of ſtiffneſs, particularly the ankles; by which ſtiffneſs the feet of children are generally pointed downward, and they are prevented from ſetting them flat upon the ground.

At firſt the general health of the patient ſeems not to be at all, or at leaſt not materially affected; but when the diſeaſe has continued for ſome time, and the curvature is thereby increaſed, many inconveniences and complaints come on; ſuch as difficulty in reſpiration, indigeſtion, pain, and what they call *tightneſs at the ſtomach*, obſtinate conſtipations, purgings, involuntary flux of urine and fæces, &c. with the addition of ſome nervous complaints, which are partly cauſed by the alterations made in the form of the cavity of the thorax, and partly by impreſſions made on the abdominal viſcera.

Mr Pott was led to a knowledge of the true cauſe and cure of this diſtemper, from obſerving the caſe of a youth of 14, who was reſtored to the uſe of his limbs immediately after a ſeemingly accidental abſceſs near the part. From this he was inclined to think, that the curvature of the ſpine was not the original cauſe of the diſorder, but that the ſurrounding parts were prediſpoſed towards it by ſome affection of the ſolids and fluids there; and he was confirmed in theſe ſuſpicions by a variety of appearances, which he obſerved both in the living body and upon diſſection of the ſubject after death; all of which are narrated at full length in his treatiſe upon this ſubject.

Of the Diſeaſes of the Arterial Syſtem.

"The remedy (ſays he) for this moſt dreadful diſeaſe conſiſts merely in procuring a large diſcharge of matter, by ſuppuration, from underneath the membrana adipoſa on each ſide of the curvature, and in maintaining ſuch diſcharge until the patient ſhall have perfectly recovered the uſe of his legs. To accompliſh this purpoſe, I have made uſe of different means, ſuch as ſetons, iſſues made by inciſion, and iſſues made by cauſtic; and although there be no very material difference, I do upon the whole prefer the laſt. A ſeton is a painful and a naſty thing: beſides which it frequently wears through the ſkin before the end for which it was made can be accompliſhed. Iſſues made by inciſion, if they be large enough for the intended purpoſe, are apt to become inflamed, and to be very troubleſome before they come to ſuppuration; but openings made by cauſtic are not in general liable to any of theſe inconveniences, at leaſt not ſo frequently nor in the ſame degree: they are neither ſo troubleſome to make or maintain. I make the eſchars of an oval form, about two-thirds of an inch in diameter on each ſide of the curve, taking care to leave a ſufficient portion of ſkin between them. In a few days, when the eſchar begins to looſen and ſeparate, I cut out all the middle, and put into each a large kidney-bean: when the bottoms of the ſores are become clean by ſuppuration, I ſprinkle, every third or fourth day, a ſmall quantity of finely powdered cantharides on them, by which the ſores are prevented from contracting, the diſcharge increaſed, and poſſibly other benefit obtained. The iſſues I keep open until the cure is complete; that is, until the patient recovers perfectly the uſe of his legs, or even for ſome time longer: and I ſhould think that it would be more prudent to heal only one of them firſt, keeping the other open for ſome time; that is, not only until the patient can walk, but until he can walk firmly, briſkly, and without the aſſiſtance of a ſtick: until he can ſtand quite upright, and has recovered all the height which the habit or rather the neceſſity of ſtooping, occaſioned by the diſtempers, had made him loſe."

Chap. VII.

145

Of the Diſeaſes of the Arterial System.

Sect. I. *General Remarks on the Diſeaſes of the Arterial Syſtem.*

The diſeaſes of the vaſcular ſyſtem form an important claſs in ſyſtems of Noſology. In the diſeaſes of every organ, the action of the arteries and veins is more or leſs influenced, though the changes of ſtructure to which theſe veſſels are ſubject are very limited. The only

diſeaſes.

Of Aneuriſms.

diſeaſes to be conſidered in a ſyſtem of ſurgery, are aneuriſm and varix.

146

Sect. II. *Of Aneuriſms.*

The term *aneuriſm* was originally meant to ſignify a tumor formed by the dilatation of the coats of an artery; but by modern practitioners it applies not only to tumors of this kind, but to ſuch as are formed by blood effuſed from arteries into the contiguous parts. There are three ſpecies generally enumerated; the true or *encysted*, the falſe or *diffuſed*, and the *varicoſe* aneuriſm.

147 Of the encyſted aneuriſm.

The *true* or *encysted* aneuriſm, when ſituated near the ſurface of the body, produces a tumor at firſt ſmall and circumſcribed; the ſkin retains its natural appearance: when preſſed by the fingers, a pulſation is evidently diſtinguiſhed; and with very little force the contents of the ſwelling may be made to diſappear; but they immediately return upon removing the preſſure. By degrees the ſwelling increaſes, and becomes more prominent; the ſkin turns paler than uſual, and in more advanced ſtages is œdematous: the pulſation ſtill continues; but parts of the tumor become firm from the coagulation of the contained blood, and yield little to preſſure; at laſt the ſwelling increaſes in a gradual manner, and is attended with a great degree of pain. The ſkin turns livid, and has a gangrenous appearance. There is an oozing of bloody ſerum from the integuments; and, if mortification do not take place, the ſkin cracks in different parts; and the artery being now deprived of the uſual reſiſtance, the blood burſts out with ſuch force as to occaſion the almoſt immediate death of the patient.

When affections of this kind happen in the larger arteries, the ſoft parts not only yield to a great extent, but even the bones frequently undergo a great degree of derangement.

148 Of the diffuſed aneuriſm.

The *falſe* or *diffuſed* aneuriſm conſiſts in a wound or rupture in an artery, producing, by the blood thrown out of it, a ſwelling in the contiguous parts. It is moſt frequently produced by a wound made directly into the artery. A tumor, about the ſize of a horſe-bean, generally riſes at the orifice in the artery ſoon after the diſcharge of the blood has been ſtopped by compreſſion. At firſt it is ſoft, has a ſtrong pulſation, and yields a little to preſſure, but cannot be made entirely to diſappear; for the blood forming the tumor being at reſt, begins to coagulate. If not improperly treated by much preſſure, it generally remains nearly of the ſame ſize for ſeveral weeks. The enlargement however proceeds more rapidly in ſome caſes than in others. Inſtances have occurred of the blood being diffuſed over the whole arm in the ſpace of a few hours; while, on the contrary, ſwellings of this kind have been many months, nay even years, in arriving at any conſiderable ſize.

As the tumor becomes larger, it does not, like the true aneuriſm, grow much more prominent, but rather ſpreads and diffuſes itſelf into the ſurrounding parts. By degrees it acquires a firm conſiſtence; and the pulſation, which was at firſt conſiderable, gradually diminiſhes, till it is ſometimes ſcarcely perceptible. If the blood at firſt thrown out proceed from an artery deeply ſeated, the ſkin preſerves its natural appearance till the diſorder is far advanced: but when the blood gets at firſt into contact with the ſkin, the parts become inſtantly livid, indicating the approach of mortification; and a real ſphacelus has ſometimes been induced. The tumor at firſt produces little uneaſineſs; but as it increaſes in ſize, the patient complains of ſevere pain, ſtiffneſs, numbneſs, and immobility of the whole joint; and theſe ſymptoms continuing to augment, if the artery be large, and aſſiſtance not given, the teguments at laſt burſt, and death enſues.

Of Aneuriſms.

149 Of the varicoſe aneuriſm.

When an artery is punctured through a vein, as in blood-letting at the arm, the blood generally ruſhes into the yielding cellular ſubſtance, and there ſpreads ſo as to ſhut the ſides of the vein together. But in ſome inſtances where the artery happens to be in contact with the vein, the communication opened has been preſerved; and the vein not being ſufficiently ſtrong for reſiſting the impulſe of the artery, muſt conſequently be dilated. This is a *varicoſe aneuriſm.* Soon after the injury the vein immediately communicating with the artery begins to ſwell, and enlarge gradually. If there be any conſiderable communications in the neighbourhood, the veins which form them are alſo enlarged. The tumor diſappears upon preſſure, the blood contained in it being chiefly puſhed forwards in its courſe towards the heart; and when the tumor is large, there is a ſingular tremulous motion, attended with a perpetual hiſſing noiſe, as if air was paſſing into it through a ſmall aperture.

If a ligature be applied upon the limb immediately below the ſwelling, tight enough to ſtop the pulſe in the under part of the member, the ſwelling diſappears by preſſure, but returns immediately upon the preſſure being removed. If, after the ſwelling is removed by preſſure, the finger be placed upon the orifice in the artery, the veins remain perfectly flaccid till the preſſure is taken off. If the trunk of the artery be compreſſed above the orifice, ſo as effectually to ſtop the circulation, the tremulous motion and hiſſing noiſe immediately ceaſe; and if the veins be now emptied by preſſure, they remain ſo till the compreſſion upon the artery be removed. If the vein be compreſſed a little above, as well as below the tumor, all the blood may generally, though not always, be puſhed through the orifice into the artery; from whence it immediately returns on the preſſure being diſcontinued.

When the diſeaſe has continued long, and the dilatation of the veins has become conſiderable, the trunk of the artery above the orifice generally becomes greatly enlarged, while that below becomes proportionably ſmall; of conſequence the pulſe in the under part of the member is always more feeble than in the ſound limb of the oppoſite ſide.

150 Diagnoſis of aneuriſm.

Aneuriſms have frequently been miſtaken for abſceſſes and other collections of matter, and have been laid open by inciſion; on which account great attention is ſometimes required to make the proper diſtinction. In the commencement of the diſeaſe the pulſation in the tumor is commonly ſo ſtrong, and other concomitant circumſtances ſo evidently point out the nature of the diſorder, that little or no doubt reſpecting it can ever take place; but in the more advanced ſtages of the diſeaſe, when the ſwelling has become large and has loſt its pulſation, nothing but a minute attention to the previous hiſtory of the caſe can enable the practitioner to form a judgment of its nature.

Aneuriſms may be confounded with ſoft encyſted tumors,

Of Aneurisms.

mors, scrofulous swellings, and abscesses situated so near to an artery as to be affected by its pulsation. But one symptom, when connected with strong pulsation, may always lead to a certain determination that the swelling is of the aneurismal kind, viz. the contents of the tumor being made easily to disappear upon pressure, and their returning on the compression being removed. The want of this circumstance, however, ought not to convince us that it is not of that nature; for it frequently happens, especially in the advanced stages of aneurisms, that their contents become so firm that no effect is produced upon them by pressure. Hence the propriety, in doubtful cases, of proceeding as if the disease was clearly of the aneurismal kind.

151 Prognosis.

In the prognosis, three circumstances are chiefly to be attended to; the manner in which the disease appears to have been produced, the part of the body in which the swelling is situated, and the age and habit of body of the patient.

If an aneurism has come forward in a gradual manner, without any apparent injury done to the part, and not succeeding any violent bodily exertion, there will be reason to suppose that the disease depends upon a general affection either of the trunk in which it occurs, or of the whole arterial system. In such cases art can give little assistance; whereas if the tumor has succeeded an external accident, an operation may be attended with success.

In the varicose aneurism a more favourable prognosis may generally be given than in either of the other two species. It does not proceed so rapidly; when it has arrived at a certain length, it does not afterwards acquire much additional size; and it may be sustained without much inconvenience for a great number of years. As long as there is reason to expect this, the hazard which almost always attends the operation ought to be avoided.

Treatment.—In every case of aneurism, the use of pressure has been indiscriminately recommended, not only in the incipient period of the disease, but even in its more advanced stages. In the diffused or false aneurism, as pressure cannot be applied to the artery alone, without at the same time affecting the refluent veins; and as this, by producing an increased resistance to the arterial pulsations, must force an additional quantity of blood to the orifice in the artery—no advantage is to be expected from it, though it may be productive of mischief.

152 Pressure.

In the early stages of encysted aneurism, while the blood can be yet pressed entirely out of the sac into the artery, it often happens, by the use of a bandage of soft and somewhat elastic materials, properly fitted to the part, that much may be done in preventing the swelling from receiving any degree of increase; and on some occasions, by the continued support thus given to the weakened artery, complete cures have been at last obtained. In all such cases, therefore, particularly in every instance of the varicose aneurism, much advantage may be expected from moderate pressure.

But pressure, even in encysted aneurism, ought never to be carried to any great length; for tight bandages, by producing an immoderate degree of reaction in the containing parts to which they are applied, instead of answering the purpose for which they were intended, have evidently the contrary effect. Indeed the greatest length to which pressure in such cases ought to go, should be to serve as an easy support to the parts affected.

Of late years the subject of aneurism has attracted the notice of several eminent surgeons of this country; and arterial trunks have been successfully tied, which had been often proposed, but never executed. Mr John Bell several years ago, tied the trunk of the gluteal artery. Mr Abernethy of St Bartholomew's hospital, tied the common femoral. Mr Astley Cooper of Guys, tied the common carotid; and Mr Ramsden of St Bartholomew's hospital, has lately tied the subclavian artery.

Sect. III. *Of the Popliteal Aneurism.* 153

We are indebted to Mr John Hunter for the ingenious operation for popliteal aneurism. The operation consists in exposing the femoral artery about the middle of the thigh, and putting a ligature round the vessel. An incision is to be made through the integuments, two inches and a half in length on the inner edge of the sartorius muscle (see Plate DXVI. fig. 1.). An incision is to be made through the sheath containing the artery with its accompanying vein and nerve, and a double ligature is to be introduced underneath it, by means of a blunt needle; care being taken not to include either the femoral vein, or crural nerve. One ligature is to be tied as high up, and the other as low as the artery is separated from the contiguous parts; the distance between the two being rather more than half an inch. The artery should then be divided by a probe-pointed bistoury, (Plate DXIII.) in the interspace between the two ligatures, but nearer to the lower ligature than to the upper one. The ligature should be moderately thick, in order that the noose may be drawn as tightly as possible, without risk of tearing, or cutting the coats of the vessel. The limb may be kept warm after the operation, by artificial heat if necessary; and the wound treated in the usual manner.

* See Plate DXIII.

Sect. IV. *Of the Femoral Aneurism.* 154

The external iliac artery was first tied by Mr Abernethy*; and there are now eight cases on record where the practice has been followed, six of which were successful. Mr Abernethy's operation consists in making an incision through the integuments of the abdomen, about three inches in length in the direction of the artery, beginning just above Poupart's ligament, (see Plate DXVI. fig. 1.) and half an inch on the outside of the abdominal ring, in order to avoid the epigastric artery. The aponeurosis of the external oblique muscle is then to be divided in the direction of the wound. The lower margin of the internal oblique and transverse muscles is to be cut with a crooked bistoury. The finger may then be passed between the peritonæum by the side of the psoas muscle, so as to touch the artery. A double ligature is to be put underneath the vessel, and tied as in the operation for popliteal aneurism.

* See *Mr Abernethy's Surgical Observations.*

Sect. V. *Of the Carotid Aneurism.* 155

It had been repeatedly proposed to tie the carotid artery; but the operation was first performed by Mr Astley

Aſtley Cooper. There are three inſtances of this artery having been ſucceſsfully tied, ſo that there is ſufficient encouragement to adopt the practice in future caſes, where there is room to tie the artery above the ſternum. The operation is to be done by making an inciſion on the ſide of the artery next the trachea, laying bare the veſſel, and carefully avoiding the par vagum and the recurrent branch in placing the ligature.

156 SECT. VI. *Of the Axillary Aneuriſm.*

Mr Keate of St George's Hoſpital, tied with ſucceſs the axillary artery, where it paſſes over the firſt rib; and Mr Ramſden has lately tied the ſubclavian artery for an axillary aneuriſm. The patient however died. A ſimilar operation was attempted by Mr Cooper, but he failed in tying the ligature round the artery, from the bulk of the tumor. The great difficulty felt in theſe operations was the paſſing of the ligature below the veſſel on account of its depth. Some contrivance is therefore neceſſary in order to facilitate this part of the operation.

CHAP. VIII.

Of the Diſeaſes of the VENOUS SYSTEM.

157 SECT. I. *Of Varicoſe Veins.*

WHEN the veins of any organ become preternaturally dilated, they are ſaid to be *varicoſe*. This ſtate of the veins is moſt uſually met with in thoſe which are ſuperficial, and ſeems to ariſe either from ſome mechanical cauſe preventing the ready flow of blood through them, or from the veins themſelves loſing the neceſſary ſupport of the ſkin and adjacent parts. The gravid uterus, by preſſing on the iliac veſſels, frequently renders the veins of the lower extremity varicoſe. Various tumors produce ſimilar effects. We alſo ſee the veins of the integuments of old people become tortuous and ſwelled from no mechanical preſſure.

Varicoſe veins are a frequent attendant on ulcers of the leg, and it has been obſerved that the ulcer ſeldom or ever heals until the varix is cured.

Varicoſe veins of the extremities may generally be much relieved by the application of a proper bandage from the toes upwards; and in caſes where this does not give relief, the venous trunk ſhould be tied with a ligature as directed in aneuriſm.

158 SECT. II. *Varicoſe Spermatic Veins* (Variocele).

The veins of the ſpermatic cord often remain varicoſe after inflammation of the teſticle, and alſo in early life without any known cauſe. The diſeaſe is generally eaſily diſtinguiſhed by the tortuous irregular ſwelling. It ſometimes, however, acquires a large ſize; but even then its nature may be readily diſtinguiſhed by placing the patient in a horizontal poſition, and applying preſſure to the tumor. By this the ſwelling diſappears, and if the upper part be graſped ſo as to allow nothing to paſs out of the abdomen, the ſwelling will nevertheleſs be again formed.

The diſeaſe occurs moſt frequently in the left ſide, and this may ariſe from the vein in that ſide not terminating directly in the vena cava, but in the emulgent.

Treatment.—The uſe of aſtringents, along with a proper ſuſpenſory bandage, will generally afford relief. It has alſo been propoſed to tie a ligature round one or more of the varicoſe veſſels. In one caſe this was done with complete ſucceſs.

159 SECT. III. *Of Hæmorrhoidal Tumors.*

The hæmorrhoidal tumor conſiſts in a dilatation of the veins about the anus and extremity of the rectum. They are round ſmooth tumors of a purple colour, and more or leſs painful. They vary in their ſize and number. Sometimes they are accompanied by a regular periodical diſcharge of blood (bleeding piles), and in other caſes no ſuch diſcharge takes place (blind piles), and then they are more ſubject to inflammatory attacks.

Hæmorrhoids occur more frequently in women than in men, and they commonly ariſe from a long continued preſſure on the rectum; as obſtinate coſtiveneſs, prolapſus, geſtation, calculus or tumors about the bladder, uterus, or vagina.

Treatment.—When they are inflamed, local bleeding, fomentations and poultices give much relief, care being taken at the ſame time to keep the tumors within the anus, and to keep the bowels very open by mild laxatives and clyſters.

In ſome caſes the piles acquire a very conſiderable bulk, and form a number of large and looſe tumors round the anus, which prevent the free diſcharge of fæces. In ſuch caſes the tumors ought to be removed, and this may be beſt done with the knife; or, as ſometimes happens, if they be ſo ſituated as to render this dangerous, they may be removed by a ligature.

CHAP. IX.

Of the Diſeaſes of the GLANDULAR SYSTEM.

General Remarks on the Pathology of the Glands. 160

WE obſerve a vaſt variety of diſeaſes of the glandular ſyſtem, and the greater number of theſe ariſe from a morbid ſtate of their ſecretions. We ſee ſtriking examples of an increaſed ſecretion in diabetes, in the mercurial ſalivation, and in many bilious diſorders: on the other hand the natural ſecretion is diminiſhed in ſuppreſſion of urine, in dryneſs of the mouth, &c.

An alteration in the ſecretory function is not, however, the only diſeaſe of this ſyſtem; there are a great number of organic alterations of ſtructure with which they are affected, and a variety of tumors are alſo found to form in them. As, however, moſt of the principal glands of the body are ſituated within the larger cavities, few of their diſeaſes come within the province of the ſurgeon.

SECT. I. *Of the Diſeaſes of the Teſticle.* 161

1. *Of the Schirrus and Cancer of the Teſticle*, (Sarcocele).

This affection is liable to a conſiderable variety in its appearances; and as in the deſcription of it which has been given by authors, they have included ſymptoms of diſeaſes

diſeaſes which are very different from the true ſchirrus.

The moſt remarkable ſymptom of ſchirrous teſticle is a gradual enlargement and induration of the body of the gland or epididimis, advancing from one point, without marks of inflammation or pain. Along with its increaſe in bulk it acquires additional hardneſs, and its

162 ſurface, from being ſmooth, turns by degrees unequal and
ymptoms. knotty. The integuments become of a purpliſh red, at laſt ulcerate, diſcharge a fœtid ichor, and a cancerous fungus grows from the wound. The ſpermatic chord alſo becomes enlarged, knotty, and hard, and the glands of the groin ſwell, the health of the patient becoming entirely deſtroyed, and at laſt carrying him off in the greateſt miſery.

The progreſs of this diſeaſe is in general ſlow, and is commonly attended with an aching ſenſation about the teſticle, and ſevere pain darting from it to the loins, particularly when the teſticle is not ſupported. The diſeaſe is moſt frequent in the advanced ſtages of life. It commonly ariſes from an unknown cauſe. It has at times been known to ſucceed a venereal affection, but this is by no means common, and it is ſometimes preceded by a blow or ſome accident which excites inflammation.

163 When the ſchirrous teſticle is examined by diſſection,
Appear- Dr Baillie obſerves that "it is found to be changed into
ances on a hard maſs of a browniſh colour, which is generally
ſiſſection. more or leſs interſected by membrane. In this there is no veſtige of the natural ſtructure, but cells are frequently obſervable in it containing a ſanious fluid, and ſometimes there is a mixture of cartilage." Sometimes water is found collected in the cavity of the tunica vaginalis, but more frequently the tunics adhere to each other. When the ſpermatic chord is affected, that exhibits the ſame changes of ſtructure as the teſticle itſelf.

164 *Treatment.*—When a teſticle is known to be affected with the true ſchirrus, all proſpect of a cure by the exhibition of internal or external remedies becomes hopeleſs, as there is no fact better known and more ſeverely felt in the hiſtory of ſchirrus and cancer in every organ of the body, than its reſiſting all means of relief, but by the complete removal of the diſeaſed part. In a few rare caſes, by a moderate diet, keeping the bowels open, ſuſpending the tumor, avoiding violent exerciſe, or any thing which may prove a ſource of irritation, the diſorder has been ſaid to be not only prevented from increaſing, but has in a gradual manner entirely diſappeared; but we much ſuſpect that theſe caſes whoſe termination was ſo favourable, have not been of a ſchirrous nature. This is probable from what is known of the termination of ſchirrus in other organs of the body, and alſo from the difficulty we have in forming an accurate diagnoſis in the diſeaſes of the teſticle. There are, we heſitate not to ſay, many teſticles extirpated which might have been ſaved; for our imperfect knowledge of the various morbid changes of this organ, has made it too much an eſtabliſhed practice to extirpate all teſticles which are enlarged and hard, and which do not yield to mercury.

When, however, by an attentive examination of the hiſtory and ſymptoms of the diſeaſe, no doubt is entertained of its ſchirrous or cancerous nature, the more ſpeedily the tumor is removed, the better chance there is of a permanent cure. In performing the operation, care ſhould be taken to remove completely every part ſuſpected to be diſeaſed, and no part of the ſkin ſhould be left with a view of covering the wound more completely which has the leaſt diſcolouration or mark of diſeaſe.

Mode of extirpating the Teſticle. 165

The parts being previouſly ſhaved, the patient is to be laid upon a firm table covered with a blanket or mattreſs. His legs ſhould hang over the table, and be ſupported by aſſiſtants. An inciſion is to be made through the integuments with a common ſcalpel, extending from a little above the external abdominal ring to the bottom of the ſcrotum. The cellular membrane around the ſpermatic chord is to be diſſected back, and the chord laid fairly bare; and this part of the operation is much more eaſily accompliſhed when the inciſion through the ſkin is very free. A ligature of conſiderable thickneſs is to be put underneath the chord, and it may be introduced with a blunt-pointed needle or inſtrument (fig. 17. Plate DXIII.). The extent of the diſeaſe in the chord ſhould now be examined as accurately as poſſible, and the ligature ſhould be tied firm with a running knot, as far above the diſeaſed part as poſſible. If any hardneſs extends to the external abdominal ring, the chord may be even diſſected up along the inguinal canal, and the ligature put on at that place. The chord may be divided one-fourth of an inch below where the ligature has been applied, and then the whole of the teſticle and its vaginal coat may be readily diſſected away, taking care not to cut into the vaginal cavity of the oppoſite ſide of the ſcrotum. After the teſticle is removed, the ligature ſhould be looſened, and the ſpermatic artery and veins included in ſeparate ligatures. The ligature upon the ſpermatic chord is to be left looſe, ſo as to act as a tourniquet if a hæmorrhagy ſhould enſue. Much care ſhould alſo be taken to ſecure any arteries of the integuments of the ſcrotum which are ſeen bleeding; as we once met with a very troubleſome hæmorrhagy from one of theſe retracting among the looſe cellular texture, and not being ſeen after the operation. It therefore will be a good general rule to tie thoſe with ligatures immediately after they are divided.

The wound is to be dreſſed, ſo as to be healed if poſſible by adheſion; and this may generally be accompliſhed, except at the upper part where the ligatures come through. With this view the wound and ſcrotum are to be carefully waſhed, and two or three ſtitches, as may be thought moſt expedient, are to be put through the edges of the wound; for in a part like the ſcrotum, where the ſkin is looſe and puckered, it is hardly poſſible to apply adheſive ſtraps with ſufficient accuracy, ſo as to ſerve the purpoſe. Small pieces of adheſive plaſter, however, ſhould be neatly placed between each of the ſtitches, along the whole extent of the wound, and a pledget of ſimple ointment and compreſs afterwards to be laid over it, the whole being ſecured with a T bandage.

After the operation, the patient is to be put to bed, being directed to lie on his back with a pillow between the thighs, ſo as to ſupport the ſcrotum.

Opiates ſhould be given to allay pain, and if any inflammatory ſymptoms ſupervene, bleeding at the arm ſhould be had recourſe to without the leaſt heſitation;

for we have made a general remark, that after almoſt all ſurgical operations, there has ſcarcely ever an inſtance occurred where the patient died from loſs of blood, and on the contrary, that almoſt all patients who have loſt much blood, or who have been previouſly much emaciated, have recovered more quickly than thoſe in full health. The antiphlogiſtic regimen in almoſt every caſe ſhould be rigidly purſued, until at leaſt all inflammatory appearances of the wound are gone, and a healthy

166 Mode of dreſſing the wound.

ſuppuration commenced. About four, five, or ſix days, according to circumſtances, the dreſſings ſhould be removed, and if the wound has healed by adheſion, the ſtitches may be withdrawn, and the edges of the wound kept together by adheſive plaſters. The ligature on the ſpermatic chord may now be ſafely taken away, and that round the ſpermatic artery and veins generally comes readily away before the tenth dreſſing. In this manner the wound ſhould be dreſſed daily until it is cicatriſed. When the wound, inſtead of healing by adheſion, ſuppurates, the ſtitches may be taken away as ſoon as it appears that the edges of the wound can be accurately kept together with the adheſive plaſters; for if the ſtitches are allowed to remain long, they generally ulcerate the contiguous ſkin, and form ſinuſes, which continue to diſcharge matter after the reſt of the wound has healed. The wound ſhould be dreſſed once or even twice in twenty-four hours if the diſcharge be profuſe, and care ſhould be taken to waſh away with a ſponge any matter which may be depoſited on the ſound ſkin of the ſcrotum or groin. The edges of the wound ſhould be brought accurately together at each dreſſing, any matter collected in different parts of it ſhould be gently ſqueezed out, ſo as to prevent any lodgement from taking place. Should the patient become weak from the continuance of the diſcharge, he ſhould be ordered a nouriſhing diet, with a proper proportion of wine; and if the diſcharge be at any time thin and very profuſe, we have found much benefit in ſuch a caſe from the internal uſe of bark (cinchona).

2. *Inflammation of the Teſticle* (Hernia humoralis).

167 Symptoms.

Inflammation is one of the moſt frequent diſeaſes of the teſticle. Sometimes the inflammation is confined to the ſubſtance of the teſticle, at other times it affects the epididimis, and in ſome caſes it ſpreads to the albuginea and vaginalis. The ſurface of the inflamed teſticle is uniform and ſmooth, more or leſs ſenſible to the touch, equally firm and tenſe throughout when preſſed upon, and the integuments are generally diſcoloured, having a bluſh of redneſs, and interſperſed with varicoſe veins. When examined by diſſection, the teſticle exhibits, according to Dr Baillie, preciſely the ſame appearances as the inflammation of the ſubſtance of other parts. The vas deferens ſometimes partakes of the inflammation, its coats becoming conſiderably thickened, and in other inſtances the veins of the ſpermatic chord become varicoſe. Inflammation of the teſticle moſt frequently is preceded by gonorrhœa, but it alſo occurs from a variety of cauſes. It occurs ſometimes from expoſure to cold, from violent exerciſe, and is often excited from blows, riding on horſeback, &c.

The inflammation of the teſticle concomitant of gonorrhœa generally begins by ſpreading along the vas deferens from the proſtate gland through the inguinal canal till it comes to the teſticle; it is in moſt caſes attended with excruciating pain from the rapidity of its progreſs; and as it commonly comes on when the gonorrhœal diſcharge diminiſhes or diſappears, and ſubſides when the diſcharge returns, many authors have ſuppoſed that it was a true metaſtaſis of the venereal matter.

If the diſeaſe be left to itſelf, the body of the teſticle becomes more hard and painful, with all the ſymptoms of local inflammation, and the tumor ſometimes acquires an enormous bulk. Sometimes the inflammation is accompanied with violent fever, with a pulſe hard and ſtrong in the plethoric, and feeble and rapid in conſtitutions which are delicate and irritable. The patient alſo often complains of pains in the loins, and has naufea and vomiting. In general the diſcharge from the urethra diminiſhes conſiderably, and often it ceaſes altogether before the teſticle becomes affected; but ſometimes that does not happen in any remarkable degree till one or two days after the ſwelling has begun to appear. It never happens that both teſticles are affected at the ſame time, but when the ſwelling of one diſappears, often the other one begins to be attacked.

The teſticles ſometimes ſwell and inflame from the abſorption of the matter of a chancre, and as the progreſs of the ſwelling is in ſuch caſes ſlow, and generally more irregular, it has ſometimes been miſtaken for a ſchirrous teſticle; but an inveſtigation into the hiſtory of the caſe, and particular attention to the appearance of the ſkin of the ſcrotum, and any ſymptoms of the venereal diſeaſe in other parts of the body, will generally lead to a knowledge of the true nature of the caſe. It ſometimes happens that inflammation is chiefly confined to the ſpermatic chord, and in many caſes it affects the epididimis alone. The extent of the diſeaſe is always eaſily aſcertained by a careful examination of the parts. It ſeldom happens that both teſticles are inflamed at once; we have, however, remarked this to take place. Inflammation, ſuch as has now been deſcribed, generally abates by the application of proper remedies: in ſome caſes, however, an induration of the teſticle remains. It terminates, though rarely, in ſuppuration.

Treatment.—When an inflammation has ariſen from 168
a blow, from expoſure to cold, or from any injury done to the teſticle, it ought to be treated according to the general plan laid down of treating inflammation of other organs. Local bleeding by leeches is a moſt uſeful remedy, and ought to be the firſt thing employed if there is the ſlighteſt pain, tenderneſs, or redneſs of the ſcrotum. Fomenting the ſcrotum with warm water, or a decoction of poppy heads, chamomile flowers, or tobacco leaves, often gives much relief, and great attention ſhould be paid in ſupporting the teſticle with a ſilk net truſs (Plate DXIV.). Some have alſo uſed with ſucceſs the application of ice or ſnow to the part. If the ſymptoms and pain are very violent, bleeding at the arm may be neceſſary. The bowels ſhould be kept open, and even purged; the patient ſhould be confined to a low diet, and he ſhould keep as much as poſſible to the horizontal poſture, as this is found to be of the greateſt importance in promoting the cure.

When the inflammation ariſes from gonorrhœa, particular attention muſt be paid not only to the diſeaſe in the teſticle, but to that of the urethra. Indeed it is of much importance in the treatment of gonorrhœa to uſe

means

Of the Diſeaſes of the Teſticle.

means to prevent the teſticles from becoming inflamed; and as every thing which cauſes a ſuppreſſion of the diſcharge tends to produce a ſwelling of the teſticle, it is natural to ſuppoſe, that in order to prevent this troubleſome diſorder, every thing ſhould be avoided capable of increaſing the irritation and inflammation of the urethra, as expoſure to cold, violent exerciſe, ill choſen injections, and balſamic medicines; but, above all, the uſe of a ſuſpenſory is moſt efficacious, and Swediaur * recommends one to be worn in every caſe of gonorrhœa from the commencement of the diſeaſe, to prevent all riſk of the teſticles becoming inflamed. When the inflammatory ſymptoms are ſevere, the treatment ſhould be adopted as we have recommended in common inflammation of the teſticle. If the diſcharge from the urethra is ſtopt, means ſhould be uſed to reſtore it. Whenever the inflammatory fever is rendered more mild, Swediaur recommends, with this view, a doſe of opium to be given, and according to circumſtances, an injection compoſed of two or three ounces of oil of linſeed and decoction of barley, along with fifty or ſixty drops of the vinous tincture of opium. This may be repeated every ten or twelve hours, taking care always to have the bowels well opened before uſing it. Swediaur has found the extract of hyoſcyamus in many caſes anſwer better than opium. Fomentating the penis and adjacent parts with warm vinegar and water, injecting warm oil, and the uſe of bougies, may alſo be advantageous in promoting the diſcharge from the urethra.

* *Traité ſur les Maladies Veneriennes.*

169 3. *Induration of the Teſticle.*

After the inflammatory ſymptoms have abated, it generally happens that a degree of ſwelling and hardneſs of the body of the teſticle, but ſtill more frequently of the ſpermatic cord or epididimis, remains, and in many caſes continues for months, or even during life. This effect takes place from whatever cauſe the inflammation may have ariſen. In many caſes the teſticle itſelf remains quite ſound, and the epididimis is converted into a very hard unyielding maſs, which feels as if it were injected with quickſilver. Sometimes the teſticle, whilſt it remains hard, diminiſhes in ſize, and becomes much ſmaller than natural. When the teſticle is examined by diſſection, it is found to have loſt its natural ſtructure, and is ſometimes changed into a hard brown-coloured maſs (Voigtel), interſected more or leſs by membranous bands; ſometimes parts having a cartilaginous quality appear in it, and ſometimes cells are formed which contain matter. The ſeminal veſſels are ſo changed and hardened, that they cannot be diſtinguiſhed from each other. In ſome caſes the whole teſticle has been found converted into a cartilaginous maſs, and in a few inſtances ſome parts of it have been converted into bone.

170 Treatment. The treatment uſually recommended in caſes of induration of the teſticle preceded by inflammation, are ſtrong ſtimulating and aſtringent applications; ſuch as ſolutions of the muriate of ammonia, acetate of lead, ſulphate of zinc, &c. either applied by moiſtening with them a piece of linen, which is to be kept conſtantly wet, or by uſing them in the form of a poultice. Frictions with mercurial ointment, either ſingly or combined with camphor, over the ſcrotum and perinæum, ſometimes produce a good effect; mercurial fumigations to the genital organs have alſo been recommended. In ſome caſes the internal uſe of mercury has been found neceſſary. A mercurial plaſter with camphor, or the common ſoap plaſter, is alſo a good application, and is very uſeful in defending the teſticle.

Of the Diſeaſes of the Teſticle.

The internal and external uſe of the hemlock (*conium maculatum*) has been much recommended by Plenk. Electricity has alſo been ſucceſsfully employed. The muriate of lime, and the muriate of barytes, have been uſed by ſome authors. Swediaur ſays that he has known ſome affections of the teſticle produced by gonorrhœa, and alſo ſome diſeaſes of the eye from the ſame cauſe, cured by the patient getting a freſh infection. In a few caſes of induration, and ſwelling of the teſticles, we have employed bliſtering with good effects. The ſcrotum ſhould be ſhaved before this is done; and it is often neceſſary to repeat the bliſter ſeveral times before the hardneſs or ſwelling begin to abate.

4. *Abſceſs of the Teſticle.*

171 Symptoms. It ſometimes, though rarely happens, that the teſticle ſuppurates. The matter which is formed, is commonly a tough, thready, yellow-coloured ſubſtance, which adheres to the ſurface of the cavity in which it is contained. Sometimes there is only one abſceſs; in other caſes the matter is contained in ſeveral ſmall irregular-ſhaped cavities. Sometimes the matter is formed in the very middle of the body of the teſticle; in other caſes we have obſerved ſmall abſceſſes in different parts of the epididimis, the body of the teſticle remaining quite ſound. When an abſceſs is formed in the teſticle, the ſtructure of the gland becomes more or leſs changed; generally inſtead of being ſoft, and the tubes of which it is compoſed being eaſily ſeparated, it degenerates into a hard firm maſs.

172 Treatment. Abſceſſes of the teſticle ſhould be opened as ſoon as poſſible, in order to prevent the ſubſtance of the teſticle from being deſtroyed. The preſence of matter is learnt by a fluctuation which can be felt externally; but it is often extremely difficult to determine the true ſituation of the abſceſs, whether it is formed in the body of the teſticle, in the epididimis, or between the albuginea and tunica vaginalis, or in the cellular membrane external to the tunica vaginalis; for when ſuch a degree of inflammation has taken place as to terminate in the formation of an abſceſs, the accompanying ſwelling deſtroys the natural form of the parts, and involves the whole into a undetermined ſhapeleſs maſs. Richter remarks, that there are ſometimes ſoft ſpots in the teſticle, in which it is believed there is a fluctuation. When ſuch ſwellings are opened no matter is diſcharged, nothing but blood appears, and the inflammatory ſymptoms are afterwards increaſed. The more matter which is diſcharged from an abſceſs of the teſticle, the ſmaller the teſticle grows, as the matter is ſometimes formed partly of the thready ſubſtance of the teſticle. Caſes have occurred where the whole teſticle has been pulled away, the ſurgeon having miſtaken the ſeminiferous tubes for ſloughs. Abſceſſes of the ſubſtance of the teſticle ſeldom heal, and generally a fiſtulous opening remains, through which there is a conſtant oozing of the ſeminal fluid.

5. *Fiſtulous Sinus of the Teſticle.* 173

As far as we know, no author has taken notice of this appearance. In one caſe we obſerved it very remarkable. The epididimis alone was ſwelled, and there was

Of the Diſeaſes of the Teſticle.

a thickened portion of ſcrotum adhering to one part of it, in which there was a ſmall *ſinus*, and through which the ſeminal fluid conſtantly oozed. In a ſimilar caſe the ſinus was laid open, but with no good effect; for a ſmall opening remained unhealed, through which the ſemen continued to be diſcharged.

6. *Scrofulous Teſticle.*

174 Symptoms. When the teſticle is affected with ſcrofula, it preſents ſome of thoſe general characters of ſcrofula in other glandular parts. Its tubular appearance is deſtroyed; it becomes enlarged; and when cut, it is found to be compoſed of a dull white ſubſtance, of the conſiſtence of curd, which in ſome parts is mixed with a thin puriform fluid. The ſcrotum is in almoſt all caſes involved in the diſeaſe; it becomes red and inflamed, and the vaginal coat adheres to the albuginea. Abſceſſes alſo form in various parts of the cellular membrane of the ſcrotum, which ſometimes communicate with the body of the teſticle. This diſeaſe generally occurs during the early periods of life, and moſt commonly only one teſticle is affected with it. Sometimes, however, when one recovers, the ſame diſeaſe attacks the other.

175 Treatment. In moſt caſes of this kind ſurgical aid does not avail much, for the progreſs of the diſeaſe cannot be checked by any internal and external remedies. All that can be done is to relieve the inflammatory ſymptoms, to allay pain, and to prevent the formation of ſinuſes. With a view to alleviate the ſymptoms of inflammation, nothing is ſo beneficial as the application of leeches to the ſcrotum, and the uſe of fomentations and poulticing, or ſolutions of the acetate of lead. Opiates and laxatives may be alſo freely given, unleſs in caſes where from experience theſe are known to diſagree. When matter has once formed, the ſooner it is diſcharged the better, and this ſhould be done by a ſmall inciſion. After one abſceſs has healed, others are very apt to form in ſucceſſion; theſe ſhould be treated in the ſame manner, and if at any period of the diſeaſe ſinuſes form, they ſhould be at once laid completely open to the bottom; or if they are very deep and extenſive, a ſeton may be introduced; if this, however, does not produce an adheſion of the cavity, they ſhould be laid open with a biſtoury in the manner directed when treating of *ſinuſes*.

176 ### 7. *Teſticle preternaturally ſmall, or wanting.*

After violent attacks of inflammation, or in caſes of abſceſs, the teſticle ſometimes diminiſhes greatly in ſize, is almoſt entirely abſorbed; and in a few inſtances people have been born with them much ſmaller than natural (Baillie). Sometimes a teſticle has been known to waſte away without any known cauſe, ſo as to diſappear altogether. Sometimes one teſticle, and ſometimes both remain in the cavity of the abdomen through life; ſo that a perſon appears to have only one teſticle or to be without them altogether. Mr Hunter ſuſpects that in theſe caſes they are not ſo perfect as when they deſcend into the ſcrotum; and if we were to reaſon from what is obſerved in other animals, in the horſe particularly, where this by no means unfrequently takes place, it is highly probable that when the teſticles do not deſcend into the ſcrotum, they are not capable of performing their functions.

Theſe caſes, though they cannot be relieved by medical aid, yet they are worthy of the notice of medical men.

8. *Fungus of the Teſticle.*

Of the Diſeaſes of the Mamma.

There ſometimes ariſes from the teſticle a ſpecies of fungous tumor, which was firſt accurately deſcribed by Mr Lawrence, demonſtrator of anatomy at Bartholomew's hoſpital, in London.

177 Symptoms. The patient generally aſſigns the origin of the complaint to ſome injury. In ſome caſes, it is the conſequence of *hernia humoralis*, and in others it appears ſpontaneouſly. The ſcrotum, after a certain length of time inflames, and adheres to the teſticle already ſwelled; at laſt the ſkin ulcerates, and the opening thus formed, inſtead of diſcharging matter, is filled up with a fungous tumor, which is of a firm texture, and generally inſenſible. Whilſt the fungus is increaſing, the inflammation of the ſcrotum diminiſhes; and if the fungus is at this time removed, a cicatrix is formed in the ſkin, which adheres to the teſticle. There is ſometimes a copious and very fœtid diſcharge from the whole ſurface of the fungus. On diſſection, the fungus is found to ariſe from the pulpy ſubſtance of the teſticle, more or leſs of which remains according to the duration and extent of the diſeaſe.

It may be worth while to remark here, that we have met with one caſe, where, from an abſceſs and ulceration of the ſcrotum, the teſticle itſelf ſlipt out at the ulcerated orifice, and exhibited very much the appearance of the fungus above deſcribed.

178 Treatment. This ſpecies of tumor may be ſafely removed by the knife, by ligature, or by eſcharotics; the removal by the knife is perhaps the ſafeſt, and certainly the moſt expeditious method.

For an account of *Fungus Hæmatodes* in the teſticle, we refer to *Wardrop's Obſervations on Fungus Hæmatodes*.

Sect. II. *Of the Diſeaſes of the Mamma.*

179 General obſervations. From the changes which take place in the female breaſt at the age of puberty, during the menſtrual diſcharge, and before and after the birth of the child, we ought to expect a conſiderable variety in the diſeaſes of this organ; and, in conſidering theſe, we ſhould always keep in view the powerful ſympathy between that gland and the uterine ſyſtem.

The gland of the mamma is ſubject to inflammation and abſceſs. Scrofulous tumors alſo form in it; it is ſubject to a particular diſeaſe, called milk abſceſs, to ſcirrhus, and to other ſpecies of indurations, the nature of which is not well aſcertained.

The nipple and integuments around it are alſo ſubject to particular kinds of excoriations and ulcerations; the lymphatic glands which lie cloſe to the mamma, are alſo frequently diſeaſed, and the contiguous cellular membrane is ſubject to thoſe diſeaſes which are met with in the cellular membrane of other parts of the body.

At the age of puberty, when the uterine ſyſtem becomes fully developed, the female breaſt ſwells, turns hard, and becomes tender, or even painful. A change alſo takes place during pregnancy; the breaſt enlarges, becomes very tender and painful, and a dark-coloured zone is obſerved round the nipple. In women who are ſuckling about the ninth or tenth month after parturition, and ſometimes ſooner, the menſes reappear; and

if

Of the Diſeaſes of the Mamma.

if the woman afterwards continues to ſuckle, at each monthly return a remarkable change takes place in the milk; it loſes its ſweetneſs, acquires a bitteriſh taſte, becomes of a reddiſh colour, and excites a temporary derangement in the ſyſtem of the child. Obſtructions of the menſes, their final ceſſation, and all the diſeaſes of the womb, affect more or leſs the mamma; and it is at the age of puberty, at the time of menſtruation, during pregnancy, in the early months of ſuckling, and at the time of the ceſſation of the menſes, which are the peculiar periods when blows and other injuries are moſt apt to produce diſeaſe in the mamma.

This conſent between the mamma and uterine ſyſtem ought to be always kept in view when forming our opinion of any diſeaſe in theſe organs; and it is particularly worthy of the notice of ſurgeons when operations on that organ become neceſſary.

1. *Of Inflammation and Abſceſs of the Mamma.*

This diſorder occurs moſt frequently in nurſes by the ſtoppage of the milk, which is always occaſioned by ſudden or imprudent expoſure to cold.

180 Treatment. In the early ſtages of the affection, reſolution is to be attempted, unleſs the ſwelling appears to have an evident tendency towards ſuppuration. The remedies uſed in inflammation, in general, ſeem uſeful in every caſe of inflammation of the breaſts. When the patient happens to be nurſing, a ſudden evacuation of blood is apt to diminiſh the quantity of milk: In ſuch caſes, therefore, blood is to be extracted in ſmall quantities at a time. The application of cooling ſaturnine poultices is adviſeable. When ſuppuration is taking place, fomentations and poultices are to be uſed, and the matter is to be diſcharged by making an inciſion in the moſt depending part of the tumor.

2. *Of Scirrhus and Cancer of the Mamma.*

Cancer has been met with in the female breaſt more frequently than in any other part of the body. We have alſo ſeen an example of it in that gland of the male; but ſuch inſtances are extremely rare.

The commencement and progreſs of a ſcirrhous tumor in the female breaſt, is extremely various in different people; and has been often the cauſe of ſcirrhous tumors, and tumors of a more benign nature, being miſtaken for one another.

181 Symptoms. Scirrhous tumors have generally made ſome progreſs before they are taken notice of. Sometimes they are firſt felt like a pea underneath the ſkin, and lying looſe over the gland of the mamma; in other inſtances, a portion of the central part of the gland is found indurated. Of whatever bulk, and in whatever ſituation the ſwelling be diſcovered, it is remarkable for its unyielding and incompreſſible hardneſs, and its rugged unequal feel.

When the tumor is ſmall it ſeldom gives any pain, and the patient generally diſcovers its preſence by accident. In ſome caſes its exiſtence is diſcovered by an acute pang darting through the breaſt leading to its examination; but in many caſes it acquires the bulk of a large hazel nut or walnut, particularly when the patient is fat, before any circumſtance leads to its diſcovery.

As the tumor increaſes in bulk, it advances towards the ſurface of the body and adheres to the ſkin. The ſkin then becomes thickened, inflamed, and ulcerated. If the tumor be ſituated near the nipple, the diſeaſe ſpeedily affects that part, ſometimes enlarging and hardening it; and in other caſes puckering it and drawing it inwards. When the nipple becomes involved in the diſeaſe, the ſanious fluid formed in the tumor often eſcapes before the ſkin ulcerates, by the lactiferous tubes.

The pain which accompanies the tumor in its more advanced form, is generally of a lancinating kind; but its frequency and degree is ſuſceptible of great variety. Sometimes ſharp ſtinging pains paſs frequently from the tumor as a centre, and extend through the whole breaſt; in other caſes there is more of a burning heat in the part.

The progreſs of the diſeaſe is generally very ſlow, and in many caſes three, four, or more years elapſe before it ulcerates. When ulceration has taken place, the appearance of the ulcer is ſimilar to that we have deſcribed when treating of cancer of the ſkin *; and the progreſs of the ulceration is often ſo ſlow, as that many years elapſe before the diſeaſe proves fatal.

* See Chap. II. ſect. IV.

Scirrhous tumors have been met with in the mamma, from the age of twenty or twenty-five, to a very advanced period of life; but they occur about that period, when the catamenia diſappear, much more frequently than at any other.

182 *Treatment.*—There is no part of practice about which leſs has been ſatisfactorily eſtabliſhed, than the treatment of ſcirrhus in the mamma. The good effects of an early extirpation of cancer in the ſkin is very generally admitted; but the want of ſucceſs in removing ſcirrhous mammæ in the hands of many, has not only led ſome ſurgeons to deſiſt performing an operation, except in very recent caſes, but has even deterred others from attempting their removal in the firſt ſtages. There are no doubt many patients who ſubmit to a painful operation from which no relief can be reaſonably expected; on the contrary, the irritation and fever occaſioned by it ſeem to haſten the progreſs of the diſeaſe. But there are others where this practice has had a happier effect, and where the patients have lived for many years without a return of the diſeaſe. Whenever, therefore, a ſcirrhous tumor appears in the mamma, which is moveable and diſtinctly circumſcribed, paſt experience warrants us in removing it. On the other hand, when any of the abſorbent glands have become enlarged and hardened, or when the ſkin has ulcerated, we believe the operation in all ſuch caſes ſhould not be reſorted to. Some ſolitary examples of the diſeaſe, aſſuming this form, may have occurred to individuals, where an operation has arreſted the progreſs of the diſeaſe; but theſe oppoſed to the vaſt number of unſucceſsful caſes, are by no means ſufficient to warrant us in propoſing the operation.

183 *Method of Extirpating the Mamma.*—In extirpating the mamma, which we ſhall firſt ſuppoſe is to be done where the ſkin is ſound, and where the tumor has no uncommon adheſion to the pectoral muſcle, the patient ought to be placed horizontally in a bed, or upon a table covered with a mattreſs. Two inciſions are to be made with a common ſcalpel through the ſkin and cellular ſubſtance along the whole extent of the tumor, including a ſmall portion of ſkin. When the longeſt diameter of the tumor is acroſs the body, inſtead of a longitudinal inciſion, a tranſverſe one is to be made. The integuments being diſſected from the mamma on both ſides of the inciſions, the patient's arm is to be extended

Of the Diſeaſes of the Mamma.

ed to ſave the pectoral muſcle; and the whole glandular part is to be detached from the muſcle, though a ſmall portion only ſhould be diſcaſed, beginning at the upper ſide, and ſeparating downwards. After the diſeaſed parts are removed, the wound is to be cleaned with a ſponge wrung out of warm water, which will generally render the ſmall bleeding veſſels more conſpicuous. Theſe are to be tied, and the integuments are to be cloſely applied to the parts underneath, and retained there by adheſive ſtraps. A large pledgit of ſimple ointment is now to be laid over the whole; and this is to be covered with a compreſs of lint, tow, or ſoft linen; and the dreſſings to be kept in their place, and moderate preſſure made by a circular roller and ſcapulary bandage.

184

3. *Of Sore Nipples.*

Women are more generally affected with ſore nipples in ſuckling their firſt child than at any future period. This may, in ſome meaſure, be owing to the ſmallneſs of the nipples; but very often it ariſes from their being unaccuſtomed to the irritation of ſucking. In ſome caſes, the nipples are ſo flat, and ſo much ſunk in the breaſt, as to render it difficult for the child to lay hold of them. Here aſſiſtance can ſometimes be given, by the mother preſſing back the prominent part of the breaſt, ſo as to make the nipple project between two of her fingers. Should this be inſufficient, the nipple may be made to project by applying to it a ſtout child ſeveral months old: but when this cannot be done, breaſt-glaſſes * may anſwer the ſame purpoſe. By applying theſe to the nipple, and ſucking out the air, the child will commonly be enabled to lay hold of it.

* See Plate DXV.

The nipples at this time are liable to excoriations, cracks, or chops; which, though not attended with a formidable appearance, are frequently more diſtreſſing than large ulcers. Mild, aſtringent, and drying applications are moſt to be depended upon in ſuch complaints; ſaturnine water, or lime-water, will anſwer; and either ought to be applied warm. After bathing the parts with any of theſe, the nipple ſhould be covered with Goulard's cerate. Even a little ſoft pomatum frequently rubbed upon the part, and covered with a ſoft linen rag, is ſometimes found to give conſiderable relief. But the nipple ſhould be perfectly cleared of theſe applications before the child is laid to the breaſt; and this may be done with a little port wine, or equal parts of brandy and vinegar. If proper attention be paid to theſe remedies, they will commonly be found to have the deſired effect; but if the contrary ſhould happen, another remains to be mentioned, which, in different inſtances, has given great relief: it conſiſts in the application of a thin ſkin to the nipple, as the neck and part of the body of a ſwine's bladder with an aperture in it; which, being properly moiſtened and fixed to the breaſt, will completely protect it in the time of ſucking. As long as the nipples remain any way affected, ſmall cups of glaſs or tin are uſeful for retaining the dreſſings, defending the nipples from the friction of the clothes, and receiving any milk which may fall from the breaſt.

185 Anomalous ſwellings of the mamma.

Swellings and hardneſſes are found in the breaſt which are not of a ſcirrhous nature. Scrofulous indurations are particularly frequent. They often become old and hard, and are then commonly conſidered as *ſcirrhus*. If the ſurgeon ſucceeds in diſcuſſing them by means of any kind of remedy, he is apt to think that he has diſcuſſed a ſcirrhus. Theſe ſcrofulous ſwellings ſometimes inflame, and the progreſs of the inflammation is very tedious. The breaſt is long painful before any ſoftening or fluctuation can be perceived. The ſurgeon then perhaps conſiders it as an occult cancer, extirpates it, and thinks that he has ſucceſsfully cured a *cancerous* affection. If the ſurgeon opens ſuch a ſuppurating knot before all the hardneſs is diſſolved by the ſuppuration, and if he makes a large opening, then commonly follows a very malignant ulcer, which may be alſo miſtaken for a cancerous ſore. Many caſes, where ulcerated cancers have been ſuppoſed to have been extirpated with ſucceſs, may have been of this kind.

Venereal indurations are not unfrequent in the breaſt, and alſo cauſe ſimilar miſtakes in practice. Encyſted tumors are alſo met with in the breaſt, and are moſt commonly of that kind called *meliceris*.

In the breaſt of young girls, ten or twelve years of age, hardneſſes ſometimes appear, which diſappear as ſoon as menſtruation takes place. Sometimes they do not go away until the firſt delivery. Sometimes the breaſt ſwells to an enormous ſize, and becomes indeed not hard, but throughout firm, like muſcular fleſh. In ſuch a caſe the extirpation has been ſucceſsfully performed.

Sometimes conſiderable and often quite hard ſwellings appear in the breaſts, which proceed merely from blood. In ſuch caſes blood flows from the nipple at each menſtrual period. When the menſes diſappear with years, the diſcharge of blood no longer appears from the breaſt; but then there is a hard not painful ſwelling ariſes, which often acquires a conſiderable ſize. If it is opened, coagulated and fluid blood is diſcharged, and a fiſtula follows, which diſcharges a purulent fluid, and ſometimes pure blood, and often continues ſeveral years, without giving great uneaſineſs. The ſwelling, which was at firſt quite hard, ſometimes becomes ſoft, and then the ſurgeon is commonly induced to open it. Sometimes ſuch ſwellings are obſerved in women who have the menſtrual diſcharge; and in ſuch caſes the ſwelling always becomes greater at each period. Sometimes hectic fever and death follow the opening of theſe tumors. (Monro). The mamma is alſo ſubject to *fungus hæmatodes*; for an account of which, we refer our readers to Wardrop's *Obſervations on Fungus Hæmatodes*.

Sect. III. *Of the Diſeaſes of the Tonſils and Uvula.* 186

1. *Of the Enlargement of the Tonſils and Uvula.*

The tonſils ſometimes grow ſo large and hard as to become incurable, and even to threaten ſuffocation. The tumors have been commonly conſidered to be of a ſcirrhous nature; but they are neither attended with ſhooting pain, nor are they apt to degenerate into cancer; neither do ſwellings return after the tonſils have been extirpated: hence they ought not to be removed till by their ſize they eſſentially impede deglutition or reſpiration; but whenever they do this, they may be removed with ſafety. The only proper method of removing them is by ligature, which is not only void of danger,

Of the Diſeaſes of the Tonſils and Uvula.

187 Treatment

the Diſ-es of the nſils and Uvula.

danger, but ſeldom fails to perform a cure. If the baſe of the tonſil be ſmaller than the top, the ligature is to be uſed as for polypi in the throat; but however broad the baſe of it may be, much difficulty will ſeldom occur in fixing it, for the ſwelling is always very prominent. In diſeaſes of this kind both tonſils are generally affected; but if the removal of one of them forms a ſufficient paſſage for the food, the other may be allowed to remain. When, however, it is neceſſary to extirpate them both, the inflammatory ſymptoms produced by the extirpation of the firſt ſhould be allowed to ſubſide before any attempt be made to remove the other.

When the form of the tonſils happens to be conical, ſo that the ligature would be apt to ſlip over their extremities, Mr Cheſelden has recommended a needle (Plate DXV.) with an eye near the point: a double ligature being put into the eye, the inſtrument is to be puſhed through the centre of the baſe of the tumor, and the ligature being laid hold of by a hook and pulled forwards, the inſtrument is to be withdrawn; then the ligature is to be divided, and ſo tied that each part may ſurround one half of the tumor. This method, however, is ſcarcely ever found to be neceſſary.

188 Enlargements of the uvula.

Enlargements of the uvula, from inflammation or from other cauſes, may generally be removed by the frequent uſe of aſtringent gargles, as of ſtrong infuſions of red roſe-leaves or of Peruvian bark. But when theſe fail, and the enlargement is ſo conſiderable as to give great uneaſineſs by impeding deglutition, irritating the throat, and ſo cauſing cough, retching, and vomiting, extirpation is the only thing upon which any dependence can be placed. Exciſion is the readieſt method when the uvula is only elongated; but when the ſize is conſiderable, dangerous hæmorrhagies ſometimes attend this method; on which account a ligature is preferable.

189 Treatment.

In performing the operation, the ſpeculum oris (Plate DXV.) is neceſſary to keep the mouth ſufficiently open, and the uvula ſhould be laid hold of by a pair of forceps or a ſmall hook, ſo as to keep it firm, and prevent it from falling into the throat. After the operation, if the bleeding be conſiderable, it may be checked by aſtringent gargles, or by touching the part with lunar cauſtic; but this will ſeldom be neceſſary.

When a ligature is to be employed, it may be readily done according to the method recommended in the extirpation of polypi. A double canula with a ligature may be paſſed through the noſe, or the ligature may be applied according to Cheſelden's method in extirpation of the tonſils.

190 2. *Of Scarifying and Fomenting the Throat.*

In inflammatory affections of the throat, the means commonly employed are gargles, fomentations, ſcarification, or topical bleeding. Gargles are uſeful for cleaning the fauces from mucus, or in caſes of ulceration. In relaxation of the parts, they are employed with advantage when made of aſtringent materials. Fomentations may be of ſome uſe when externally applied; but the ſteam of water, &c. drawn into the throat, by means of Mudge's inhaler (fig. 1.) is preferable. Sometimes it is neceſſary to draw blood from the part affected. Here recourſe may be had to ſcarifying, which may be readily done by the ſcarificator (Plate DXIV. fig. 14.). After a ſufficient number of punctures have been made, the flow of blood may be promoted by the patient's frequently applying warm water to the punctures. When an abſceſs forms, notwithſtanding the uſe of theſe remedies, the matter may be diſcharged with the ſcarificator already mentioned.

Plate DXV. fig. 11.

Of the Diſeaſes of the Eye.

Chap. X.

Of the Diſeaſes of the Eye and its Appendages. 191

In the account of the diſeaſes of the eye, we ſhall follow the ſame principles of arrangement as we have already adopted, and treat of the diſeaſes of each particular texture of which the eye is compoſed, in the order in which they appear moſt natural; as the diſeaſes of the *conjunctiva*, *cornea*, *iris*, *cryſtalline lens*, &c.

Sect. I. *Of Inflammation of the Conjunctiva.*

192 General remarks.

The general phenomena of inflammation of the conjunctiva, are analogous to thoſe which have been already enumerated, when treating of the inflammation of *mucous* membranes *. Along with the ſymptoms there enumerated, there are others which ariſe from the peculiar functions of the organ. The eye cannot endure the uſual quantity of light, viſion becomes obſcured, and there is an increaſed ſecretion of tears. The inflammation is ſometimes confined to the palpebræ, ſometimes to the conjunctiva covering the white of the eye, in ſome caſes to that portion of it which forms the external layer of the cornea, and in others it ſpreads over the whole of theſe ſurfaces. Theſe differences merely regard the extent of the inflammation: but there are others which ariſe from a difference in the ſpecific nature of the diſeaſe, forming three diſtinct ſpecies; 1. The purulent ophthalmia; 2. The purulent eyes of new-born children; and, 3. The gonorrhœal ophthalmia.

* See Chap. III.

1. *Of the Purulent Ophthalmia.*

193 Symptoms.

The purulent ophthalmia appeared in this country as an epidemic after the return of our troops from Egypt in the year 1801. Since that period, it has ſpread with the greateſt violence over moſt part of Britain. This diſeaſe generally begins with a peculiar purple-coloured redneſs over the whole eyeball and inner membrane of the eyelids. There is a ſudden pain produced in the eye, as if ſand or ſome foreign ſubſtance was lodged between it and the eyelid. As the redneſs increaſes, the conjunctiva becomes ſwelled, from the effuſion of a tranſparent fluid in the looſe cellular membranes, between it and the ſclerotic coat. There is at firſt a profuſe diſcharge of tears from the eye, and the eyelaſhes are glued together when the patient awakes. There is ſoon created intenſe pain in the ball of the eye, and a dull aching pain in the forehead. The cornea ſometimes becomes opaque; and if the violence of the inflammation continues, it ulcerates and ruptures, allowing the aqueous humour to be diſcharged; after which, an abatement of the inflammatory ſymptoms generally takes place.

Before the diſeaſe advances thus far, the eyelids are generally conſiderably ſwelled; and, beſides the flow of tears,

tears, there is a profuſe diſcharge of a puriform fluid. The inflammation uſually attacks both eyes, and it begins in one ſeveral days before the other.

194 *Treatment.*—In ſlighter caſes of the diſeaſe, fomenting the eye with a decoction of poppy heads, and a briſk purge, have been found ſufficient to abate the inflammatory ſymptoms. In other caſes, however, it has been neceſſary to draw blood to a very great extent. When the diſeaſe occurs in a ſtrong plethoric perſon, recourſe ſhould be immediately had to the lancet, and the operation repeated on any recurrence of the ſymptoms. It has been the uſual practice of Dr Veitch, and of thoſe who have had extenſive opportunities of treating this diſeaſe, to draw the blood from the arm. A ſmaller quantity, however, taken from the temporal artery or external jugular vein, would be found to have an equally good effect.

When the purulent diſcharge becomes profuſe, ſome have recommended the uſe of collyria, in the form of injections. The aqua camphorata is recommended by Mr Ware; and a weak ſolution of corroſive ſublimate, with opium, has been found to have equally good effects. In thoſe caſes where there are much pain and tenſion in the eyeball and brow, along with a turbid ſtate of the anterior chamber, and ulceration beginning in the cornea, the diſcharge of the aqueous humour has been attended with much ſucceſs*. This operation may be eaſily, and at all times ſafely performed, by making a puncture with a common extracting knife, through the ſound part of the cornea, near its junction with the ſclerotic coat.

* See *Mr Ware's Treatiſe on the Purulent Ophthalmia.*

2. *Of the Purulent Ophthalmia in Children.*

195 The ſymptoms of the purulent eyes of children are very ſimilar to thoſe which have been mentioned. The diſeaſe generally appears a few days after birth by an increaſed redneſs of the palpebral membrane, more or leſs ſwelling, and a puriform diſcharge. Sometimes the membrane ſwells ſo much as to evert the eyelids, and render it impoſſible to examine the eye-ball. The cornea becomes obſcure, ulcerates, and allows the aqueous humour to be diſcharged. The diſeaſe generally affects both eyes. From what we know of the origin of purulent ophthalmia, and from ſome ingenious obſervations of Mr Gibſon of Manchester,* it appears probable, that the origin of this diſeaſe is communicated by the lodgement of an acrimonious diſcharge upon the eyes of the child, from the vagina of the mother. In a great proportion of caſes, Mr Gibſon found the mothers of thoſe children, affected with purulent ophthalmia, had leucorrhœa; and it is probable, that this, as well as other acrimonious diſcharges, which we know to take place from the mucous membranes of theſe parts, produces the diſeaſe.

* See *The Edinburgh Medical and Surgical Journal*, vol. iii.

196 *Treatment.*—Solutions of ſaccharum ſaturni and opium, injected between the eyelids, or the aqua camphorata of *Beates*, ought to be employed in the firſt ſtage of the diſeaſe; and the eyelids ought to be likewiſe covered with ſome mild unctuous application. When ulceration has advanced ſo as to endanger a rupture of the cornea, that may be prevented by diſcharging the aqueous humour. In the ſecond ſtage of the inflammation, ſcarifying the eyelids, and applying the red precipitate ointment, will generally be found to be uſeful in allaying the inflammation and ſwelling of the eyelids, and in reſtoring the tranſparency of the cornea.

3. *Of the Gonorrhœal Ophthalmia.*

197 The gonorrhœal ophthalmia occurs very rarely; and it has been known to ariſe from the ſuppreſſion of a gonorrhœa, or from the accidental application of the gonorrhœal matter to the eyes. In this reſpect, its origin is very ſimilar to the common purulent or Egyptian ophthalmia, and to the purulent ophthalmia which occurs in children.

The ſymptoms and progreſs of the diſeaſe are alſo ſimilar, only that its progreſs is much more violent, and it generally completely deſtroys the organ.

198 *Treatment.*—When it is ſuſpected that the diſeaſe has ariſen from a ſuppreſſed gonorrhœa, ſuch means ought to be employed as are moſt likely to reſtore the diſcharge from the urethra; ſuch as the introduction of a bougie, the injecting of warm oil, and the application of poultices and fomentations to the perinæum. If the inflammatory ſymptoms run high, powerful evacuants ſhould be employed. Beſides purgatives, blood ſhould be taken from the arm or temporal artery.

The local applications ſhould conſiſt of weak injections of corroſive ſublimate and opium, or acetate of lead and opium; and the ſwelling and redneſs may be alſo relieved by the application of the red precipitate ointment, or the ointment of Janin.

Sect. II. *Of the Pterigium.*

199 The word pterigium denotes all thoſe morbid changes in which that portion of the conjunctiva covering any part of the cornea or ſclerotic coat becomes thickened, vaſcular, and opaque. If the diſeaſe be confined to a particular part of the conjunctiva, the diſeaſe is obſerved at its commencement like a ſmall globule of fat, or condenſed cellular ſubſtance, ſituated moſt frequently near the junction of the cornea and ſclerotic coat; and this ſpot extending imperceptibly along the ſurface of the conjunctiva at length paſſes over the cornea, the conjunctiva on the adjoining part of the ſclerotic coat becomes puckered, and as if it were forcibly drawn over the cornea. The portion of it which lies on the ſclerotic coat is commonly looſe, and can be eaſily elevated, but that which is on the cornea adheres more firmly. This ſpecies of pterigium has generally a triangular form; one of the angles of the triangle advancing towards the cornea, or covering a portion of it, and the baſe lying on the ſclerotic coat. Sometimes the thickening of the conjunctiva is firſt perceived on the cornea; the conjunctiva covering the ſclerotic coat remaining quite ſound. A pterigium is always conſiderably elevated above the adjacent cornea; but the degree of its thickneſs varies from that of a thin membrane to that of a fleſhy maſs.

Pterigia ariſe moſt commonly at the naſal angle of the eyeball. They are formed, alſo, at the temporal angle; and they ſometimes occur at both places in the ſame eye. In one caſe there were two pterigia in each eye. They are formed very rarely on the upper and under parts of the eyeball.

200 *Treatment.*—The only mode of removing this diſeaſe is by exciſion. This may be done by elevating the diſeaſed portion of the conjunctiva with a pair of forceps; and ſeparating it at its baſe by cutting it through with a pair

pair of ſciſſars; and then carefully diſſecting it off to its apex. If any portion of it has been allowed to remain, or if the wound ſhews any tendency to form a fungus, lunar cauſtic ought to be applied to it, and the application repeated as often as may appear neceſſary. Any ſlight inflammation or weakneſs in the eye which may continue after the operation, may be ſpeedily removed by the application of the vinous tincture of opium.

Sect. III. *Of Puſtules* (Ophthalmia puſtuloſa).

201 Symptoms.

Puſtules are ſmall tumors which are formed both on the cornea and ſclerotic coat, but they occur moſt frequently near the junction of theſe membranes. A puſtule commonly firſt appears like a duſky yellow or reddiſh ſpot, a little elevated above the ſurface of the cornea or ſclerotic coat; and in a ſhort time it becomes a diſtinct conical tumor. The adjacent part of the cornea is always more or leſs dim; and a conſiderable degree of inflammation accompanies it, which is either confined to the white of the eye contiguous to the puſtule, or is ſpread over the whole eyeball. Whilſt the puſtule is forming, the inflammation is generally confined to that part of the white of the eye which is in its immediate vicinity. The blood veſſels are of a pale livid hue; they appear ſuperficial, and can be readily elevated by a pointed inſtrument; each trunk can be diſtinguiſhed, for they are never ſo numerous as to appear confuſed, or like one red maſs. They ſometimes run in various directions, anaſtomoſe freely with one another, forming net-works upon the white of the eye.

If the inflammation and puſtule remain for ſome time, the puſtule generally advances to ſuppuration. When ſuppuration takes place, the apex of the puſtule ulcerates, and frequently a chalky white ſpot appears at the centre of the ulceration; and the opacity of the cornea at the ſame time daily increaſes around it. In other caſes, the opaque matter ſeparates, and leaves behind it a deep ulcerous excavation.

Sometimes the ſuppuration proceeds more like a common pimple or phlegmon of the ſkin; a ſmall quantity of a thick matter collects within the puſtule, and when it is diſcharged, a conical tumor remains, which has a depreſſion at the apex. When the puſtule contains a watery fluid, the fluid is moſt frequently abſorbed in a gradual manner; but at other times the puſtule breaks, and an ulcer is formed.

If, in either of theſe caſes, the contents are artificially diſcharged, all the accompanying inflammatory ſymptoms are much increaſed.

Moſt frequently there is only one puſtule, and only one eye affected; but in ſome caſes there are ſeveral both on the cornea and ſclerotic coat of each eye.

The diſeaſe, at its commencement, is almoſt invariably accompanied with the ſenſation of a mote in the eye, and the whole conjunctiva covering the ſclerotic coat has often a yellowiſh and ſhining glaſſy colour before the redneſs appears. There is often alſo a degree of redneſs and ſwelling, chiefly of the upper eyelid; and the tarſi are found adhering together in the morning, from the exudation of a yellow matter among the ciliæ. There is frequently an unuſual dryneſs felt in the eye; but if it be expoſed to a bright light, or if an attempt be made to uſe it, the ſecretion of tears is increaſed.

This ſpecies of inflammation is always accompanied with a much greater degree of general fever, in proportion to the ſeverity of the local ſymptoms, than any other ophthalmia. The pain is rarely acute till the puſtule ulcerates; but, if that takes place, it is commonly very ſevere.

An eye which has been once affected with puſtule, is very ſubject to repeated attacks of the diſeaſe. Puſtules of the cornea are met with in people of all ages; but they are more common in young people than in thoſe advanced in life.

Treatment.—Sudorific medicines, cooling diluent drinks, and purgatives, ought to be employed in the firſt ſtage of the diſeaſe; and given according to the violence of the conſtitutional ſymptoms. The eye, and parts around it, ſhould be fomented three or four times a-day, with a decoction of poppy heads; to which may be added a ſmall quantity of ſpirits. When the ſymptomatic fever abates, and the redneſs aſſumes a more purple hue, the vinous tincture of opium may be applied to the eye once or twice a-day; and this will be found equally uſeful whether the puſtule is in a ſtate of ſuppuration or not; and it ought to be continued as long as there are any remains of the diſeaſe.

Sect. IV. *Of Matter collected between the Lamellæ of the Cornea.* 202

Purulent matter is ſometimes collected between the lamellæ of the cornea, when the diſeaſe is termed *unguis* or *onix;* or in the anterior chamber, when it is called *hypopion.*

When the matter is collected between the lamellæ of the cornea, it appears in the form of a yellow ſpot; and as the quantity increaſes, the ſpot becomes larger, but does not alter its ſituation from the poſition of the head.

When the matter is collected in the anterior chamber, it generally appears like a ſmall yellow globule between the iris and cornea, occupying the inferior part of the cavity. Theſe abſceſſes are commonly the effect of violent ophthalmia, occaſioned by a blow, or injuries of the eyeball; they are alſo formed, though rarely, without any accompanying inflammatory ſymptoms.

Treatment.—Though the purulent matter may be more or leſs abſorbed on the abatement of the accompanying inflammatory ſymptoms; yet it would be found a good general practice to evacuate the matter whenever it appears, by making an inciſion through the cornea. The diſcharge of the aqueous humour along with the matter, never fails to diminiſh the inflammation; and this perhaps may be the reaſon why the practice is ſo uſeful. Beſides this, fomentations, briſk purges, and cupping at the temples, may be neceſſary if the inflammatory ſymptoms are ſevere.

Sect. V. *Of Ulcers of the Cornea.* 203

Ulcers of the cornea have been divided by ſome authors into a number of ſpecies, from differences in their ſize, in their duration, in the degree of the ſeverity of the accompanying ſymptoms, and from the various cauſes from which they have been ſuppoſed to originate.

The moſt frequent variety of ulcer is that which remains after the cornea has ſuppurated and burſt; either in conſequence of a puſtule or of an abſceſs.

When a puſtule ſuppurates, the central part of it ge-

Of the Diſeaſes of the Eye.

nerally gives way; and as the diſeaſe continues, the ulceration extends in all directions from that point. Ulcers of this kind are generally circular, and the edges rounded and ſmooth; having ſometimes the appearance of a ſmall artificial dimple: in other inſtances they have an irregular ſhape, and their edges are jagged and acute. The ſize of ulcers is very various; in ſome caſes they do not appear larger than a depreſſion made by the point of a pin, whilſt in others they cover a large ſurface. Moſt frequently the part of the cornea contiguous to the ulcer becomes more or leſs dim; and in ſome caſes red veſſels may alſo be traced in it.

Treatment.—The acute pain which generally attends moſt ulcers, particularly thoſe which are the conſequence of puſtules, will generally be much relieved by the application of the vinous tincture of opium, repeated two or three times a day. When this produces no good effect, and the ulcer ſpreads rapidly, attended with acute pain, much relief will be obtained by touching the ſurface of it with lunar cauſtic, or if there is a riſk of the ulcer eroding the whole thickneſs of the cornea, and a prolapſus of the iris to take place, it may be adviſable to prevent this by diſcharging the aqueous humor.

204

Sect. VI. *Of Specks of the Cornea.*

There are three forms of the corneal ſpeck; the *firſt* and moſt ſimple variety, is when a particular part of the cornea loſes its natural tranſparency, and appears clouded; objects being ſeen by the patient as if looked at through a miſt or ſmoke. Some of theſe ſpecks are undefined, others diſtinctly circumſcribed, and they have each an equal degree of opacity throughout, or one part is more opaque than the reſt. They are moſt commonly of a circular form; but in ſome caſes their ſhape is very irregular. This ſize varies from the ſmalleſt ſpot, to ſuch an extent as occupies the whole cornea.

In the *ſecond* form of the corneal ſpeck, the opacity is of a darker ſhade, giving the cornea a bluiſh, or in ſome parts a milky appearance. It is ſeldom equally opaque through its whole extent; being generally more ſo at the centre, and becoming gradually of a lighter ſhade towards the margin. In ſome inſtances the ſhade is very unequal in the different parts of the ſpeck.

In the *third* form of the corneal ſpeck, the cornea becomes of the opaque gliſtening white colour of common pearl, and the opacity generally extends through the whole of the lamellæ of the cornea; ſo that if even ſeveral of thoſe layers which are external be removed, the remaining ones completely interrupt viſion. Specks of this deſcription ſometimes produce a ſlight thickening of the cornea, and are accompanied by adheſions between the cornea and iris. They are almoſt always diſtinctly circumſcribed, though generally not ſo opaque at the edge. When they are of any conſiderable ſize, they are nouriſhed by one or more red veſſels.

In the firſt form of ſpeck, the iris can be ſeen through the diſeaſed portion of the cornea; but in the ſecond and third form of the diſeaſe, the degree of opacity is ſuch, that nothing can accurately be diſtinguiſhed behind it. If there is an external inflammation accompanying the ſpeck, the red veſſels will be ſeen in a cluſter on that part of the ſclerotic part neareſt to it; and ſome of the branches can often be traced paſſing over the edge of the cornea, and terminating in the ſubſtance of the ſpeck. As the accompanying inflammation abates, the number of the red veſſels on the cornea commonly diminiſhes; but ſometimes one or more trunks remain, and are diſtributed on the ſpeck. In ſome caſes, there are large ſpecks with numerous blood-veſſels ſupplying them during the continuance of active inflammation; and although the opacity remains extenſive after the inflammation abates, yet no red veſſels continue to nouriſh it. The number of blood-veſſels is in no caſe in proportion to the degree or extent of the opacity during any ſtage of the accompanying inflammation. For we frequently obſerve a net-work of blood-veſſels on a cornea which has very little obſcurity, and at other times there is a large opaque ſpot, with only one, or even without a ſingle red veſſel ſupplying it. Specks appear on every part of the cornea, but moſt frequently towards its centre.

Of the Diſeaſes of the Eye.

Specks appear to be formed moſt frequently on the external lamella of the cornea; but it is difficult to determine accurately their ſituation. They vary in number. Commonly there is only one; but it frequently happens that there are two, three, or more diſtinct ſpots on one cornea, all of which differ in their ſize, ſhape, and in degree of opacity.

Specks impede viſion in proportion to the degree of their obſcurity, and according to their ſituation. Even a ſpeck of the ſlighteſt ſhade, which is hardly perceptible to a common obſerver, if it be placed directly oppoſite the pupil, materially injures the ſight; whereas thoſe of the opaque kind, if placed beyond its circumference, diminiſh the ſphere, but not the diſtinctneſs of viſion. In thoſe caſes where the ſpeck is of a moderate ſize, and placed towards the centre of the cornea, the patient ſees better in a dull, than in a clear light. For in a clear light the pupil contracts ſo much, that it becomes covered by the ſpeck, and the rays of light are prevented from entering; but in a dull light it becomes larger, ſo that the rays of light enter by its edge.

Specks, moſt commonly, are either preceded or accompanied by inflammation of the cornea. Likewiſe wounds, if they do not unite without ſuppuration, and ulcers of the cornea, are followed by a ſpeck.

Specks are formed at every period of life; but they occur moſt frequently in young people; probably becauſe in them the cornea is much ſofter, and more ſpongy; and alſo as they are more ſubject to inflammatory complaints of the eye than adults.

Treatment.—Thoſe ſpecks which have been deſcribed under the *firſt* and *ſecond* form of the diſeaſe, generally diſappear either by the uſe of remedies, or in ſome caſes after the inflammatory ſymptoms abate. 205

When the eye is inflamed, and the eyelids turgid with blood, ſlightly ſcarifying the eyelids, and immediately after the bleeding ceaſes, applying a quantity of an ointment compoſed of the red oxide of mercury (ten grains to a dram of ſimple ointment), will be found a very active remedy. And the ſcarifications along with the ointment ſhould be repeated every ſecond or third day as long as any inflammation continues. When there is no inflammation accompanying the ſpeck, the ointment may be applied alone. The unguentum citrinum, and various powders compoſed of the ſulphate of alum, ſulphate of zinc, ſub-borate of ſoda, diluted with from a fourth to an eighth

eighth part of ſugar, may alſo be advantageouſly employed. In ſpecks of long duration, it will be found uſeful to vary the application, and to employ two or three of the above medicines ten days or a fortnight alternately.

Thoſe ſpecks of the *third* form, ſeldom become more tranſparent, even by the uſe of the moſt active remedies. In thoſe caſes where only a ſmall central portion is of that deſcription, the ſize of the ſpeck may be diminiſhed by the treatment already mentioned; and in ſome caſes, much benefit has ariſen from cutting away an external layer of the moſt opaque part; and afterwards uſing the above applications. It often happens, however, that if portions of a very old and opaque ſpeck be cut away, the part is regenerated by an equally opaque matter.

The ſpecks which are formed rapidly, are in general moſt ſpeedily removed. They go away, too, much more quickly in children than in old people; and in them, alſo, a much greater degree of obſcurity can be made entirely to diſappear. When a part of the cornea has become opaque, the opacity begins to diſappear at the circumference of the ſpeck, or at that portion of it neareſt to the circumference of the cornea. In ſome caſes it may alſo be obſerved, that the external laminæ of the cornea firſt regain their tranſparency.

206

Sect. VII. *Of the Staphyloma.*

When the cornea, beſides loſing its tranſparency, ſwells to ſuch a degree, that its internal ſurface comes in contact with, and adheres to the iris, and when it forms a prominent tumor externally, the diſeaſe has generally been called *ſtaphyloma*. When the whole cornea is affected, it generally aſſumes a more or leſs conical form; loſes entirely its natural tranſparency; and viſion is completely deſtroyed. The opacity is generally moſt remarkable towards the apex of the tumor, and is generally of a pearl white colour diffuſed through the whole corneal ſubſtance. The internal ſurface of the cornea adheres to the iris, and the pupil is in moſt caſes altogether obliterated.

In many caſes the cornea does not project beyond the eyelids; but in others, particularly in children, a large tumor is formed, which projects beyond the eyelids, and is attended with pain and inflammation, which, in ſome inſtances, renders the other eye weak and irritable.

Treatment.—When a part of the tumor gives way, and allows the contents of the tumor to be diſcharged, the patient always experiences a ſpeedy relief, but the tumor is ſoon formed again; ſo that in order to prevent its growth, it is neceſſary not only to diſcharge its contents, but alſo to remove a portion of the diſeaſed cornea of ſuch a ſize as to prevent the humors from again collecting. A common extracting knife may be paſſed through the tumor, ſo as to divide a ſegment nearly equal to half the cornea, and the other half may be readily cut away with ſciſſars. Inflammation and ſuppuration ſucceed; and the eyeball finally collapſes if there be not a ſufficient degree of inflammation excited. A pointed inſtrument may be introduced through the wound, ſo as to allow the cryſtalline lens, or any portion of the vitreous humour which may have remained, to be preſſed out.

207

Sect. VIII. *Of Inflammation of the Iris.*

Inflammation ſeldom affects the iris alone, though in ſome caſes it appears to be the principal diſeaſed part of the organ. The diſeaſe is accompanied with intenſe pain on expoſure to light; diſcoloration of the iris from the addition of red blood; diſpoſition of the pupil to contract; and lymph to be effuſed on the ſurface of the iris and pupil.

Treatment.—Copious bleedings from the arm, or temporal artery, are generally neceſſary; and in order to prevent any permanent contraction of the pupil from taking place, much benefit will be derived from keeping it dilated by the action of an infuſion of *belladona*.

208

Sect. IX. *Of the mode of Making an Artificial Pupil.*

The iris, whether from previous inflammation or other cauſe, has been often found with the pupil ſo much contracted, and adheſions formed between it and the capſule of the cryſtalline, to ſuch a degree, as to prevent viſion. The pupillar edge of the iris, too, ſometimes adheres to the cornea, and is contracted; and ſometimes a portion of cornea oppoſite to the pupil is a cauſe of blindneſs. In all ſuch caſes it has been repeatedly attempted to make an artificial pupil; but this operation has ſeldom been ſucceſsful. Various modes have been propoſed to perform it, but that recommended by Scarpa is entitled to moſt attention. This method conſiſts in introducing a curved couching needle (Plate DXVII. fig. 20.), as in the operation of couching the cataract, paſſing its point through the iris at the place where it is intended the new opening ſhould be made, and then forcibly tearing down a portion of iris from its connection with the ciliary ligament. After the operation it will be found uſeful to keep the iris for ſome time under the influence of belladona. We underſtand that Mr Gibſon, an ingenious ſurgeon in Manchester, has operated with great ſucceſs in a new manner. He makes the punctuation of the cornea at its tranſparent part with an extracting knife (Plate DXVII. fig. 1.), and preſſes the eyeball ſo as to ſqueeze the iris through the inciſion of the cornea; or if any adheſions render that impracticable, he drags it out with a hook (Plate DXVII. fig. 19.), and afterwards cuts away with a ſciſſars the prolapſed portion. Then immediately the perforated iris falls back into its natural ſituation, leaving a proper opening.

209

Sect. X. *Of the Cataract.*

The moſt common diſeaſe of the lens is a loſs of its natural tranſparency; and this ariſes either from a change in its ſtructure, or from a depoſition of new matter. The capſule of the lens is alſo ſubject to opacities. Theſe diſeaſes are known by the name of *cataract*.

There are *four* ſpecies of cataract generally enumerated. In the firſt, the cryſtalline lens itſelf becomes opake (*cataracta crystallina*). In the ſecond, the capſule is changed in its ſtructure (*cataracta membranacea*). In the third, the liquor Morgagni becomes opake (*cataracta interſtitialis*); and when all thoſe parts are affected at the ſame time, it has been denominated the mixed cataract, (*cataracta mixta*).

Of the Diſeaſes of the Eye.

When the cryſtalline lens becomes opake, the opacity generally begins towards the central part of the lens, and extends towards its circumference; in other caſes a general obſcurity extends over the whole lens.

210 Conſiſtence of cataracts.

The conſiſtence of the lens varies very much in the different kinds of cataract. Sometimes it is converted into an aqueous or milky fluid, or like thin jelly; at other times it becomes harder and firmer than natural; and in ſeveral caſes it has been found converted into bone or into a chalky looking ſubſtance. It has been generally remarked, that the fluid or milky cataract is moſt frequent in children, but we have alſo met with it in thoſe advanced in life. The ſolid or concrete cataract, on the other hand, has been generally found in adults. At the ſame time, we have obſerved the lens of young people converted into a hard and white ſubſtance reſembling chalk.

211 Colour of cataracts.

The colour of different cataracts is very various; and they never appear of the ſame colour in the eye as when removed from it. The moſt uſual colour of them in the eye is a bluiſh white or gray; ſometimes clouded in different parts or ſtriated, ſometimes of a lead colour, ſometimes greeniſh, and ſometimes of a yellow or amber colour. When taken out of the body, thoſe which appeared white or gray are generally dark yellow or amber; and thoſe of a yellow tinge in the eye often appear white when extracted.

212 Diagnoſis between hard and ſoft cataracts.

There is ſcarcely any diagnoſtic mark of a ſoft and hard cataract which can be altogether depended on. The colour proves nothing, thoſe of a milky colour being often quite hard, and ſometimes thoſe of a pearl colour are quite ſoft. Neither is there any thing to be learnt from the degree of the opacity; for it will be found that thoſe who ſee no more than to be able to diſtinguiſh light from darkneſs have the lens quite ſoft, whilſt thoſe who can diſtinguiſh colours and large objects have the lens quite hard. Richter, however, has remarked two ſymptoms, which he ſays have ſeldom deceived him in aſcertaining this point. The ſofter the lens is, the larger and thicker it is in general, and therefore approaches nearer to the plane of the iris or to the edge of the pupil. Hence he always concludes that the cataract is ſoft when it is near the pupil. In order, however, to judge of the ſpace between the pupil and lens, the ſurgeon muſt look into the patient's eye from one ſide; and in general it requires much experience to judge of this with accuracy.

We are alſo able, in ſome caſes, to diſcern points, ſtreaks, or inequalities, in the ſhade of a cataract. If, after having obſerved the place, figure, and diſpoſition of them, we find that in ſome days afterwards, or upon rubbing the eye pretty hard, they have undergone any change in their figure, ſituation, or ſhade of colour, we may then conclude with certainty that the cataract is ſoft; only we muſt be cautious not to draw an oppoſite concluſion, viz. that we are not to conceive the cataract to be hard if theſe changes ſhould not be perceptible.

* See *Bemerkungen, uber den Grauer Star.*

"A perfectly *hard* cataract," ſays Beer,* "ſhows itſelf very plainly before the operation; the pupil is equally opake in its whole circumference; there are not to be obſerved any points, ſtreaks, or ſpots, of a clearer or darker colour; the lens is evidently ſeparated from the iris, ſo that a ſufficient number of rays of light can enter, and the patient is ſtill capable of diſtinguiſhing ſome objects from the ſide of the eye; the motions of the pupil are extremely lively, and it never remains conſiderably enlarged. The opacity behind the pupil at the commencement of the diſeaſe is firſt obſerved in the middle, and it then extends, but very ſlowly, towards the circumference. Such patients, if the middle part of the pupil is completely opake, can for the moſt part read writing by the aſſiſtance of a magnifying glaſs, and diſtinguiſh ſmall objects. The colour of the hard cataract is gray, paſſing more or leſs to a greeniſh hue; and the ſmooth level of the lens may be very plainly remarked."

Of the Diſeaſes of the eye.

213 Cataract generally a local diſeaſe.

In moſt patients the cataract is to be conſidered as a local diſeaſe, though there are alſo many caſes where an opacity of the lens comes on after or along with other diſeaſes of the eye. It has been obſerved in gouty and rheumatic conſtitutions, and in ſuch people there is reaſon to ſuſpect that it is more or leſs connected with the general conſtitutional affection. This obſervation is of importance; for when an operation is performed in ſuch caſes, a total blindneſs is uſually the conſequence. Richter operated on a man who had been much troubled with gout, and his ſight was reſtored. In ſeven months afterwards the pupil gradually contracted, at laſt cloſed, and a ſecond blindneſs followed. In one caſe of a ſimilar kind on which we operated, an attack of gout ſucceeded the operation, the eye ſuppurated, and the inflammation has never altogether diſappeared, though two years have elapſed ſince the operation. Even in ſuch caſes the operation is not to be entirely forbidden: the ſucceſs is leſs certain, and the patient will require a very careful preparation before it, and much attention after it.

214 Hereditary cataract.

There are ſome varieties of cataract which are conſidered to be hereditary. Richter extracted a cataract from a man whoſe father and grandfather were both blind from that complaint. Maitre Jean and Janin have both met with ſimilar caſes. Richter alſo ſaw three children, born of the ſame parents, who had all cataracts at the age of three years. We have known ſeveral ſimilar facts, and particularly one of twins, who both were affected with cataract when one year old.

215 Cataract of the capſule.

When the cataract is ſeated in the capſule above, it in general ariſes from a blow or wound with a pointed inſtrument. Sometimes the whole anterior portion is opake and very much thickened, whilſt that which is poſterior remains tranſparent; and in ſome caſes the capſule has been extracted in the form of a bag, having become altogether opake, and containing within it the cryſtalline. Such caſes have been called by Richter the *cataracta cystica*. He ſays he has only met with one caſe of that form of the diſeaſe; Beer, however, mentions many; and from meeting with them he has been led to propoſe the extraction of the capſule along with the cryſtalline in all caſes of the diſeaſe.

The *cataracta membranacea primitiva* of Scarpa is alſo another form of the diſeaſe. In this variety the lens diſappears, and leaves the capſule opake, or at moſt in its interior a ſpeck not larger than a pin-head. This kind of cataract, Scarpa remarks, occurs moſt frequently in infants, or in people under twenty years of age. It may be diſtinguiſhed by its reſemblance to a very thin ſcale, or by a very white point, at the centre or at the circumference of the cryſtalline.

216 Trembling cataract.

The *tremulous* cataract (*cataracte tremblante* of the French), is another variety of the diſeaſe which deſerves to be noticed. It is generally of a very opake white colour,

colour, and ſeldom large. It moves about on every motion of the eye, and the whole iris trembles and fluctuates to and fro. Sometimes they altogether diſappear, at times paſſing behind the iris, but they ſoon regain their ſituation. In one example of this diſeaſe we obſerved that the opake lens ſometimes fell into the anterior chamber through the pupil. In this form of the diſeaſe it generally happens that the functions of the retina are impaired or loſt; though this is not always the caſe.

217 Cataract combined with amauroſis.

Cataract is often accompanied with a complete amauroſis. In ſome caſes of this kind there is a great dilatation and immobility of the pupil, and the opake lens is obſerved of a very large ſize behind it. The patient can ſeldom diſtinguiſh light from darkneſs; and the want of ſight generally precedes any obſcurity of the lens. In ſome caſes, where there is a combination of cataract and amauroſis, the pupil remains of its natural form, and alters according to the quantity of light. But, as in the former variety of the diſeaſe the opacity of the lens moſt commonly precedes the amauroſis, it generally too comes on ſuddenly, preceded by ſparks of fire appearing before the eyes, or clouds flying before them, or headach, and pains about the brow or temples. We have ſeen an inſtance of a ſimple cataract in one eye, and in the other cataract and amauroſis combined.

Commonly cataract affects both eyes ſimultaneouſly; but there are alſo many examples of the diſeaſe affecting only one eye. It alſo happens, that firſt one eye is affected, and many years afterwards the ſecond. We have in general obſerved, that when the cataract takes place only in one eye in young people, or when it ſucceeds a blow, the other eye is ſeldom affected. But on this we ſhould not truſt much, for it is an undeniable fact, that a great ſympathy exiſts between the two eyes; and that when one of them becomes diſeaſed, the other is very apt to become ſimilarly affected. We have ſeen a caſe where a ſtaphyloma aroſe in one eye in conſequence of a wound, and in a few years afterwards the other eye became ſtaphylomatous. A man who received a blow on one eye, which produced amauroſis, had ſoon afterwards a cataract formed on the other. Richter mentions an analogous caſe. St Ives mentions a very remarkable caſe of a man who was wounded in the right eye with a ſmall ſhot, and ſhortly after that eye was affected with a cataract. Some time afterwards the ſame diſeaſe took place in the left eye, but which gradually diſappeared after the cataract had been extracted from the *right* eye. Theſe obſervations on the connection between the two eyes, have led ſome ſurgeons to adviſe operating for cataract when only one eye is affected, in order to prevent the ſecond eye from becoming diſeaſed. There are a few caſes where this practice has been ſucceſsfully adopted, and there are others where it has failed. We know of one gentleman, now upwards of ſeventy years of age, who was couched for a cataract in one eye when twenty years old, and the diſeaſe has never attacked the other eye. Richter once performed the operation on a woman who had a complete pearl-coloured cataract in the *left* eye, and an incipient one in the right, which, before the operation took place, was beginning to advance rapidly. After operating on the left eye, the progreſs of the diſeaſe in the *right* ſeemed to be checked, and for years after the operation it had not made the ſmalleſt progreſs. On the other hand, we have operated in ſeveral caſes where the diſeaſe was juſt commencing in one eye, and when the operation did not appear to arreſt its progreſs in the ſecond one. It is therefore a point not yet determined in what caſes it would be adviſable to operate when only one eye is affected; for in thoſe where the progreſs of the diſeaſe in the ſecond eye cannot be arreſted by an operation on the firſt, no operation ſhould be performed on either eye until viſion is nearly altogether deſtroyed.

218 Progreſs of the diſeaſe.

The progreſs of this diſeaſe is very various; ſometimes it proceeds ſo ſlowly as not to deſtroy viſion for many years, at other times a complete obſcurity of the lens has been known to take place almoſt inſtantaneouſly. Richter and Eſchenback both relate caſes where people labouring under gout, which ſuddenly retroceded, were entirely deprived of their ſight in one night. We have obſerved analogous caſes, though we could not determine the exiſtence of any conſtitutional affection.

From the ſound cryſtalline being chiefly compoſed of *albumen* and a ſmall quantity of *gelatine*, whatever might produce a coagulation of theſe, would deſtroy the pellucidity of the lens. Whatever too would produce inflammation of the capſule of the lens might alſo render it obſcure; for when any ſerous ſurface is inflamed, and to that claſs belongs the capſule of the lens, its tranſparency is deſtroyed, and it becomes thickened from an effuſion of albuminous matter on its ſurface. Cataracts ariſing from wounds are probably produced in this manner.

In old people there is often diſtinguiſhable a ſlight obſcurity of the lens, and ſometimes it even forms a complete cataract. In ſuch caſes the obſcurity probably ariſes from a want of balance in the ſecreting and abſorbent ſyſtems, or the neceſſary perfection of theſe functions to preſerve the natural ſtate of parts, which we obſerve to decay in many other organs, as well as the eye, in thoſe far advanced in life.

219 Symptoms remarked by the patient.

Beſides the ſymptoms which are to be obſerved in an eye affected with cataract, there are others remarked by the patient. Objects appear to him as viewed through a miſt or cloud; and as the opacity of the lens increaſes, the cloud appears greater until it finally prevents even the largeſt objects from being diſtinguiſhable.

The patient, at the commencement of the diſeaſe, can diſtinguiſh objects better in a moderate than in a bright light; and the ſame thing happens if the light be interrupted by the interpoſition of the hand or any other ſhade. The reaſon of this is obvious; becauſe the pupil is more dilated in a moderate than in a bright light, and thus ſtill admits a certain number of rays of light by means of the pellucid circle of the lens.

When the exterior part of the lens is leſs obſcured than the centre, the patient ſees thoſe objects much better which are placed by his ſide, than thoſe which are oppoſite to him.

If the obſcurity has not affected the middle of the lens, but ſome part of its edge, any circular body looked at by the patient, appears to have its edge imperfect. It has been alſo remarked that ſome patients ſee every thing with perforations in them. The cataract is ſeldom accompanied with any pain. When it is brought on from internal cauſes, both eyes are generally affected.

Of

Of the Diſeaſes of the Eye.

Of the Treatment of Cataract.

220 In the treatment of cataract, recourſe has generally been had to a ſurgical operation. Some have pretended to cure cataract by internal medicines. Small doſes of *calomel*, *electricity*, *extractum hyoſcyami*, *aqua laurocerafi*, have been extolled; but their uſe is now very generally given up. In ſome caſes of cataract which have ariſen from an injury of the eye, Mr Ware has ſeen them diſappear by an external application of æther, which promoted the abſorption of the opaque body*.

* See his *Surgical Operations.*

There are two operations which have been propoſed for the cure of the cataract; the one called *extraction*, and the other *couching*. In the firſt, an inciſion is made into the cornea, and the lens removed by puſhing it through the pupil. In the ſecond, the lens is taken out of its capſule, and lodged in ſome part of the vitreous humour, where it may be entirely out of the axis of the eye. Each of theſe methods has been much practiſed; and though a decided preference ſeems at preſent to be given by the moſt diſtinguiſhed ſurgeons to the mode by extraction, yet there are alſo caſes attended with peculiar circumſtances, in which the operation of couching may be ſucceſsfully employed. Both operations ought therefore to be well underſtood by every ſurgeon.

221 Preparatory ſteps.

It was formerly the cuſtom, before performing either of theſe operations, to confine the patient for ſeveral weeks, or even months, to a ſtrict antiphlogiſtic regimen; but this precaution, except in very particular caſes, may be generally diſpenſed with. People who have become blind, generally lead a quiet life, and are not expoſed to any of thoſe diſſipations which are likely to affect the conſtitution. It will therefore generally be found ſufficient precaution, before attempting an operation, to enjoin the patient to live moderately; to avoid ſpirituous liquors, and take a few doſes of any of the common laxative medicines. If he be ſtrong and plethoric, it will be neceſſary to purſue ſuch a courſe a little further; to give doſes of laxative medicines for a longer period, and even to bleed the patient in the arm. Many ſurgeons lay it down as a general rule, to take ſome blood on the morning of the day of the operation, either from the arm, from the temples, or from the neck by cupping; and either of theſe methods is to be preferred, according to the quantity of blood which is intended to be taken. In old people of a healthy conſtitution, we have often found it unneceſſary to uſe any of theſe means, no inflammatory ſymptom having ariſen during the progreſs of the cure. In many caſes, inſtead of bleeding before the operation, we have preferred doing it after the operation was performed, when the patient was put quiet in bed. Blood taken at this period may be reaſonably ſuppoſed to have a more powerful effect in giving check to any inflammatory attack which might be apt to ſucceed the operation, than if an equal quantity had been taken away before it. The bleeding too, immediately after the operation, we have often obſerved, renders the patient calm, and more diſpoſed to reſt, whereas at the ſame time any of thoſe diſagreeable ſymptoms are avoided during the operation, which are apt to remain for ſeveral hours after bleeding, when the patient is in the erect poſture. It is alſo of importance before the operation is performed, the patient being ſo ſituated, that he can be eaſily put to bed. The operation ſhould therefore be performed in the ſame chamber in which he is to remain, or in one immediately adjoining; and he ſhould be clothed in a bed-gown or ſome looſe dreſs, ſo as to enable him to get into bed without much trouble. The bed ſhould be placed in ſuch a poſition in the room that the light does not fall directly on the patient's face, ſo that during the cure, all glaring lights may be eaſily avoided.

Of the Diſeaſes of the Eye.

Of the Extraction of the Cataract.

222

In this operation the object of the ſurgeon is to make a wound in the cornea, and to extract through it the opake lens. In performing it there are four ſteps which require to be particularly conſidered. The *firſt* of them is the means to be employed for ſecuring the eye during the operation. The *ſecond* is the mode of making the inciſion through the cornea; the *third*, the mode of opening the capſule of the cryſtalline lens; and the *fourth* is the extraction of the lens. All theſe ſhall be conſidered ſeparately.

Mode of ſecuring the Eye and Eyelids.

223

One of the great improvements in modern ſurgery is the ſimplicity of the mechanical means employed in performing operations. A great variety of contrivances have been propoſed, in order to ſecure the eyeball and eyelids during the extraction of the cataract. Experience, however, ſhews, that almoſt all theſe are completely uſeleſs, and moſt of them extremely hurtful. To diſpenſe, therefore, with theſe inſtruments, and to be able to execute with the fingers alone thoſe parts of the operation for which they were employed may be juſtly conſidered as a material improvement. The eyeball and eyelids may be completely ſecured in almoſt all caſes, by the fingers of one hand of the operator, and thoſe of an aſſiſtant. The aſſiſtant will generally find that, with the forefinger of one or of both hands placed upon the tarſus, one upon the internal, and another towards the external angle of the eye, he will be eaſily able to raiſe the upper eyelid, ſo as to expoſe the cornea; and by the finger being placed towards the internal angle he will be alſo able to aſſiſt the operator in preventing the eyeball from being turned inwards, when the inciſion into the cornea is about to be made. The operator is to ſecure the under eyelid by the fore and middle fingers of his left hand. They are to be placed in ſuch a manner over the edge of the tarſus, that they may come in contact with the eyeball; and the middle finger is to be preſſed pretty firmly in the internal angle of the eye, between the eyeball and lachrymal caruncle, ſo as effectually to prevent the motion of the eye towards the noſe. In this poſition of the fingers of the operator and aſſiſtant, thoſe who are accuſtomed to perform operations on the eye, find that they are completely maſter of the motions of the eyeball; and by altering the poſitions of the points of the fingers, and applying more or leſs preſſure, they are able to counteract any untoward motion of the organ. Before attempting to ſecure the eyeball, the operator ſhould be prepared to advance in every ſtep of the operation; for it will be generally found, that if an attempt has been made to open the eyelids forcibly, a certain degree of irritation and watering of the eye takes place; ſo that, when a ſecond attempt is made, with

Of the Diſeaſes of the Eye.

with a view of proceeding to the other ſteps of the operation, more difficulty is met with in holding the eye than at firſt would have been the caſe. It is a good precaution, however, for the ſurgeon to take an opportunity, before the day of the operation, to try to fix the eye, and to explain to the patient this ſtep of the operation; for it often happens, that patients ſtart, and make great reſiſtance by ſqueezing the eyelids, when the operation comes to be performed; ſo that by habituating them to the mode of ſecuring the eye, it is more eaſily accompliſhed. The firſt thing to be attended to, before attempting to fix the eye, is a proper light, the poſition of the patient's head, and the height of the chair in which he is to ſit. The light of the room ſhould come from one window, and the patient ſit in ſuch a manner that the light falls obliquely over his noſe upon the eye to be operated on. If he be placed ſo that the rays of light from the window fall in the direct line of the eye, the ſurgeon will find that he is obliged, either to ſit in his own light, or that the reflections upon the cornea tend to embarraſs him. As ſoon as the other eye is covered, ſo as to prevent it from having any motion, and communicating that motion to the eye on which the operation is to be performed, the aſſiſtant is to be placed behind the patient, and the patient's head to be ſupported firmly on his breaſt. The height of the chair on which the patient is to be placed, will depend on the height of the patient, and always ſhould be ſo low, that the aſſiſtant is able to look over the head, and completely command the motion of his own fingers. The operator and aſſiſtant ſhould open both eyelids at the ſame time, which will more readily ſecure the eyeball in a proper poſition. The eyeball, however, is apt to be turned upwards, ſo that the cornea is thrown out of view. When this happens, the upper eyelid ſhould be firſt raiſed, and the aſſiſtant ſhould be always ready with the points of his fingers, to preſs in ſuch directions, that when the eyeball at any moment places itſelf in a proper poſition, he may be ready to ſecure it. When, on the other hand, the eyeball is thrown downwards, the operator himſelf muſt place it in a proper poſition, and in this manner both the operator and aſſiſtant are to co-operate with each other, and the one or the other placing his fingers in ſuch a manner as to counteract moſt effectually any awkward poſition of the eyeball. When the eyeball appears ſteady, the inciſion of the cornea ought to be immediately performed. But before entering the knife, it will be found a uſeful precaution to touch the cornea frequently with its back, and ſee if the patient ſtarts, or if the eyeball remains quite ſteady. It will often happen, that whenever the point of the inſtrument touches the eyeball, it is ſuddenly thrown into motion; and was the inciſion of the corner to have been begun at this moment, much difficulty would have ariſen. If, however, the eye be repeatedly touched with the knife, the ſtarting motion will ſooner or later ceaſe, and then the inciſion of the cornea may be begun with every poſſible advantage. When the knife has paſſed through both ſides of the cornea, there is no danger of any motion of the eyeball hindering the operation.

It ſometimes happens that the eye is extremely ſmall, and that it is ſunk deep in the orbit. In ſuch people the operation becomes much more difficult; and we have met with caſes, where, from theſe circumſtances, it was almoſt impoſſible to ſecure the eyeball with the fingers; the room which the fingers neceſſarily take preventing the knife from being properly managed, and covering a portion of the cornea. In ſuch caſes, the ſpeculum contrived by M. Pellier will be found to be a uſeful inſtrument. See Plate DXVII. fig. 8. The ſpeculum conſiſts of a piece of ſilver wire, bent in the manner repreſented in the plate; and though in itſelf extremely ſimple, it requires a good deal of management and nicety in uſing it. The curved edge of the wire (*a*) is to be placed upon the inſide of the *ciliæ* on the horizontal plate of the tarſus; the ſkin of the upper eyelid being previouſly ſtretched upwards. The aſſiſtant is then to move the ſpeculum upwards, imitating, as it were, the natural motion of the eyelids; and, when the eyeball is ſufficiently expoſed, the ſpeculum, with the handle (*b*) reſting on the brow of the patient, is to be kept firm and ſteady in the ſame poſition. In uſing the ſpeculum, it is neceſſary to make a conſiderable preſſure on the eyeball, in order to prevent the eyelid from ſlipping from underneath the ſpeculum. At the ſame time as little preſſure ſhould be employed, as will prevent this from taking place. Many ſurgeons, in uſing the ſpeculum, place it behind the *ciliæ*; and whenever any watering of the eye takes place, from the irritation of the inſtrument, it is very apt to ſlip from the moiſture of the ſkin. In order to prevent this, we have found very material benefit from ſimply folding round the ſpeculum a thin fold of crape, which, from its roughneſs, effectually prevents the riſk of the ſpeculum ſlipping. The operator is to manage the under eyelid in the ſame manner as if the upper eyelid was covered by the fingers of an aſſiſtant; and it more particularly reſts with him to prevent the eyeball from rolling inwards, the ſpeculum merely ſerving to ſupport the upper eyelid.

After the knife has penetrated both ſides of the cornea, the aſſiſtant is to be aware that no preſſure is to be made upon the eyeball. When, therefore, this ſtep of the operation is completed, the aſſiſtant, if he be uſing the ſpeculum, is to be particularly careful in taking off any preſſure which it may make, and merely to ſupport the eyelid.

Mode of making the Inciſion of the Cornea.

The great object to be kept in view in making an inciſion of the cornea is, that it be of ſufficient ſize to allow the eaſy extraction of the cryſtalline lens, and that any cicatrix which may remain may not interrupt the entrance of the rays of light through the pupil. The mode which has been recommended to effect theſe purpoſes, is to make a ſemicircular inciſion, parallel to the circumference of the cornea, and about half a line diſtant from the junction of the cornea and ſclerotic coat. One of the knives (Plate DXVII. fig. 1, 2, 3.) is to puncture the cornea half a line diſtant from its circumference, to be carried acroſs the anterior chamber to the oppoſite ſide, and brought through the cornea at the ſame diſtance from the ſclerotic coat to where it was entered; afterwards the inciſion is to be finiſhed by puſhing the knife forwards till the inciſion is completed.

Inſtead of making the inciſion in this manner, Mr James Wardrop has propoſed another form of inciſion, in order to remove ſeveral objections to which the other operation was liable *. The diſadvantages which Mr Wardrop

* See *Edinburgh Medical and Chirurgical Journal*, vol. iv.

Of the Diſeaſes of the Eye.

drop ſuppoſes to ariſe from the uſual mode recommended are,

1. The cornea being of very conſiderable thickneſs, a great part of the ſemicircular inciſion will be carried through between its laminæ, and therefore the length of the inciſion of the internal lamina will be much leſs than that of the external one. This he explains by two plans, Plate DXVII. fig. 11. and 12. where beſides the external form of the inciſion (*a a a*), there is drawn a ſecond line (*b*), intended to repreſent the inciſion of the internal lamina. The dark ſpace, therefore, included between theſe two lines (*b* and *a*) is intended to repreſent that portion of the inciſion which is made between the laminæ.

2. The external form deceives us in the extent of the internal inciſion, and much more difficulty is met with in bringing the lens through it, than from its apparent length could have been expected; for, as the line of the internal inciſion has a very ſlight curvature, the thickneſs and tenſion of the cornea allow the edges of the wound from being ſeparated only a little way from one another.

3. When the cornea is divided nearly at its union with the ſclerotic coat, and when the aqueous humour and lens have eſcaped, the portion of the iris oppoſite to the centre, and moſt depending part of the wound, loſes its natural ſupport given to it by the cornea, and is puſhed forward, ſo that it comes in contact with the cornea, and even inſinuates itſelf between the edges of the inciſion. The greater the opening is, the more danger there is of a prolapſus, both of the iris and vitreous humour; for it would ſeem as if theſe two parts of the eye were puſhed forwards in conſequence of the contraction of the coats of the eye, which takes place as ſoon as the inciſion is made; and if two thirds of the cornea be cut, there is certainly much leſs reſiſtance than when the half only has been divided. Thus, the iris and cornea form permanent adheſions in conſequence of the inflammation which always follows the operation. The pupil becomes of an irregular form, is drawn from the centre of the eyeball; is ſometimes very much contracted, and retains but a very limited ſphere of contraction and dilatation.

4. The contraction of the muſcles of the globe of the eye preſſing forward the contents of the poſterior chamber, are very apt to puſh a portion of the vitreous humour through the pupil and wound of the cornea. When this happens, the pupil becomes irregular, and drawn down towards the inciſion, the form of the eyeball is ſomewhat altered, and the prolapſed vitreous humour incloſed in its capſule, appears externally in the form of a round tranſparent tumor.

5. As the external edge of the ſemicircular flap of the cornea is very thin, and lies looſe, the ſmalleſt movement of the eyelids, particularly of the upper one, is apt to catch and raiſe it out of its proper ſituation, and thus that ſpeedy union is prevented which would take place if the two divided ſurfaces had been kept in accurate and conſtant contact.

6. and laſtly; As the internal edge of the inciſion is often unavoidably made, from the ſmallneſs of the anterior chamber, and the flatneſs of the cornea, nearly oppoſite to the inferior margin of the pupil; and as all the extent of the cut ſurface *a b* (Plate DXVII. fig. 12.), ſometimes remains opaque after the wound is healed, the opacity of the cicatrix muſt diminiſh the ſphere of viſion.

Of the Diſeaſes of the Eye.

All theſe diſadvantages in the uſual mode of making an inciſion of the cornea, appeared to Mr Wardrop to ariſe chiefly from the want of a ſufficient portion of the cornea being left at the inferior part of the wound, to ſupport the iris, and to prevent the preſſure of the parts contained within the eyeball, and the occaſional action of the muſcles puſhing forward the iris towards the wound of the cornea; he therefore conceived that if the inciſion could be made in ſuch a manner that a larger portion of the cornea could be left at the inferior part of the wound, being at the ſame time made of ſuch a form as to allow the eaſy extraction of the cataract, and the cicatrix not afterwards to interfere with viſion, a conſiderable improvement would be made in the operation. With this view he made the inciſion in the following manner.

225
Of the cornea knife.

The beſt knife for the purpoſe is of the ſame ſize and ſhape with that delineated in Plate DXVII. fig. 1. The blade is of a ſimple triangular form, the back being one continued line with the handle, except merely the point. The point, though extremely ſharp, ſhould be made firm, and the blade ſhould turn gradually thicker from the point towards the handle. The point of the knife muſt be ſharp on both edges for at leaſt the breadth of a line, in order that it may penetrate the cornea quickly and eaſily. The back of the knife ſhould not be left angular, but the edges rounded off and made ſmooth, ſo that it be convex on both ſides. Particular care ought to be taken that the point of the knife be well conditioned; and it is not only neceſſary that it be ſharp, but that the metal of which it is made be neither too hard nor too ſoft. This may be eaſily aſcertained by preſſing the point upon the nail; for if it bend readily, not being ſo brittle as to break through, and ſufficiently elaſtic to recover the ſtraight line, we may be confident that it will anſwer the purpoſe. It is alſo a good precaution to have the knife ſharpened the day before, or the morning of the operation; and in caſe of any accident happening to the point, the operator himſelf ſhould carefully examine by trying how it penetrates a thin piece of leather, immediately before uſing it. From the point of the knife being too brittle, we have known a caſe where the point of it was broken off, when attempting to penetrate the inner part of the cornea; and from the point being too ſoft, we in one caſe, after puncturing the cornea, found it impoſſible to penetrate with the knife the oppoſite ſide, and this we found had ariſen from the point of the knife bending round.

Having previouſly ſmeared the knife with oil, or ſmoothed the edge of it upon the palm of the hand, in order to make it cut more keenly, its point is to be thruſt through the cornea at its tranſverſe diameter, and at leaſt half a line diſtant from the ſclerotic coat, and in a direction as if it was to wound the iris, or nearly perpendicular to the ſpherical ſurface of the cornea (ſee Plate DXVII. fig. 13. and 15. *a*). When the point of the knife reaches the plane of the iris, it is to be turned towards the oppoſite ſide of the cornea, by moving the blade upon the inciſion already made, as a fulcrum. It is then to be carried forward, ſo that the cornea is again punctured at its tranſverſe diameter *b*, at the ſame diſtance from the ſclerotic coat at which it had been entered on the

the Diſeaſes of the Eye.

226 the incision of the cornea.

the oppoſite ſide (fig. 13.). By theſe two inciſions the blade of the knife has cut perpendicularly, or very nearly ſo, to the ſpherical ſurface of the cornea, and the gradual thickening of the knife, by filling up the wound as faſt as it is made, prevents any of the aqueous humour from making its eſcape. The eye is now completely ſecured with the knife, and the aſſiſtant who has been ſupporting the upper eyelid, ſhould receive a ſignal from the operator, to take away all preſſure from the eyeball, and merely to ſupport the eyelid ſufficiently to allow the inferior half of the cornea to be ſeen. When the knife has been puſhed forward a little way, as is repreſented in fig. 15. the inciſion is to be finiſhed, by turning round the blade on its axis, and thus keeping the edge turned outwards, in ſuch a manner, that the remaining part of the inciſion is made a ſtraight line, and therefore nearly perpendicular to the lamellæ of the cornea (fig. 13. *c*). Whenever the laſt ſtep of the operation is begun, the aqueous humour begins to eſcape, which allows the knife to cut the cornea readily and in any direction.

Suppoſing, therefore, that the cornea, inſtead of being ſpherical, were a plain ſurface, the inciſion now deſcribed would be repreſented by the lines *a*, *b*, and *c*, fig. 13.; but as it is a ſegment of a ſphere, the form will more reſemble that repreſented in fig. 14.; at leaſt this is the form of the inciſion which the operator ſhould have in view when performing the operation. By the inſpection of theſe figures (13 and 14), it appears,

1. That a large portion or ring of the cornea is left attached to the ſclerotic coat, and muſt form, from its thickneſs, a complete ſupport to the iris.

2. That as the inciſion is made throughout nearly perpendicular to the lamellæ of the cornea, the length of the inciſion of the internal lamella will be nearly equal to that of the external one, and will be greater than when it is made in the uſual manner, by the ſemicircular inciſion; and conſequently the cataract will be more eaſily extracted through it.

3. The upper edge of the internal inciſion is at a greater diſtance from, or further below the edges of the pupil.

4. As the flap of the cornea is very ſmall, the external edge thick, and not eaſily moveable, or apt to be caught by the motion of the eyelids, the edges of the inciſion are not liable to be diſplaced, and conſequently the wound has a much better chance of uniting by adheſion.

Laſtly, the cicatrix which remains is ſcarcely perceptible, and cannot even be diſtinguiſhed when the cornea is looked upon in a direction perpendicular to its ſurface. The inciſion ſhould be made ſo that the inferior edge of the wound (fig. 3. *c*) is half way between the circumference of the cornea and the edge of the pupil, ſuppoſing the pupil to be in a moderate ſtate of dilatation. If it be made nearer to the ſclerotic coat, then the advantages to be expected from this mode of operating will be loſt; and on the other hand, if it be made at too great a diſtance from the ſclerotic coat, and conſequently too near the pupil, the edge of the pupil will be apt to paſs through between the lips of the wound. In one caſe in which this accident happened, partly on account of the inciſion being at too great a diſtance from the ſclerotic coat, and alſo from the knife having been entered too far above the tranſverſe diameter of the cornea, the wound was long in uniting, and after it was healed, the pupil remained very irregular and contracted.

In making the inciſion of the cornea in the manner that has been directed, another circumſtance alſo particularly deſerves notice, which is, that after having punctured both ſides of the cornea, in giving the knife the motion round its axis, ſome of the aqueous humour eſcapes, and there is a great riſk of the iris turning over the cutting edge of the knife. An operator who meets with this for the firſt time, is apt to think an wound of the iris is inevitable; but if he cautiouſly ſtops the progreſs of the knife by gliding the point of the fore-finger over the cornea, and preſſing the iris from its edge, the inciſion will be completed with perfect ſafety.

It ſometimes happens that after the knife has entered the cornea, the eyeball makes a ſudden motion inwards, towards the noſe, and a conſiderable part of the cornea is thus thrown out of view. This accident happens either from a fault in the operator or his aſſiſtant, and ought to be particularly guarded againſt; for when it has taken place, it is irremediable. The operator muſt not attempt to proceed any further, but immediately withdraw the knife, allow the wound of the cornea to heal, the aqueous humour to be regenerated, and after any ſlight inflammation which might ſucceed, has gone off, the operation may be a ſecond time attempted without any additional riſk.

It ſometimes happens that, on puncturing the cornea on the naſal ſide, the point of the knife does not come through at the proper diſtance from the ſclerotic coat. If it paſs through too near the centre of the cornea, as is repreſented in Plate DXVII. fig. 17. conſiderable diſadvantage ariſes; for beſides the inciſion being too ſmall, ſo that the lens is extracted with difficulty, the eye is apt to receive conſiderable injury, and the cicatrix afterwards to interfere with viſion. When this accident happens, it will be the moſt prudent practice to proceed no further in the operation, but to allow the wound to heal by adheſion, ſo that a ſecond operation might be afterwards attempted with all the advantages of the firſt. It is aſtoniſhing the rapidity with which a wound of the cornea made by a cutting inſtrument heals, and except it be very large, ſcarcely can the moſt acute eye detect any cicatrix. It is therefore much more prudent whenever any fault in the inciſion ariſes, that the wound be allowed to reunite, ſo that afterwards a ſecond operation may be ſucceſsfully performed, inſtead of attempting by ſciſſars or other inſtruments to correct any bungling. If the knife paſſes through the cornea too cloſe to the ſclerotic coat, it is not attended with ſuch bad effects as when it paſſes near to the pupil; and was it not for the danger in wounding the iris, it would be adviſable in all caſes to lay it down as a general rule to make the knife come out very cloſe to the ſclerotic coat. See fig. 18.

Of the Mode of opening the Capſule of the Lens. 227

After the operator has completed the inciſion of the cornea, he ſhould make a pauſe, and allow the patient to compoſe himſelf a little, in caſe of any involuntary motion of the eyeball injuring any part of its ſtructure. It ſometimes happens, indeed, that the moment the inciſion of the cornea is finiſhed, the lens ſuddenly follows the knife; but this is a circumſtance never to be wiſhed for, as the ſame cauſe which throws out the lens may alſo

Of the Diſeaſes of the Eye.

alſo puſh after it ſome of the vitreous humour. When the inciſion of the cornea is finiſhed, and nothing has eſcaped but the aqueous humour, the patient ſhould be directed to turn his eye from the light, and to keep his eyelids ſhut, taking great care not to ſqueeze them, ſo that the pupil may be allowed to dilate. In moſt ſurgical operations, particularly thoſe attended with much pain, it is of importance to finiſh them as quickly as poſſible. This, however, is not the caſe in the extraction of the cataract. It will be in general found that the ſeverity of an injury done to any part of the body depends, not only on its extent, but on the ſudden manner in which it is inflicted. Thus, a ſmall drop of blood ſuddenly effuſed on the ſurface of the brain, often produces a ſeries of much more diſtreſſing ſymptoms than a large collection of purulent matter in that organ. It is therefore reaſonable to expect that if the different ſteps of the operation for the extraction of the cataract are gone through in a rapid manner, the eye will be much more injured than if the ſame operation be performed more ſlowly. There is another advantage too, derived from performing the operation in a cautious manner; by holding the eye firmly for ſome time, the muſcles become fatigued, and during the latter ſteps of the operation, when there is the greateſt danger of injuring the organ, the power of reſiſtance to the operator is much diminiſhed.

228 Mode of puncturing the capſule.

The next ſtep of the operation is to make a puncture in the capſule of the cryſtalline lens, ſo that the lens is allowed to paſs through the pupil. On opening the eyelids, it will generally be found that the pupil has a very irregular appearance, which a beginner may often ſuppoſe to be in conſequence of a wound of the iris, though no ſuch accident has happened. Some ſurgeons employ an aſſiſtant to ſupport the upper eyelid, whilſt others take both eyelids completely under their own management; and when the operator finds that he can eaſily accompliſh this laſt mode, he ſhould always prefer doing ſo. When the eyelids are opened in ſuch a manner as to expoſe the inciſion of the cornea and pupil, the point of the inſtrument called the *curette* *, is to be introduced through the wound of the cornea and pupil, to puncture the capſule of the lens. Richter adviſes that the capſule ſhould be punctured ſeveral times with the point of this inſtrument, in order that a large opening may be made into it. When the lens is ſoft and milky, this may be neceſſary, but when it is of a firmer texture, if one puncture is made, it ſufficiently tears the capſule ſo as to allow itſelf to come away eaſily. Before introducing the *curette*, moderate preſſure ſhould be made on the eyeball, which has the effect not only of keeping the eye ſteady, but alſo of dilating the pupil. The convex part of the inſtrument (*a*) is then to be introduced through the wound of the cornea, and conducted to the central part of the pupil. When it reaches the pupil, from the curvature of the inſtrument, a very ſmall turn of the handle will place the point upon the capſule of the cryſtalline lens, and by puſhing the point upwards, the capſule will be readily punctured. It is not neceſſary that the point of this inſtrument be very thin; a rounded point will anſwer all the purpoſes of puncturing the capſule; whilſt from this form there will be leſs danger of wounding the iris from any unexpected motion of the eyeball. Very little force is neceſſary to puncture the capſule, and when the point of the curette paſſes through it, it gives the ſenſation as if puncturing a piece of very fine paper with a pin.

* See Plate DXVII. fig. 19.

Of the Diſeaſes of the Eye.

This part of the operation we have often found to be one of the moſt difficult; for in many patients the eye becomes extremely unſteady, and whenever an attempt is made to hold it firm, or introduce the point of the curette, the eyeball is immediately rolled upwards under the roof of the orbit. The eyeball, too, is apt to make ſome untoward motion, after the point of the curette has been introduced into the anterior chamber; ſo that if the operator be not on his guard, the iris may be caught and torn by the point of the curette. In one caſe where, after the point of the curette was introduced through the pupil, the eye turned ſuddenly upwards, and the hooked part of the inſtrument catching the edge of the iris, pulled it a good way downwards, though fortunately it did not tear it.

Mode of Extracting the Lens.

229

Whenever the capſule of the lens is punctured, the lens in many caſes begins to move forward, and the pupil to dilate. The operator carefully watching this effect, ſhould keep up an equal and moderate preſſure upon the eyeball, which will aſſiſt the lens in getting through the pupil. Whilſt the lens is making its eſcape, and appears to preſs very much on the inferior part of the pupil, the iris ſhould be ſupported by the back of the ſpoon, (*b* Plate DXVII. fig. 19.) which is generally for conveniency, fixed upon the oppoſite end of the handle of the curette. In applying the preſſure on the eyeball, it is of great importance that it be kept up uniformly, and it ſhould always be proportioned to the effects which it appears to produce on the dilatation of the pupil. In moſt caſes a very moderate preſſure will be found to anſwer the purpoſe. We have met with others, however, where it was neceſſary to compreſs the eye with a good deal of force, before it was poſſible to remove the lens.

Any ſmall portion of opaque lens which now remains in the capſule, or on its ſurface, muſt be extracted by means of a ſmall ſcoop. When the fragment lies on the ſurface of the capſule, or in any part of the anterior chamber, it is in general eaſily removed; but when the opaque body remains within the capſule, it becomes neceſſary, that the ſcoop ſhould enter the capſule through the opening which was made in it. When this opening is large and wide, the ſcoop will eaſily get in, and reach the opaque fragment; but, on the contrary, when the opening is ſmall, the ſcoop may be moved about in every direction, in hopes of laying hold of it, for the ſcoop is on the outſide of the capſule, and cannot procure an entrance. It has happened accordingly, that every endeavour to extract the remaining fragment has been fruitleſs, and in ſuch caſes it was ſuppoſed by the operator to adhere to the capſule. It was more probable, however, that the capſule had not been ſufficiently opened, and that the ſcoop could not reach the ſmall fragments. In all caſes, however, it is an object of importance, completely to remove the opaque body; for though any remaining portions be ultimately abſorbed, yet in the mean time the operation is by no means ſo complete as it would have been, had nothing been allowed to remain. It has been adviſed by ſome, (and the practice has certainly been attended with

with good effects), that after the principal part of the lens is removed, any fragments which may remain, and which are not viſible, may be brought into view by ſhutting the eye-lids, and cautiouſly rubbing them with the finger.

230 *Of the Extraction of the Capſule.*

When, after the cryſtalline lens is removed, the capſule is found to be opaque, it is abſolutely neceſſary that it be at the ſame time taken away. Opacities of the capſule are generally ſituated in its anterior parts, which renders the removal of them much more practicable. The forceps for this purpoſe (Plate DXVII. fig. 9.) are to be cautiouſly introduced through the wound of the cornea and pupil, and any opaque portion laid hold of, and cautiouſly removed. It has been obſerved that though the capſule did not appear opaque during the operation, yet in conſequence of inflammation, which occurs more or leſs afterwards, the capſule has become opaque. This circumſtance has led to a propoſal, that in all caſes the capſule ſhould be extracted along with the opaque lens. From the natural ſtructure of the eye, and the ſtrong adheſion which exiſts between the poſterior part of the capſule of the lens and the anterior portion of the capſule of the vitreous humour, it would appear impracticable to ſeparate them from each other, ſo as to extract the capſule entire. Many caſes, however, are recorded by different authors, where, in performing the common operation, the lens incloſed in its capſule has made its eſcape. In theſe caſes, however, it is probable, that the natural adheſion between the capſules of the two humours had been deſtroyed by ſome morbid alteration of ſtructure. Such caſes have probably been the cauſe of the propoſal to extract in all caſes the capſule of the lens. Mr Beer, a celebrated oculiſt in Vienna, has publiſhed a work *, in order to recommend and deſcribe the mode in which ſuch an operation ſhould be performed. After ſome general obſervations on the bad conſequences which ariſe from portions of the capſule remaining behind after the lens is removed, he deſcribes his mode of operating in the following words.

Practiſche eobachungen.

"Immediately after dividing the cornea, I dilate the pupil as much as poſſible, by a gentle preſſure on the eyeball with the finger. I then introduce the lancet (Plate DXVII. fig. 4.) through the wound of the cornea, and plunge it into the lens; one ſurface being turned upwards, and the other downwards, ſo that none of the lancet is viſible. It is particularly to be recommended to the inſtrument-maker, that this lancet have a pretty thick body, by which means, the moment of introducing it, the lens will be ſomewhat preſſed back, and its weak anterior adheſion will be ſeparated. The lancet muſt now, when in the middle of the lens, be moved upwards and downwards, in order to divide its connections above and below. Laſtly, the inſtrument muſt be turned ſuddenly on its axis, and moved to the inner angle of the eye, and then drawn out in a ſtraight direction. The lens often follows with its capſule, immediately after the lancet is withdrawn, or at leaſt it comes out quite eaſily, along with its capſules, on a continued preſſure of the finger. There is not merely a ſleight of hand, which muſt be carefully obſerved in the uſe of the lancet; experience has taught me many precautions which muſt not be neglected the moment that the lens comes out, otherwiſe the capſule may be very eaſily rubbed off from the lens, either in paſſing the pupil, or in the wound of the cornea.

Of the Diſeaſes of the Eye.

"In order to avoid this, the opening of the cornea ſhould be made as large as poſſible, and it is beſt to divide two-thirds of it; thereby the operator has the following advantages.

"1. The pupil dilates of itſelf after the diviſion of the cornea by the preſſing forward of the lens; and this dilatation may be eaſily increaſed by the ſlighteſt preſſure.

"2. The more the pupil is dilated, the better the operator can obſerve the management of the lancet; he can move his inſtrument more freely in different directions in the lens, and conſequently ſeparate more quickly and more ſurely, the lens along with the capſule, from all its connections.

"3. The lens with its capſule paſſes more eaſily through the pupil, the wider the opening in the cornea, (which indeed requires in moſt caſes much ſpace), and the further and more eaſily the pupil dilates, the leſs danger there is of the capſule being ſeparated on coming out. If the wound of the cornea is ſmall, the capſule will be either ſeparated from the lens in the pupil, or in the wound of the cornea, or paſſed back again either entirely, or at leaſt partly, into the poſterior chamber of the eye."

To thoſe who are accuſtomed to perform operations on the eye, the method which we have detailed will at once appear to be difficult, extremely dangerous, and in many caſes totally impracticable. The cauſes of failure in the operation for the cataract ſeldom ariſe from an opacity of the capſule of the lens, and when this does occur, it is always in conſequence of a violent or long-continued inflammation of the eyeball. Whenever, therefore, the inflammation which takes place after the operation is checked by proper remedies, a cataract of the capſule will ſeldom be met with.

Of the Treatment after the Operation. 231

After the lens has been extracted, and the eyelids allowed to remain ſhut for a ſhort time, the eye ought to be examined, in order to aſcertain that the edges of the wound of the cornea are in their proper place; that no portion of the iris has paſſed through it, and the pupil is quite regular. When the inciſion of the cornea is made in the manner and ſize already deſcribed, the edges of the wound, from their firmneſs and thickneſs, accurately apply themſelves to each other; and if the iris has ſuſtained no injury, it will remain in its natural ſituation, and the pupil will become perfectly circular. When the pupil is not regular, it has been generally recommended to expoſe the eye to a bright light, in order to make it contract, and thus detach it from any part to which it might have adhered. When a portion of the iris protrudes through the wound, this generally ariſes, not from any injury in that part, but in conſequence of the inciſion of the cornea having been made too large. If the inciſion be more than ſemicircular, (or two-thirds of the circumference of the cornea as directed by Mr Beer) this accident will almoſt conſtantly happen; and when it does take place, can never, as far as we know, be remedied. In ſuch caſes the operator ſhould be careful not even to attempt with the ſpoon, nor any ſuch inſtrument, to replace the prolapſed iris; for it has always been

Of the Diſeaſes of the Eye.

been obſerved, that attempts of this kind are fruitleſs, and never fail to increaſe the inflammation which ſucceeds the operation.

In applying the neceſſary compreſſes and bandages on the eye, the objects to be held in view are, to keep the eyelids in ſuch a poſition, that they cannot diſturb the wound of the cornea by their motion, and that the eye be not expoſed to any light. The upper eyelid will be completely ſecured, by placing over it, and in the hollow of the orbit, a ſmall ſtripe of wet caddis. The piece of caddis ſhould not be ſo large as to preſs much upon the eye, and from its being wet, it will be readily kept in its ſituation. Above the caddis ſhould be placed a piece of linen covered with ſimple ointment, large enough to cover both eyes; and this may be ſecured by one turn of a bandage round the head. In applying the bandage, care ſhould be taken to place it ſo that the pins are put in at the forehead and temples. The conveniency of this will be afterwards found, the bandage being eaſily removed without moving the patient's head from the pillow. The patient ſhould now be put cautiouſly to bed, and his head kept extremely low. The room in which he ſleeps ſhould be made ſo dark, that no light may paſs through the bandage to the eye. In an hour or half an hour after the operation, after the patient has become compoſed, he ſhould be bled in the arm, if from the previous ſtate of the patient's health that ſhould be deemed a proper precaution. Reſt, quietneſs, and abſtinence, ought to be rigidly adhered to for the firſt day after the operation; the patient ſhould be allowed no food except that which is liquid, in order that any motions of the jaw may be avoided, and the food ſhould be given through a tea-pot, in order to prevent any motion of the head. Sixteen or twenty hours are ſufficient to produce an adheſion of the cornea in favourable caſes; and after this period, the compreſs of wet caddis placed upon the upper eyelid, becomes no longer neceſſary; for if it be allowed to remain any longer, it becomes hard and dry, and will be apt to irritate. The bandage and plaſter ought therefore to be looſened, and the piece of caddis removed. The eyelids will now be found to adhere, and the patient will find much relief by cautiouſly wetting the ciliæ with cold water, in order to liberate the eyelids. From this period it is adviſeable to keep the eyelaſhes conſtantly greaſy with an unctuous application.

In all caſes, the ſymptoms which we are particularly to guard againſt after this operation, are thoſe of inflammation: for when theſe ariſe, various effects may be produced which might fruſtrate all our endeavours to reſtore the patient's ſight. If the wound in the cornea, inſtead of uniting by adheſion, goes through a tedious proceſs of ſuppuration, the pupil becomes irregular and contracted; or if there is an effuſion of lymph in the pupil, or if an opacity of the capſule takes place, theſe effects, all of which may ariſe in conſequence of inflammation, might either greatly impair, or entirely deſtroy viſion. The patient, therefore, ought to be carefully watched every ſix or eight hours for ſeveral days, and on the evening of the day of the operation, or at any future period, if ſymptoms ariſe which indicate the commencement of inflammation, he ought to be freely bled. The ſymptoms which are to guide us in adopting ſuch means, are pain and uneaſineſs darting through the eye or head, and a frequent and full pulſe.

Of the Diſeaſes of the Eye.

We have often remarked, after this operation, that even in thoſe caſes where no bleeding is neceſſary, the pulſe becomes unuſually full. This ſymptom alone would not, therefore, be ſufficient to warrant us in proceeding far in adopting ſuch a practice. We have long believed, that the ſucceſs of all ſurgical operations, depends much on the adoption of the means to prevent any inflammatory action. It is well known the danger of amputation, and ſuch operations in a vigorous and healthy conſtitution; it is equally well known the ſpeedy recovery of patients from operations, who have been much debilitated from previous diſeaſe; and we have repeatedly remarked that patients who have loſt much blood from ſome accident, after an operation, have recovered much more ſpeedily than thoſe to whom no ſuch accident had happened. Aware of theſe circumſtances, we have invariably adopted rigorouſly the depletive ſyſtem after the operation for the cataract; and in many of thoſe patients from whom a very conſiderable quantity of blood has at different periods been taken, we have obſerved that the ſucceſs of the operation has been more ſpeedy and more complete. The ſurgeon will ſometimes find caſes where, from the mildneſs of the ſymptoms, he is led to heſitate on the propriety of bleeding. In ſuch a ſituation it is the ſafeſt plan to have recourſe to it; for in general, wherever no ſymptoms have ariſen which may indicate the impropriety of ſuch a practice, if it be not uſeful, it is at leaſt never followed by any bad conſequences.

Veneſection at the arm is the eaſieſt and beſt mode of extracting the blood; but ſhould any circumſtances occur which render the operation at this place impracticable, or ſhould it be thought neceſſary to take away the blood nearer to the inflamed organ, an opening may be made in the temporal artery. For the firſt two or three nights after the operation, the patient's arms ſhould be watched, or ſecured in ſuch a manner, that when he is aſleep, he ſhall not be able to raiſe his hand towards his eye; for the moſt gentle ſtroke upon the eye, even ſeveral days after this operation, is attended with moſt excruciating pain, and is generally ſucceeded by violent inflammation. The patient ſhould be enjoined to lie on his back, or on the ſound ſide of the head; and after the firſt twelve hours he may be allowed to raiſe his head to the uſual height. Moſt authors who have laid down rules to be followed after this operation, have directed that the eye ſhould be kept ſhut up, and in total darkneſs for many days after the operation. We have, however, found an oppoſite practice attended with the moſt beneficial effects, and we have always conſidered it as a general principle to be followed, that the eye, from the very day after the operation, be gradually reſtored to its natural ſtate, that the globe of the eye and eyelids be allowed to move, and that day after day the quantity of light to which it is expoſed be gradually increaſed. In regulating the quantity of light, and the motion of the eye and eyelids, we ſhould be entirely guided by the patient's feelings. Whatever be the quantity of light to which the eye is expoſed, or its extent of motion, if it does not create uneaſineſs or pain, it will never be found to prove injurious; but on the contrary, if ſuch a quantity of light be admitted as to create uneaſineſs, or if any motion of the eyes or eyelids gives pain, theſe circumſtances will all tend to increaſe the inflammatory ſymptoms.

It has been already mentioned, that on the firſt day after the operation, the wet caddis ſhould be removed, and the eyelids ſeparated and covered with ſome unctuous ſubſtance, ſo that the patient may, from time to time, cautiouſly move the eyelids, provided it gives him no uneaſineſs. The pledget of ointment covering the eyes will prevent, during this day, any light from entering.

On the ſecond day the pledget of ointment may be removed, and both eyes covered with two or three folds of old linen, the patient being directed to bathe his eye frequently with a little warm water, ſo as to remove any glutinous or concreted matter from the eyelids. He ſhould alſo continue frequently to move the eyelids, and by opening them, to expoſe the eye to the ſmall quantity of light which paſſes through the linen. On the following days, the light is to be admitted more and more freely into the room, and by degrees the patient will find that he is able to look down upon the bedclothes, or any large object, without uneaſineſs. People are often apt, from the joy which they feel in having their ſight reſtored, to make too much uſe of the eye, and to render it weak and painful. Too much care, however, cannot be taken, to avoid any accident of this kind; and though the patient may feel his eye perfectly eaſy, and has no other complaint, yet it is always prudent to confine him to his bed for the firſt ſix or eight days. After the ſecond or third day he may raiſe the head or body ſafely in bed; but we have repeatedly obſerved that when patients began to ſit up early, and particularly when they approached too near a fire, they have been ſeized with a peculiar headach and inflammation of the eye, which were attended with much diſtreſs, and very difficult to remove. In ten or twelve days after the operation, the patient is commonly able to uſe the eye with conſiderable freedom, and to look even at minute objects without pain or uneaſineſs. It ſometimes happens that after this period, a ſlight irritability of the eye remains, but this in general is ſpeedily removed by the uſe of the vinous tincture of opium, or ſometimes by the application of a weak ointment compoſed of the red oxide of mercury. The application of the vinous tincture of opium will be found peculiarly uſeful; and we have known many inſtances of patients who have undergone this operation, who were frequently, for a long time afterwards, attacked with ſlight pain or inflammation of the eye, which were always ſpeedily and completely removed by the uſe of this medicine. It is ſcarcely neceſſary to obſerve that during the whole of the after treatment, the antiphlogiſtic regimen ſhould be rigidly purſued, and that the patient ſhould avoid every kind of food which from experience he knows to be apt to diſagree with him; and that above all he ſhould abſtain from the uſe of wine and ſpirituous liquors of every deſcription.

Of Couching.

232

By this operation the lens is depreſſed from its natural ſituation behind the pupil, by introducing a needle into the poſterior chamber.

The operation may be performed by introducing a needle (Plate DXVII. fig. 20.) through the ſclerotic coat, about two lines diſtant from its junction with the cornea. The point of the needle is to be directed immediately over the opaque lens, and the lens to be depreſſed a little with the convex ſurface of the end of the needle. The point is to be puſhed in a tranſverſe direction as far as the inner edge of the lens. Then the operator is to incline the handle of the inſtrument towards himſelf, by which means its point will be directed through the capſule into the ſubſtance of the opaque lens, and by inclining the needle downward and backward, the former will be lacerated and conveyed with the latter deeply into the vitreous humour. The treatment to be employed after couching is ſimilar to that after extraction.

Sect. XI. *Of the Fiſtula Lacrymalis.*

233

When the lacrymal ſac is diſtended with a puriform fluid, or when it has ulcerated, and the tears do not paſs freely down the naſal duct, the diſeaſe is called *fiſtula lacrymalis*. In the firſt ſtage of the diſeaſe, a diſtinct tumor is formed in the ſituation of the ſac, which, when compreſſed, a quantity of puriform fluid flows upon the eyeball through the puncture, or ſome of it paſſes through the noſe. In the ſecond ſtage of the diſeaſe, the integuments covering the ſac ulcerate, and the puriform fluid and tears are conſtantly oozing through the fiſtulous opening. The eyelids are affected moſt commonly in the ſecond ſtage of the diſeaſe, and ſometimes alſo in the firſt, though not always. From the affection of the internal palpebral membrane, Scarpa has ſuppoſed that all the puriform fluid contained in the ſac was ſecreted by it, but this does not always happen.

Treatment.—When the diſeaſe has originated in the mucous membrane of the eyelids, applications to it alone will be ſufficient to remove the accumulation in the ſac. A collyrium of the muriate of mercury, and the daily application of the ointment of Janin, or of an ointment compoſed of the red oxide of mercury, are well ſuited for this purpoſe. When the ſac has been the original ſeat of the diſeaſe, a ſolution of corroſive ſublimate, acetite of zinc or of lead, will be uſeful, and theſe may be uſed by allowing them to be abſorbed by the puncta into the ſac, along with the tears, or by injecting them into the puncta by a proper ſyringe, (ſee Plate DXVII. fig. 23.).

If there be a complete obſtruction in the naſal duct, theſe remedies generally fail, and it becomes neceſſary to open the ſac, and remove the cauſe of obſtruction in the duct. The ſac may be readily opened by boldly plunging a common lancet into it while diſtended with matter. The ſac ſhould then be examined with a probe, and the probe paſſed down into the noſe in the direction of the natural canal. A ſurgeon well acquainted with the ſituation and direction of the duct, can never fail in introducing the probe; for we never met with any caſe where the obſtruction could not be overcome. A ſtyle, (Plate DXVII. fig. 24.) ſuch as has been recommended by Mr Ware, is to be introduced in place of the probe, and allowed to remain until the canal is quite open. When the parts around the ſac appear healthy, the ſtyle may be withdrawn, and the opening of the ſac then heals. In many caſes the diſeaſe returns, and in ſuch after the parts are a ſecond time healthy, a tube (Plate DXVII. fig. 25.) may be introduced and allowed to remain during life. This operation requires that there be a free external opening, and that the head of the tube be preſſed completely down

Of the Diſeaſes of the Eye.

down below the edge of the ſkin. Generally the external opening heals in a few days. When the ſac has ulcerated, there will generally be found ſome ſinuſes in the integuments covering the ſac, all which ſhould be freely laid open, and the ſtyle introduced as in the former caſe. After the ſkin and ſac are apparently healthy, the tube may be introduced as in the former caſe. Beſides the uſe of the ſtyle, it is alſo requiſite to apply the eye-waters and ointments recommended in the firſt ſtages of the diſeaſe.

234 SECT. XII. *Of the Pſorophthalmia.*

In this diſeaſe there are numerous ſmall brown coloured eminences formed at the roots of the ciliæ of both eyelids, and generally both eyes are affected. The adjacent ſkin has a browniſh red tinge, and becomes ſcurfy; the ciliæ drop out, and the patient has a difficulty and uneaſineſs in opening the eyelids, particularly in candle-light. The blood-veſſels of the internal palpebral membrane are alſo turgid, and preternaturally numerous. This diſeaſe affects often many branches of the ſame family.

Treatment.—The unguentum citrinum is a ſpecific remedy in this diſeaſe. When there is much inflammation of the eyelids, they ought to be ſcarified, and the ointment applied immediately after. A collyrium compoſed of a weak ſolution of corroſive ſublimate is alſo ſometimes uſeful.

235 *Of the Ophthalmia Tarſi.*

In many people who uſe their eyes much, particularly in candle light, and in thoſe who live freely, the internal membrane of the eyelid often becomes gorged with blood; a thick puriform fluid glues the ciliæ together in the morning, and the patient complains of an inability to move the eyelids, or to look at an object in a bright or dazzling light, without much uneaſineſs being excited. In other inſtances the eyelids become affected with ſcrofulous inflammation, the glands of Meibomius ſwell and ſuppurate, the ciliæ drop out, and the eyelids loſe their natural form.

Treatment.—Scarifying the inflamed veſſels, and applying immediately afterwards a quantity of the red precipitate ointment, ſeldom fails in bringing relief, and in many inſtances alone the ointment will anſwer. In ſome caſes the diſeaſe in the eyelid is much aggravated, and connected with affections of the ſtomach and bowels, and in ſuch the greateſt attention becomes requiſite to keep the belly regular, and even to purge.

236 *Of the Entropion.*

When the eyelids are inverted, ſo that the tarſus with its ciliæ come in contact with the eyeball, the diſeaſe is called *entropion*. This diſeaſe, Mr Crampton has ſhown, ariſes in ſome caſes from a thickened and diſeaſed ſtate of the internal palpebral membrane. In others the ciliæ are turned in upon the eye from repeated and tedious inflammation altering the form of the tarſus, and in ſome old people where the integuments are very looſe, the whole tarſus is inverted by the action of the orbicularis muſcle.

Treatment.—In the firſt caſe, Mr Crampton has ingeniouſly recommended that the tarſi be divided at their junction towards the external canthus, and that the eyelids thus liberated be kept in their proper ſituation by plaſters, compreſſes, and when in the upper eyelid by fixing the ſpeculum of Pellier, until ſuch time as the wound has healed. In the ſecond caſe little can be done but pulling out from their roots any of the ciliæ which may have taken a wrong direction, and repeating the operation whenever they grow again. In the third caſe the diſeaſe may be cured by removing an oval portion of the ſkin the whole length, and cloſe to the tarſus, and uniting the wound by one or two ſtitches and adheſive plaſters. This operation may be alſo adviſeable along with that of Mr Crampton, when one is not ſufficient to cure the complaint.

Of the Diſeaſes of the Nervous Syſtem.

CHAP. XI.

Of the Diſeaſes of the EAR.

237

THE functions and ſtructure of the internal membrane of the external meatus, and alſo of the euſtachian tube and cavity of the tympanum, prove that it belongs to the mucous ſyſtem, and that it is not a continuation of the perioſteum as many anatomiſts have ſuppoſed. The analogy in the diſeaſes of this organ prove the ſame. In catarrhal affections of the pituitary membrane of the pharynx, the ear is always more or leſs affected, and often the function of the organ is much impaired. Polypi alſo grow from the cavity and membrane of the tympanum of a ſimilar ſtructure to thoſe found in other mucous ſurfaces. See *Polypi*. It is alſo ſubject to hæmorrhagies, and when it becomes inflamed, inſtead of ſuppuration taking place, there is a diſcharge of a puriform fluid from the ſurface, the ſame as what is obſerved in inflammation of the urethra, noſe, &c. *

The internal membrane of the ear is alſo ſubject to the ſame kind of thickening and contraction of the canal, as what takes place in the urethra and lacrymal ſac, &c. in conſequence of long continued inflammation †. This we might conclude from analogy, but the fact has been proved in one inſtance. Bichat diſſected the body of a perſon who had been expoſed during his life to a puriform diſcharge from the ear, in which he found a very remarkable thickening of the membrane of the tympanum, but no mark of eroſion could be detected.

The moſt common diſeaſe of the ear, and almoſt the only one which the ſurgeon can relieve, is a collection of wax in the meatus externus. Its preſence can always be determined by the inſpection of the ear; and it can be removed by directing the patient to drop ſome warm water into the ear for a few ſucceſſive nights, and afterwards ſyringing out the ſoftened wax, an operation which may be performed with a ſyringe (ſuch as is repreſented in Plate DXVII.), having fitted for it a pipe of conſiderable length.

* See *Inflammation of the Mucous Membranes.*

† See *Structures of Mucous Membranes.*

CHAP. XII.

Of the Diſeaſes of the NERVOUS SYSTEM.

238

SECT. I. *General Remarks on the Pathology of the Nerves.*

A GREAT number of diſeaſes have been conſidered under the claſs of *nervous*; and much obſcurity has been thrown on this department of medical ſcience, from

Of the Diſeaſes of the Nervous Syſtem.

from our imperfect knowledge of the laws which regulate this part of the natural ſyſtem, and from mere ſymptoms having often been conſidered as primary affections.

Pathological inveſtigations have been alſo unſucceſsful; and in only a few caſes has the knife of the moſt ſkilful anatomiſt been able to detect any morbid alteration of ſtructure in nerves, which, during life, had been the ſeat of agonizing diſeaſe. In a few caſes, where tumors have been found growing in their ſubſtance, it is not unlikely, that the cellular ſtructure, connecting their fibrillæ, has been the firſt part affected. Their arteries and veins are ſubject to the diſeaſes of theſe ſyſtems in other organs; and we have ſeen an aneuriſmal tumor as big as a hazel nut formed in the nutrient artery of the popliteal nerve; and Bichât mentions having ſeen the veins of the ſciatic nerve varicoſe in a paralytic limb. Mr E. Home has deſcribed in the Philoſophical Tranſactions a particular tumor of one of the axillary nerves, in which it is difficult to aſcertain if the medullary portion be affected; and in the *Encyclopedie Methodique* there is a deſcription of a caſe of a diſeaſe, reſembling in ſome reſpects the caſe of Mr Home's. The diſeaſe was in the middle of the radial nerve; and as the hand had neither loſt its ſenſibility nor the movement of any of the fingers, this circumſtance led to the ſuppoſition, that the *medullary* portion of the nerve was not affected, but merely its *neurilema*. In the *fungus hæmatodes*, it is by no means improbable that there is a morbid alteration in the medullary matter of the nerves; though this fact can only be determined by an accurate examination of the diſeaſe in various organs.

Moſt diſeaſes belonging to this ſyſtem have been fully treated of in the article MEDICINE. There is only one which becomes an object of ſurgical treatment.

239 SECT. II. *Of the Tic Doleureux* (Nevralgie).

Affections of this kind are diſtinguiſhed by the nature of the pain, which is ſharp, gnawing, and, particularly at its commencement, accompanied with torpor, and ſometimes with pulſations. It is attended with no heat or redneſs, or any tenſion or ſwelling of the part. It comes on in paroxyſms, more or leſs long, and at different intervals. Sometimes the attack is periodical.

The pain is always fixed in the trunk or branch of a nerve; and, during the paroxyſm, it darts from the part firſt affected through all the ramifications of the nerve.

Many nerves of the body have been found affected with this diſeaſe. The firſt pair of the loins (nevralgie ilio-ſcrotale), the poſterior crural (iſchias nervoſa poſtica), the crural, but particularly the nerves of the face are ſubject to it. When the diſeaſe affects the face, it is generally ſituated either in the frontal nerve, in the infra-orbitar nerve, or in the ſubmental nerve. Sometimes the pain affects not only all the branches of theſe nerves, but it extends to their anaſtomoſing branches, and ſpreads to one or more of the trunks.

This diſeaſe appears to be produced from a variety of cauſes, according to which its ſymptoms are varied. Sometimes it has been known to ſucceed a local irritation, ſuch as an injury on the trunk of the nerve; and in other caſes, the affection of the particular nerve is ſympathetic of a diſeaſe in ſome diſtant organ. Of Herniæ.

In ſome inſtances we have obſerved this diſeaſe ariſe from an affection of the primæ viæ; ſo that in all caſes it becomes the firſt object of the ſurgeon to trace the cauſe of the diſeaſe.

Treatment.—When the ſtomach or inteſtinal canal are diſordered, along with the particular affection of the nerve, the nervous affection will often ceaſe when they are reſtored to their natural ſtate. This is to be accompliſhed in moſt caſes by emetics, and a courſe of laxative medicines, purſued according to the qualities and quantity of the evacuated matter.

In ſome caſes, particularly in the affection of the frontal nerve, we have found great relief from the repeated application of ſmall bliſters over the nervous trunk. In ſome inſtances, too, the patients have experienced great relief, and have even completely recovered, by a continued attention to a very ſpare vegetable diet, or to a milk diet. The celebrated Marmontel was a remarkable inſtance of this kind.

There are, however, caſes where theſe means fail, and where the diſeaſe appears to depend on ſome fixed cauſe of irritation in the affected nervous trunk. In ſuch caſes, it is the uſual practice to divide the trunk of the nerve. This operation generally gives inſtant relief; but its effects have, we believe, in moſt caſes, been but of ſhort duration. It is a fact completely eſtabliſhed, that the ramifications of the nervous as well as of the vaſcular ſyſtem, though divided, are gradually regenerated. The numerous anaſtomoſes preſerve the life of the part on which the divided trunk was diſtributed, and the divided edges of the trunk gradually coaleſce; ſo that the nerve is again able to perform its natural functions. This reunion of the nerves does not take place ſo rapidly as we obſerve it in the arteries, in the ſkin, cellular membrane, or muſcle; and months elapſe before it is completed: but, from this reunion, it is probable, that the morbid action in tic doleureux, of the nature of which we are ignorant, the operation, in moſt caſes at leaſt, brings merely temporary relief.

When the operation is to be performed, the neceſſary ſteps are extremely ſimple. Some have contented themſelves with introducing a ſharp-pointed biſtoury through the integuments towards one ſide of the exit of the nerve, paſſing the point underneath it, and then dividing it; thus leaving only a ſmall puncture of the ſkin.

When, however, the operation is done in this manner, the divided extremities, from being ſeparated only a little way, are apt immediately to reunite; a circumſtance which ſhould be prevented. We could therefore adviſe that a free inciſion be made immediately above the nerve; that the nerve be completely divided, and either a portion cut altogether away, or the divided extremities ſeparated to a diſtance, and the wound allowed to heal by ſuppuration.

CHAP. XIII.

Of HERNIÆ.

242

THE word hernia has been uſed to ſignify a protruſion of any viſcus, from its proper cavity; but we ſhall only treat in this place of abdominal hernia. The viſcera of this cavity are moſt frequently protruded at the inguinal and

Of Herniæ.

and crural rings and the umbilicus. They, however, protrude alſo at the *foramen ovale*, at the *perinæum*, through the *iſchiatic notch*, and *diaphragm*.

The names that have been given to different kinds of hernia, have been derived both from the contents of the hernia, and from its ſituation. If they contain omentum only, they are called *omental hernia*, or *epiplocele;* if only inteſtine, *inteſtinal* hernia; if both, omentum and inteſtine, *entero-epiplocele;* if the ſtomach is contained in the tumor, *gaſtrocele;* if the liver, *hepatocele;* if the bladder, *cystocele;* if the uterus, *hysterocele*.

The peritonæum generally protrudes prior to any of the viſcera, forming a bag called the *hernial ſac*, in which the protruded viſcera are afterwards contained. The protruded portion of peritonæum is not dragged from its natural ſituation, but becomes elongated by gradual diſtenſion; and it is uſually not only lengthened, but more or leſs thickened.

241

Sect. I. *Of the Inguinal Hernia.*

In an inguinal hernia, the protruded viſcus enters the *abdominal* ring, paſſes along the inguinal canal, and comes out either at the inguinal ring, and goes into the ſcrotum (ſcrotal hernia), or burſts through the tendon of the external oblique muſcle (inguino-abdominal). Or, it paſſes through the tendon of the tranſverſalis, and internal oblique, and appears at the inguinal ring (abdomino-inguinal).

Inguinal hernia is more frequent in men than women, the round ligament of the uterus being of a ſmaller ſize than the ſpermatic chord. It ſometimes appears on both ſides, but moſt frequently on the right ſide.

242 Appearances on diſſection.

When the ſkin of the ſcrotum of an inguinal hernia is removed by diſſection, a faſcia is found lying underneath it, which varies in thickneſs, according to the bulk and duration of the tumor. This faſcia comes off from the tendon of the external oblique muſcle above the abdominal ring. Below this faſcia is the cremaſter muſcle, which is united both to the faſcia and hernial ſac, though eaſily ſeparable from them by diſſection. When the faſcia and cremaſter muſcle are removed, the hernial ſac is expoſed. The epigaſtric artery is ſituated on the *pubic* ſide of the ſac. The ſpermatic cord lies generally behind the ſac; ſometimes to one ſide, and ſometimes on its anterior part. Often the veſſels of the cord are ſplit, the epididimis paſſing along one ſide of the ſac, and the artery, veins, and abſorbents, on the other. Sometimes there are more than one hernial ſac on the ſame ſide. Mr Cooper found, in one caſe, two within the inguinal canal. This ariſes in ſome caſes from wearing a truſs.

In the *inguino-abdominal herniæ*, the ſac enters the abdominal ring; and, inſtead of being continued along the inguinal canal, it paſſes through the tendon of the external oblique muſcle. The hernial ſac, in this caſe, is compoſed of two diſtinct layers; the one internal and peritoneal, the other external, and produced by an elongation and gradual thickening of the aponeuroſis of the external oblique muſcle *.

* *Merry* and *Petit.*

In the *abdomino-inguinal* hernia, the ſac paſſes through the tendon of the tranſverſalis or the tendons of both the tranſverſalis and oblique muſcle, enters the inguinal canal, appears at the inguinal ring, and then paſſes down into the ſcrotum. In this caſe, Mr Cooper obſerves, that the ſpermatic cord lies on the upper or outer part of the ſac. The epigaſtric artery lies on the outſide of the ſac †.

Of Herniæ.

† *Richter, Deſſault, Rougemont.*

The inguinal hernia is generally pyriform, ſmall towards the ring, and enlarging as it deſcends. It may be diſtinguiſhed from other ſwellings of theſe parts, by the following ſymptoms: 1. When the patient is deſired to cough, the tumor becomes immediately diſtended, owing to the preſſure of the abdominal muſcles forcing into the ſac more of the viſcera or of their contents. 2. When the patient can remember that the tumor uſed to diſappear when in the horizontal poſition. 3. When the progreſs of the tumor has been from the groin to the ſcrotum. 4. When the tumor contains inteſtine, it is elaſtic and uniform; and, when puſhed up into the abdomen, it returns with a gurgling noiſe. When omentum is contained, the tumor is leſs equal on its ſurface, receives an impreſſion with the fingers, and does not return with a gurgling noiſe. Moſt commonly, however, both inteſtine and omentum are contained in the ſac. 5. The functions of the viſcera are ſomewhat interrupted, producing eructations, ſickneſs, conſtipation, colicky pains, and diſtenſion of the abdomen.

The inguinal herniæ ought to be carefully diſtinguiſhed from hydrocele of the vaginal coat, from encyſted hydrocele of the ſpermatic cord, from enlargements of the teſticle, from hæmatocele, and from varicocele. Hydrocele and hernia, too, are often combined, particularly omental herniæ.

Sect. II. *Of Reducible Inguinal Hernia, and of Truſſes.*

243

Herniæ are either reducible, irreducible, or ſtrangulated. In the reducible ſtate, the parts may be returned into the cavity of the abdomen. To prevent the eſcape of the bowels, and the danger of ſuch an accident, a conſtant preſſure ſhould be applied at the part where the hernia opens into the abdomen, to ſhut the mouth of the ſac, and thus oppoſe an effectual reſiſtance to the protruſion of its contents. To accompliſh theſe purpoſes, various *truſſes* have been contrived. The truſs ſhould be made of ſteel, and the ſpring not ſtronger than what is ſufficient to keep up the bowels; for, if the preſſure be great, the abdominal muſcles, where it is applied, are weakened, and even abſorbed. Mr Cooper adviſes the pad to be made of a conical form, the apex of which ſhould reſt on the mouth of the ſac. But, as there will be found much variety in the ſituation and ſize of the opening through which the hernia paſſes, it will often be neceſſary to vary the form and bulk of the pad. The truſs ought to be applied ſo that it makes preſſure not on the inguinal ring where the hernia comes out, but upon that part where the ſpermatic cord, and with it the hernia, firſt quit the abdomen; and this point may always be determined, by making the patient cough after the hernia has been reduced, and aſcertaining the furtheſt part from the inguinal ring, where the hernial ſac is found to protrude. On this point the pad ſhould reſt. If the pad be too large, and preſs merely on the inguinal ring, it will allow the bowels to paſs through the internal or abdominal ring, and enter into the inguinal canal. On the other hand, the pad ſhould

not

Inguinal Herniæ.

not be too ſmall, ſo as to preſs into the mouth of the ſac and plug it up, for that would prevent all chance of a permanent cure; the bowels may be prevented from entering into the ſac; but the pad will act as a dilater or bougie, keep the mouth of the ſac conſtantly open, and even increaſe its diameter. The pad, therefore, ought always to be made of ſuch a ſize and ſhape, as to make a preſſure on the abdominal ring, inguinal canal, and inguinal ring.

244

Sect. III. *Of Irreducible Herniæ.*

Herniæ become irreducible when the protruded parts are ſuffered to remain long in the hernial ſac and increaſe much in bulk, when membranous bands form acroſs the ſac and entangle its contents, or when an adheſion takes place between the ſac and its contents, or amongſt the contents themſelves.

Treatment.—In ſuch caſes, a bag truſs ought to be worn, ſo as to keep up a uniform and ſteady preſſure on the ſcrotum. The application of ice, too, has been known to procure the return of a hernia which appeared irreducible.

Sect. IV. *Of Strangulated Herniæ.*

A hernia is ſaid to be ſtrangulated when not only the inteſtine and omentum are irreducible, but when the protruded bowels are inflamed, and when the paſſage of the fæces through the ſtrangulated portion is completely interrupted.

245 mptoms.

The tumor is attended with conſiderable pain, which ſometimes extends through the abdomen, and is often ſituated at the umbilicus. Hiccup and vomiting ſucceed; at firſt the contents of the ſtomach only are evacuated, but afterwards thoſe of the lower portions of the alimentary canal. The bowels are completely obſtructed, except that portion below the ſeat of ſtrangulation. The pulſe is commonly quick and hard; ſometimes, however, it is full. If the diſeaſe continues, the ſkin covering the tumor becomes diſcoloured and ſlightly œdematous, and the abdomen tender and tenſe; the pulſe becomes ſmall and thready, the countenance has an expreſſion of anxiety; and all theſe ſymptoms are ſubject to exacerbations. They are greatly mitigated for a while, but ſoon recur with increaſed violence.

After having ſuffered great pain during the firſt ſtage of the diſeaſe, the patient becomes ſuddenly eaſy, and the tumor becomes of a purple colour, and has a crackling feel. The abdomen becomes more tenſe, a cold ſweat covers the body, and the pulſe is weak and intermittent. At laſt the patient, deluded with the hopes of a recovery, ſinks under the complaint.

246 ppear- ces on ſection.

On diſſection, the hernial ſac is generally found to contain a quantity of dark bloody ſerum. The inteſtine is of a dark chocolate brown, with black ſpots interſperſed over it, which are eaſily torn on being touched with the finger. The ſurface is covered with a layer of coagulated lymph. Even when the inteſtine is not mortified the colour is extremely dark, but then the black ſpots do not appear. Within the abdomen the whole inteſtinal canal ſometimes appears quite natural; at other times portions of the inteſtines appear inflamed, and in ſome rare caſes they are glued together by an effuſion of lymph.

On examining the ſeat of ſtricture, it will be found to take place either at the abdominal or inguinal ring. In large herniæ, Mr Cooper has remarked that the ſtricture is moſt frequent at the external opening, and then it may be often ſeen from the particular ſhape of the tumor, a conſtriction being diſtinguiſhable at that part. In other caſes the ſtricture is ſeen at the entrance of the ſpermatic veſſels into the inguinal canal; ſo that, in operating for hernia, it is not ſufficient to dilate the external ring, but it becomes neceſſary to dilate the upper part of the canal.

Of Inguinal Herniæ.

Treatment.—In the treatment of ſtrangulated hernia, the leading object which is to be kept in view, is to return the diſplaced viſcera as ſpeedily as poſſible, and, at the ſame time, while doing this, to diminiſh the ſymptoms of inflammation or prevent their acceſſion. 247 The firſt thing to be attempted, except when the tumor Taxis. is much inflamed and painful, is the *reduction* of the hernia. In doing this, it is neceſſary to attend to the poſition of the patient and the mode of applying the preſſure. The body of the patient ſhould be placed on an inclined plane, with the head downwards, and the thighs bent towards the trunk of the body. The preſſure which is employed on the tumor ſhould always be directed upwards and outwards along the courſe of the ſpermatic cord, and it may be perſevered in from a quarter to half an hour. Beſides theſe mechanical means, tobacco clyſters and cold have been uſeful in accompliſhing the reduction. Ice is the eaſieſt and beſt mode of applying cold to hernial tumors; but, when this cannot be procured, Mr Cooper uſes a mixture of equal parts of ſal ammoniac and nitre. To one pint of water in a bladder, ten ounces of the mixed ſalts are added, the bladder tied up, and then laid over the tumor. If, after four hours, the ſymptoms become mitigated, and the tumor leſſens, this remedy may be perſevered in for ſome time longer; but if they continue with equal violence, and the tumor reſiſt every attempt to reduction, no further trial ſhould be made of the application.

248 Operation.

The operation which it is now neceſſary to perform, conſiſts in making an inciſion through the integuments along the upper part of the tumor, making an opening into the hernial ſac, and extending it, ſo as to allow the contents to be examined, and the fore finger to reach the ſeat of ſtricture. The ſtricture will be readily detected by the point of the finger, and may be eaſily divided by introducing the biſtoury along the finger, till the point of it paſſes below the ſtricture *. A very * See Plate DXIX. ſlight preſſure of the edge of the inſtrument will be ſufficient to divide the ſtricture, and allow the bowels to be returned into the abdomen. If merely the ſtricture is divided, and it is never neceſſary to extend the inciſion further, it is of little importance in which direction the inciſion is made; though ſurgeons have been at great pains to point out the dangers which might ariſe were it of too great an extent.

Sect. V. *Of Femoral Herniæ.*

249

In femoral hernia, the hernial ſac lies beneath the crural arch, being puſhed through an opening between the edge of the broad inſertion of Poupart's ligament and the pubic ſide of the femoral vein †. As the tumor † See Plate DXX. enlarges, inſtead of falling downwards like the inguinal hernia,

Of Femoral Herniæ.

hernia, it passes forwards, and often turns over the anterior edge of the crural arch. As it proceeds, the swelling increases more laterally than upwards or downwards; so that it assumes an oblong shape. In the crural hernia, the sac has two coverings besides the integuments; the superficial fascia of the external oblique muscle, and the *fascia propria* of Mr Cooper, which is formed by the protrusion of the fascia which naturally covers the opening through which the hernia passes, and the fascia of the crural sheath. The taxis and use of trusses are the same in femoral as in inguinal hernia; and the same series of symptoms indicate the necessity of an operation in both when strangulated.

Operation.—Mr Cooper recommends that the incision of the integuments be made in the form of a T, beginning one incision about an inch and a half above the crural arch, in a line with the middle of the tumor, and extending it downwards below the arch, and meeting a second incision nearly at right angles with the other, the whole length of the tumor. The two fascias are next to be divided, and the hernial sac opened at its lower part, sufficiently large to admit readily the finger. The seat of the stricture is to be ascertained by the introduction of the point of the fore finger under the crural arch, and it may be readily divided in a direction upwards and inwards, of a sufficient extent to liberate the intestine; generally a very slight motion of the edge of the bistoury will be found sufficient for that purpose.

250

Chap. XIV.

Of Hare-lip.

The hare-lip is a fissure in the upper lip, very seldom in the under one.* It is attended with want of substance, and has its name from a resemblance to the lip of a hare. In general it is only a simple fissure, though sometimes it is double.

* See Plate DXXIV.

In proceeding to the operation, the patient, if a child, should be secured upon a table; but if an adult, he is to be seated upon a chair, in a proper light. The frænum connecting the gums to the upper lip is to be divided; if a fore-teeth project so much as to prevent the parts from being brought properly together, it is to be extracted; or when the fissure runs through the bones of the palate, if a small portion of the bone project, this must be removed. The operator is then to lay hold of one side of the fissure between the thumb and fore-finger, or between the forceps †, then with a pair of sharp and very strong scissars, or with a scalpel, to cut off a thin portion of the lip, and to repeat the same thing upon the other side of the fissure, so as to render the whole edges of the fissure completely raw; by which, if the operation be properly performed, a piece will be separated in form like an inverted V. After the incisions have been made, the vessels should be allowed to bleed freely to prevent inflammation; and when the bleeding has ceased, the sides of the wound are to be brought accurately together, and kept in that state by the twisted suture. The first pin ought to be as near as possible to the red edge of the lip; another is to be inserted near the upper angle; and if the patient be an adult, a third pin will generally be necessary, half way between the other two. In passing them, they ought to go rather deeper than half through the lip, that the edges of the wound may be kept properly in contact. An assistant now keeps the parts together, while the operator applies a firm waxed ligature first to the under pin; and having made three or four turns with it in the form of an eight figure, it should then be carried about the second, and in a similar way about the third, care being taken that the thread be drawn of a proper tightness. When, from a great want of substance, the retraction has been considerable, some advantage is derived from the use of adhesive plasters applied to the cheeks and tied between the pins. During the time of the cure the patient should be fed upon spoon-meat, and prevented from making any exertion with the lips, otherwise the cure might be considerably retarded. At the end of five or six days the pins may be taken out, when the parts will commonly be found completely united.

† Plate DXXIV.

Amputation.

In the case of a double hare-lip, the operation should be first done upon one fissure; and when a cure is completed there, it may be done safely upon the other.

Chap XV.

Of Amputation.

251

There are two modes generally employed for performing amputation; the common operation by two circular incisions, and the *flap* operation. We shall describe in detail both these modes of operating in the thigh.

252 Amputation of the thigh.

The patient should be placed on a table of a convenient height, in such a manner that the diseased limb may hang over the edge of it, and be secured by an assistant seated on a low chair before him; the other limb and the arms are also to be secured by proper assistants. The tourniquet (see Plate DXVI.) is to be placed on the thigh, three or four inches below Poupart's ligament, where the femoral artery may be most easily and completely compressed. Dessault preferred to the tourniquet, the finger of a strong and intelligent assistant. A cushion fixed on a handle answers very well for making pressure on the artery when a tourniquet is not to be used; and it is a useful instrument to have in readiness, in case the tourniquet should go wrong; or when it becomes necessary to amputate the thigh so far up, that a tourniquet cannot be safely fixed.

After the operator has determined on the place for the incision of the integuments, an assistant should grasp the limb with both hands a little above the place where the skin is to be divided, and draw it upwards as far as possible. The operator then with the knife (see Plate DXXII. fig. 10.) makes a circular incision through the skin and cellular membrane, down to the muscles; and this may be done, either by one stroke of the knife, or by first making one semicircular incision round the under part of the limb, and afterwards another incision upon the upper part corresponding with the former. When this is made, the integuments retract considerably from their natural elasticity, and they are to be separated from the muscles and dissected with the point of the knife, as far back as to leave a sufficient quantity of skin to cover the stump. The skin being turned back, the operator,

mputa-tion.

operator, by a ſecond inciſion carried cloſe to its inverted edge, cuts the muſcles perpendicularly down to the bone. During this part of the operation, care ſhould be taken to avoid wounding the edge of the ſkin, by tracing attentively the edge of the knife during the whole courſe of the inciſion. After the muſcles are divided, a conſiderable retraction takes places, and any muſcular fibres attached to the periofteum ſhould be ſeparated from it by the point of the knife, in order to allow the bone to be ſawn through as high as poſſible, and thus ſecure to it a firm fleſhy covering. All the ſoft parts are next to be drawn upwards as far as their ſeparation from the bone will admit of. They are to be kept in this ſituation by an inſtrument called the *retractors*, until the bone is ſawn through. The retractors may be either made of iron plates (ſee Plate DXXII. fig. 5.), or a piece of linen or leather cut as repreſented in fig. 6. The aſſiſtant who uſes either of theſe inſtruments, ſhould take care when he applies them, that the ſoft parts are completely out of the reach of the ſaw, and that they are held back as far as the place where the bone is to be divided. Any ſharp edges which may be left on the end of the bone after it has been ſawn through, ſhould be taken away with pliers, Plate DXXII. fig. 8. The arteries are next to be tied, and both the femoral artery and vein may be included in one ligature. The bleeding being ſtopped, and the wound cleaned, the tourniquet is to be altogether taken away, and the ſoft parts drawn down, ſo as to cover the extremity of the bone. In order to keep them in this ſituation, a bandage of thin flannel or cotton cloth, not exceeding two inches and a half in breadth for an adult, is to make one or two circular turns round the body above the ilium; it is then to be carried obliquely over the groin, and turned round the upper part of the thigh pretty firmly two or three times, forming as it were at this place a point of ſupport to the muſcles and ſkin. It is afterwards to be paſſed in a ſpiral manner downwards to near the edge of the wound, taking care to pull the ſoft parts towards the ſtump, whilſt applying each turn of the bandage. The turns ſhould not be ſo tight as to cauſe pain, but ſufficient to keep the parts in the ſituation in which they are placed. The ſurface of the muſcles and the edges of the ſkin are now to be accurately brought together in ſuch a direction, that the wound forms a ſtraight line, extending from the anterior to the poſterior aſpect of the limb. Strips of adheſive plaſter, about half an inch in breadth, and eight or ten inches in length, ſhould be applied, in order to keep the lips of the wound in this poſition. Thoſe over the middle part of the wound ought to be put on firſt; and great attention is neceſſary in their application, to prevent the edges of the ſkin from overlapping and puckering. They ſhould be of ſuch a number as completely to cover the ſurface of the wound, leaving only a ſmall opening for the ligatures of the arteries to be brought out at that part of the wound neareſt the place where the artery is ſituated. The wound is to be afterwards covered with a piece of linen or caddis ſpread with ſimple ointment, and a compreſs of fine tow laid over it, the whole being ſecured by a few turns of the roller.

The bedclothes ſhould be kept from preſſing upon, and coming in contact with the ſtump, by a frame or cradle, as it is called. (See Plate DXXIII. fig. 11.).

When this operation is to be performed, the inciſion of the integuments may be made, either with a common ſcalpel, or with the end of the amputating knife, as repreſented in Plate DXXII. fig. 10. After the ſkin is divided, it is of importance to allow it to retract as much as poſſible, by cutting the fibres of cellular membrane which connect it with the faſcia of the thigh, before dividing the muſcles. If the limb be much emaciated, the diviſion of the muſcles may be alſo made with the ſcalpel; if, on the contrary, the limb be bulky, the inciſion ought to be made by a common amputating knife, in order that the ſurface of the flaps be plain and uniform. After dividing the muſcles obliquely upwards down to the bone, they ſhould be ſeparated from it a ſufficient way, ſo as to leave enough to cover the end of the bone, and they ſhould be allowed to contract as much as poſſible before the bone is ſawn through. After the limb is amputated, and the circular bandage applied, the flaps will be found to meet very accurately together, and to form a round and ſmooth ſtump. From the angles of the ſkin being removed, no puckering or corners are left, and the two ſurfaces and muſcles being applied to each other, and covering the end of the bone, give it a firm and fleſhy covering, whereas in amputations performed in the common mode, the bone is covered by integuments alone. The adheſive plaſters are to be applied in the ſame manner, and the patient is to be treated afterwards as in the other modes of operating.

Lithotomy.

253

Flap operation.

The general rules to be attended to in amputation in other parts of the body, are the ſame as thoſe already mentioned; and in Plate DXXII. and DXXIII. we have delineated the place and direction of the inciſions.

Chap. XVI.

Of Lithotomy.

254

The manner of preparing the patient for this operation depends upon a variety of circumſtances. If he be plethoric, a few ounces of blood ſhould be taken away, and at proper intervals the bowels ought to be emptied by any gentle laxative which will not gripe. The diet ſhould conſiſt of light food for ſome time previous to the operation. If the pain be violent, opium is neceſſary. Sometimes it is relieved by keeping the patient in bed with the pelvis raiſed, ſo as to remove the ſtone from the neck of the bladder. He ought not to ſit up, or take any exerciſe, in the time of preparation. The warm bath ought to be uſed two or three times, and the patient ſhould remain in it half an hour at each time. A laxative ought to be given on the day preceding the operation, and an injection a few hours before it is performed. The patient ought to drink plentifully of ſome diluent liquor, and to retain the urine ſeveral hours previous to the operation. If this cannot be readily effected, a ſlight compreſſion, by means of a ligature, may be made upon the penis, ſo as to have the bladder ſufficiently diſtended, that there may be no danger of the poſterior ſurface being hurt by the end of the gorget. The perinæum and parts about the anus ſhould be well ſhaved.

A table ſomewhat more than three feet in height, and of ſufficient ſtrength, is to be firmly placed,

Lithotomy. and properly covered with blankets, pillows, &c. Upon this the patient is to be laid and properly secured; and for this purpose there ought to be two pieces of broad firm tape, each about five feet in length, which are to be doubled, and a noose formed upon them. A noose is to be put upon each wrist, and the patient desired to lay hold of the middle of his foot upon the outside. One end of the ligature is to go round the hand and foot, and the other round the ankle and hand, and cross again, so as to repeat the turns in the reverse way. A running knot is to be tied, by which the hand and foot will be properly secured. The buttocks are then to be made to project an inch or two over the table, and to be raised considerably higher than the shoulders by a couple or more pillows, and one pillow ought to be put under his head.

The operator is now to introduce a grooved staff (Plate DXXI. fig. 5.) of proportionable size, and open to the end, through the urethra into the bladder; and having fully satisfied himself of the existence of a stone, he inclines the staff, if he be right-handed, obliquely over the right groin, so that the convex part of the staff may be felt in the perinæum on the left side of the raphe. He then fixes it, and delivers it to his assistant, who is to hold it with his right hand, desiring him to press it gently, in order to make the sulcus of the staff project in the direction in which he received it. With his left hand the same assistant is to raise and support the scrotum.

The thighs of the patient being sufficiently separated by the assistants, and the surgeon being seated upon a chair of a proper height, and in a convenient light, he makes an incision with a common convex edged scalpel through the skin and cellular substance, below the symphysis of the ossa pubis, which is a little below the scrotum, and where the crus penis and bulb of the urethra meet, and on the left side of the raphe, and continues it in a slanting direction downwards and outwards to the space between the anus and tuberosity of the ischium, ending somewhat lower than the basis of that process, by which a cut will be made of three or four inches in length. This incision ought not to be shorter than is here directed, otherwise there will not be room for the rest of the operation. As soon as the integuments are divided, he ought to introduce two of the fingers of the left hand. With one he keeps back the lip of the wound next the raphe, and with the other he presses down the rectum. He ought likewise particularly to guard against cutting the crura of the penis, which he can readily feel, and separate at their under part with one of his fingers. He next makes a second incision almost in the same direction with the first, but rather nearer to the raphe and anus, by which he preserves the trunk of the *arteria pudica*. By this incision he divides the transversalis penis, and as much of the levator ani and cellular substance within these as will make the prostate gland perceptible to the finger. If any considerable vessel be cut, it is immediately to be secured, though this is seldom necessary. He is now to search for the groove of the staff with the fore finger of his left hand, the point of which he presses along from the bulb of the urethra to the prostate gland, which surrounds the neck of the bladder. He keeps it there; and turning the edge of the knife upwards, he cuts upon the groove of the staff, and freely divides the membranous part of the urethra, till the staff can be felt perfectly bare, and that there is room to admit the nail of the finger; and as the finger assists in keeping the parts stretched, and effectually prevents the rectum from being hurt, the incision into the urethra may be made with perfect ease and safety. Lithotomy.

The next part of the operation, viz. dividing the prostate gland and neck of the bladder, might, by a dexterous operator, be safely performed with a common scalpel, with the edge turned the opposite way. But to guard against accidents, a more convenient instrument, called the *cutting gorget*, is now in general use. It was originally invented by Mr Hawkins of London, and since his time has undergone various alterations *. The membranous part of the urethra being now divided, and the fore finger still retained in its place, the point of the gorget, previously fitted to the groove, is to be directed along the nail of the finger, which will serve to conduct it into the groove of the staff; and as this is one of the nicest parts of the operation, the most particular attention is required that the point of the gorget be distinctly felt to rub in the bare groove. * See Plate DXXI. fig. 2.

The operator now rises from his seat, takes the staff from the assistant, raises it to near a right angle, and presses the concave part against the symphysis of the ossa pubis; satisfies himself again that the point or beak is in the groove, and then pushes on the gorget, following the direction of the groove till the beak slip from the point of the staff into the bladder. The gorget is not to be pushed farther than this, otherwise it may wound the opposite side of the bladder, &c.

The gorget having now entered the bladder, which is readily known by the discharge of urine from the wound, the staff is to be withdrawn, and the finger introduced along the gorget to search for the stone, which, when felt, will point out the direction to be given to the forceps; at any rate, the introduction of the finger serves to dilate the wound in the bladder; and this being done, a pair of forceps † of a proper size, and with their blades as nearly together as their form will allow, are to be introduced, and the gorget withdrawn slowly, and in the same direction in which it entered, so as to prevent it from injuring the parts in its return. After the forceps are introduced, and passed till they meet with a gentle resistance, but no farther, the handles ought to be depressed till they are somewhat in an horizontal direction, as this will most correspond with the fundus of the bladder. One blade of the forceps is to be turned towards the symphysis of the pubes, to defend the soft parts there; the other of consequence will guard the return. After they have distinctly touched the stone, by moving them a little in various directions, they are then to be opened, and the stone laid hold of, which may generally be done with considerable ease. It frequently happens, however, that when the stone is small, it is not readily felt with the forceps; and instances may happen where the under and back part of the bladder may be so depressed as to conceal the stone. In such a situation, nothing will more readily bring it in the way of the forceps than to introduce the finger into the rectum, and elevate this part of the bladder. Straight forceps are generally used; crooked ones, in some very rare cases, however, may be necessary, and therefore the surgeon ought to be provided with them. † Plate DXXI. fig. 6. & 7.

After

Lithotomy. After the forceps has laid hold of the ſtone, if it be ſmall and properly placed, it may readily be extracted: but if, on the contrary, the handles of the forceps are now obſerved to be greatly expanded, it is certain the ſtone is improperly fixed, or that it is remarkably large: in either caſe it ſhould not be held faſt, but allowed to move into the moſt favourable ſituation; or the finger is to be introduced ſo as to place it properly for extraction. If this cannot be done with the finger, it ought to be allowed to ſlip out of the forceps, in order to get it more properly fixed; and as the moſt common form of the ſtone is flat and oval, or ſomewhat like a flattened egg, the forceps ſhould have hold of the ſmalleſt diameter, while an end preſents to the neck of the inſtrument. The ſtone ſhould be graſped with no greater firmneſs than is merely ſufficient to bring it fairly out, and it ſhould be extracted in a ſlow gradual manner. Lithotomy.

EXPLANATION OF THE PLATES.

Plate DXIII.

Fig. 1. and 2. Common ſcalpels. Fig. 3. A blunt-edged ſilver knife for diſſecting cloſe to important parts. Fig. 4. and 5. A ſharp and blunt-pointed biſtoury. Fig. 6. Richter's hernia knife. Fig. 7. Diſſecting forceps. Fig. 8. A blunt hook. Fig. 9. and 12. Directories. Fig. 10. and 11. Diſſecting hooks. Fig. 13. Lancet. Fig. 14. 15. and 16. Seton-needles. Fig. 17. and 18. Sharp and blunt-pointed needles. Fig. 19. Outline of a ſteatomatous tumor, the dotted line pointing out the direction in which the inciſion of the integuments ought to be made for its extirpation.

Plate DXIV.

Fig. 1. 2. and 3. ſhew the different forms of the points of bougies. Fig. 4. 5. and 6. are different ſizes of ſilver balls uſed by Mr C. Bell for introducing into the urethra, in order to determine the form and length of ſtrictures. Fig. 7. an outline taken from a caſt of the urethra, to ſhew the difference of the diameter at different parts of that canal. Fig. 8. and 9. ſhew the form of ſtrictures in the urethra. Fig. 10. ſhews a ſtricture in the œſophagus. Fig. 12. and 13. Male and female ſyringes. Fig. 14. Scarificator for the throat. Fig. 15. is the apparatus for injecting hydrocele.

Plate DXV.

Fig. 1. and 2. Forceps for removing polypi deſcribed in Chap. III. Sect. V. Fig. 3. 5. and 6. Inſtruments for removing polypi by ligature. Fig. 7. Outline of one large and two ſmall polypi in the rectum. Fig. 8. A breaſt-glaſs. Fig. 9. Cheſelden's needle. Fig. 10. A ſpeculum oris. Fig. 11. Mudge's inhaler.

Plate DXVI.

Fig. 1. Drawing of a femoral aneuriſm given by Mr Freer. *a* is the direction and extent of the inciſion, as made by Mr Abernethy. The artery, however, may be more eaſily tied by making an inciſion parallel to Poupart's ligament (*b*). *c* is the place and direction where the inciſion ought to be made in the high operation for popliteal aneuriſm. Fig. 2. is the inſtrument uſed for compreſſing the artery or aneuriſmal tumor. Fig. 3. The common tourniquet.

Plate DXVII.

Fig. 1. 2. and 3. Different forms of extracting knives. Fig. 4. Beer's lancet for extracting the capſule of the lens. Fig. 5. Inſtruments for ſcarifying the eyelids. Fig. 6. A thin ſcalpel for paring the cornea. Fig. 7. Inſtrument for holding down the under eyelid. Fig. 8. Pelier's ſpeculum. Fig. 9. Capſule forceps of Wenzel. Fig. 10. Eye ſciſſars. Fig. 11. 12. 13. 14. and 15. have been referred in N° 224. Fig. 16. repreſents the wound of the cornea where the knife has been entered too near the inner edge of the pupil; Fig. 17. where it has been brought out at too great a diſtance from the ſclerotic coat; Fig. 18. where it has been brought out too cloſe to the ſclerotic coat. Fig. 19. A curette and Daniel's ſpoon. Fig. 20. Scarpa's needle: Fig. 21. ſhews its point magnified. Fig. 22. Common ſpear-pointed couching needle. Fig. 23. Fiſtula lachrymalis ſyringe. Fig. 24. The ſtyle for introducing into the lachrymal duct. Fig. 25. Tube for introducing into the lachrymal duct; and fig. 26. Inſtrument for introducing the tube.

Plate DXVIII.

Shews the external appearance of herniæ. Fig. 1. is a femoral hernia, the tumor being unequal and divided into two portions at *a*; the iliac portion is formed of ſwelled glands, and the pubic contains the inteſtine. Fig. 2. is a ſpecimen of inguinal hernia; and fig. 3. of inguino-abdominal.

Plate DXIX.

Fig. 1. Common inguinal hernia, copied from Mr Cooper's plate. *a*, The abdominal ring. *b*, Poupart's ligament. *c*, The femoral artery. *d*, The epigaſtric artery. *e*, Hernial ſac below the ring. *f*, Hernial ſac above the ring. *g*, Sharp part of the knife introduced between the ring and the ſac, with its ſide placed towards the ſac. Its edge ſhould be turned forwards to divide the ſtricture. Fig. 2. The hernia on the inner ſide of the epigaſtric artery. *a*, The abdominal ring. *b*, Poupart's ligament. *c*, The femoral artery. *d*, The epigaſtric artery. *e*, Internal oblique and tranſverſe muſcles paſſing over the ſac. *f*, Tendon of the tranſverſe muſcle paſſing under it. *g*, Faſcia from Poupart's ligament, from which the cord has been withdrawn to ſhew the place through which it paſſes. *h*, *i*, The hernial ſac. *k*, Knife introduced to ſhew the manner of dilating the ſtricture, which Mr Cooper directs always to be done forwards and upwards, oppoſite to the middle of the mouth of the hernial ſac, in all the varieties of inguinal hernia. Fig. 3. Form of the hernial truſs; and fig. 4. Mode in which it ſhould be applied.

Plate DXX.

Fig. 1. Crural hernial ſac removed to ſhew the hole by which it deſcended in the female. *a*, Seat of the pubes. *b*, Crural arch extending towards the ilium. *c c*, Abdominal muſcles. *d*, Crural arch. *e*, Faſcia lata.

Explanation of the Plates.

lata. *f*, Semilunar edge of the faſcia lata. *g*, Third inſertion of the external oblique. *h*, Crural artery. *i*, Crural vein. *k*, Crural ſheath. *l*, Abdominal ring. *m*, The orifice by which the crural hernia deſcends formed on the outer ſide by the crural ſheath; on the inner by the ſemicircular inſertion of the tendon of the external oblique: and above, in part, by the crural, and in part by the ſemilunar edge of the faſcia lata. Fig. 2. A ſmall crural hernia in the female; ſhewing its paſſage through the crural ſheath, and its diſtance from the crural arch. *a*, Seat of the ſymphyſis pubis. *b*, Spinous proceſs of the ilium. *c*, Crural arch. *d*, Abdominal ring. *e*, Faſcia lata. *f*, Semilunar edge of the faſcia lata. *g*, Portion of the crural ſheath. *h*, Saphena major vein paſſing into the crural ſheath. *i*, Hernial ſac incloſed in its faſcia, which is extremely denſe, and is proportionably ſo as the hernia is ſmall. *k*, The hole in the crural ſheath through which the hernia paſſes. Fig. 3. A ſmall crural hernia diſſected. *a*, Seat of the ſymphyſis pubis. *b*, Seat of the ſpinous proceſs of the ilium. *c*, Tendon of the external oblique muſcle. *d*, Internal oblique and tranſverſalis. *e*, Faſcia of the tranſverſalis. *f*, Tendon of the tranſverſalis. *g*, Inner portion of the faſcia tranſverſalis, paſſing to unite itſelf with the tendon. *h*, The crural arch. *i i*, Round ligament. *k*, The round ligament paſſing into the abdomen. *l*, Crural artery. *m*, Crural vein. *n*, Origin of the epigaſtric artery. *o*, Courſe of the epigaſtric artery behind the round ligament. *p*, Crural nerve. *q*, Superficial faſcia. *r*, Faſcia propria of Mr Cooper, the hernial ſac having been drawn into the abdomen to ſhew this faſcia diſtinctly. Fig. 4. ſhews the form and mode of applying the truſs in femoral hernia.

Plate DXXI.

Fig. 1. An umbilical hernia truſs. *(a)*, The pad. *(b)*, The ſpring added to the pad. *(c)*, An elaſtic band to aſſiſt the preſſure of the pad; the lower *(b)* points to the belt which is added to keep this truſs in its place in corpulent people. Fig. 2. 3. 4. Different forms of the gorget, as uſed by Hawkins, Cline, and Cooper. Fig. 5. The ſtaff. Fig. 6. and 7. Different forms of the forceps for the extraction of ſtones from the bladder.

Plate DXXII.

Explanation of the Plates.

Fig. 1. A lateral view of the thigh and leg; the dotted lines ſhewing the direction of the inciſion in amputation. Fig. 2. An anterior view. Fig. 3. Form of the ſtump; and, Fig. 4. Mode of applying the circular bandage. Fig. 5. 6. and 7. Retractors. Fig. 8. Pliers for removing any ſpiculæ of bone. Fig. 9. Head of a trephine, two thirds of the cutting teeth being removed. This inſtrument is intended for removing the ends of bones, particularly thoſe of the metatarſus and metacarpus. Fig. 10. and 11. Amputating knives. Fig. 12. Amputating ſaw.

Plate DXXIII.

Fig. 1. Lateral view of the arm and hand, the dotted lines ſhewing the direction of the inciſion, in amputation at the ſhoulder joint and laſt joint of the forefinger. Fig. 2. and 3. Saws uſed in amputations of the hands and feet. Fig. 4. 5. 6. 7. 8. and 9. ſhew the different parts of an artificial leg. Fig. 11. Cradle uſed after amputation in order to prevent the bedclothes preſſing upon the limb.

Plate DXXIV.

Fig. 1. ſhews the hare-lip with a fiſſure of the palate. Fig. 2. The ſimple hare-lip. Fig. 3. A double hare-lip with two irregular teeth. Fig. 4. ſhews the part of the lip into which the pins ought to be introduced. Fig. 5. ſhews the mode in which the ligatures ought to be applied. Fig. 6. The lip after the operation. Fig. 7. and 8. Pins for the lip. Fig. 9. Lip forceps. Fig. 10. Lip forceps, with one blade broader than the other, which is covered with wood in order to make reſiſtance, and not injure the edge of the knife. Fig. 11. Strong ſciſſars for dividing the lip. Fig. 12. Sciſſars with curved blades, to be uſed when the lip is very thick, and not eaſily graſped by the common ſciſſars. Fig. 13. Shews the appearance of the club-foot. Fig. 14. Machine invented by Scarpa for the cure of club-feet. Fig. 15. Diſtorted foot from a relaxed ſtate of the ligaments, a deformity which may, in general, be removed by wearing a boot, fig. 16. to which is fixed a ſteel-rod, extending from the ſole of the foot to the knee.

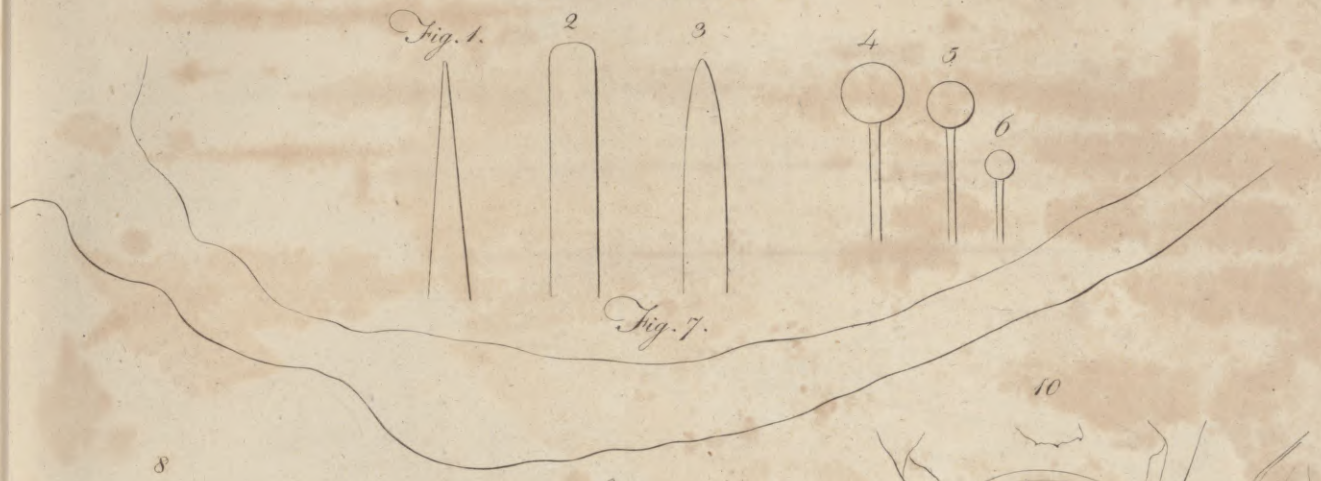
INDEX.

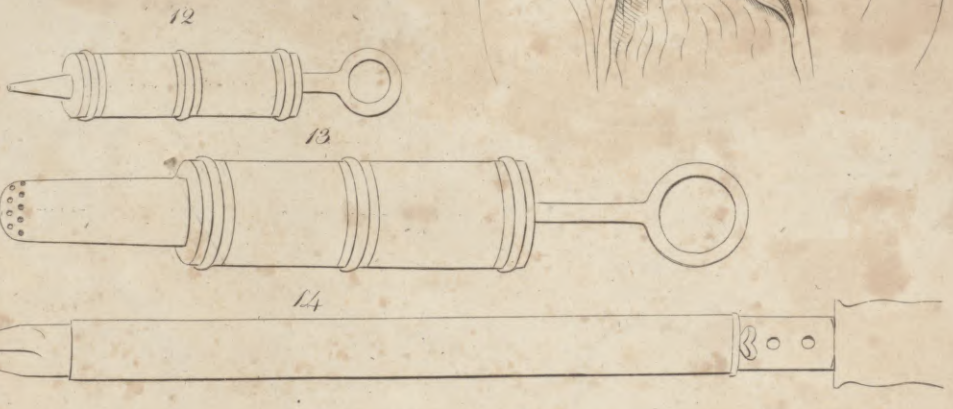
Maturation

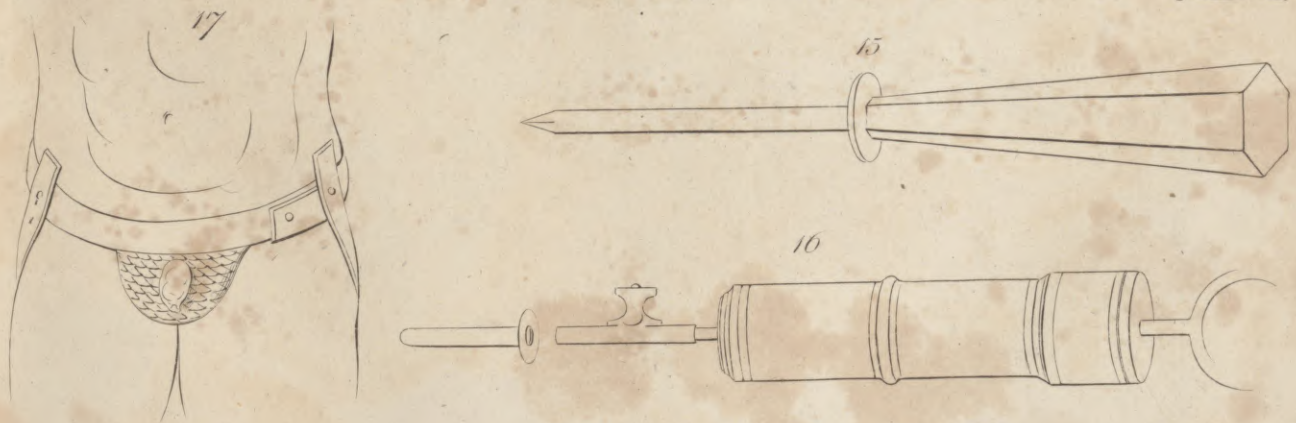

Fig. 1.
Boog
Fig. 2.
Fig. 3.
Fig. 4.
Stoddart
Fig. 5.
6
7
8
9
10
11
12
13
Boog
14
15
16
17
18
19
E. Mitchell Sculp.t

SURGERY.

PLATE DXIV.







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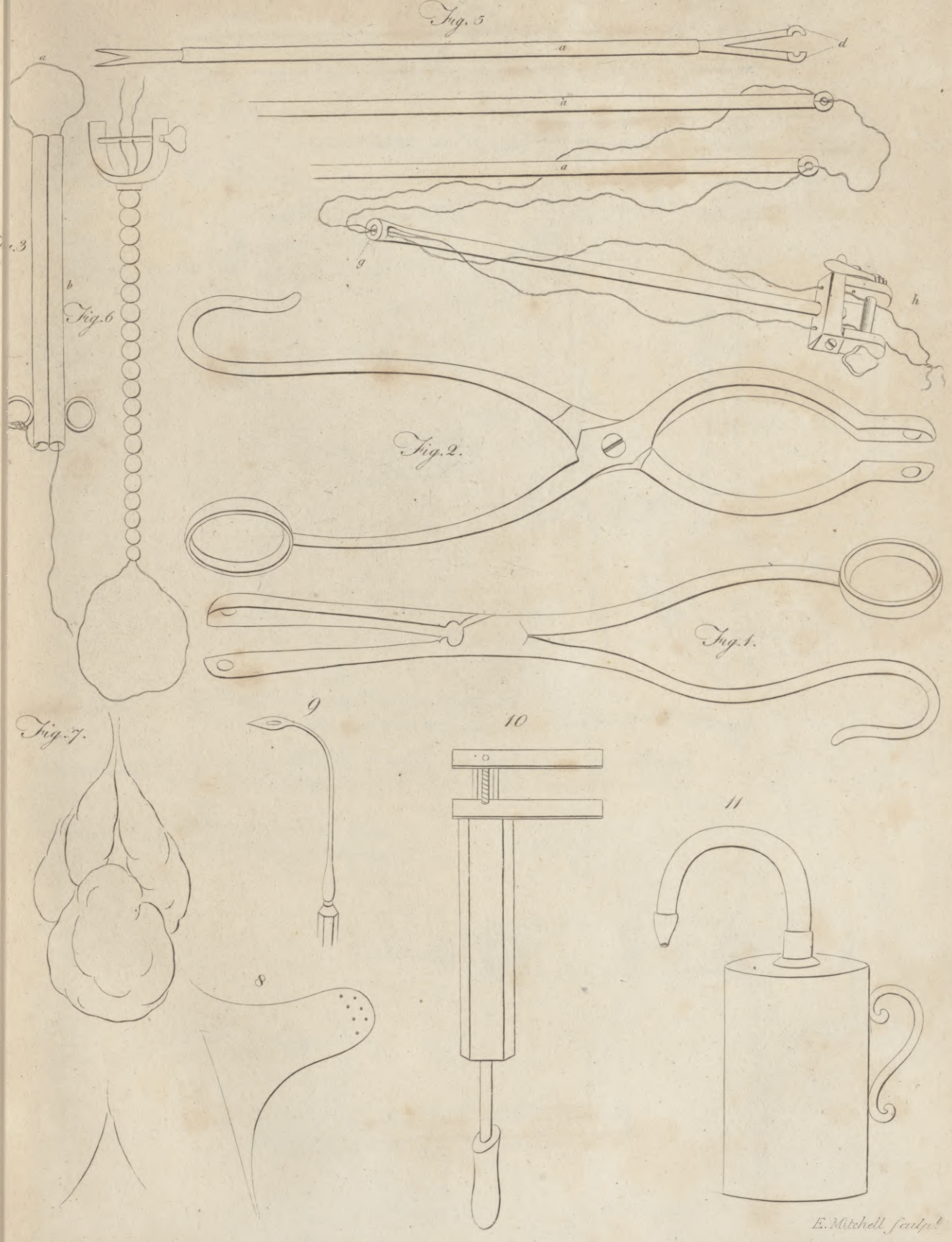
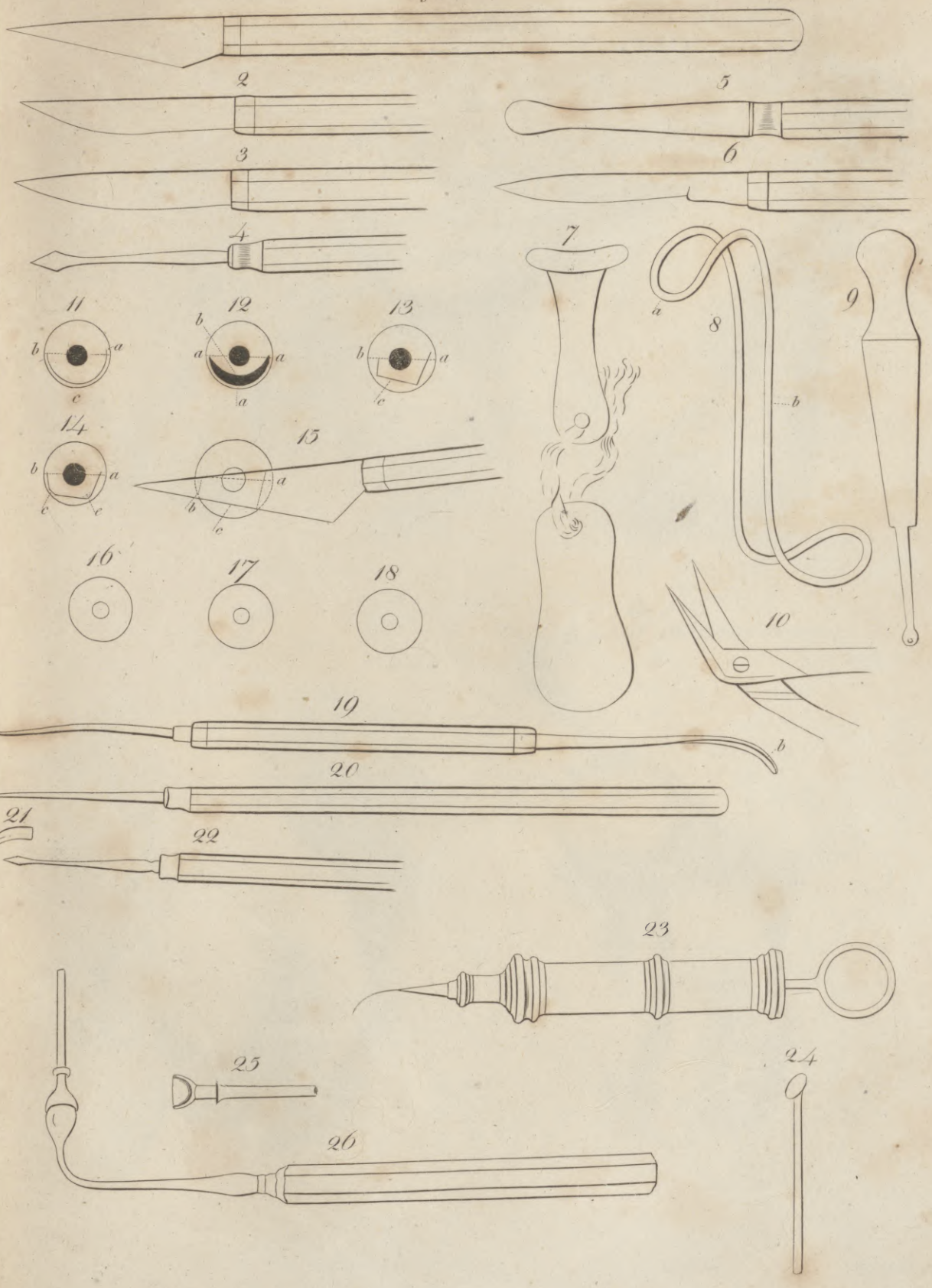


E. Mitchell sculpt.

SURGERY.

PLATE DXVII.

Fig. 1.



E. Mitchell sculp.t

Fig. 1.
Femoral Hernia

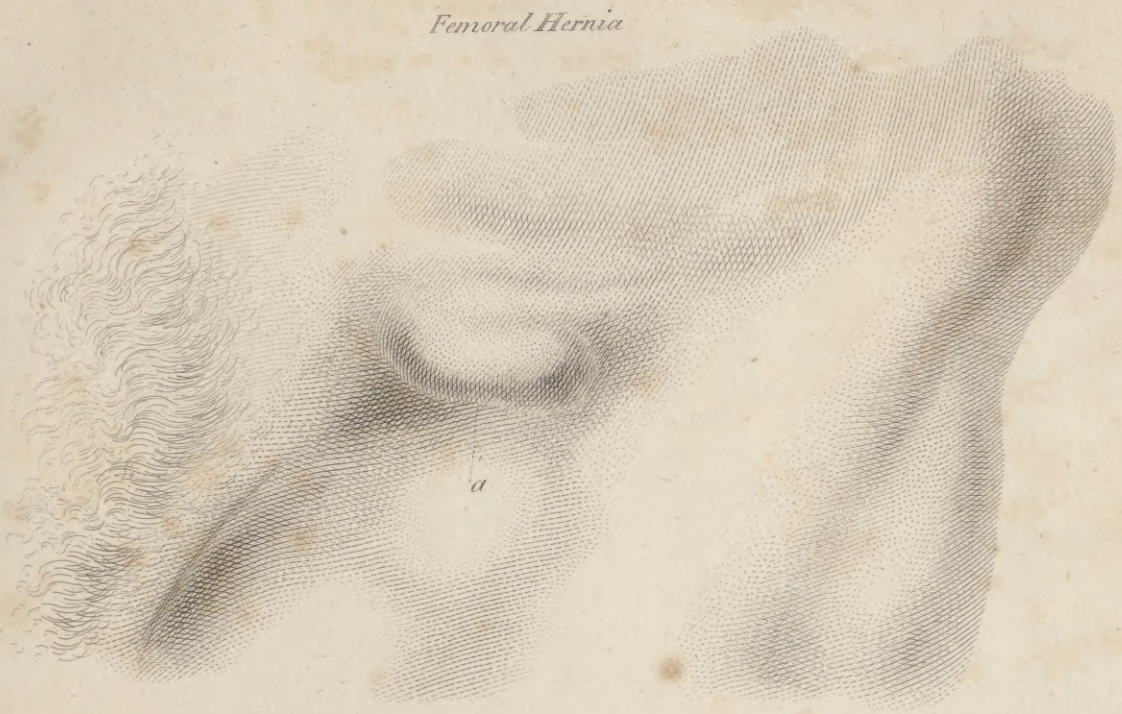


Fig. 2.
Inguinal Hernia

Fig. 3.
Inguinol Abdominal Hernia

E. Mitchell Sculp.t

Fig. 1.

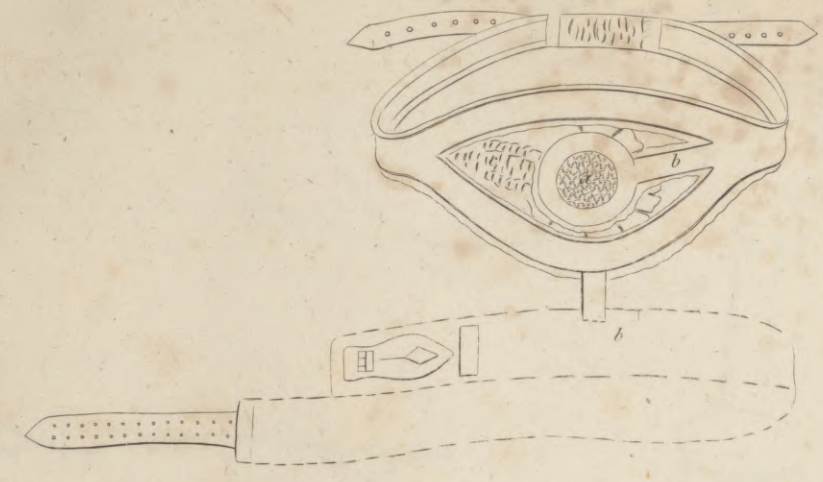


Fig. 5.

Fig. 6.

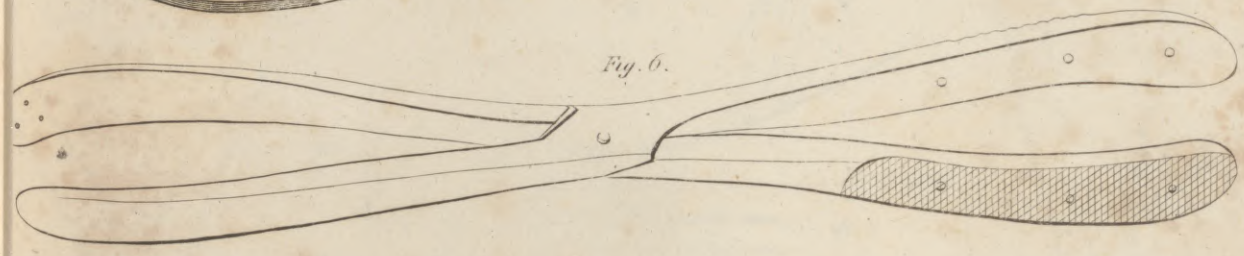


Fig. 7.

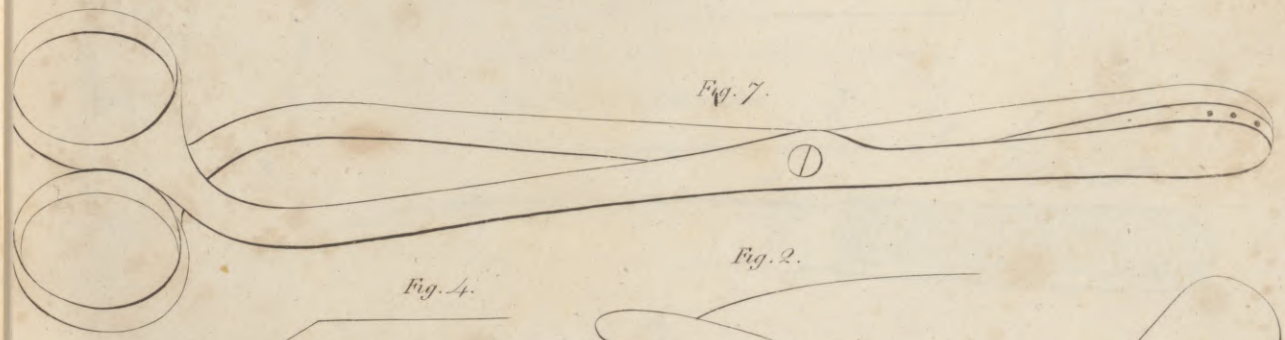


Fig. 2.

Fig. 4.

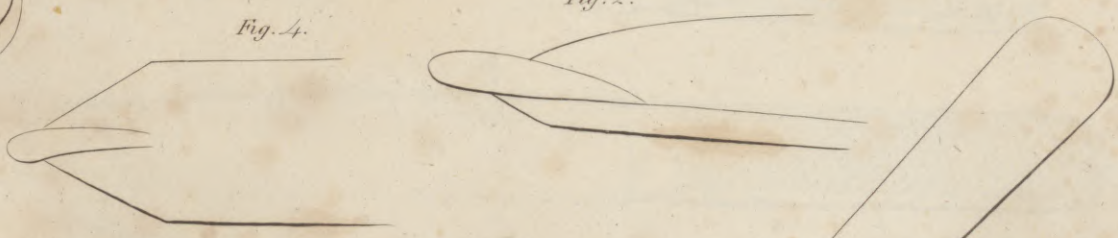
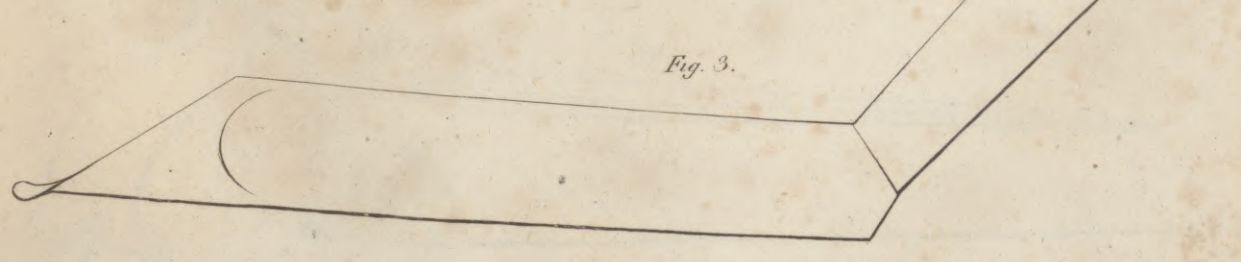


Fig. 3.



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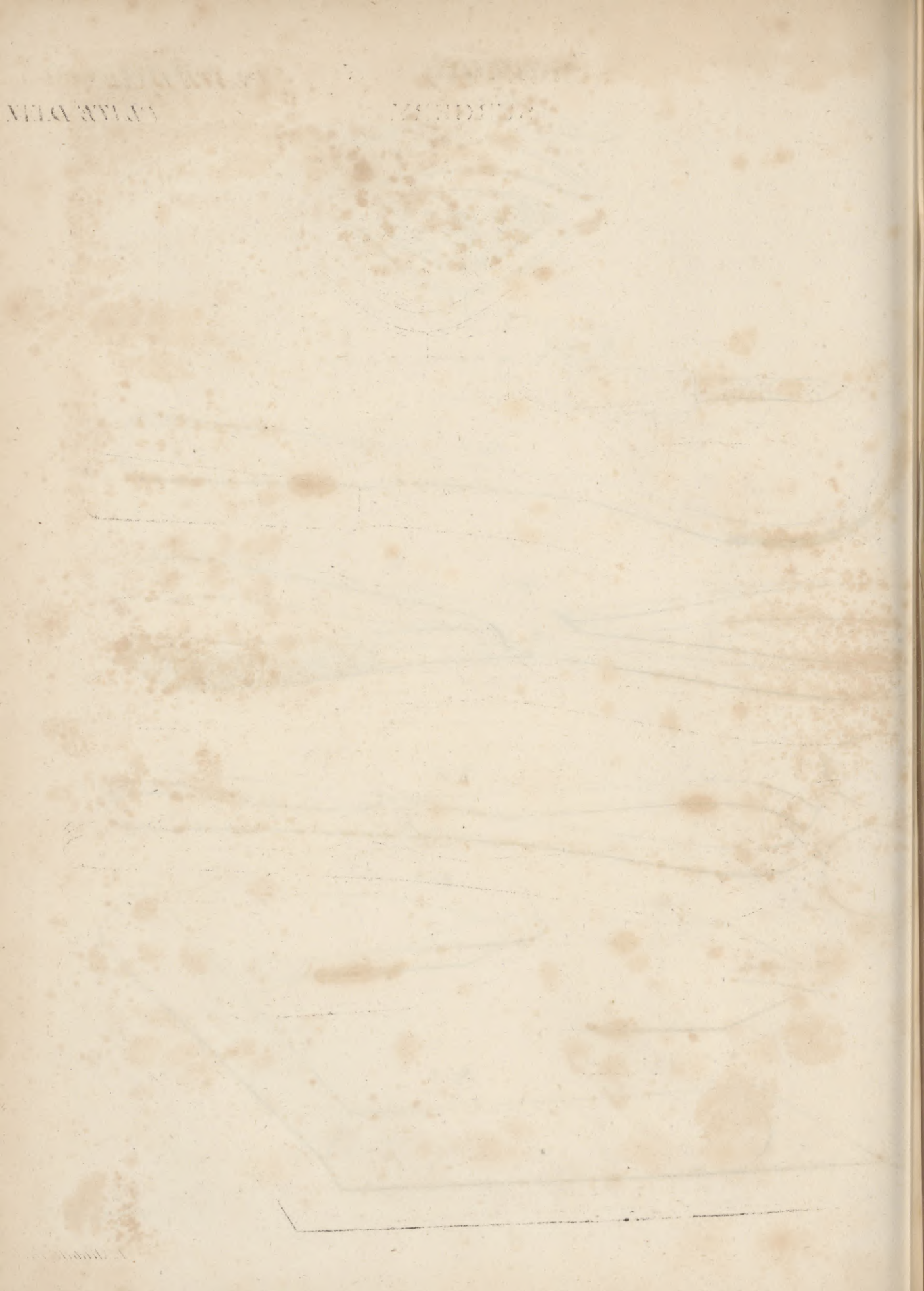

Fig. 1.

Fig. 2.

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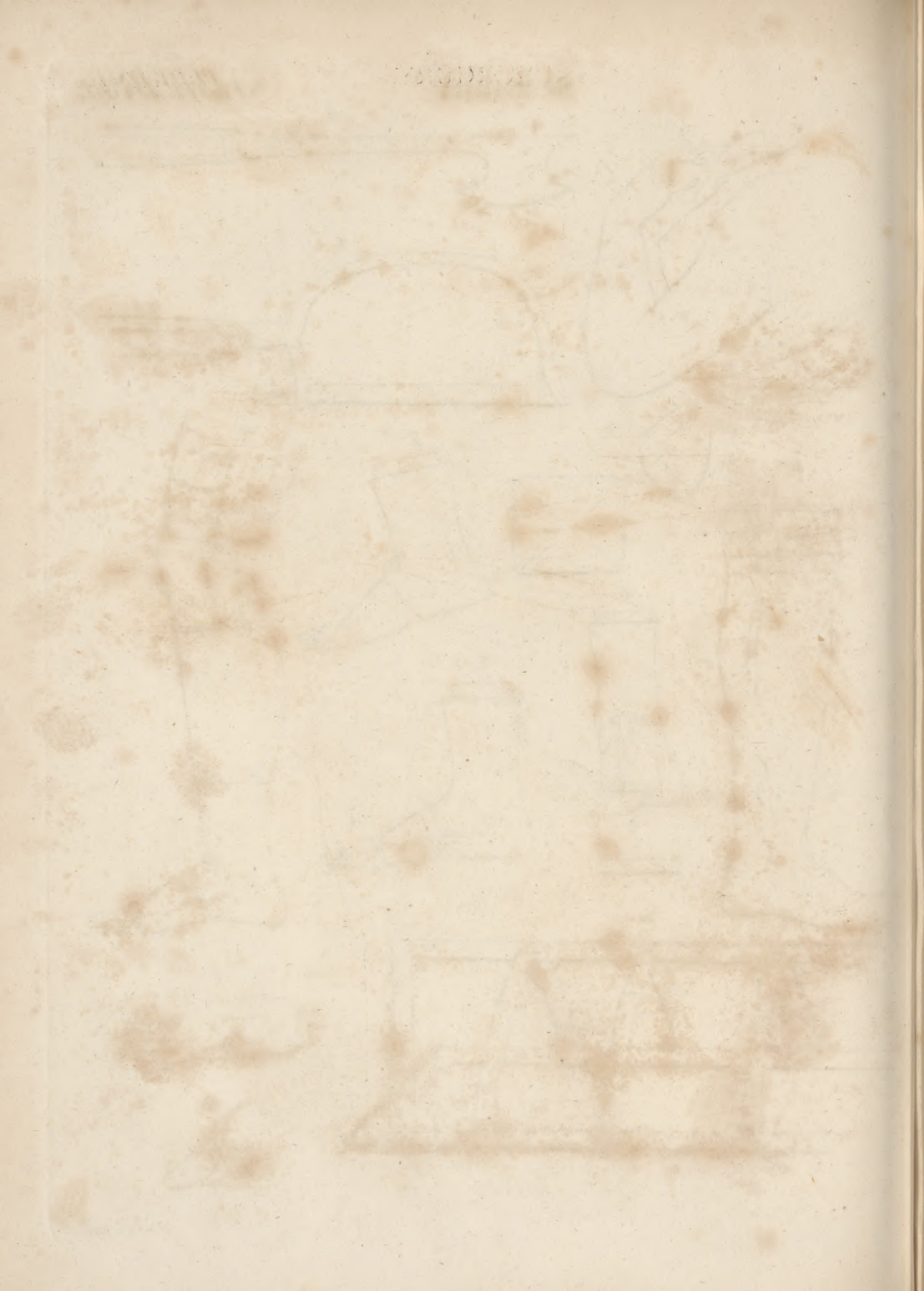
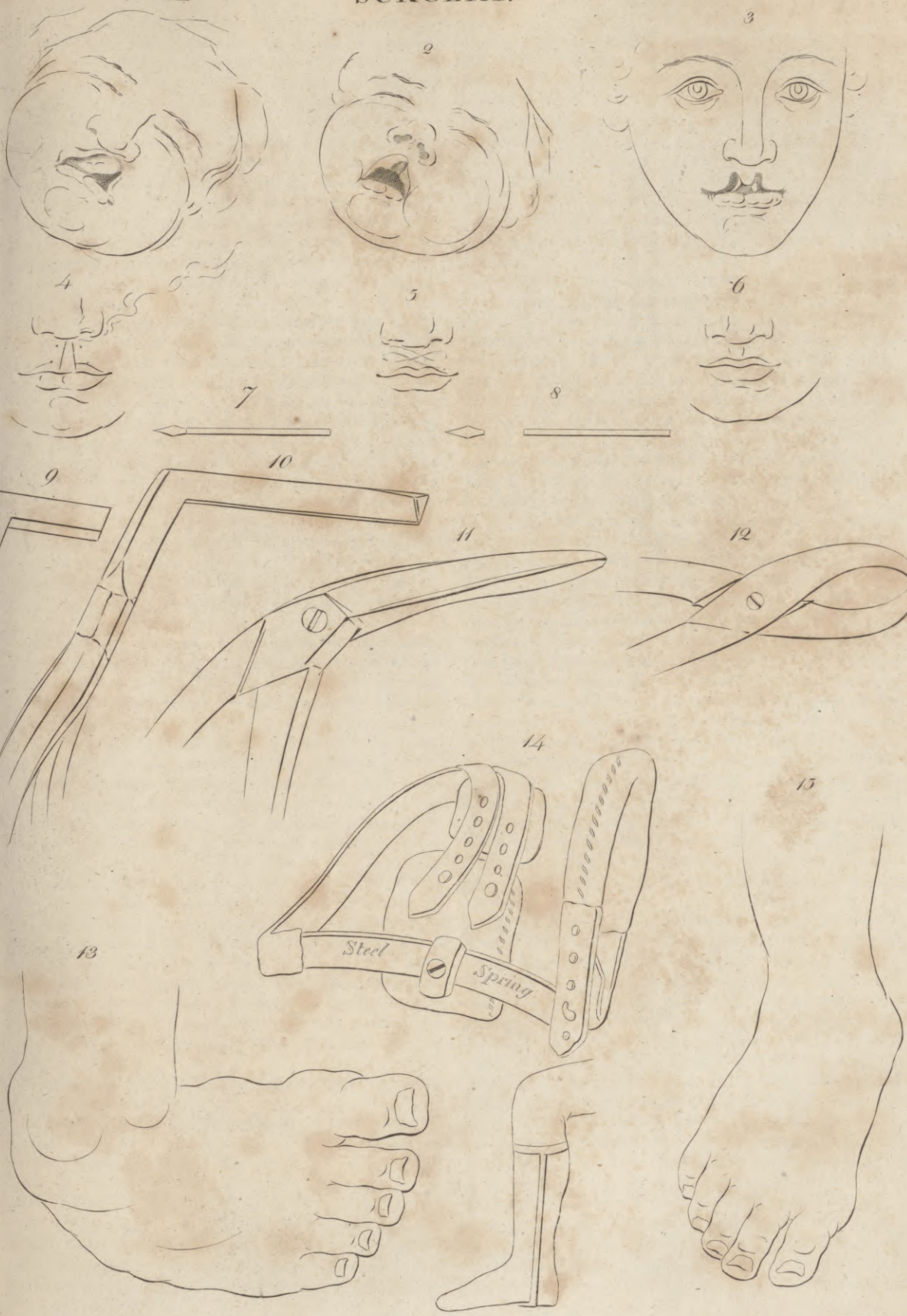




E. Mitchell sculpt.

Surinam || Surmullet.

SURINAM, a country of Guiana, which extends about 75 miles along a river of the ſame name, in N. Lat. 6. 16. This river is navigable for 90 miles up the country. The chief productions of Surinam are, wood for dyeing, indigo, cotton, ſugar, tobacco, gums, and different ſpecies of fruit. Prodigious numbers of monkeys infeſt the woods, as well as very large ſerpents. This ſettlement was ceded to the Dutch in 1674, as an equivalent for New York, but was retaken by the Britiſh in 1799. Paramaribo is the capital. N. Lat. 6. 16. W. Long. 56. 0. The productions of this country, when in the hands of the Dutch, yielded, in the year 1775, the ſum of 822,905l. ſterling; and it may be preſumed that the value of theſe will not diminiſh in the hands of its preſent proprietors. Population about 100,000 perſons.

Demerara.—Connected with Surinam we may notice the colony of Demerara, which ſurrendered to the Britiſh troops in 1781; was taken ſoon after by a French frigate, and afterwards recaptured by the forces of Great Britain. Its productions cleared from the port of Demerara from January 1806 to the ſame month of 1807, were 19,337 hogſheads, 474 tierces, and 801 barrels of ſugar; 4722 puncheons and 17 hogſheads of rum; 23,604 bales, two bags of cotton; 12,390,102 pounds of coffee; and 1694 caſks of melaſſes; a produce which we hope will be conſtantly increaſing under the mild and humane conduct of the Britiſh government, by the troops of which it was laſt taken in 1796, under Sir Ralph Abercromby. It is deemed a valuable acquiſition, on account of its flouriſhing condition. Stabroek is the capital of Demerara.

Eſſequibo, on the banks of a river of the ſame name, was firſt founded in 1698, but came into the hands of the Britiſh much about the ſame time with the preceding. The unaccountable neglect ſhewn by Holland towards her colonies rendered them an eaſy conqueſt.

Berbice is ſituated between Demerara and Surinam, containing about 104 ſmall plantations, ſcattered at conſiderable diſtances from each other, the produce of which was long ago valued at 50,000l. ſterling, but may be expected to have a rapid increaſe. Population between 8000 and 9000 perſons of various deſcriptions.

Pomaroon is a country which has a rich and fertile ſoil; yet the inhabitants chiefly confine themſelves to the cultivation of cotton, for the produce of which it is found to be admirably adapted. It is not ſo well fitted to yield good crops of coffee or ſugar, as the land is by far too rich, and ſtrongly impregnated with ſaline matters. In 1799 and 1800; a thirſt for planting cotton was greatly increaſed, as the crops of that article were then the largeſt ever known to be produced in the colonies.

SURMOUNTED, in *Heraldry*, is when one figure is laid over another.

SURMULLET. See MULLUS, ICHTHYOLOGY *Index*.

SURNAME, that which is added to the proper name for diſtinguiſhing perſons and families. It was originally diſtinguiſhed from *ſirname*, which denotes the name of the *ſire* or progenitor: thus Macdonald, Robertſon, are ſirnames expreſſing the ſon of Donald, the ſon of Robert. The word *ſurname*, again, ſignified ſome name ſuperadded to the proper name to diſtinguiſh the individual, as Artaxerxes *Longimanus*, Harold *Harefoot*, Malcolm *Canmore*. From this it is evident that every ſirname was a ſurname, though the reverſe was not ſo. In modern times they are confounded; and as there is now no occaſion to preſerve the diſtinction, Dr Johnſon has rejected the word *ſirname* altogether. See NAME. Surname.

Surnames were introduced among all nations at an early period, and ſeem to have been formed at firſt by adding the name of the father to that of the ſon. This was the practice among the Hebrews, as appears from the ſcriptures. Caleb is denominated the ſon of Jephunneh, and Joſhua the ſon of Nun. That the ſame thing was cuſtomary among the Greeks, every one who has read the poems of Homer muſt remember. We have an inſtance of it in the very firſt line of the Iliad: Αχιλλης Πηληιαδεω, "Achilles the ſon of Peleus." This is perhaps the general origin of ſurnames, for it has been common among moſt nations (A).

The Romans generally had three names. The firſt called *prænomen* anſwered to our Chriſtian name, and was intended to diſtinguiſh the individuals of the ſame family; the ſecond called *nomen* correſponded to the word *clan* in Scotland, and was given to all thoſe who were ſprung from the ſame ſtock; the third called *cognomen* expreſſed the particular branch of the tribe or clan from which an individual was ſprung. Thus Publius Cornelius Scipio, *Publius* correſponded to our names John, Robert, William; *Cornelius* was the name of the clan or tribe, as Campbell was formerly the name of all the duke of Argyle's clients, and Douglas the name of the retainers of the duke of Hamilton's progenitors. *Scipio* being added, conveyed this information, that Publius, who was of the tribe of the Cornelii, was of the family of the Scipios, one of the branches or families into which that tribe was divided. Reſpecting the three names which were common among the Romans, we may ſay that the firſt was a name and the other two ſurnames.

Du Cheſne obſerves, that ſurnames were unknown in France before the year 987, when the lords began to aſſume the names of their demeſnes. Camden relates, that they were firſt taken up in England, a little before the conqueſt, under King Edward the Confeſſor: but he adds, they were never fully eſtabliſhed among the common people till the time of Edward II.; till then they varied with the father's name; if the father, e. gr. was called *Richard*, or *Roger*, the ſon was called *Richardſon*, or *Hodgson;* but from that time they were ſettled, ſome ſay, by act of parliament. The oldeſt ſurnames are thoſe we find in Domeſday-Book, moſt of them

(A) This might be ſupported by examples borrowed from many nations. The old Normans uſed *Fitz*, which ſignifies ſon; as Fitzherbert, Fitzſimmons, the ſon of Herbert, the ſon of Simmons. The Iriſh uſed *O;* as O'Neal, the ſon of Neal. The Scotch Highlanders employed *Mac;* as Macdonald, the ſon of Donald. The Saxons added the word *ſon* to the end of the father's name, as Williamſon.

Surname, Surplice.

them taken from places, with the addition of *de;* as Godefridus *de* Mannevilla, Walterus *de* Vernon, Robert *de* Oyly, &c. Others from their fathers, with *filius*, as Gulielmus *filius* Oſberni; others from their offices, as Eudo *Dapifer*, Gulielmus *Camerarius*, Giſlebertus *Cocus*, &c. But the inferior people are noted ſimply by their Chriſtian names, without any ſurnames at all.

Surnames ſeem to have been introduced into Scotland in the time of William the Conqueror by the Engliſh who accompanied Edgar Atheling when he fled into that kingdom. Theſe had their proper ſurnames, as Moubray, Lovell, Liſle, uſing the particle *de* before them; which makes it probable that theſe ſurnames had been derived from the lands which their anceſtors or they themſelves had poſſeſſed. In Kenneth II.'s time in 800 the great men had indeed begun to call their lands by their own names; but the ordinary diſtinctions then uſed were only perſonal, and did not deſcend to ſucceeding generations, ſuch as thoſe employed by the Hebrews and Greeks: For example, *John the ſon of William;* or the names of office, as Stewart; or accidental diſtinctions from complexion or ſtation, as Black, White, Long, Short; or the name of their trade, as Tailor, Weaver.

It was long before any ſurnames were uſed in Wales, except that of ſon, as Evan ap Rice, Evan the ſon of Rice; Evan ap Howel, Evan the ſon of Howel: but many of them have at length formed ſeparate ſurnames, as the Engliſh and Scots, by leaving out the *a* in *ap*, and joining the *p* to the father's name: thus Evan ap Rice becomes Evan Price; Evan ap Howel, Evan Powel.—We are told, ſurnames were unknown in Sweden till the year 1514, and that the common people of that country uſe none to this day; and that the ſame is the caſe with the vulgar Iriſh, Poles and Bohemians.

When we come to inquire into the etymology of ſurnames, we muſt allow that many of them were originally ſignificant of the qualities of mind, as Bold, Hardy, Meek; ſome of the qualities of body, as Strong, Low, Short; others expreſſive of the trade or profeſſion followed by the perſons to whom they were applied, as Baker, Smith, Wright; Butler, Page, Marſhal. But the greateſt number, at leaſt of the ancient ſurnames, were borrowed from the names of places. Camden ſays, that there is not a village in Normandy but has given its name to ſome family in England. He mentions as examples, Percy, Devereux, Tankervil, Mortimer, Warren, &c. They were introduced with William the Conqueror. Several have been derived from places in the Netherlands, as Gaunt, Tournay, Grandiſon; and many from the names of towns and villages in England and Scotland, as Wentworth, Markham, Murray, Aberdeen. Many have been formed from the names of animals, as quadrupeds, birds, fiſhes; from vegetables, and parts of vegetables, as trees, ſhrubs, flowers, and fruits; from minerals of different kinds. Others are formed from ſuch a variety of accidents that it is impoſſible to particularize them.

SURPLICE, the habit of the officiating clergy in the church of England. By Can. 58, every miniſter ſaying the public prayers, or miniſtering the ſacrament or other rites of the church, ſhall wear a decent and comely ſurplice with ſleeves, to be provided at the charge of the pariſh. But by 1 Eliz. c. 2. and 13 and 14 Car. II. the garb preſcribed by act of parliament, in the ſecond year of King Edward VI. is enjoined; and this requires that in the ſaying or ſinging of matins and even ſongs, baptizing and burying, the miniſter in pariſh churches and chapels ſhall uſe a ſurplice. And in all cathedral churches and colleges, the archdeacon, dean, provoſts, maſters, prebendaries, and fellows, being graduates, may uſe in the choir, beſides their ſurplices, ſuch hoods as pertain to their ſeveral degrees. But in all other places every miniſter ſhall be at liberty to uſe a ſurplice or not. And hence in marrying, churching of women, and other offices not ſpecified in this rubric, and even in the adminiſtration of the holy communion, it ſeems that a ſurplice is not neceſſary. Indeed for the holy communion the rubric appoints a white ALB plain, which differs from the ſurplice in being cloſe-ſleeved, with a veſtment or cope.

Surplice || Surrender.

SURREBUTTER, in *Law*, is ſecond rebutter; or the replication of the plaintiff to the defendant's rebutter.

SURREJOINDER, is a ſecond defence of the plaintiff's declaration, by way of anſwer to the defendant's rejoinder.

SURRENDER, in *Common Law*, a deed, or inſtrument, teſtifying that the particular tenant of lands and tenements, for life or years, doth ſufficiently conſent and agree, that he who has the next or immediate remainder or reverſion thereof, ſhall have the preſent eſtate of the ſame in poſſeſſion; and that he hereby yields and gives up the ſame to him, ſo that the eſtate for life or years may merge or drown by mutual agreement of the parties. Of ſurrenders there are three kinds; a ſurrender properly taken at common law; a ſurrender of copyhold or cuſtomary eſtates; and a ſurrender improperly taken, as of a deed, a patent, &c. The firſt is the uſual ſurrender, and it is uſually divided into that in deed, and that in law.

SURRENDER, in deed, is that which is really made by expreſs words in writing, where the words of the leſſee to the leſſor prove a ſufficient aſſent to ſurrender his eſtate back again.

SURRENDER, in *Law*, is that wrought by operation of the law, and which is not actual.—As if a man have a leaſe of a farm for life or years, and during the term he accepts a new leaſe; this act is, in law, a ſurrender of the former.

SURRENDER of a bankrupt. See *COMMISSION of Bankruptcy*.

SURRENDER of Copyholds is the yielding up of the eſtate by the tenant into the hands of the lord, for ſuch purpoſes as are expreſſed in the ſurrender: as to the uſe and behoof of A and his heirs, to the uſe of his own will, and the like. This method of conveyance is ſo eſſential to the nature of a copyhold eſtate, that it cannot poſſibly be transferred by any other aſſurance. No feoffment, fine, or recovery (in the king's courts) hath any operation upon it. If I would exchange a copyhold with another, I cannot do it by an ordinary deed of exchange at the common law, but we muſt ſurrender to each other's uſe, and the lord will admit us accordingly. If I would deviſe a copyhold, I muſt ſurrender it to the uſe of my laſt will and teſtament; and in my will I muſt declare my intentions, and name a deviſee, who will then be entitled to admiſſion.

Blackſt. Comment. vol. ii.

SURRENDER of Letters Patent and Offices. A surrender may be made of letters patent to the king, so that he may grant the eſtate to whom he pleaſes, &c. and a ſecond patent for years to the ſame perſon for the ſame thing is a ſurrender in law of the firſt patent. 10 Rep. 66. If an officer for life accept of another grant of the ſame office, it is in law a ſurrender of the firſt grant; but if ſuch an officer take another grant of the ſame office to himſelf and another, it may be otherwiſe.

SURREPTITIOUS. See SUBREPTITIOUS.

SURROGATE, in *Law*, denotes a perſon that is ſubſtituted or appointed in the room of another.

SURRY, a county of England, bounded on the weſt by Berkſhire and Hampſhire, on the ſouth by Suſſex, on the eaſt by Kent, on the north by Middleſex, from which it is parted by the Thames, whence it had the name of *Suth-rey* from the Saxons, *i. e.* the country on the ſouth ſide of the river. It is 38 miles in length from eaſt to weſt, 23 in breadth from north to ſouth, and 112 in circumference. It contains 13 hundreds, 140 pariſhes, of which 35 are vicarages, 13 market-towns, 450 villages, 592,000 acres, and about 269,043 inhabitants. The members ſent from it to parliament are 14, of which two are ſent by each of the following boroughs, viz. Southwark, Bleechingley, Ryegate, Guildford, Gatton, Haſlemere, and two for the county.

The air of this county, towards the middle, which conſiſts moſtly of hills and heath, is ſharp, but pure and wholeſome. About the ſkirts, where it is more level, and the ſoil richer, the air is milder, but alſo ſalubrious. In the middle parts the ſoil is barren enough in general; but towards the extremities, and where the country is open and champaign, it is fruitful in graſs and corn, particularly on the ſouth ſide in Holmſdale, in which meadows, woods, and corn-fields, are agreeably intermixed. The ſoil is alſo very fertile along the Thames, eſpecially towards London, where it greatly contributes to maintain plenty in the London markets. It has ſeveral rivers, abounding with fiſh, the chief of which are the Wye, the Mole, and the Wandle.

SURSOLID, or SURDESOLID, in arithmetic, the fifth power of a number, or the fourth multiplication of any number, conſidered as a root.

SURVEYING. That part of practical mathematics which teaches the method of aſcertaining the limits and extent of lands or eſtates, and of repreſenting theſe in maps or plans, is called *ſurveying*, or *land ſurveying*; but this term, in a more extended ſenſe, includes the valuing of landed property, the buying and ſelling of eſtates, and the dividing or laying out of landed property to the beſt advantage.

Conſidered as a branch of practical mathematics, ſurveying depends for its principles on GEOMETRY and TRIGONOMETRY, and as far as it is confined to the menſuration of plain ſurfaces, has already been conſidered under the article MENSURATION. It is the object of the preſent article to explain and illuſtrate the moſt approved methods of applying theſe principles to practice, and in particular to point out the uſe of the field book, and the mode of ſurveying large eſtates, towns, counties, or ſimilar extenſive tracts of land. We ſhall alſo point out the moſt approved mode of ſurveying ſubterraneous works, as coal-pits, mines, &c. a ſubject which has hitherto been entirely neglected in works of this nature.

Surveying.

1 Objects of ſurveying.

Before entering on the practical part of the ſubject, it may be proper to mention the previous knowledge which a ſurveyor ought to poſſeſs, and to notice the inſtruments which he is to employ in his operations.

2 Preliminary knowledge proper for a ſurveyor.

As a ſurveyor has perpetual occaſion for calculation, it is neceſſary that he be familiar with the four firſt rules of ARITHMETIC, and the rule of *Proportion*, both in *whole numbers*, and in *Fractions*, eſpecially *Decimals*, with the nature of LOGARITHMS, and the uſe of *Logarithmic Tables*; and with, at leaſt, ALGEBRAIC *Notation*. As it is his buſineſs to inveſtigate and meaſure lines and angles, and to deſcribe theſe on paper, he ſhould be well acquainted with the elements of GEOMETRY and TRIGONOMETRY, and with the application of theſe principles to the MENSURATION of *Heights*, *Diſtances*, and *Surfaces*. In particular, he ſhould be familiar with the beſt practical methods of ſolving the ordinary geometrical problems, and ſhould be expert in drawing lines and deſcribing figures. He ſhould be acquainted with the principles and practice of LEVELLING; ſhould know ſomething of the principles of OPTICS and MAGNETISM, and ſhould poſſeſs at leaſt a ſmattering of the arts of DRAWING and PAINTING.

3 Inſtruments.

The inſtruments uſually employed in ſurveying, have been enumerated under MENSURATION, vol. xiii. pp. 511, 519, and of theſe the *chain*, the *plane-table*, the *croſs*, and the *theodolite*, are there ſufficiently deſcribed, and the CIRCUMFERENTOR, the COMPASS, LEVELS, the PERAMBULATOR, and PROTRACTORS, are deſcribed, and their uſes explained under their proper heads in the general alphabet of this work.

The moſt ſimple methods of ſurveying, are thoſe in which the chain or the plane-table are employed, and of theſe methods a general idea has been given under MENSURATION. It may be neceſſary in this place to deſcribe a little more at large the uſe of the plane table, as this inſtrument is one of the moſt convenient for ſurveying fields, or other ſmall plots of ground.

4 Practical directions for uſing the plane-table.

In preparing the plane table for uſe, a ſheet of paper that will about cover the plane-table, is to be wetted, then ſpread flat on the table, the marginal frame of which is to be preſſed down on its edges, ſo as to keep it ſmooth and even. On this paper thus ſtretched, the plan of the field or other plot is to be traced in the following manner.

Suppoſe it be required to make a plan of a field that has the figure repreſented at A, B, C, D, E, F, fig. 1. Plate DXXV. and in ſuch a ſituation, that all its angles are acceſſible. Plate DXXV. Figs. 1. and 2.

The plane table is to be fixed at one of the angles, as at A, in the poſition repreſented at fig. 2. and its ſurface muſt be brought to a horizontal plane. A point is then to be made on the paper with a pencil, as at *a*, to repreſent the point A, where the plane table is ſtationed. Fixing a needle perpendicularly at this point, the index of the table is to be applied to the needle, on that ſide which correſponds with the ſight vanes, and is to be turned round this point, ſliding on the table, till the eye looking through the ſights, perceives a mark ſet up at the point B. A line is now to be drawn from *a* along the edge of the index. In the ſame manner a line is to be drawn from *a*, marking the direction of the ſide AF. Thus the angle *b a f*, (fig. 2.) will be ſimilar to the angle BAF (fig. 1.): the plane table is now to be removed from the point A, to another corner Fig. 2.

Surveying. of the field, as B, and a pole or other mark is to be left at A. The length AB is to be measured by the chain, and a proportional length marked off on the paper, in the direction *a*, *b*, from a plotting scale, or scale of equal parts. Proceeding as at first, a line is to be drawn from *b* towards *c*, in the direction of the side BC, and marking the measure of the angle CBA. In this manner, by placing the plane table successively at each corner of the field or plot of ground, the outline figure of the whole will be transferred to the paper, and *a*, *b*, *c*, *d*, *e*, *f*, will be the plan of the field A, B, C, D, E, F.

If it be not convenient to place the plane table at the corners of the ground to be surveyed, the plan may be taken by placing the instrument anywhere within the area, as at E (fig. 3.) in the middle of the field A, B, C, D. In this case we can readily find the direction of the lines EA, EB, EC, ED, and the angles which they form at the point E. By measuring the distances from E to the several angular points, and transferring the proportional distances from the plane scale upon the paper, and then joining the points thus found, there is easily traced the outline of the whole field.

Fig. 3.

It may happen that no part of the ground to be measured is accessible, except one line, as the line AE in the space A, B, C, D, E, F, G, (fig. 4.).

Fig. 4.

In this case, the plane table is to be fixed at the point A, of the base line AE, and a point made on some part of the paper at pleasure, to represent the station A, and the base line AE is in the usual manner to be ascertained and laid down. Then from the station A, the situation or direction of the points B, C, D, E, F, G, are to be observed through the sights of the index; and lines corresponding to the lines AB, AC, AD, AE, AF, AG, are to be laid down on the paper, but of an indefinite length. When this is done, great attention must be paid to preserve the table steady and perfectly horizontal. The length of the base line AE being determined, the table is now to be removed to the other extremity E, and so disposed that the base line on the paper may be exactly over the base line EA of the field; and proceeding as before, the directions of the lines EA, EB, EC, ED, EF, EG, are to be determined, and corresponding indefinite lines drawn on the paper. The points where these last lines cross those before traced, are to be carefully noted, and the outline joining all these points of section, will correspond to the outline of the plot to be surveyed.

The following general directions to be observed in using the plane table, are given by Dr Hutton. 1. Let the lines on which stations are made be directed towards objects as far distant as possible; and when any such object is set, go round the table and look through the sights from the other end of the index, to see if any other remarkable object be directly opposite; if there be none such, endeavour to find another forward object, such as shall have a remarkable backward opposite one, and make use of it, rather than the other; because the back object will be of use in fixing the table in the original position, either when you have measured too near to the forward object, or when it may be hid from your sight at any necessary station by intervening hedges, &c.

2. Let the said lines, on which the stations are taken, be pursued as far as conveniently can be done; for that will be the means of preserving more accuracy in the work. Surveying.

3. At each station it will be necessary to prove the truth of it, that is, whether the table be straight in the line towards the object, and also whether the distance be rightly measured and laid down on the paper. To know whether the table be set down straight in the line, lay the index on the table in any manner, and move the table about, till through the sights you perceive either the fore or back object; then, without moving the table, go round it, and look through the sights by the other end of the index, to see if the other object can be perceived; if it be, the table is in the line; if not, it must be shifted to one side, according to your judgement, till through the sights both objects can be seen. The aforesaid observation only informs you if the station be straight in the line; but to know if it be in the right part of the line; that is, if the distance has been rightly laid down: fix the table in the original position, by laying the index along the station line, and turning the table about till the fore and back objects appear through the sights, and then also will the needle point at the same degree as at first. Then lay the index over the station point and any other point on the paper representing an object which can be seen from the station; and if the said object appear straight through the sights, the station may be depended on as right; if not, the distance should be examined and corrected till the object can be so seen. And for this very useful purpose, it is advisable to have some high object or two, which can be seen from the greatest part of the ground accurately laid down on the paper from the beginning of the survey, to serve continually as proof objects.

When from any station, the fore and back objects cannot both be seen, the agreement of the needle with one of them may be depended on for placing the table straight on the line, and for fixing it in the original position *.

* See *Hutton's Measurer.*

5 Method of measuring offsets.

The foregoing examples are extremely simple, as the bounding lines are straight and regular. Here, therefore, it is not requisite to measure what surveyors call the offsets, or the perpendicular distances between a base line, and the several angles which it subtends. It seldom happens, however, that the work can be carried on in so regular a way, as the bounding lines, even of small pieces of ground, are generally more or less crooked.

Let us suppose A, *l*, *m*, *n*, *o*, *p*, *q*, *r*, (fig. 5.) to be a crooked hedge, or other boundary of a piece of ground, and A B the general base line subtending its several angles. In measuring along this base, when the surveyor comes opposite to any of the bendings or corners of the fence, as at *c*, *d*, *e*, &c. he measures the perpendicular offsets *c l*, *d m*, *e n*, &c. either with the offset staff, or, if they are of considerable length, with the chain. These offsets are to be noted down, as will be explained immediately.

Fig. 5.

When the offsets are not very large, their places may be determined pretty exactly by the eye, especially when assisted by laying down the offset staff in a direction perpendicular to the base, and opposite to the angles; but when the offsets are very large, their positions are best determined by the cross, or the plane table, in the following manner. In measuring along A B (fig. 5.), when

when coming nearly oppoſite to *l*, where an offset is likely to ſtand, the croſs or plane-table is there to be fixed, as at *c* in the line A B, and its index is to be turned till the extremities of the baſe A and B can be ſeen through the ſights, both backward and forward. Then looking along the croſs ſights of the croſs, or the croſs line on the index of the plain table, it is eaſy to obſerve whether the ſtation of the inſtrument be exactly oppoſite to the corner. If it be not, the inſtrument muſt be moved backward or forward along the line A B, preſerving the index in the ſame ſituation till the ſtation and the point *l* be exactly oppoſite to each other. The exact meaſured diſtance between A and *c*, is then to be noted and regiſtered, and the meaſure of the offset *c l* is to be ſet down oppoſite to the former, and on the left hand of it, as the work is advancing from A to B. In the oppoſite direction the offsets would of courſe appear on the right hand. In this method, no field book or regiſter is uſually neceſſary, but where the ſurvey is more extenſive, and where the theodolite or other complex inſtruments are required, it is neceſſary to have recourſe to ſome method of regiſtering the ſucceſſive operations.

The field book employed on theſe occaſions is variouſly conſtructed, according to the taſte or particular object of the ſurveyor. The following is a ſpecimen of the uſual field book, as deſcribed by Dr Hutton.

Offsets and remarks on the left.	Stations, Bearings, and Diſtances.	Offsets and remarks on the right.
	⊙ 1	
	105° 25′	
	00	25 corner.
92	73	
	248	Brown's hedge.
Croſs a hedge, 24	610	35
	954	00
	⊙ 2	
	53° 10′	
	00	00
Houſe corner, 51	25	21
	120	29 a tree.
34	734	40 a ſtile.
	⊙ 3	
	67° 20′	
	61	35
A brook, 30	248	
	639	16 a ſpring.
Footpath, 16	810	
Croſs-hedge, 18	973	20 a pond.

Of the three columns which compoſe this field book, the middle or principal column is for noting down the ſtations, angles, bearings and diſtances, as they are aſcertained, and the columns on the right and left are for the offsets to the right and left of the principal courſe, which are placed againſt their correſponding diſtances in the middle column, as alſo for occaſional remarks or memorandums, to which it may be uſeful to refer in drawing the plan of the ſurveyed lands.

Here ⊙ 1 is the firſt ſtation, where the angle or bearing is 105° 25′. On the left, at 73 links in the diſtance or principal line, is an offset of 92; and at 610 an offset of 24 to a croſs hedge. On the right, at 0, or the beginning, an offset 25 to the corner of the field; at 248 Brown's boundary hedge commences; at 610 an offset 35; and at 945, the end of the firſt line; the 0 denotes its terminating in the hedge. And ſo on for the other ſtations. A line is drawn at the end of every ſtation line, to prevent confuſion.

Various improvements have been made on the field-book, eſpecially by Mr Abraham Crocker, and Mr John Bodham. We ſhall give a ſpecimen of each.

Fig. 6. repreſents a page of Mr Crocker's field-book, exhibiting a part of the ſurvey of an eſtate called the Mill Eſtate; the outlines of which were ſurveyed with the theodolite, and the interior parts filled up with the chain. In this book the operations are noted down, ſo as to begin from the foot of the page, carrying them on upwards.

In ſurveying after this method, Mr Crocker adviſes to chooſe two or more eminences, as principal ſtations, and meaſure a general baſe line from one ſtation to the other, noting each hedge, brook, or other remarkable object as it is paſſed by; meaſuring alſo ſuch ſhort perpendicular lines to ſuch bends of hedges as may be near the baſe. From the extremities of this baſe-line, or from any convenient parts of it, the ſurveyor muſt proceed with other lines to ſome remarkable object ſituated towards the ſides of the eſtate, without regarding the angles they make with the baſe-line or with one another, remembering to note every hedge, brook, or other object by which he paſſes. Theſe lines, when laid down by interſections, will with the baſe-line form a principal triangle on the ground to be ſurveyed; ſeveral of which, if neceſſary, being thus laid down, the ſurveyor may proceed to form other ſmaller triangles and trapezoids, on the ſides of the former; and ſo on till the ſeveral encloſures are finiſhed.

This principal triangle being completed, and laid down on the rough plan paper, the parts, exterior as well as interior, are to be completed by ſmaller triangles and trapezoids.

When the whole plan is laid down on paper, the contents of each part of the eſtate may be calculated by the methods already explained under MENSURATION.

In countries where the lands are encloſed with high hedges, and where many lanes or roads paſs through an eſtate, a theodolite may be employed with advantage, in aſcertaining the angles of ſuch lands; and by theſe means an outline of the eſtate may be obtained, and the lane lines ſerve as the baſes of ſuch triangles and trapezoids as are neceſſary to fill up the interior parts.

To illuſtrate this method, let us take AB in the plan of the eſtate, (fig. 8.) for the principal baſe line. From B go off to the tree at C, noting down in the field book every croſs hedge as you meaſure on, and from C meaſure back to A, noting down every thing remarkable, as before directed. This figure alſo illuſtrates the method of meaſuring the croſs lines, offsets, and interior parts and encloſures.

Fig. 7. repreſents a page from Mr Rodham's field book. His method of procedure is as follows:—Like Mr Crocker, he begins from the bottom of the page, and writes upwards; denoting the croſſing of fences, by lines

Surveying. lines drawn acroſs the middle column, or only a part of ſuch a line on the right and left oppoſite the figures, to avoid confuſion, and the corners of fields, and other remarkable turnings in the fences, towards which offsets are taken, by lines joining like the fences, as will be beſt ſeen by comparing the ſpecimen at fig. 7. with the plan at fig. 9.

The marks called *a*, *b*, *c*, &c. are beſt made in the fields, by making a ſmall hole with a ſpade, and placing there a chip or ſmall piece of wood, with the particular letter marked on it, to prevent one mark being taken for another, on any return to it, though in general the name of a mark is very eaſily ſeen, by referring in the book to the line in which it was made. After the ſmall Italic letters have been gone through, the capitals may be next employed, and the Roman letters afterwards, and ſo on. Perhaps it would be preferable to diſtinguiſh the marks by figures.

The letters in the left hand corner at the beginning of each line, denote the mark or place meaſured *from;* and that at the right hand corner of the end, is the mark meaſured *to*. But when it is not convenient to go exactly from a mark, the place meaſured from is deſcribed *ſuch a diſtance* from *one mark* towards *another;* and where a mark is not meaſured to, the exact place is aſcertained by writing, turn to the right or left hand, *ſuch a diſtance* to *ſuch a mark*, it being always underſtood that thoſe diſtances are taken in the chain line.

The characters uſed are ⌜ for *turn to the right hand*, ⌝ for *turn to the left hand*, and ʌ placed over an offset, to ſhew that it is not taken at right angles with the chain line, but in the line with ſome ſtraight fence, being uſed chiefly when croſſing their directions, and is a better mode of aſcertaining their true places than by offsets at right angles.

When a line is meaſured whoſe poſition is determined, either by former operations (as in the caſe of producing a given line or meaſuring from one known place or mark to another) or by itſelf (as in the third ſide of a triangle) it is called a *faſt line*, and a double line is drawn acroſs the book at the concluſion of it; but if its poſition be not determined (as in the ſecond ſide of a triangle) it is called a *looſe line*, and a ſingle line is drawn acroſs the book. When a line becomes determined in poſition, and is afterwards continued, a double line is drawn half through the book.

When a looſe line is meaſured, it becomes abſolutely neceſſary to meaſure ſome line that will determine its Fig. 9. poſition. Thus, the firſt line *a b*, (fig. 9.) being the baſe of a triangle, is always determined, till the third ſide *j b* is meaſured; then the triangle may be conſtructed, and the poſition of both is determined.

At the beginning of a line to fix a looſe line to the mark or place meaſured from, the ſign of turning to the right or left hand muſt be added (as at *j* in the third line); otherwiſe a ſtranger, when laying down the work, may as eaſily conſtruct the triangle *h j b*, on the wrong ſide of the line *a h*, as on the right ſide; but this error cannot be committed, if the ſign above named be carefully obſerved.

In chooſing a line to fix a looſe one, care muſt be taken that it does not make a very acute or obtuſe angle, as in the triangle *p* B*r*; by the angle at B being very obtuſe, a ſmall deviation from truth would make the error at B when conſtructed very conſiderable; but Surveyi by conſtructing the triangle *p* B*g*, ſuch a deviation is of no conſequence.

When the words *leave off* are written in the field book, it is to ſignify that the taking of offsets is from thence diſcontinued; and of courſe ſomething is wanting between that and the next offset *. * Hutton Math. D art. Surv ing.

9 Practical directions for the u of the th odolite.

The general uſe of the theodolite in meaſuring ſeparate plots, has been deſcribed under MENSURATION. The following practical directions for the uſe of this inſtrument are given by Mr Crocker, and apply to his field book, exemplified at fig. 6. and the plan at fig. 10.

Suppoſe the ſurveyor to plant his theodolite in the road ⊙1, and having duly adjuſted it, by placing its head exactly horizontal, by the levels; and ſetting the index part of the limb exactly at 360°; and by moving the whole head about till 360° in the compaſs-box comes to the line in the north end of the needle; there fixing all faſt, by the ſcrew under the head, between the legs, he will have his inſtrument completely adjuſted.

The theodolite thus adjuſted, the ſurveyor ſends one of his aſſiſtants forward as far as he can conveniently Fig. 1 ſee how to meaſure a ſtraight line, as at ⊙2. Taking then his angle of obſervation, by his teleſcope, to the picket at that ſtation, he finds it to be 69° from the north part of his magnetic meridian line towards the eaſt, which he enters in his field book, noting it with NE, as a memorandum on which ſide of the magnetic meridian it lies. He is now to faſten his limb to the other part of the head, by a ſcrew for that purpoſe.

His chain-man having laid the chain in the direction to the picket ⊙2, in order to meaſure the line, he makes ſuch offsets to the right and left, in this firſt chain's length, as may be neceſſary. At his firſt ſtation, he finds that on the right, the general road fence is 30 links, and alſo a nook of 40 links more, and 30 links broad; and that on the left of his ſtation he has an offſet of 10 links, all of which he muſt note in his field book. Proceeding forward on this line, he finds at 300 he has an offset of 25 on the right, where is a gate, which he has to notice; and, on the left 20, which determines the breadth of the road at that ſpot. At 400, he will find 10 on the right and 20 on the left to be the breadth; and at 700 (the end of the line) he will find 35 on the right and 15 on the left to be the breadth of the road; where alſo he will find a ſmall road branching off to the right. Thus the firſt ſtation line is finiſhed.

To this ſpot (which is his ſecond ſtation) he brings the theodolite; and after ſetting it level, he unlocks the under ſcrew, and turns the whole head about, till, through the teleſcope, he ſees the back picket or ſtation ſtaff to be cut by the croſs hairs. Here, again, locking the head of his theodolite firm by the under ſcrew, he muſt unſcrew the limb, and turn it about, till through the teleſcope, he has a view of the picket at ⊙3; the bearing of which he will find to be 253° 10′ from the north to the eaſtward, which he will enter in his field book. Meaſuring on from ⊙2, towards ⊙3, he will find at 130 links, that he is come to a turnpike, where the breadths at the right and left are 30 and 15. At 200, he has an offset of 15 on the left, and a break off at the right of another road, at 25 from his line, with two other offsets, as expreſſed in the field book. It

muſt

Surveying. must be noted where this road leads to. At 265 he has offsets of 30 on the left, and 20 on the right. Thus ends the second ſtation line.

Now bringing his inſtrument to ⊙3, he is to adjuſt it in the manner before directed at ⊙2; and turning the limb about towards the picket forward, he will find the angle of bearing to be 57° 45′, ſtill from the north to the eaſtward. At 20 links he will be oppoſite to a croſs hedge on the left, belonging to the eſtate he is ſurveying. At 293 he ends the line of this ſtation, where the offsets are 5 and 35, as noted in the field book.

Coming next to ⊙4, and having adjuſted his theodolite, he finds his next angle = 226° NE. At 120 his offsets are 20 and 15. At 410, they are 15 and 30, where, on the left, is a croſs hedge, of a backward direction. At 480 his offsets are 5 and 25, where is another croſs hedge. At 750, is a break-in of the fence, and the offsets are 30+15 on the left, and 10 on the right. At 1050, the offsets are 20 on each hand, and another croſs hedge on the left. At 1150 are offſets of 20 and + 20, where ſtands a houſe. At 1300, the offset of 30 on the right terminates the houſe; and at 5 on the left is a croſs hedge, of a backward direction. 1350 ends this line, where roads diverge to the right and left.

At ⊙5, the inſtrument being adjuſted, the angle is found to be 284° 50′ nearly W. At 50, his offset to the hedge is 15; at 220 it is alſo 15, where is a croſs hedge, the other end of which was noted at 1050 in the laſt line. At 320 the offset is 25; at 350, the end of the ⊙, the diſtance from the fence is 15.

At ⊙6, the bearing is 305° 35′ N. W. At 130 the offset is 30, where a croſs hedge goes off to the point which was noted at 750, in the line from ⊙4 to ⊙5. At 160 the line is nearly cloſe to the fence, ending at 210.

At ⊙7, the angle forward is 106° 25′ N. W. The line is 143 long, with an offset at the end of 15.

At ⊙8 the bearing is 269° 20′ N. W. At 100 and at 300 the offsets are 15 and 10.

The bearing at ⊙9 is 70° 45′ S. W. At 30 the meaſurer finds it expedient to croſs the fence, and proceed within the bounds of the eſtate. At 90 he has an offset of 30 to the right, where he croſſes a hedge. At 880 he croſſes another hedge, having there an offset of 20: at 940 is an offset of 50. At 990 he again croſſes the hedge; and at 1020 is an offset of 20 to the left: at 1040 he again croſſes the hedge: at 1080 he comes to the corner of the farm houſe; and 1165 ends his line, where is a ſmall curve at the right.

At ⊙10, the bearing is 204° S. W. At 70 is an offset of 5 at the right: at 200 is 15 at the left, and a croſs hedge: at 600 is 25 on the left, and 20+15 on the right: 690 ends the line, where are 15 on each ſide, where there is alſo a croſs hedge.

The angle at ⊙11 is 355° 30′ S. E. At 280 is an offset of 30 on the right, and 10 with a croſs hedge on the left: at 400 is an offset of 30, and another croſs hedge on the left; and 470 ends the line, where are offsets of 10 and 20 on the right and the left.

At ⊙12 the angle is 155° S. E. At 60 is a croſs hedge: at 219 the offsets are 10 and 15; and at 229 he comes to cloſe his work at ⊙1, from which he ſet out.

Having thus taken the circuit of this eſtate, the meaſurer muſt proceed to plot the ſame on paper, with ſome convenient ſcale *. Surveying.

* *Crocker's Elements.* p. 235.

The ſcale uſually employed for this purpoſe is that called the *plotting ſcale*, *plane ſcale*, or *ſcale of equal parts*, repreſented at fig. 11. and 12. 10 Deſcription and uſe of the plotting-ſcales. Figs. 11. and 12.

This inſtrument contains different ſcales or divided lines, on both ſides. There are on one ſide a number of plane ſcales, or ſcales of equal diviſions, each of a different number to the inch, and alſo ſcales of chords for laying down angles, and ſometimes the degrees of a circle marked on one edge, anſwering to a centre marked on the oppoſite edge, by which means it alſo anſwers the purpoſe of a protractor. There are ſeveral diagonal ſcales on the other ſide, of different ſizes, or different dimenſions to the inch, ſerving to take off lines expreſſed by numbers to three dimenſions, as units, tens, hundreds, as alſo a ſcale of diviſions which are the 100th parts of a foot. The moſt uſeful of all the lines which can be laid down on this inſtrument, though not always done, is a plane ſcale on the two oppoſite edges, made thin for the purpoſe. This line is very uſeful in ſurveying; for by laying down the inſtrument on paper, with its divided edge along a line whereon ſeveral diſtances are to be laid off, for the places of offsets, &c.; theſe diſtances are all transferred at once from the inſtrument to the line on the paper, by making ſmall points or marks againſt the reſpective diviſions on the edge of the ſcale.

11 Directions for plotting or planning.

The buſineſs of *plotting* or laying down a plan of an eſtate from the memoranda of a field book, is a very important branch of the ſurveyor's office. This will beſt be underſtood by an example, which we ſhall take alſo from Mr Crocker. It is adapted to the page of his field book, already alluded to; and the plan, when completed, is ſeen at fig. 10.

The vellum or paper on which the plan is to be drawn, being ſmoothly laid on a drawing board, the magnetic meridian is to be repreſented by a line drawn from the bottom to the top.

A point is to be made about the middle of this line, on which is to be laid the centre of the circular protractor, placing the ſtraight edge in ſuch a manner as to coincide with the ſaid meridian line: draw a pencil line around at the edge of the protractor.

The protractor being thus placed, and firmly fixed by means of pins in that poſition, or by a lead weight, the field book is to be inſpected for the quantity of the angle at ⊙1, which, in the preſent caſe is ſtated at 69° north-eaſterly. This degree is then to be looked for on the circular edge of the protractor, and a mark made on the paper with a fine plotting-pin, at that number, which is to be marked 1, denoting ⊙1.

The field-book is then to be inſpected for the ∠ at ⊙2, which in this caſe is 253° 10′, where a mark is to be made as before.

A ſimilar proceſs is to be followed with all the other angles, till the ſurveyor comes to the cloſe on ⊙1.

All the angles being thus marked off, the protractor is to be removed.

The place where the beginning of the work ſhould be placed is then to be conſidered, that the whole may come within the compaſs of the paper laid down; where a mark is to be made, noting it as ⊙1, the beginning of the plot.

The fore edge of the parallel ruler is then laid from the

Surveying. the central point where the protractor lay, to the mark on the pencilled circle denoting ⊙1. The fore edge of the parallel ruler is next moved till it touch the point determined on for the beginning of the plot, from which a pencil line in the direction from the north to the eaſtward, is drawn, about the length of the whole line of this ⊙=760.

A feather-edge ſcale is applied to this pencil or obſcure line, the 0 diviſion of it at the beginning, marking off every progreſſive number where any offsets have been made, as at 300, 400, and 760.

The ſcale is then turned acroſs the line (by ſome croſs diviſion), and the offsets on each ſide of the ſtation line are pricked off. At 0, or ⊙1, the field book ſhews that on the left hand, at 10 links, is the boundary line of that ſide, where there is likewiſe a ſmall road branching off. The offset on the right hand is 30, which, with + 40, goes to the extent of a ſmall corner, alſo 40 links in breadth. At 300 on the left there is an offset of 20, and on the right another of 25, where there is alſo a gate to be noticed. At 760 there is an offset on the left of 15; and on the right, one of 35, where a ſmall roadway branches off. All theſe offsets are to be pricked off as the ſurveyor proceeds. The boundary lines are drawn through theſe offset points, and in this manner the firſt ſtation is completed.

The parallel ruler is then laid from the centre to the angular point of ⊙2; the limb of it is moved till it touches the end of the laſt ſtation line, from which another obſcure line is drawn, from the north-eaſterly, as noted in the field book.

The edge of the ſcale is then applied as before, and the numbers 30, 200, and 265 are pricked off. There is a toll gate at 30 links, and a lane of 30 links broad, going off at an acute angle. At 265, the end of this ſtation, the offsets are 30 and 10.

The line from ⊙3 is then laid off, as before directed, north-eaſterly, and the numbers 20 and 293 are pricked off. Oppoſite to 20 is a hedge branching off to the left, and at 293 the offsets are 35 and 5.

The line north-eaſterly is laid off from ⊙4, and the numbers on that line are pricked off as they appear in the field book, and the offsets are made as follows. At 120, 15 and 20 are ſet off; at 410 are 30 and 15, where two hedges branch off nearly in the direction of the ſide ſketches. At 480 the offsets are 25 and 5, where there is a croſs hedge on the left. At 750 on the left, is 30+15 with a croſs hedge, and on the right 10. At 1050 on the left, is 20 with a croſs hedge, and 20 on the right. At 1150 on the right, is 20+20, where ſtands a houſe. At 1300 on the left, is 5 with a croſs hedge; on the right is 30, with a road branching from it: 1350 completes this line.

At ⊙5 the work takes another direction, and goes backward towards the weſt. The ruler is laid from the centre to this ſtation, and an obſcure line drawn in the direction mentioned. The diſtances and offsets are pricked off as in the field book. Here are offsets on one ſide only, not being in a road way.

At ⊙6 ſet off the line ſouth-weſterly, pricking off the diſtances and offsets as in the field-book.

This ſpecimen is ſufficient to give a complete idea of the practice of plotting; and more would be only a tedious repetition. It muſt, however, be obſerved, that the accuracy and facility of the work greatly depend on Sutvey the judgement and care exerciſed in keeping a correct and clear field-book.

When a circuit is plotted off, the meaſurer muſt fill up the interior, by ſeparately completing the meaſure of each field with the chain, ſo that they may be laid down on the plan in their proper ſituations and dimenſions. The lines taken with the theodolite will here be of great ſervice, as the baſe lines of a number of interior angles.

The ſurveyor having thus on paper, a repreſentation of the eſtate, muſt draw ſuch meaſuring lines on it, as will enable him to calculate the content of each field ſeparately. Having made out a fair plot of his work, another line muſt be drawn for the true meridian, to the eaſtward of the former, according to the variation of the magnetic needle, where the eſtate lies. On this true meridian line may be placed any device whatever, as a north point. A title muſt alſo be given to the map, a ſcale drawn of the proportion uſed in the plotting, and a border to the whole *.

*See C. er's Ele ments, p. 240.

Having thus explained the general practice of ſurveying according to the lateſt improvements, we ſhall ſhew how a ſurveyor is to proceed in meaſuring and planning counties and towns. 12

Metho ſurveyi counti diſtrict

To ſurvey a County or large Tract of Land.—1. Chuſe two, three, or four eminent places for ſtations, ſuch as the tops of high hills or mountains, towers, or church ſteeples, which may be ſeen from one another, and from which moſt of the towns, and other places of note, may alſo be ſeen. And let them be as far diſtant from each other as poſſible. On theſe places raiſe beacons, or long poles, with flags of different colours flying at them, ſo as to be viſible from all the other ſtations.

2. At all the places which are to be ſet down in the map, plant long poles with flags at them of ſeveral colours, to diſtinguiſh the places from each other, fixing them on the tops of church ſteeples, or the tops of houſes, or in the centres of ſmaller towns.

It is not neceſſary to have theſe marks at many places at once, as ſuppoſe ten at a time. For when the angles have been taken at the two ſtations, to all theſe places, the marks may be removed to new ones, and ſo ſucceſſively to all the places required. Theſe marks being ſet up at a convenient number of places, and ſuch as may be ſeen from both ſtations, go to one of theſe ſtations, and with an inſtrument for taking angles, ſtanding at that ſtation, take all the angles between the other ſtation, and each of theſe marks, obſerving which is blue, which red, &c. and on which hand they lie; and ſet all down with their colours. Next go to the other ſtation, and take all the angles between the firſt ſtation, and each of the former marks, and ſet them down with the reſt, each againſt thoſe correſponding with the ſame colour. If practicable, the angles may alſo be taken at ſome third ſtation, which may ſerve to prove the work, if the three lines interſect in that point where any mark ſtands. The marks muſt be allowed to remain till the obſervations are finiſhed at both ſtations, and then they muſt be taken down, and ſet up at freſh places. The ſame operations muſt be performed at both ſtations, for theſe freſh places, and the like for others. The inſtrument for taking angles muſt be exceedingly accurate, made on purpoſe with teleſcopic ſights,

Surveying. sights, and of three, four, or five feet radius. A circumferentor is reckoned a good inſtrument for this purpoſe.

3. Though it be not abſolutely neceſſary to meaſure any diſtance; becauſe a ſtationary line being laid down from any ſcale, all the other lines will be proportional to it; yet it is better to meaſure ſome of the lines, to aſcertain the diſtances of places in miles: and to know how many geometrical miles there are in any length; and from thence to make a ſcale for meaſuring any diſtance in miles. In meaſuring any diſtance, it will not be exact enough to go along the high roads, on account of their turnings and windings, and ſcarcely ever lying in a right line between the ſtations, which would cauſe endleſs reductions, and create trouble to make it a right line, for which reaſon it can never be exact. But a better way is to meaſure in a right line with a chain, between ſtation and ſtation, over hills and dales, or level fields, and all obſtacles. Only in caſes of water, woods, towns, rocks, banks, &c. where one cannot paſs, ſuch parts of the line muſt be meaſured by the method of inacceſſible diſtances; and beſides, allowing for aſcents and deſcents, when we meet with them. A good compaſs that ſhews the bearing of two ſtations, will always direct to go ſtraight, when the two ſtations are not ſeen; but when a ſtraight progreſs can be made, offsets may be taken to any remarkable places, likewiſe noting the interſection of the ſtationary line, with all roads, rivers, &c.

4. From all the ſtations, and in the whole progreſs, care muſt be taken to obſerve ſea coaſts, the mouths of rivers, towns, caſtles, houſes, churches, windmills, watermills, trees, rocks, ſands, roads, bridges, fords, ferries, woods, hills, mountains, rills, brooks, parks, beacons, ſluices, floodgates, locks, &c. and in general every thing remarkable.

5. When the firſt and main ſtation lines are done, which command the whole country, inner ſtations are then to be taken at ſome places already determined, which will divide the whole into ſeveral partitions, and from theſe ſtations may be determined the places of as many of the remaining towns as poſſible. If any remain in that part, more ſtations may be taken at ſome places already determined, from which the reſt may be determined. Proceeding thus through all parts of the country, ſtation may be taken after ſtation, till all that are required be determined. In general, the ſtation diſtances muſt always paſs through ſuch remarkable points as have been formerly determined by the preceding ſtations.

6. The poſition of the ſtation line meaſured, or the point of the compaſs on which it lies, muſt be determined by aſtronomical obſervation. Hang up a thread and plummet in the ſun over ſome part in the ſtation line, obſerving when the ſhadow runs along that line, and at that moment take the ſun's altitude; then having his declination, and the latitude, the azimuth will be found by ſpherical trigonometry. The azimuth is the angle which the ſtation line makes with the meridian, and therefore a meridian may eaſily be drawn through the map; or a meridian may be drawn through it by hanging up two threads in a line with the pole ſtar, when due north, which may be known from aſtronomical tables. Or thus: Obſerve the ſtar Alioth, or that in the rump of the Great Bear, being that next the ſquare; or elſe Caſſiopeia's hip; obſerving by a line and plummet when either of theſe ſtars and the pole ſtar comes into a perpendicular; and at that time they are due north. Therefore two perpendicular lines being fixed at that moment, towards theſe two ſtars, will give the poſition of the meridian. Surveying.

13 Method of ſurveying towns.

A Town or City may be ſurveyed with any of the inſtruments for taking angles, but beſt of all with the plane table, where every minute part is drawn while in ſight. It is alſo proper to have a chain of 50 feet long, divided into 50 links, and an offset-ſtaff of 10 feet long.

Begin at the meeting of two or more of the principal ſtreets through which the longeſt proſpect may be had, to get the longeſt ſtation lines. Having there fixed the inſtrument, draw lines of direction along thoſe ſtreets, uſing two men as marks, or poles ſet in wooden pedeſtals, or perhaps ſome remarkable places in the houſes at the farther ends, as windows, doors, corners, &c. Meaſure theſe lines with the chain, taking offsets with the ſtaff, at all corners of ſtreets, bendings, or windings, and to all remarkable objects, as churches, markets, halls, colleges, eminent houſes, &c. Then remove the inſtrument to another ſtation along one of theſe lines, and there repeat the ſame proceſs as before, and ſo on till the whole be completed.

Thus, in fig. 13. (part of the New Town of Edinburgh) fix the inſtrument at A, and draw lines in the direction of all the ſtreets meeting in that place, and meaſure AB, noting the ſtreet on the left at *m*. At the ſecond ſtation B, draw the directions of the ſtreets meeting there, and meaſure CD. Do the ſame at D, and meaſure DE, noting the place of the croſs ſtreets at *p*. In this manner go through all the principal ſtreets. This being done, proceed to the ſmaller and intermediate ſtreets; and laſtly to the lanes, alleys, courts, yards, and every part which it may be deemed expedient to repreſent *.

* See *Hutton's Math. Dict.* art. *Surveying*.

14 Subterraneous ſurveying.

We ſhall conclude this article with a few practical remarks on *ſubterraneous ſurveying*, or the method of ſurveying mines, and other works below ground, taken chiefly from Mr. Fenwick's work on *ſubterraneous ſurveying*, lately publiſhed.

The inſtruments employed in ſurveying under ground, are the circumferentor, the chain (in coal mines) containing 100 links, and an inſtrument for taking the angles of elevation or depreſſion, to reduce the meaſurements to horizontal diſtances, where the lines are not level. In lead mines, they ſometimes employ a cord, divided into 10 feet, inſtead of a chain.

In conducting a ſubterraneous ſurvey, the inſtrument uſed is placed where the ſurvey is intended to commence, and a perſon goes forward in the direction of the line to be ſurveyed, holding a lighted candle in his hand, to the remoteſt point at which his light can be ſeen through the ſights of the inſtrument; its bearing is then taken by the circumferentor, and noted down in the ſurvey book. The ſurveyor then proceeds to take the diſtance of the light, or object, from the inſtrument, which is afterwards removed, and a perſon ſtands on the ſpot where it ſtood, holding one end of the chain in his hand, while another, going towards the object, holds the other end, together with a lighted candle, in the ſame hand, and being directed by the former, till the hand holding the

Surveying.

candle and the chain is in a direct line with the object or light whose bearing was taken. At that place, the first chain is marked. The person who stood where the instrument was placed then comes forward to the mark at the end of the first chain, the other advancing forward another chain, with the chain and candle in the same hand, as before directed: here the second chain is to be marked. Proceeding in this manner till the distance of the object be determined, which being noted down in chains and links in the survey book, opposite to the bearing, the first bearing and distance is completed. Fixing the instrument again where the light as an object stood, or at the termination of the foregoing bearing and distance, and taking the second bearing, by directing the person to go forward as before, so far as his light can be seen, or at any convenient distance, the surveyor is to proceed as before, till the whole is completed.

Such surveys would require five people to be employed, that the work may be expeditiously performed; viz. one to carry forward the survey, and make the requisite observations and remarks; another to carry the instruments employed; another to direct the chain; a fourth person to lead it, and a fifth to go forward with a light, as an object, from one station to another. During the time of making the survey, care must be taken not to admit any iron or steel within four feet of the instrument, for fear of attracting the needle, which has been known to be affected at nearly three times that distance, by a massy piece of iron. If the glass of the instrument should require cleaning, it must be rubbed as gently as possible, and not with any silken substance, by means of which electric matter may be excited, and prevent the needle from traversing. Should such matter be excited, it may be discharged by touching the surface of the glass with a wet finger.

To render this system of surveying familiar to the young miner, it would be necessary for him to put up a number of marks on the surface, taking afterwards their bearing and distance from each other, according to the method before directed; but to make a nearer approach to the form of subterraneous surveying, it would be better to perform it at night, by the assistance of candles; and many evenings might be found favourable for this method of practising. Lanterns may be employed, if the current of air should be too strong for the flame of a candle *.

* *Fenwick on Subterraneous Surveying*, p. 9.

The method of *surveying and recording bearings* is as follows,

Suppose the bearing of ABC (fig. 14) is required. Set the circumferentor on A (the north being represented by N, and the south by S); then turning that part of the instrument having the *fleur de lis*, or other device, from you, or towards B, turn the instrument till the object B is seen through, and cut by the hair in the sights; and the angle N A B being the angle that the sights and line A B make with the magnetic meridian, N S will be the bearing of B from A, suppose 30°; which also being to the right side of the north meridian, will be north 30° east. Then bring the instrument forward to B, fixing it there, and directing the same sight at B towards C, as was directed at A, towards B; then observe the angle that B C makes with the magnetic meridian, which suppose 25° N B C; and being to the left of the meridian, will be north 25° west. To prove the work, and try the accuracy of the instrument when it is standing at B, apply the eye to that sight which was next B when it stood at A; then take the bearing of A from B, which, if found to be the reverse of B from A, shows the work to be so far true. The bearing of B being taken in like manner from C, will prove the truth of the survey. The degrees of each bearing must always be taken by the same end of the needle.

Surveyi

Suppose the bearing of B from A, C from B, and D from C, (fig. 15.) be required. Fix the instrument at A, with the *fleur de lis*, or other arbitrary device, towards B; then take the bearing of B, as before described, which suppose to make an angle of 30° NAB to the right with the magnetic meridian, or north 30° east; let the instrument be removed to B, and take the bearing of C, which suppose =30° NBC to the left, or north 30° west; then remove the instrument to C, and take the bearing of D, which suppose =65° SCD to the left, or south 65° east: Thus,

From A to B north 30° east.
—— B to C north 30° west.
—— C to D south 65° east.

This survey may be proved in the same manner as the preceding.

Suppose the subterraneous working ABCDA (fig. 16.) to be surveyed, beginning at the pit A: Fix the instrument at the centre of the pit A; then let a person hold a lighted candle at B (being the utmost distance at which it can be seen through the sights of the instrument), the bearing of which being taken from A, suppose due south, or in the direction of the magnetic meridian of A, and its distance from A suppose 6 chains 57 links, which is placed in the survey book as under: Remove the instrument to B, where the candle stood, and direct the person to place the lighted candle at C; then take its bearing from B, which suppose it to make an angle CBS = 80° with the magnetic meridian, or to bear south 80° west, and its distance being found 7 chains 10 links, remove the instrument to C, the candle being removed to D; then take its bearing and distance as before, which suppose north 10° west 5 chains; remove the instrument to D, and direct the candle to be placed at the centre of the pit A, where the survey commenced; then take its bearing from D, north 70° east 8 chains 35 links, and the survey is finished.

	Chains.	Links.
AB south	6	57
BC south 80 west	7	10
CD north 10° west	5	0
DA north 70° east	8	35

This survey may be proved by adding together the degrees contained in the interior angles, which, if they amount to 360, the work will be right.

The proof may be made by finding the northing, southing, easting and westing of all the bearings and distances. If the southings are equal to the northings, and the westings equal to the eastings, then will the work be right.

Thus,

	C.	L.	Northings. C.	L.	Southings. C.	L.	Eastings. C.	L.	Westings. C.	L.
Thus, S.	6	57	0	0	6	57	0	0	0	0
S. 80° W	7	10	0	0	1	23	0	0	6	98
N. 10° W	6	0	4	93	0	0	0	0	0	87
N. 70° E.	8	35	2	87	0	0	7	85	0	0
			7	80	7	80	7	85	7	85

Ib. p. 29. The southings and northings therefore being equal, as also the eastings and westings, the work is thus proved to be right *.

Mr Fenwick gives the following directions for planning subterraneous surveys, and for determining errors that may arise in plotting, through inattention to the magnetic variation.

As the magnetic meridian is always changing, the bearings of the same object, taken by such a meridian at different times, must also vary from each other, except reduced to bearings with the true meridian. Let NS (fig. 17.) represent the meridian of a plan, which is also supposed to be the true meridian; and if a subterraneous excavation is to be plotted on it from the pit A, and this excavation is found to form a bearing of north 10° west 10 chains, by an instrument whose needle had 20° of west variation; now if the excavation north 10° west 10 chains be plotted on the plan by its meridian NS, which is the true meridian, it will be represented by AB; but the bearing being taken by a needle having 20° of west variation, it should form a bearing of north 30° west with the meridian NI, as represented by A *b*; then A *b* will be the true direction of the excavation from the pit A, and *b* B will be the magnitude of the error. Or, instead of reducing the excavation to its bearing with the true meridian NI, it will be equally as true if *n s* is drawn on the plan, and made to represent the magnetic meridian of the needle by which the bearing was taken, with which AB will form a bearing of north 10° west.

We shall add a few examples illustrative of the error arising from plotting a subterraneous survey on a plan, without attending to the variation of the magnetic meridian, and also how its magnitude can be ascertained.

Example I.—The following is a subterraneous survey, commencing at a pit called the B pit, north 30°, west 6 chains, north 70°, east 10 chains, north 30°, east 5 chains, and north 25°, west 8 chains, which was surveyed by an instrument whose needle had 24° of west variation; under what bearings must the survey be plotted on a plan whose delineated meridian has 15° of west variation?

Reduce the bearings, as taken by a meridian having 24° of west variation, to bearings with a meridian having 14° of west variation: thus,

Bearings with a meridian of 24° of west variation.	Chains.	*Bearings with a meridian of 15° of west variation.*	Chains.
North 30° west	6	North 39° west	6
North 70° east	10	North 61° east	10
North 30° east	5	North 21° east	5
North 25° west	8	North 34° west	8

The survey must be plotted under bearings with a magnetic meridian having 15° of west variation, as above, commencing at the B pit.

Example II.—If the following subterraneous survey, north 9° west 8 chains, north 30° east 7 chains, and north 21° west 8 chains be made by an instrument whose needle has 23° of west variation, and plotted on a plan by a meridian having 5° of magnetic variation, without being reduced thereto; what will be the magnitude of the error resulting from such neglect?

Suppose A (fig. 18.) the point of commencement of the survey on the plan, and let the meridian of the plan be represented by N *s*, having 5° of west variation with the true meridian NS; then the first bearing, north 9° west 8 chains, will be represented by AB; the second, north 30° east 7 chains, by BC; and the third bearing, north 21° west 8 chains, by CD; then ABCD will represent the survey plotted, without attending to the magnetic variation: But as the survey was made by an instrument whose needle had 23° of west variation, therefore each bearing, when truly plotted, must be set off from a meridian of that variation, which, let *n s* represent; then, north 9° west 8 chains will be represented by A *b*, north 30° east 7 chains by *b c*, and north 21° west 8 chains by *c d*; then A *b c d* will represent the survey truly plotted, and *d* D will be the magnitude of the error.

Or the survey may be plotted by reducing the bearings, as taken by a meridian of 23° of west variation, to bearings with a meridian of 5° of variation, as represented by N *s*, and plotted from it accordingly; which will exactly coincide with A *b c d*, as before.

To discover, by calculation, the magnitude of the error, reduce the bearings of the survey, as taken by a magnetic meridian having 23° of west variation, to bearings with the true meridian; and also the same bearings, as if taken by a meridian having 5° of west variation, to bearings with the true meridian; then determine the northing and easting of D from *d*: thus,

With a meridian of 23° of west variation.	Chains.	*With the true meridian.*	C
N. 9° W.	8	N. 32° W.	8
N. 30° E.	7	N. 7° E.	7
N. 21° W.	8	N. 44° W.	8

With a meridian of 5° west variation.	C.	*With the true meridian.*	C.
N. 9° W.	8	N. 14° W.	8
N. 30° E.	7	N. 25° E.	7
N. 21° W.	8	N. 26° W	8

Surveying.

	C.	Northing. C. L.	Southing. C. L.	Eaſting. C. L.	Weſting. C. L.
N. 32° W.	8	6 78			4 23
N. 7° E.	7	6 94		0 85	
N. 44° W.	8	5 75			5 55
		19 47	A *a*		9 78
					0 85
					8 93 *a d.*

	C.	C. L.	C. L.	C. L.	C. L.
N. 14° W.	8	7 76			1 93
N. 25° E.	7	6 34		2 95	
N. 26° W.	8	7 19			3 50
		21 29	A *e*		5 43
					2 95
					2 48 *e* D or *a f.*

a d 8 chains 93 links—*a f* 2 chains 48 links=*f d* 6 chains 45 links.
A *e* 21 chains 29 links—A *a* 19 chains 47 links=*a e* or *f* D 1 chain 82 links.

Then, as *f d* 6.45	.8095595
Is to radius	10.0000000
So is *f* D 1.82	.2600714
To tang. ∠ *d* 15° 45′	9.4505117

From 90°—15° 45′=74° 15′, ∠ N *d* D.

—2 —2

And √ 6.45+1.82=6.7 *d* D, or 6 chains 70 links.

Ex. p. 155. Therefore, the amount of the error, or the bearing and diſtance of D from *d*, will be north, 74° 15′ eaſt 6 chains 70 links with the true meridian.

SURVEYOR, a perſon who has the overſight and care of conſiderable works, lands, or the like.

SURVEYOR, likewiſe denotes a gauger; as alſo a perſon who ſurveys lands, and makes maps of them.

SURVIVOR, in *Law*, ſignifies the longeſt liver of joint tenants, or of any two perſons jointly intereſted in a thing.

SURVIVORSHIP, is that branch of mathematics which treats of reverſions payable provided one or more particular perſons ſurvive certain others. By reverſions are meant payments not to take place till ſome future period. Survivorſhip forms one of the moſt difficult and complicated parts of the doctrine of reverſions and life-annuities. It has been very fully treated of by Mr Thomas Simpſon in his Select Exerciſes, and conſiderably improved by Dr Price and Mr Morgan, who have beſtowed a great deal of attention on this ſubject; though ſome parts of their principles are erroneous.

The calculations are founded on the expectation of lives at different ages, deduced from tables formed from bills of mortality, of which ſee ſeveral examples under the article *Bills of* MORTALITY. By the expectation of life is meant the mean time that any ſingle or joint lives at a given age is found to continue; that is, the number of years which, taking one with another, they actually enjoy, and may be conſidered as ſure of enjoying; thoſe who ſurvive that period enjoying as much more time in proportion to their number as thoſe who fall ſhort of it enjoy leſs. Thus, ſuppoſing 46 perſons alive all 40 years of age, and that one will die every year till they are all dead in 46 years, half 46 or 23 will be the *expectation* of each of them. If M. de Moivre's hypotheſis were true, that men always decreaſe in an arithmetical progreſſion, the expectation of a ſingle life is always half its complement (A), and the expectation of two joint lives one-third of their common complement. Thus, ſuppoſing a man 40, his expectation would be 23, the half of 46, his complement; the expectation of two joint lives, each 40, would be 15 years 4 months, or the third part of 46.

The number expreſſing the expectation, multiplied by the number of ſingle or joint lives (of which it is the expectation), added annually to a ſociety, gives the whole number living together, to which ſuch an annual addition would in time grow. Thus, ſince 19, or the third of 57, is the expectation of two joint lives, whoſe common age is 29, twenty marriages every year between perſons of this age would in 57 years grow to 20 times 19,

(A) By the complement of a life is meant what it wants of 86, which M. de Moivre makes the boundary of human life. Thus if a man be 30, the complement of his life is 56.

Survivorship.

19, or 380 marriages, always exiſting together. And ſince the expectation of a ſingle life is always half its complement, in 57 years 20 ſingle perſons added annually to a town will increaſe to 20 times 28.5, or 570; and when arrived at this number, the deaths every year will juſt equal the acceſſions, and no farther increaſe be poſſible. It appears from hence, that the particular proportion that becomes extinct every year, out of the whole number conſtantly exiſting together of ſingle or joint lives, muſt, wherever this number undergoes no variation, be exactly the ſame with the expectation of thoſe lives, at the time when their exiſtence commenced. Thus, was it found that a 19th part of all the marriages among any bodies of men, whoſe numbers do not vary, are diſſolved every year by the deaths of either the huſband or wife, it would appear that 19 was, at the time they were contracted, the expectation of theſe marriages. In like manner, was it found in a ſociety, limited to a fixed number of members, that a 28th part dies annually out of the whole number of members, it would appear that 28 was their common expectation of life at the time they entered. So likewiſe, were it found in any town or diſtrict, where the number of births and burials are equal, that a 20th or 30th part of the inhabitants die annually, it would appear that 20 or 30 was the expectation of a child juſt born in that town or diſtrict. Theſe expectations, therefore, for all ſingle lives, are eaſily found by a table of obſervations, ſhowing the number that die annually at all ages out of a given number alive at thoſe ages; and the general rule for this purpoſe is, to divide the ſum of all the living in the table, at the age whoſe expectation is required, and at all greater ages, by the ſum of all that die annually at that age and above it; or, which is the ſame, by the number (in the Table) of the living at that age; and half unity ſubtracted from the quotient will be the required expectation. Thus, in Dr Halley's table, given in the article ANNUITY, the ſum of all the living at 20 and upwards is 20,724, which, divided by 598, the number living at the age of 20, and half unity ſubtracted from the quotient, gives 34.15 for the expectation of 20.

In calculating the value or expectation of joint lives, M. de Moivre had recourſe to the hypotheſis, that the probabilities of life decreaſe in a geometrical progreſſion; believing that the values of joint lives, obtained by rules derived from it, would not deviate much from the truth. But in this he was greatly miſtaken; they generally give reſults which are near a quarter of the true value too great in finding the preſent value of one life after it has ſurvived another in a ſingle payment, and about two-fifths too great when the value is ſought in annual payments during the joint lives. They ought therefore to be calculated on the hypotheſis (if they are calculated on hypotheſis at all), that the probabilities of life decreaſe in arithmetical progreſſion, which is not very far from the truth. Even this hypotheſis never correſponds with the fact in the firſt and laſt periods of life, and in ſome ſituations not in any period of life. Dr Price and Mr Morgan therefore have given tables of the value of lives, not founded on any hypotheſis, but deduced from bills of mortality themſelves. Some of theſe we ſhall give at the end of this article. Mr Morgan has likewiſe given rules for calculating values of lives in this manner.

M. de Moivre has alſo fallen into miſtakes in his rules for calculating the value of reverſions depending on ſurvivorſhip: theſe have been pointed out by Dr Price in the third eſſay in the firſt volume of his Treatiſe on Reverſionary Payments; who has alſo given proper rules for calculating theſe values, the moſt important of which are comprehended in the following paragraphs.

Survivorſhip.

1 Method of finding the number of annuitants that will come on a ſociety.

Suppoſe a ſet of married men to enter into a ſociety in order to provide annuities for their widows, and that it is limited to a certain number of members, and conſtantly kept up to that number by the admiſſion of new members as the old ones are loſt; it is of importance, in the firſt place, to know the number of annuitants that after ſome time will come upon the eſtabliſhment. Now ſince every marriage produces either a widow or widower; and ſince all marriages taken together would produce as many widows as widowers, were every man and his wife of the ſame age, and the chance equal which ſhall die firſt; it is evident, that the number of widows that have ever exiſted in the world, would in this caſe be equal to half the number of marriages. And what would take place in the world muſt alſo, on the ſame ſuppoſitions, take place in this ſociety. In other words, every other perſon in ſuch a ſociety leaving a widow, there muſt ariſe from it a number of widows equal to half its own number. But this does not determine what number, all living at one and the ſame time, the ſociety may expect will come to be conſtantly on it. It is, therefore, neceſſary to determine how long the duration of ſurvivorſhip between perſons of equal ages will be, compared with the duration of marriage. And the truth is, that, ſuppoſing the probabilities of life to decreaſe uniformly, the former is equal to the latter; and conſequently that the number of ſurvivors, or (which is the ſame, ſuppoſing no ſecond marriages) of widows and widowers alive together, which will ariſe from any given ſet of ſuch marriages conſtantly kept up, will be equal to the whole number of marriages; or half of them (the number of widows in particular) equal to half the number of marriages. Now it appears that in moſt towns the decreaſe in the probabilities of life is in fact nearly uniform. According to the Breſlaw Table of Obſervations (ſee ANNUITY), almoſt the ſame numbers die every year, from 20 years of age to 77. After this, indeed, fewer die, and the rate of decreaſe in the probabilities of life is retarded. But this deviation from the hypotheſis is inconſiderable; and its effect, in the preſent caſe, is to render the duration of ſurvivorſhip longer than it would otherwiſe be. According to the London Table of Obſervations, the numbers dying every year begin to grow leſs at 50 years of age; and from hence to extreme old age there is a conſtant retardation in the decreaſe of the probabilities of life. Upon the whole, therefore, it appears that, according to the Breſlaw Table, and ſuppoſing no widows to marry, the number inquired after is ſomewhat greater than half the number of the ſociety; but, according to the London Table, a good deal greater. This, however, has been determined on the ſuppoſition that the huſbands and wives are of equal ages, and that then there is an equal chance who ſhall die firſt. But in reality huſbands are generally older than wives, and males have been found to die ſooner than females, as appears inconteſtably from ſeveral of the tables in Dr Price's Treatiſe on Reverſions. It is therefore more than an equal chance that the huſband will die before his wife. This will increaſe conſiderably the duration of

Survivorſhip.

of ſurvivorſhip on the part of the women, and conſequently the number which we have been inquiring after. The marriage of widows will diminiſh this number, but not ſo much as the other cauſes will increaſe it.

2 When the number of annuitants arrives at its maximum.

If the ſociety comprehends in it from the firſt all the married people of all ages in any town, or among any claſs of people where the numbers always continue the ſame, the whole collective body of members will be at their greateſt age at the time of the eſtabliſhment of the ſociety; and the number of widows left every year will at a medium be always the ſame. The number of widows will increaſe continually on the ſociety, till as many die every year as are added. This will not be till the whole collective body of widows are at their greateſt age, or till there are among them the greateſt poſſible number of the oldeſt widows; and therefore not till there has been time for an acceſſion to the oldeſt widows from the youngeſt part.

Let us, for the ſake of greater preciſion, divide the whole medium of widows that come on every year into different claſſes according to their different ages, and ſuppoſe ſome to be left at 56 years of age, ſome at 46, ſome at 36, and ſome at 26. The widows, conſtantly in life together, derived from the firſt claſs, will come to their greateſt age, and to a *maximum*, in 30 years, ſuppoſing, with M. de Moivre, 86 to be the utmoſt extent of life. The ſame will happen to the ſecond claſs in 40 years, and to the third in 50 years. But the whole body compoſed of theſe claſſes will not come to a *maximum* till the ſame happens to the fourth or youngeſt claſs; that is, not till the end of 60 years. After this the affairs of the ſociety will become ſtationary, and the number of annuitants on it of all ages will keep always nearly the ſame.

If a ſociety begins with its complete number of members, but at the ſame time admits none above a particular age: If, for inſtance, it begins with 200 members all under 50, and afterwards limits itſelf to this number, and keeps it up by admitting every year, at all ages between 26 and 50, new members as old ones drop off; in this caſe, the period neceſſary for bringing on the *maximum* of annuitants will be juſt doubled.

3 What a man ought to pay in a ſingle payment to entitle his widow to a certain annuity.

To determine the ſum that every individual ought to pay in a ſingle preſent payment, in order to intitle his widow to a certain annuity for her life, let us ſuppoſe the annuity 3l. per annum, and the rate of intereſt four per cent. It is evident, that the value of ſuch an expectation is different, according to the different ages of the purchaſers, and the proportion of the age of the wife to that of the huſband. Let us then ſuppoſe that every perſon in ſuch a ſociety is of the ſame age with his wife, and that one with another all the members when they enter may be reckoned 40 years of age, as many entering above this age as below it. It has been demonſtrated by M. de Moivre and Mr Simpſon, that the value of an annuity on the joint continuance of any two lives, ſubtracted from the value of an annuity on the life in expectation, gives the true preſent value of annuity on what may happen to remain of the latter of the two lives after the other.

In the preſent caſe, the value of an annuity to be enjoyed during the joint continuance of two lives, each 40, is, by Table II. 9.826, according to the probabilities of life in the Table of Obſervations formed by Dr Halley from the bills of mortality of Breſlaw in Sileſia. The value of a ſingle life 40 years of age, as given by M. de Moivre, agreeably to the ſame table, is 13.20; and the former ſubtracted from the latter, leaves 3.37, or the true number of years purchaſe, which ought to be paid for any given annuity, to be enjoyed by a perſon 40 years of age, provided he ſurvives another perſon of the ſame age, intereſt being reckoned at four per cent. per annum. The annuity, therefore, being 30l. the preſent value of it is 30 multiplied by 3.37, or 101l. 2s.

Survivorſhip.

4 What he ought to pay in annual payments.

If, inſtead of a ſingle preſent payment, it is thought preferable to make annual payments during the marriage; what theſe annual payments ought to be is eaſily determined by finding what annual payments during two joint lives of given ages are equivalent to the value of the reverſionary annuity in preſent money. Suppoſe, as before, that the joint lives are each 40, and the reverſionary annuity 30l. per annum. An annual payment during the continuance of two ſuch lives is worth (according to Table II.) 9.82 years purchaſe. The annual payment ought to be ſuch as, being multiplied by 9.82, will produce 101.1l. the preſent value of the annuity in one payment. Divide then 101.1 by 9.82, and 10.3 the quotient will be the annual payment. This method of calculation ſuppoſes that the firſt annual payment is not to be made till the end of a year. If it is to be made immediately, the value of the joint lives will be increaſed one year's purchaſe; and therefore, in order to find the annual payments required, the value of a preſent ſingle payment muſt be divided by the value of the joint lives increaſed by unity. If the ſociety prefer paying part of the value in a preſent ſingle payment on admiſſion, and the reſt in annual payments; and if they fix theſe annual payments at a particular ſum, the preſent ſingle payment paid on admiſſion is found by ſubtracting the value of the annual payment during the joint lives from the whole preſent value of the annuity in one payment. Suppoſe, for inſtance, the annual payments to be fixed at five guineas, the annuity to be 30l. the rate of intereſt four per cent. and the joint lives each 40; the value of the annuity in one preſent ſingle payment is 101.1l. The value of five guineas or 5.25 per annum, is (5.25 multiplied by 9.82 the value of the joint lives) 51.55; which, ſubtracted from 101.1l. gives 49.5l. the anſwer.

If a ſociety takes in all the marriages among perſons of a particular profeſſion within a given diſtrict, and ſubjects them for perpetuity to a certain equal and common tax or annual payment, in order to provide life annuities for all the widows that ſhall reſult from theſe marriages; ſince, at the commencement of ſuch an eſtabliſhment, all the oldeſt, as well as the youngeſt, marriages are to be intitled equally to the propoſed benefit, a much greater number of annuitants will come immediately on it than would come on any ſimilar eſtabliſhment which limited itſelf in the admiſſion of members to perſons not exceeding a given age. This will check that accumulation of money which ſhould take place at firſt, in order to produce an income equal to the diſburſements at the time when the number of annuitants comes to a *maximum*; and therefore will be a particular burden upon the eſtabliſhment in its infancy. For this ſome compenſation muſt be provided; and the equitable method of providing it is, by levying fines at the beginning of the eſtabliſhment on every member exceeding

ceeding a given age, proportioned to the number of years which he has lived beyond that age. But if ſuch fines cannot be levied, and if every payment muſt be be equal and common, whatever diſparity there may be in the value of the expectations of different members, the fines muſt be reduced to one common one, anſwering as nearly as poſſible to the diſadvantage, and payable by every member at the time when the eſtabliſhment begins. After this, the eſtabliſhment will be the ſame with one that takes upon it all at the time they marry; and the tax or annual payment of every member adequate to its ſupport will be the annual payment during marriage due from perſons who marry at the mean age at which, upon an average, all marriages may be conſidered as commencing. The fines to be paid at firſt are, for every particular member, the ſame with the difference between the value of the expectation to him at his preſent age, and what would have been its value to him had the ſcheme begun at the time he married. Or, they are, for the whole body of members, the difference between the value of the common expectation, to perſons at the mean age of all married perſons taken together as they exiſt in the world, and to perſons at that age which is to be deemed their mean age when they marry.

Survivorſhip.

5

Method of finding the preſent value of an annuity to be enjoyed by one life, after the expiration of another.

Suppoſe we wiſh to know the preſent value of an annuity to be enjoyed by one life, for what may happen to remain of it beyond another life, after a given term; that is, provided both lives continue from the preſent time to the end of a given term of years; the method of calculating is this: Find the value of the annuity for two lives, greater by the given term of years than the given lives; diſcount this value for the given term; and then multiply by the probability, that the two given lives ſhall both continue the given term; and the product will be the anſwer. Thus, let the two lives be each 30, the term ſeven years, the annuity 10l. intereſt four per cent. The given lives, increaſed by ſeven years, become each 37. The value of two joint lives, each 37, is (by Table II.) 10.25. The value of a ſingle life at 37 is (by the table under the article ANNUITY) 13.67. The former ſubtracted from the latter is 3.42, or the value of an annuity for the life of a perſon 37 years of age, after another of the ſame age, as has been ſhown above. 3.42 diſcounted for ſeven years (that is, multiplied by 0.76 the value of 1l. due at the end of ſeven years) is 2.6. The probability that a ſingle life at 30 ſhall continue ſeven years is $\frac{49}{56}$ (B). The probability, therefore, that two ſuch lives ſhall continue ſeven years, is $\frac{2401}{3136}$, or in decimals 0.765; and 2.6 multiplied by 0.765 is 1.989, the number of years purchaſe which ought to be given for an annuity to be enjoyed by a life now 30 years of age, after a life of the ſame age, provided both continue ſeven years. The annuity then being 10l. its preſent value is 19.89l.

Survivorſhip.

6

Method of finding the value of an annuity for what may happen to remain of one life after another, provided the life in expectation continues a given term.

Suppoſe the value is required of an annuity to be enjoyed for what may happen to remain of one life after another, provided the life in expectation continues a given time. 1. Find the preſent value of the annuity for the remainder of the life in expectation after the given time, which is done in this manner: Multiply the preſent value of the life at the given time by the preſent value of 1l. to be received at that time, and multiply the product again by the probability that the life in expectation will continue ſo long. Let the given time which the life in expectation is to continue be 15 years, and let the perſon then be arrived at 50 years of age. A life at fifty, according to M. de Moivre's valuation of lives, and reckoning intereſt at four per cent. is worth 11.34 years purchaſe. The preſent value of 1l. to be received at the end of 15 years, is 0.5553, and the probability that a life at 35 will continue 15 years is $\frac{146}{190}$. Theſe three values multiplied into one another give 4.44l. for the preſent value of the life in expectation. 2. Find the value of the reverſion, provided both lives continue the given time, by the rule given in parag. 5th. 3. Add theſe values together, and the ſum will be the anſwer in a ſingle preſent payment. We ſhall now illuſtrate this rule by an example.

An annuity of 10l. for the life of a perſon now 30, is to commence at the end of 11 years, if another perſon now 40 ſhould be then dead; or, if this ſhould not happen at the end of any year beyond 11 years in which the former ſhall happen to ſurvive the latter: What is the preſent value of ſuch an annuity, reckoning intereſt at four per cent. and taking the probabilities of life as they are in Dr Halley's table, given in the article MORTALITY?

The value of 10l. per annum, for the remainder of the life of a perſon now 30, after 11 years is 69.43l. The probability that a perſon 40 years of age ſhall live 11 years, is, by Dr Halley's table $\frac{335}{445}$. The probability, therefore, that he will die in 11 years, is $\frac{335}{445}$ ſubtracted from unity (C), or $\frac{110}{445}$; which multiplied by 69.43l. gives 17.16l.—The value of the reverſion, provided both live 11 years, is 17l. and this value added to the former, makes 34.16l. the value required in a ſingle preſent payment; which payment divided by 11.43l. the value of two joint lives, aged 30 and 40, with unity added, gives 3l.; or the value required in annual payments during the joint lives, the firſt payment to be made immediately.

TABLE

(B) The probability that a given life ſhall continue any number of years, or reach a given age, is (as is well known) the fraction, whoſe numerator is the number of the living in any table of obſervations oppoſite to the given age, and denominator, the number oppoſite to the preſent age of the given life.

(C) For the difference between unity and the fraction expreſſing the probability that an event will happen, gives the probability that it will not happen.

Survivorship.

TABLE I. *Showing the Present Values of an Annuity of 1 l. on a Single Life, according to M. de Moivre's Hypothesis.*

Age.	3 per ct.	3½ per ct	4 per ct.	4½ per ct	5 per ct.	6 per ct.
8	19.736	18.160	16.791	15.595	14.544	12.790
9	19.868	18.269	16.882	15.672	14.607	12.839
10	19.868	18.269	16.882	15.672	14.607	12.839
11	19.736	18.160	16.791	15.595	14.544	12.790
12	19.604	18.049	16.698	15.517	14.480	12.741
13	19.469	17.937	16.604	15.437	14.412	12.691
14	19.331	17.823	16.508	15.356	14.342	12.639
15	19.192	17.707	16.410	15.273	14.271	12.586
16	19.050	17.588	16.311	15.189	14.197	12.532
17	18.905	17.467	16.209	15.102	14.123	12.476
18	18.759	17.344	16.105	15.015	14.047	12.419
19	18.610	17.220	15.999	14.923	13.970	12.361
20	18.458	17.093	15.891	14.831	13.891	12.301
21	18.305	16.963	15.781	14.737	13.810	12.239
22	18.148	16.830	15.669	14.641	13.727	12.177
23	17.990	16.696	15.554	14.543	13.642	12.112
24	17.827	16.559	15.437	14.442	13.555	12.045
25	17.664	16.419	15.318	14.340	13.466	11.978
26	17.497	16.277	15.197	14.235	13.375	11.908
27	17.327	16.133	15.073	14.128	13.282	11.837
28	17.154	15.985	14.946	14.018	13.186	11.763
29	16.979	15.835	14.816	13.905	13.088	11.688
30	16.800	15.682	14.684	13.791	12 988	11.610
31	16.620	15.526	14.549	13.673	12.855	11.530
32	16.436	15.367	14.411	13.553	12.780	11.449
33	16.248	15.204	14.270	13.430	12.673	11.365
34	16.057	15.039	14.126	13.304	12.562	11.278
35	15.864	14.871	13.979	13.175	12.449	11.189
36	15.666	14.699	13.829	13.044	12.333	11.098
37	15.465	14.524	13.676	12.909	12.214	11.003
38	15.260	14.345	13.519	12.771	12.091	10.907
39	15.053	14.163	13.359	12.630	11.966	10.807
40	15.842	13.978	13.196	12.485	11.837	10.704
41	14.626	13.789	13.028	12.337	11.705	10.599
42	14.407	13.596	12.858	12.185	11.570	10.490
43	14.185	13.399	12.683	12.029	11.431	10.378
44	13.958	13.199	12.504	11.870	11.288	10.263
45	13.728	12.993	12.322	11.707	11.142	10.144
46	13.493	12.784	12.135	11.540	10.992	10.021
47	13.254	12.571	11.944	11.368	10.837	9.895
48	13.012	12.354	11.748	11.192	10.679	9.765
49	12.764	12.131	11.548	11.012	10.515	9.630
50	12.511	11.904	11.344	10.827	10.348	9.492
51	12.255	11.673	11.135	10.638	10.176	9 349
52	11.994	11.437	10.921	10.443	9.999	9.201
53	11.729	11.195	10.702	10.243	9.817	9.049
54	11.457	10.950	10.478	10.039	9.630	8.891
55	11.183	10.698	10.248	9.829	9.437	8.729
56	10.902	10.443	10.014	9.614	9.239	8.561
57	10.616	10.181	9.773	9.393	9.036	8.387
58	10.325	9.913	9.527	9.166	8.826	8.208
59	10.029	9.640	9.275	8.933	8.611	8.023
60	9.727	9.361	9.017	8.694	8.389	7.831
61	9.419	9.076	8.753	8.449	8.161	7.633
62	9.107	8.786	8.482	8.197	7.926	7.428
63	8.787	8.488	8.205	7.938	7.684	7.216
64	8.462	8.185	7.921	7.672	7.435	6.997
65	8.132	7.875	7.631	7.399	7.179	6.770
66	7.794	7.558	7.333	7.119	6.915	6.535
67	7.450	7.234	7.027	6.831	6.643	6.292
68	7.099	6.902	6.714	6.534	6.362	6.040
69	6.743	6.565	6.394	6.230	6.073	5.779
70	6.378	6.219	6.065	5.918	5.775	5.508
71	6.008	5.865	5.728	5.596	5.468	5.228
72	5.631	5.505	5.383	5.265	5.152	4.937
73	5.246	5.136	5.029	4.926	4.826	4.636
74	4.854	4.759	4.666	4.576	4.489	4.324
75	4.453	4.373	4.293	4.217	4.143	4.000
76	4.046	3.978	3.912	3.847	3.784	3.664
77	3.632	3.575	3.520	3.467	3.415	3.315
78	3.207	3.163	3.111	3.076	3.034	2.953
79	2.776	2.741	2.707	2.673	2.641	2.578
80	2.334	2.309	2.284	2.259	2.235	2.188
81	1.886	1.867	1.850	1.832	1.816	1.783
82	1.429	1.411	1.406	1.394	1.384	1.362
83	0.961	0.955	0.950	0.943	0.937	0.925
84	0.484	0.483	0.481	0.479	0.479	0.472
85	0.000	0.000	0.000	0.000	0.000	0.000

TABLE II. *Showing the Value of an Annuity on the Joint Continuance of Two Lives, according to M. de Moivre's Hypothesis.*

Age of the Youngest.	Age of the Eldest.	Value at 5 per cent.	Value at 3 per cent.	Value at 4 per cent.
	10	15.206	13.342	11.855
	15	14.878	13.093	11.661
	20	14.503	12.808	11.430
	25	14.074	12.480	11.182
10	30	13.585	12.102	10.884
	35	13.025	11.665	10.537
	40	12.381	11.156	10.128
	45	11.644	10.564	9.646
	50	10.796	9.871	9.074
	55	9.822	9.059	8.391
	60	8.704	8.105	7.572
	65	7.417	6.980	6.585
	70	5.936	5.652	5.391
	15	14.574	12.860	11.478
	20	14.225	12.593	11.266
	25	13.822	12.281	11.022
	30	13.359	11.921	10.736
	35	12.824	11.501	10.402
15	40	12.207	11.013	10.008
	45	11.496	10.440	9.541
	50	10.675	9.767	8.985
	55	9.727	8.975	8.318
	60	8.632	8.041	7.515
	65	7.377	6.934	6.544
	70	5.932	5.623	5.364
	20	13.904	12.341	11.067
20	25	13.531	12.051	10.840
	30	13.098	11.711	10.565
	35	12.594	11.314	10.278
	40	12.008	10.847	9.870
	45	11.325	10.297	9 420
	50	10.536	9.648	8.880

Age

SURVEYING.

PLATE DXXV.

Fig. 1.

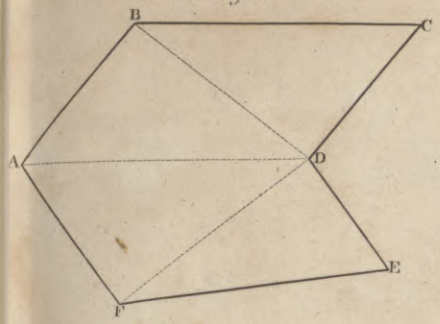


Fig. 2.

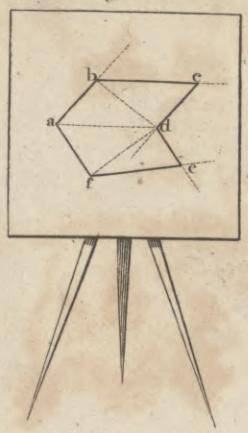


Fig. 4.

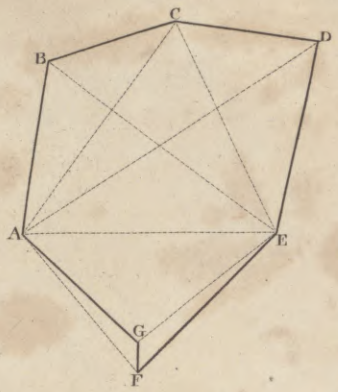


Fig. 5.

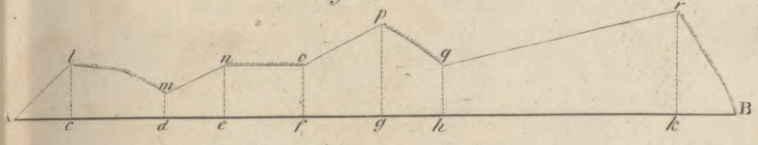


Fig. 3.

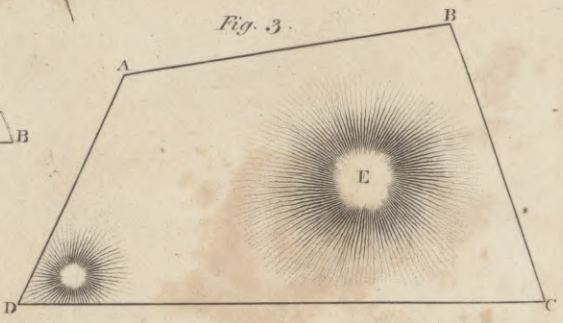


Fig. 6.

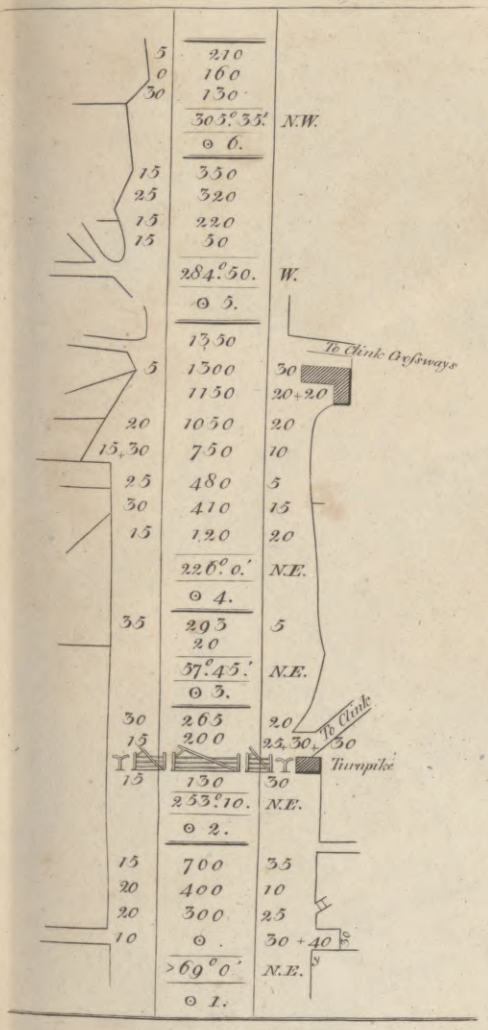
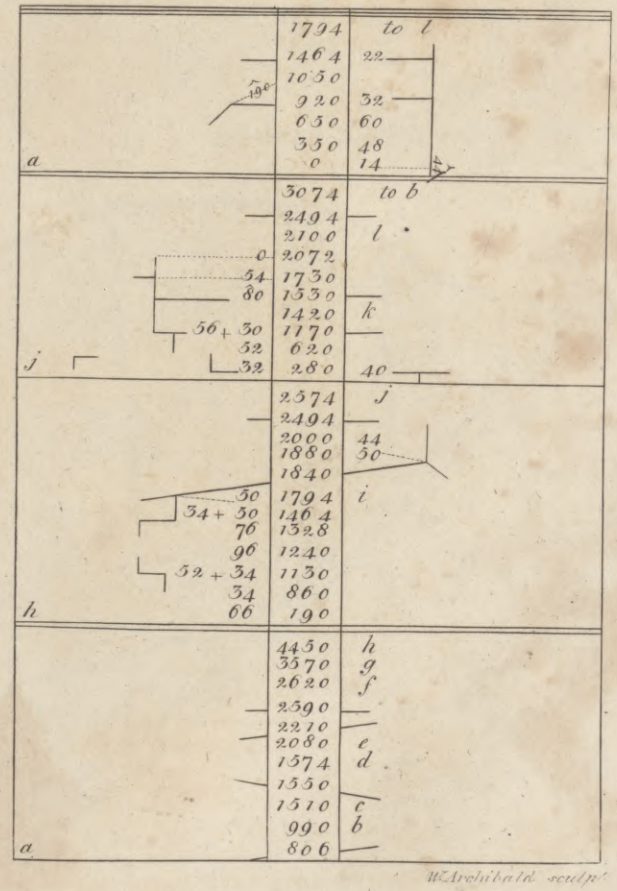


Fig. 7.



W. Archibald. sculpt.

Fig. 8.

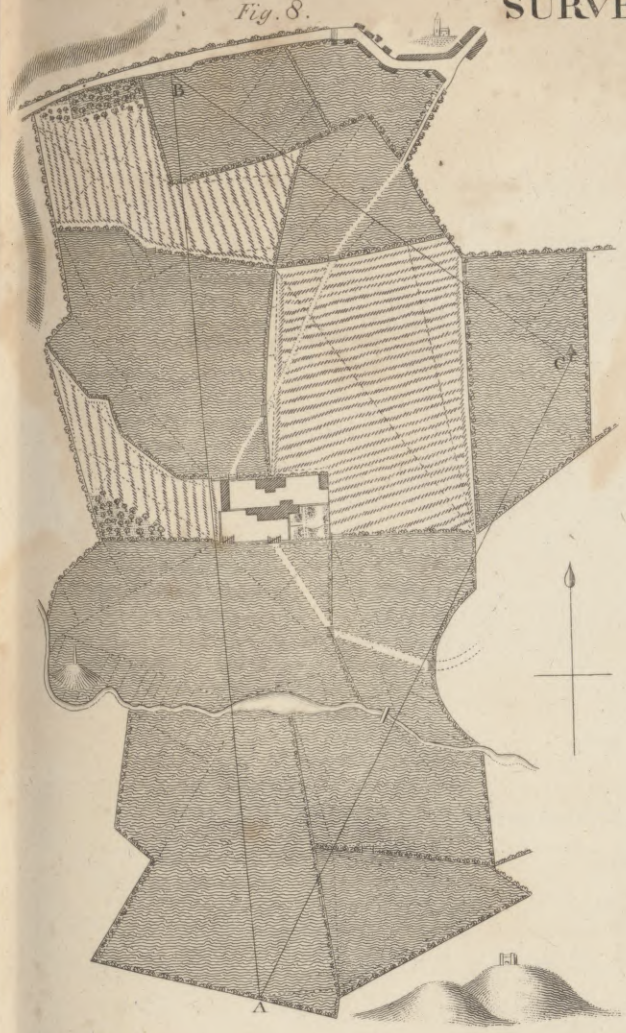
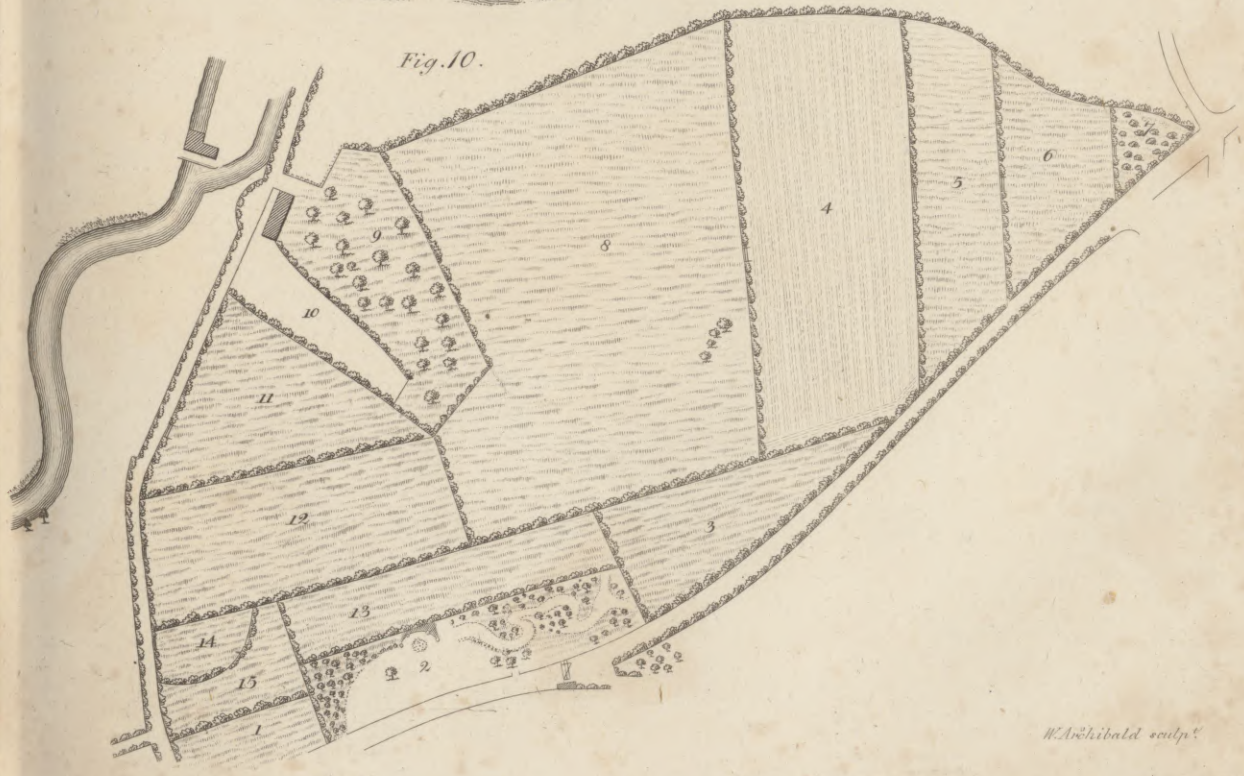


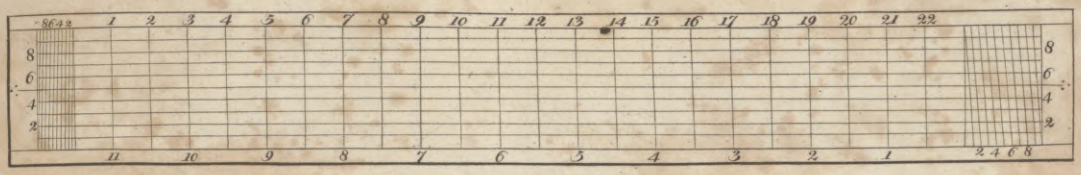
Fig. 9.

Fig. 10.



W. Archibald sculpt.

Fig. 11.



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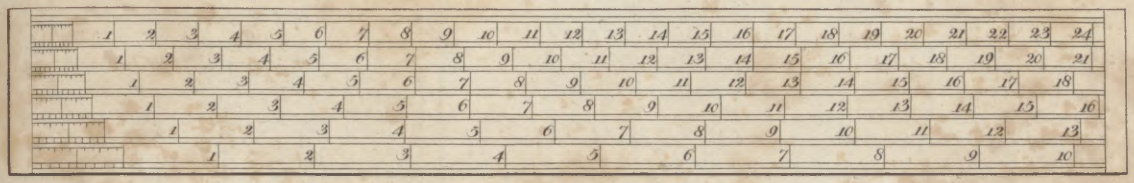
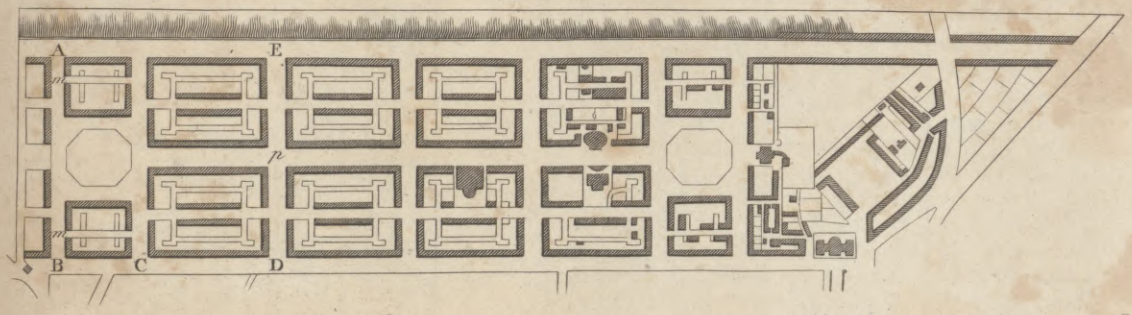


Fig. 13.



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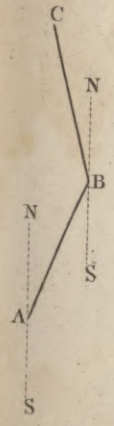


Fig. 15.

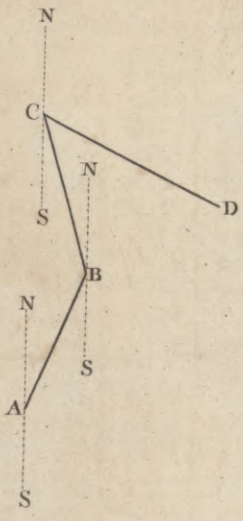


Fig. 16.

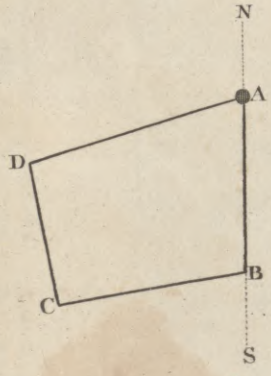


Fig. 17.

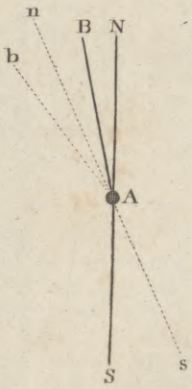
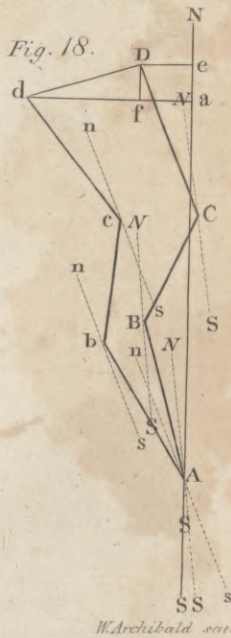


Fig. 18.



W. Archibald sculpt.

rvivor-
ship.

Age of the Youngeft.	Age of the Eldeft.	Value at 3 per cent.	Value at 4 per cent.	Value at 5 per cent.
	55	9.617	8.879	8.233
	60	8.549	7.967	7.448
	65	7.308	6.882	6.495
	70	5.868	5.590	5.333
	25	13.192	11.786	10.621
	30	12.794	11.468	10.367
	35	12.333	11.093	10.067
	40	11.770	10.655	9.708
25	45	11.130	10.131	9.278
	50	10.374	9.509	8.761
	55	9.488	8.766	8.134
	60	8.452	7.880	7.371
	65	7.241	6.826	6.440
	70	5.826	5.551	5.294
	30	12.434	11.182	10.133
	35	12.010	10.838	9.854
	40	11.502	10.428	9.514
	45	10.898	9.936	9.112
30	50	10.183	9.345	8.620
	55	9.338	8.634	8.018
	60	8.338	7.779	7.280
	65	7.161	6.748	6.373
	70	5.777	5.505	5.254
	35	11.632	10.530	9.600
	40	11.175	10.157	9.291
35	45	10.622	9.702	8.913
	50	9.955	9.149	8.450
	55	9.156	8.476	7.879
	60	8.202	7.658	7.172
	65	7.066	6.662	6.294
	70	5.718	5.450	5.203
	40	10.777	9.826	9.014
	45	10.283	9.418	8.671
40	50	9.677	8.911	8.244
	55	8.936	8.283	7.710
	60	8.038	7.510	7.039
	65	6.951	6.556	6.198
	70	5.646	5.383	5.141
	45	9.863	9.063	8.370
	50	9.331	8.619	7.987
45	55	8.662	8.044	7.500
	60	7.831	7.332	6.875
	65	6.807	6.435	6.080
	70	5.556	5.300	5.063
	50	8.892	8.235	7.660
	55	8.312	7.738	7.230
50	60	7.568	7.091	6.664
	65	6.623	6.258	5.926
	70	5.442	5.193	4.964
	55	7.849	7.332	6.873
55	60	7.220	6.781	6.386
	65	6.379	6.036	5.724
	70	5.201	5.053	4.833
	60	6.737	6.351	6.001
60	65	6.043	5.730	5.444
	70	5.081	4.858	4.653
65	65	5.547	5.277	5.031
	70	4.773	4.571	4.385
70	70	4.270	4.104	3.952

Survivor-
ship.

TABLE III. *Showing the Values of Annuities on Single Lives, among Males and Females, according to the Probabilities of the Duration of Life in the Kingdom of Sweden.*

Ages.	Males. 4 per ct.	Males. 5 per ct.	Females. 4 per ct.	Females. 5 per ct.	Lives in general. 4 per ct.	Lives in general. 5 per ct.
1	16.503	14.051	16.820	14.271	16.661	14.161
2	17.355	14.778	17.719	15.034	17.537	14.906
3	17.935	15.279	18.344	15.571	18.139	15.425
4	18.328	15.624	18.780	15.951	18.554	15.787
5	18.503	15.786	18.927	16.088	18.715	15.937
6	18.622	15.901	19.045	16.203	18.833	16.052
7	18.693	15.977	19.131	16.291	18.912	16.134
8	18.725	16.021	19.162	16.335	18.943	16.178
9	18.715	16.030	19.151	16.343	18.933	16.186
10	18.674	16.014	19.109	16.325	18.891	16.169
11	18.600	15.970	19.041	16.286	18.820	16.128
12	18.491	15.896	18.952	16.229	18.721	16.062
13	18.378	15.819	18.840	16.153	18.609	15.986
14	18.246	15.724	18.707	16.059	18.476	15.891
15	18.105	15.624	18.568	15.960	18.336	15.792
16	17.958	15.517	18.424	15.856	18.191	15.686
17	17.803	15.404	18.290	15.761	18.046	15.582
18	17.643	15.285	18.151	15.662	17.897	15.473
19	17.492	15.175	18.013	15.563	17.752	15.369
20	17.335	15.059	17.872	15.462	17.603	15.260
21	17.192	14.955	17.725	15.356	17.458	15.155
22	17.042	14.846	17.573	15.245	17.307	15.045
23	16.887	14.732	17.414	15.129	17.150	14.930
24	16.742	14.627	17.252	15.009	16.997	14.818
25	16.592	14.517	17.087	14.886	16.839	14.701
26	16.436	14.402	16.915	14.757	16.675	14.579
27	16.274	14.282	16.751	14.636	16.512	14.459
28	16.105	14.156	16.588	14.515	16.346	14.335
29	15.930	14.024	16.427	14.396	16.178	14.210
30	15.751	13.889	16.261	14.272	16.006	14.080
31	15.575	13.756	16.104	14.156	15.839	13.956
32	15.395	13.619	15.941	14.035	15.668	13.827
33	15.208	13.477	15.787	13.923	15.497	13.700
34	15.014	13.327	15.629	13.806	15.321	13.566
35	14.812	13.170	15.465	13.684	15.138	13.427
36	14.601	13.006	15.278	13.542	14.939	13.274
37	14.382	12.833	15.070	13.382	14.726	13.107
38	14.154	12.652	14.854	13.213	14.504	12.932
39	13.916	12.462	14.629	13.036	14.272	12.749
40	13.668	12.261	14.401	12.856	14.034	12.558
41	13.426	12.065	14.185	12.687	13.805	12.376
42	13.196	11.880	13.994	12.538	13.595	12.209
43	12.984	11.710	13.798	12.387	13.391	12.048
44	12.763	11.532	13.596	12.229	13.179	11.880
45	12.535	11.347	13.383	12.061	12.950	11.704
46	12.297	11.153	13.151	11.876	12.724	11.514
47	12.051	10.951	12.894	11.668	12.472	11.309
48	11.795	10.738	12.620	11.443	12.217	11.090
49	11.528	10.516	12.333	11.205	11.930	10.860
50	11.267	10.298	12.049	10.970	11.658	10.634
51	11.030	10.100	11.769	10.737	11.399	10.418
52	10.785	9.895	11.492	10.507	11.138	10.201
53	10.531	9.682	11.220	10.280	10.875	9.981
54	10.269	9.460	10.937	10.042	10.603	9.751
55	9.998	9.229	10.642	9.792	10.320	9.510

Survivorship.

Ages.	Males. 4 per ct.	Males. 5 per ct.	Females. 4 per ct.	Females. 5 per ct.	Lives in general. 4 per ct.	Lives in general. 5 per ct.
56	9.717	8.988	10.334	9.529	10.025	9.258
57	9.425	8.736	10.012	9.253	9.718	8.994
58	9.140	8.489	9.692	8.976	9.416	8.732
59	8.845	8.232	9.358	8.687	9.101	8.458
60	8.540	7.963	9.039	8.406	8.789	8.184
61	8.241	7.700	8.739	8.144	8.490	7.922
62	7.950	7.442	8.453	7.895	8.201	7.668
63	7.669	7.193	8.166	7.643	7.917	7.418
64	7.382	6.938	7.870	7.382	7.626	7.160
65	7.090	6.676	7.566	7.111	7.328	6.893
66	6.792	6.408	7.252	6.831	7.022	6.619
67	6.489	6.134	6.930	6.541	6.709	6.337
68	6.201	5.872	6.596	6.239	6.398	6.055
69	5.933	5.628	6.253	5.926	6.093	5.777
70	5.670	5.389	5.897	5.599	5.783	5.494
71	5.418	5.158	5.564	5.293	5.491	5.225
72	5.180	4.940	5.261	5.013	5.220	4.976
73	4.940	4.719	4.998	4.770	4.969	4.744
74	4.724	4.521	4.792	4.581	4.758	4.551
75	4.487	4.302	4.582	4.388	4.534	4.345
76	4.253	4.084	4.367	4.189	4.310	4.136
77	4.024	3.871	4.145	3.983	4.084	3.927
78	3.768	3.631	3.913	3.767	3.840	3.699
79	3.512	3.390	3.668	3.536	3.590	3.463
80	3.260	3.152	3.402	3.285	3.331	3.218
81	3.017	2.921	3.145	3.041	3.081	2.981
82	2.792	2.706	2.905	2.812	2.848	2.759
83	2.600	2.523	2.699	2.615	2.649	2.569
84	2.473	2.403	2.559	2.480	2.516	2.441
85	2.371	2.306	2.552	2.476	2.461	2.391
86	2.281	2.222	2.518	2.446	2.399	2.334
87	2.154	2.103	2.431	2.365	2.292	2.338
88	1.955	1.912	2.294	2.236	2.124	2.074
89	1.698	1.664	2.108	2.059	1.903	1.861
90	1.417	1.392	1.873	1.833	1.645	1.612
91	1.154	1.136	1.628	1.596	1.391	1.366
92	0.835	0.824	1.349	1.325	1.092	1.074
93	0.477	0.471	1.071	1.054	0.774	0.762
94	0.240	0.238	0.799	0.788	0.519	0.513
95	0.000	0.000	0.544	0.537		
96	0.000	0.000	0.320	0.317		

TABLE IV. *Showing the Value of Annuities on Two Joint Lives, according to the Probabilities of the Duration of Human Life, among Males and Females collectively, reckoning interest at* 4 per cent.

Interest 4 per cent.

Difference of 0, 6, 12, and 18 years.

Ages.	Value.	Ages.	Value.	Ages.	Value.	Ages.	Value.
1- 1	12.252	1- 7	13.989	1-13	13.894	1-19	13.389
2- 2	13.583	2- 8	14.780	2-14	14.557	2-20	14.008
3- 3	14.558	3- 9	15.323	3-15	14.988	3-21	14.417
4- 4	15.267	4-10	15.685	4-16	15.259	4-22	14.671
5- 5	15.577	5-11	15.817	5-17	15.326	5-23	14.725
6- 6	15.820	6-12	15.887	6-18	15.354	6-24	14740

Survivorship.

Interest 4 per cent.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
7- 7	16.003	7-13	15.914	7-19	15.351	7-25	14.727
8- 8	16.109	8 14	15.888	8-20	15.310	8-26	14.673
9- 9	16.152	9-15	15.824	9-21	15.244	9-27	14.590
10-10	16.141	10-16	15.729	10-22	15.149	10-28	14.484
11-11	16.087	11-17	15.617	11-23	15.033	11-29	14.357
12-12	15.982	12-18	15.477	12-24	14.889	12-30	14.202
13-13	15.855	13-19	15.327	13-25	14.736	13-31	14.045
14-14	15.701	14-20	15.164	14-26	14.566	14-32	13.874
15-15	15.535	15-21	15.001	15-27	14.392	15-33	13.700
16-16	15.361	16-22	14.832	16-28	14.216	16-34	13.520
17 17	15.196	17-23	14.665	17-29	14.042	17-35	13.340
18-18	15.023	18-24	14.491	18-30	13.860	18-36	13.141
19-19	14.854	19-25	14.320	19-31	13.687	19-37	13.934
20-20	14.682	20-26	14.144	20-32	13.512	20-38	12.720
21-21	14.525	21-27	13.976	21-33	13.345	21-39	12.505
22-22	14.360	22-28	13.807	22-34	13.173	22-40	12.286
23-23	14.194	23-29	13.635	23-35	12.997	23-41	12.073
24-24	14.020	24-30	13.455	24-36	12.801	24-42	11.873
25-25	13.849	25-31	13.284	25-37	12.599	25-43	11.683
26-26	13.671	26-32	13.108	26-38	12.387	26-44	11.485
27-27	13.495	27-33	12.935	27 39	12.170	27-45	11.284
28-28	13.323	28-34	12.763	28-40	11.953	28-46	11.072
29-29	13.148	29-35	12.586	29-41	11.742	29-47	10.847
30-30	12.965	30-36	12.390	30-42	11.543	30-48	10.606
31-31	12.795	31-37	12.192	31-43	11.359	31-49	10.365
32-32	12.624	32-38	11.988	32-44	11.170	32-50	10.128
33-33	12.456	33-39	11.779	33-45	10.978	33-51	9.905
34-34	12.286	34-40	11.568	34-46	10.775	34-52	9.679
35-35	12.109	35-41	11.361	35-47	10.557	35-53	9.452
36-36	11.904	36-42	11.156	36-48	10.314	36-54	9.207
37-37	11.683	37-43	10.953	37-49	10.059	37-55	8.951
38-38	11.452	38-44	10.741	38-50	9.805	38-56	8.685
39-39	11.209	39-45	10.519	39-51	9.558	39-57	8.404
40-40	10.964	40-46	10.286	40-52	9.308	40-58	8.124
41-41	10.732	41-47	10.049	41-53	9.066	41-59	7.839
42-42	10.531	42-48	9.813	42-54	8.830	42-60	7.569
43-43	10.346	43-49	9.581	43-55	8.597	43-61	7.318
44-44	10.154	44-50	9.351	44-56	8.354	44-62	7.075
45-45	9.954	45-51	9.129	45-57	8.101	45-63	6.836
46-46	9.736	46-52	8.897	46-58	7.841	46-64	6.586
47-47	9.497	47-53	8.658	47-59	7.563	47-65	6.323
48-48	9.236	48-54	8.402	48-60	7.281	48-66	6.048
49-49	8.966	49-55	8.139	49-61	7.008	49-67	5.764
50-50	8.707	50-56	7.874	50-62	6.749	50-68	5.487
51-51	8.469	51-57	7.613	51-63	6.505	51-69	5.221
52-52	8.230	52-58	7.351	52-64	6.256	52-70	4.953
53-53	7.994	53-59	7.083	53-65	6.004	53-71	4.694
54-54	7.748	54-60	6.814	54-66	5.743	54-72	4.455
55-55	7.495	55-61	6.555	55-67	5.474	55-73	4.231
56-56	7.229	56-62	6.299	56-68	5.204	56-74	4.043
57-57	6.924	57-63	6.045	57-69	4.936	57-75	3.844
58-58	6.678	58-64	5.788	58-70	4.664	58-76	3.637
59-59	6.388	59-65	5.519	59-71	4.395	59-77	3.430
60-60	6.104	60-66	5.249	60-72	4.149	60-78	3.210
61-61	5.844	61-67	4.984	61-73	3.927	61-79	2.974
62-62	5.600	62-68	4.729	62-74	3.747	62-80	2.744
63-63	5.367	63-69	4.482	63-75	3.563	63-81	2.557
64-64	5.128	64-70	4.231	64-76	3.370	64-82	2.396
65-65	4.881	65-71	3.982	65-77	3.180	65-83	2.252
66-66	4.626	66-72	3.750	66 78	2.974	66-84	2.123

urvivor-
ſhip.

Survivor-
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Intereſt 4 per cent.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
67-67	4.362	67-73	3.527	67-79	2.743	67-85	2.010
68-68	4.103	68-74	3.340	68-80	2.514	68-86	1.910
69-69	3.851	69-75	3.147	69-81	2.324	69-87	1.798
70-70	3.593	70-76	2.946	70-82	2.155	70-88	1.661
71-71	3.345	71-77	2.752	71-83	2.004	71-89	1.464
72-72	3.128	72-78	2.558	72-84	1.875	72-90	1.189
73-73	2.935	73-79	2.355	73-85	1.768	73-91	0.937
74-74	2.797	74-80	2.172	74-86	1.692	74-92	0.708
75-75	2.648	75-81	2.017	75-87	1.605	75-93	0.575
76-76	2.490	76-82	1.877	76-88	1.497	76-94	0.481
77-77	2.340	77-83	1.756	77-89	1.339	77-95	0.421
78-78	2.170	78-84	1.639	78-90	1.097		
79-79	1.967	79-85	1.524	79-91	0.863		
80-80	1.758	80-86	1.416	80-92	0.638		
81-81	1.600	81-87	1.320	81-93	0.511		
82-82	1.472	82-88	1.225	82-94	0.427		
83-83	1.364	83-89	1.095	83-95	0.379		
84-84	1.276	84-90	0.902				
85-85	1.212	85-91	0.725				
86-86	1.172	86-92	0.556				
87-87	1.127	87-93	0.459				
88-88	1.071	88-94	0.396				
89-89	0.949	89-95	0.364				
90-90	0.718						
91-91	0.516						
92-92	0.326						
93-93	0.236						
94-94	0.190						
95-95	0.024						

TABLE V. *Showing the Values of two Joint Lives, according to the Probabilities of the Duration of Human Life among Males and Females collectively.*

Intereſt 4 per cent.

Difference of age 24, 30, 36, and 42 years.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
1-25	12.832	1-31	12.196	1-37	11.465	1-43	10.546
2-26	13.409	2-32	12.730	2-38	11.913	2-44	10.946
3-27	13.778	3-33	13.066	3-39	12.164	3-45	11.168
4-28	14.003	4-34	13.264	4-40	12.284	4-46	11.260
5-29	14.037	5-35	13.277	5-41	12.242	5-47	11.183
6-30	14.033	6-36	13.242	6-42	12.185	6-48	11.062
7-31	14.006	7-37	13.170	7-43	12.112	7-49	10.915
8-32	13.944	8-38	13.059	8-44	12.004	8-50	10.743
9-33	13.855	9-39	12.913	9-45	11.865	9-51	10.560
10-34	13.741	10-40	12.743	10-46	11.694	10-52	10.357
11-35	13.604	11-41	12.563	11-47	11.493	11-53	10.140
12-36	13.428	12-42	12.379	12-48	11.259	12-54	9.898
13-37	13.234	13-43	12.196	13-49	11.011	13-55	9.644
14-38	13.023	14-44	11.997	14-50	10.759	14-56	9.371
15-39	12.798	15-45	11.787	15-51	10.514	15-57	9.087
16-40	12.570	16-46	11.562	16-52	10.264	16-58	8.799

Intereſt 4 per cent.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
17-41	12.351	17-47	11.328	17-53	10.018	17-59	8.503
18-42	12.146	18-48	11.076	18-54	9.761	18-60	8.208
19-43	11.951	19-49	10.819	19-55	9.500	19-61	7.928
20-44	11.751	20-50	10.567	20-56	9.228	20-62	7.658
21-45	11.550	21-51	10.332	21-57	8.953	21-63	7.396
22-46	11.335	22-52	10.092	22-58	8.675	22-64	7.127
23-47	11.107	23-53	9.852	23-59	8.385	23-65	6.851
24-48	10.862	24-54	9.602	24-60	8.097	24-66	6.566
25-49	10.612	25-55	9.347	25-61	7.823	25-67	6.275
26-50	10.364	26-56	9.080	26-62	7.557	26-68	5.986
27-51	10.130	27-57	8.807	27-63	7.297	27-69	5.702
28-52	9.894	28-58	8.534	28-64	7.032	28-70	5.415
29-53	9.659	29-59	8.250	29-65	6.761	29-71	5.136
30-54	9.413	30-60	7.967	30-66	6.481	30-72	4.881
31-55	9.167	31-61	7.702	31-67	6.197	31-73	4.646
32-56	8.912	32-62	7.446	32-68	5.947	32-74	4.453
33-57	8.651	33-63	7.196	33-69	5.642	33-75	4.251
34-58	8.389	34-64	6.942	34-70	5.364	34-76	4.040
35-59	8.114	35-65	6.679	35-71	5.093	35-77	3.833
36-60	7.833	36-66	6.402	36-72	4.840	36-78	3.605
37-61	7.561	37-67	6.115	37-73	4.603	37-79	3.352
38-62	7.296	38-68	5.828	38-74	4.405	38-80	3.098
39-63	7.033	39-69	5.543	39-75	4.195	39-81	2.889
40-64	6.763	40-70	5.254	40-76	3.975	40-82	2.710
41-65	6.492	41-71	4.977	41-77	3.762	41-83	2.553
42-66	6.225	42-72	4.730	42-78	3.539	42-84	2.418
43-67	5.957	43-73	4.507	43-79	3.295	43-85	2.305
44-68	5.689	44-74	4.322	44-80	3.052	44-86	2.203
45-69	5.426	45-75	4.128	45-81	2.854	45-87	2.083
46-70	5.153	46-76	3.921	46-82	2.684	46-88	1.933
47-71	4.884	47-77	3.715	47-83	2.533	47-89	1.708
48-72	4.633	48-78	3.489	48-84	2.396	38-90	1.385
49-73	4.398	49-79	3.238	49-85	2.277	49-91	1.090
50-74	4.205	50-80	2.990	50-86	2.171	50-92	0.818
51-75	4.008	51-81	2.792	51-87	2.050	51-93	0.662
52-76	3.803	52-82	2.623	52-88	1.901	52-94	0.551
53-77	3.605	53-83	2.475	53-89	1.681	53-95	0.468
54-78	3.389	54-84	2.344	54-90	1.366		
55-79	3.150	55-85	2.232	55-91	1.078		
56-80	2.909	56-86	2.130	56-92	0.810		
57-81	2.710	57-87	2.010	57-93	0.655		
58-82	2.539	58-88	1.864	58-94	0.546		
59-83	2.385	59-89	1.644	59-95	0.464		
60-84	2.248	60-90	1.333				
61-85	2.135	61-91	1.050				
62-86	2.037	62-92	0.789				
63-87	1.916	63-93	0.639				
64-88	1.790	64-94	0.533				
65-89	1.585	65-95	0.456				
66-90	1.290						
67-91	1.017						
68-92	0.764						
69-93	0.617						
70-94	0.514						
71-95	0.411						

Survivorſhip. The values of joint lives in theſe tables have been computed for only one rate of intereſt; and of ſingle lives in Table III. for only two rates of intereſt. The following rules will ſhow, that it would be a needleſs labour to compute theſe values (in ſtrict conformity to the obſervations) for any other rates of intereſt.

Account of a method of deducing, from the correct values (according to any obſervations) of any ſingle or joint Lives at one rate of Intereſt, the ſame values at other rates of Intereſt.

Preliminary Problems.

Prob. I. The expectation given of a ſingle life by any table of obſervations, to find its value, ſuppoſing the decrements of life equal, at any given rate of intereſt.

Solution. Find the value of an annuity certain for a number of years equal to twice the expectation. Multiply this value by the perpetuity increaſed by unity, and divide the product by twice the expectation: The quotient ſubtracted from the perpetuity will be the value required.

Example. The expectation of a male life aged 10, by the Sweden obſervations, is 43.94. Twice this expectation is 87.88. The value of an annuity certain for 87.88 years is (reckoning intereſt at 4 per cent.) 24.200. The product of 24.200 into 26 (the perpetuity increaſed by unity) is 629.2, which, divided by 87.88, gives 7.159. And this quotient ſubtracted from 25 (the perpetuity) gives 17.84 years purchaſe, the value of a life aged ten, deduced from the expectation of life at that age, according to the Sweden obſervations. (See the Tables in Dr Price on Reverſions, vol. ii.).

Prob. II. Having the expectations given of any two lives by any table of obſervations, to deduce from thence the value of the joint lives at any rate of intereſt, ſuppoſing an equal decrement of life.

Solution. Find the difference between twice the expectation of the youngeſt life and twice the expectation of the oldeſt life increaſed by unity and twice the perpetuity. Multiply this difference by the value of an annuity certain for a time equal to twice the expectation of the oldeſt life; and by twice the ſame expectation divide the product, reſerving the quotient.

From twice the perpetuity ſubtract the reſerved quotient, and multiply the remainder by the perpetuity increaſed by unity. This laſt product divided by twice the expectation of the youngeſt life, and then ſubtracted from the perpetuity, will be the required value.

When twice the expectation of the youngeſt life is greater than twice the expectation of the oldeſt life increaſed by unity and twice the perpetuity, the reſerved quotient, inſtead of being ſubtracted from twice the perpetuity, muſt be added to it, and the ſum, not the difference, multiplied by the perpetuity increaſed by unity.

Example. Let the joint lives propoſed be a female life aged 10, and a male life aged 15; and let the table of obſervations be the Sweden table for lives in general, and the rate of intereſt 4 per cent. Twice the expectations of the two lives are 90.14 and 83.28.

Twice the expectation of the oldeſt life, increaſed by unity and twice the perpetuity, is 134.28, which leſſened by 90.14 (twice the expectation of the youngeſt life), leaves 44.14 for the reſerved remainder. This remainder multiplied by 24.045 (the value of an annuity certain for 83.28 years), and the product divided by 83.28 (twice the expectation of the oldeſt life), gives 12.744, the quotient to be reſerved; which ſubtracted from double the perpetuity, and the remainder (or 37.255) multiplied by the perpetuity increaſed by unity (or by 26) gives 968.630, which divided by 90.14 (twice the expectation of the youngeſt life) and the quotient ſubtracted from the perpetuity, we have 14.254 for the required value. Survivorſhip.

The value of an annuity certain, when the number of years is a whole number with a fraction added (as will be commonly the caſe) may be beſt computed in the following manner. In this example the number of years is 83.28. The value of an annuity certain for 83 years is 24.035. The ſame value for 84 years is 24.072. The difference between theſe two values is 0.37; which difference multiplied by .28 (the fractional part of the number of years), and the product (.0103) added to the leaſt of the two values, will give 24.045 the value for 83.28 years.

General Rule. Call the correct value (ſuppoſed to be computed for any rate of intereſt) the firſt value. Call the value deduced (by the preceding problems) from the expectations at the ſame rate of intereſt, the ſecond value. Call the value deduced from the expectations for any other rate of intereſt the third value.

Then the difference between the firſt and ſecond values added to or ſubtracted from the third value, juſt as the firſt is greater or leſs than the ſecond, will be the value at the rate of intereſt for which the third value has been deduced from the expectations.

The following examples will make this perfectly plain.

Example I. In the two laſt tables the correct values are given of two joint lives among mankind at large, without diſtinguiſhing between males and females, according to the Sweden obſervations, reckoning intereſt at 4 per cent. Let it be required to find from theſe values the values at 3 per cent. and let the ages of the joint lives be ſuppoſed 10 and 10.

The correct value by Table IV. (reckoning intereſt at 4 per cent.) is 16.141. The expectation of a life aged 10 is 45.07. The value deduced from this expectation at 4 per cent. by Prob. II. is 14.539. The value deduced by the ſame problem from the ſame expectation at 3 per cent. is 16.808. The difference between the firſt and ſecond values is 1.602, which, added to the third value (the firſt being greater than the ſecond), makes 18.410, the value required.

Example II. Let the value be required of a ſingle male life aged 10, at 3 per cent. intereſt, from the correct value at 4 per cent. according to the Sweden obſervations.

Firſt, or correct value at 4 per cent. (by Table III.) is 18.674. The expectation of a male life aged 10 is 43.94.

The ſecond value (or the value deduced from this expectation by Prob. I.) is 17.838.

The third value (or the value deduced from the ſame expectation at 3 per cent.) is 21.277.

The difference between the firſt and ſecond is .836; which (ſince the firſt is greater than the ſecond) muſt be added to the third; and the ſum (that is, 22.113) will be the value required.

The

The third value at 5 per cent. is 15.286; and the difference added to 15.286 makes 16.122 the value of a male life aged 10 at 5 per cent. according to the Sweden obſervations. The exact value at 5 per cent. is (by Table III.) 16.014.

Again: the difference between 16.014 (the correct value at 5 per cent.), and 15.286 (the value at the ſame intereſt deduced from the expectation), is .728; which, added (becauſe the firſt value is greater than the ſecond) to 13.335 (the value deduced at 6 per cent. from the expectation) gives 14.063, the value of the ſame life, reckoning intereſt at 6 per cent.

Theſe deductions, in the caſe of ſingle lives particularly, are ſo eaſy, and give the true values ſo nearly, that it will be ſcarcely ever neceſſary to calculate the exact values (according to any given obſervations) for more than one rate of intereſt.

If, for inſtance, the correct values are computed at 4 per cent. according to any obſervations, the values at 3, $3\frac{1}{2}$, $4\frac{1}{2}$, 5, 6, 7, or 8 per cent. may be deduced from them by the preceding rules as occaſion may require, without much labour or any danger of conſiderable errors. The values thus deduced will ſeldom differ from the true values ſo much as a tenth of a year's purchaſe. They will not generally differ more than a 20th or 30th of a year's purchaſe. In joint lives they will differ leſs than in ſingle lives, and they will come equally near to one another whatever the rates of intereſt are.

The preceding tables furniſh the means of determining the exact differences between the values of annuities, as they are made to depend on the ſurvivorſhip of any male or female lives; which hitherto has been a *deſideratum* of conſiderable conſequence in the doctrine of life-annuities. What has made this of conſequence is chiefly the multitude of ſocieties lately eſtabliſhed in this and foreign countries for providing annuities for widows. The general rule for calculating from theſe tables the value of ſuch annuities is the following.

Rule. "Find in Table III. the value of a female life at the age of the wife. From this value ſubtract the value in Table IV. of the joint continuance of two lives at the ages of the huſband and wife. The remainder will be the value in a ſingle preſent payment of an annuity for the life of the wife, ſhould ſhe be left a widow. And this laſt value divided by the value of the joint lives increaſed by unity, will be the value of the ſame annuity in annual payments during the joint lives, and to commence immediately."

Example. Let the age of the wife be 24, and of the huſband 30. The value in Table III. (reckoning intereſt at 4 per cent.) of a female life aged 24, is 17.252. The value in Table IV. of two joint lives aged 24 and 30, is 13.455, which ſubtracted from 17.252 leaves 3.797, the value in a ſingle preſent payment of an annuity of 1l. for the life of the wife after the huſband; that is, for the life of the widow. The annuity, therefore, being ſuppoſed 20l. its value in a ſingle payment is 20 multiplied by 3.797, that is, 75.94l. And this laſt value divided by 14.455 (that is, by the value of the joint lives increaſed by unity), gives 5.25, the value in annual payments beginning immediately, and to be continued during the joint lives of an annuity of 20l. to a wife aged 24 for her life, after her huſband aged 30.

SURYA, the orb of the ſun perſonified and adored by a ſect of Hindoos as a god. He ſeems to be the ſame divinity with the Phœbus of Greece and Rome; and the ſect who pay him particular adoration are called *Sauras*. Their poets and painters deſcribe his car as drawn by ſeven green horſes, preceded by Arun, or the *Dawn*, who acts as his charioteer, and followed by thouſands of genii worſhipping him and modulating his praiſes. He has a multitude of names, and among them twelve epithets or titles, which denote his diſtinct powers in each of the twelve months; and he is believed to have deſcended frequently from his car in a human ſhape, and to have left a race on earth, who are equally renowned in the Indian ſtories with the Heliadai of Greece: it is very ſingular, that his two ſons called *Aſwinau* or *Aſwinicumarau*, in the dual, ſhould be conſidered as twin-brothers, and painted like Caſtor and Pollux; but they have each the character of Æſculapius among the gods, and are believed to have been born of a nymph, who, in the form of a mare, was impregnated with ſunbeams. Surya || Suſſex. *Aſiatic Reſearches*, vol i p. 262 and 263.

SUS, the HOG, a genus of quadrupeds belonging to the claſs of mammalia and order of belluæ. See MAMMALIA *Index*.

SUSA, the ancient royal reſidence of the kings of Perſia, built by Darius Hyſtaſpis, according to Pliny; though he probably only reſtored it, being a very ancient city, founded by Tithonus father of Memnon. It was in compaſs 120 ſtadia, of an oblong quadrangular form, with a citadel called *Memnoneum*. In Scripture it is called *Suſan*, the royal citadel, from the great number of lilies growing in that diſtrict (Athenæus); ſituated on the river Uhlai, or Eulæus (Daniel): and the Spaniards call at this day a lily *aſuſena* (Pinedo). Suſa was the winter, as Ecbatana was the ſummer, reſidence of the kings of Perſia, (Xenophon, Strabo, Plutarch). Here the kings kept their treaſure, (Herodotus). Now called *Tuſter*.

SUSPENSION, in *Scots Law*. See LAW, N° clxxxv. 5, 6, and 7.

SUSSEX, a county of England, deriving its name from its ſituation in reſpect of the other Saxons, and called *Suſſex*, i. e. the country of the South Saxons, has Hampſhire on the weſt, the Britiſh channel on the ſouth, Surry on the north, and Kent on the eaſt. Its length is 65 miles, its breadth 30, and its circumference 170. It is divided into 6 rapes, and theſe into 65 hundreds, in which are 342 pariſhes, of which 123 are vicarages, one city, 16 market-towns, 1,140,000 acres, and about 159,311 ſouls. It has few good ports, though it lies along the channel for 65 miles, which is its greateſt length, the coaſt being encumbered in many places with rocks; and where it is more open, ſuch quantities of ſand are thrown upon it by the ſouth-weſt winds, and the harbours ſo choked up, that they will not admit veſſels of any great draught or burden. The county is well watered by the rivers Arun, Adar, Ouſe, Rother, Lavant, Cuckmeer, Aſhburn, and Aften, by which it is well ſupplied with fiſh, as well as from the ſea. Hence different places of the county are famed for different ſorts of fiſh, as the Arun for mullets, which enter it from the ſea in ſummer in ſhoals, and by feeding upon a particular kind of herb become extremely delicious: Chicheſter for lobſters, Selſey for cockles, Amberley for trout, Pulborough for eels, Rye for herrings, and *Gough's edition of Camden's Britannia*, vol. i. p. 192.

Suſſex, Sutherland.

and the county in general for carp. It is remarkable, that all the rivers above mentioned riſe and fall into the ſea within the county.

The air, as well as the ſoil, is various in different parts of the county. Upon the coaſt the air is aguiſh, upon the hills and downs pleaſant and wholeſome; but ſomewhat moiſt and foggy in the valleys, the ſoil being deep and rich, and the vegetation in ſummer very vigorous. The downs in ſome places are very fertile in corn and graſs; in others they feed great flocks of ſheep, whoſe fleſh and wool are very fine; but of the latter no inconſiderable quantity is clandeſtinely exported to France. In the Weald and the valleys the roads are very deep, eſpecially in winter. In the north quarter are many woods, and ſome foreſts in other places; whence the king's yards are ſupplied with the largeſt and beſt timber in England, beſide what is made into charcoal and conſumed in the iron-works; for on the eaſt ſide is plenty of iron ore, with furnaces, forges, and mills for manufacturing it. The gunpowder of this county is ſaid to excel that of any other. Thoſe delicious birds called *wheat-ears* are bred in this ſhire; they are not bigger than a lark, but very fat. That part now called the *Wild* or *Weald* of Suſſex, was anciently a mere deſert for hogs and deer, of great extent, taking in a part of Kent and Surry; and was called *Anderida Silva*, *Coid Andred*, and *Andradſwald*, from Anderida an adjoining city. This county is in the home circuit and dioceſe of Chicheſter, giving title of earl to the family of Yelverton, and ſends 28 members to parliament, viz. two for the county, two for the city of Chicheſter, and two for each of the following towns, Horſham, Lewes, Bramber, Eaſt-Grinſtead, Midhurſt, Shoreham, Staining, Arundel, Haſtings, Rye, Winchelſea, and Seaford; of which the four laſt are cinque ports.

SUTHERLAND, one of the moſt northerly counties of Scotland, bordering on Caithneſs to the eaſt, and bounded by the ocean on the north, the country of Aſſynt on the weſt, Roſs-ſhire on the ſouth, and by the German ſea on the ſouth-eaſt. It ſtretches about 70 miles in length, and 40 in breadth; is generally hilly, though in many parts arable; well watered with ſmall rivers and ſtreams replete with fiſh, and containing about 60 lakes, the habitation of various fiſh, ſwans, ducks, geeſe, &c. One of the largeſt of theſe is Lochſhin, extending 18 miles in length. Some of them are interſperſed with ſmall verdant iſlands, which in ſummer yield a very agreeable proſpect. On the coaſt are many commodious harbours, and all the bays ſwarm with fiſh. Sutherland affords iron-ſtone, freeſtone, limeſtone, marble and ſlate, in abundance. Turf and peat are the common fuel. Lead ore, and ſome copper ore, have been met with in ſome parts of the county.

The air is ſo temperate, and the ſoil ſo good, that ſaffron has here been brought to perfection. Many parts of the country are remarkably fruitful in corn, and the paſturage is everywhere excellent. Deer and ſome other game are abundant in Sutherland. On the hills are fed numerous flocks of ſheep and black cattle. The northern part, called *Strathnaver*, and ſeparated from the reſt by a ridge of mountains, is bounded on the north by the Deucaledonian ſea, on the weſt by the channel called the *Minch*, on the eaſt by Caithneſs, and on the ſouth by Aſſynt. The length from eaſt to weſt, is 34 miles; but the breadth from north to ſouth does not exceed 12 in ſome places. It is very hilly; and the mountains are ſo high, that the ſnow remains on the tops of them till midſummer. It is watered by the Naver, from whence it derives its name: this diſtrict gives a title to the eldeſt ſon of the earl of Sutherland. Strathnaver has many freſh-water lakes or lochs; the chief of which are Loch Naver and Loch Lyel: there are ſeveral iſlands on the northern coaſt. In various parts of the country there are monuments of victories obtained over the Danes or other foreign invaders. The inhabitants are hardy, bold, and enterpriſing; courteous to ſtrangers; cheerful, open, frugal, and induſtrious. The ſalmon-fiſhery in this county is conſiderable, as well as the trade in black cattle, ſheep, and horſes, at the neighbouring fairs; corn, barley, ſalmon, butter, cheeſe, wool, hides, and tallow, are exported. Dornoch is the capital of the county. The population of Sutherland in 1801 amounted to 23,000. The following table ſhews the population at two different periods *.

* Sta Hiſt.

Pariſhes.	Population in 1755.	Population in xx. 1790—1798.
Aſſynt	1934	3000
Clyne	1406	1660
Creich	1705	1730
Durneſs	1000	1182
5 Dornoch	2780	2541
Edderachyllis	869	1024
Farr	2800	2600
Golſpie	1790	1700
Kildonan	1433	1365
10 Lairg	1010	1350
Loth	1193	1370
Rogart	1761	2000
13 Tongue	1093	1439
	20,774	22,961
		20,774
		Increaſe, 2,187

SUTLER, in *War*, one who follows the army, and furniſhes the troops with proviſion. Sutlers pitch their tents, or build their huts, in the rear of each regiment, and about head-quarters.

SUTRIUM, in *Ancient Geography*, a famous city, and an ancient colony of the Romans, the key of Etruria; founded about ſeven years after the taking of Rome by the Gauls (Velleius). Now *Sutri* in St Peter's patrimony, on the river Pozzolo; ſurrounded on every ſide with rocks, 24 miles to the north-weſt of Rome.

SUTTON, SAMUEL, was born at Alfreton in Derbyſhire, and going into the army ſerved under the duke of Marlborough in Queen Anne's wars with great credit. He afterwards came to London, commenced brewer, and kept a coffee-houſe in Alderſgate ſtreet, which was well frequented by the learned men of that time, by whom Mr Sutton was much reſpected, as a man of ſtrong natural parts and uncultivated genius. About the year 1740 he ſchemed a very ſimple and natural method for extracting the foul air from the wells of ſhips, by pipes communicating with the fire-places of the coppers; which operated as long as any fire was kept burning for the ſhip's uſe. He took out a patent in 1744, to ſecure the profits of his invention; and died about the year 1752.

SUTURE, in *Anatomy*, a kind of articulation peculiar to the cranium or ſkull. See ANATOMY, Part I. Sect. ii. *paſſim*.

SUTURE, in *Surgery*, a method of uniting the lips of wounds together. See SURGERY.

SWABBER, an inferior officer on board ſhips of war, whoſe employment it is to ſee that the decks are kept clean and neat.

SWABIA. See SUABIA.

SWALLOW, a genus of birds. See HIRUNDO, ORNITHOLOGY *Index*. See alſo MIGRATION.

SWALLOW-Wort. See ASCLEPIAS, BOTANY *Index*.

SWAMMERDAM, JOHN, a celebrated and learned natural philoſopher, was the ſon of John James Swammerdam, an apothecary and famous naturaliſt of Amſterdam, and was born in 1637. His father intended him for the church, and with this view had him inſtructed in Latin and Greek; but he, thinking himſelf unequal to ſo important a taſk, prevailed with his father to conſent to his applying himſelf to phyſic. As he was kept at home till he ſhould be properly qualified to engage in that ſtudy, he was frequently employed in cleaning his father's curioſities, and putting every thing in its proper place. This inſpired our author with an early taſte for natural hiſtory; ſo that, not content with the ſurvey of the curioſities which his father had purchaſed, he ſoon began to make a collection of his own, which he compared with the accounts given of them by the beſt writers. When grown up, he ſeriouſly attended to his anatomical and medical ſtudies; yet ſpent part of the day and the night in diſcovering, catching, and examining the flying inſects proper to thoſe times, not only in the province of Holland, but in thoſe of Guelderland and Utrecht. Thus initiated in natural hiſtory, he went to the univerſity of Leyden in 1651; and in 1653 was admitted a candidate of phyſic in that univerſity. His attention being now engaged by anatomy, he began to conſider how the parts of the body, prepared by diſſection, could be preſerved, and kept in conſtant order for anatomical demonſtration; and herein he ſucceeded, as he had done before in his nice contrivances for diſſecting and managing the minuteſt inſects. Our author afterwards made a journey into France, where he ſpent ſome time at Saumur, and, where he became acquainted with ſeveral learned men. In 1667 he returned to Leyden, and took his degree of Doctor of Phyſic. The next year the grand duke of Tuſcany being in Holland in order to ſee the curioſities of the country, came to view thoſe of our author and his father; and on this occaſion Swammerdam made ſome anatomical diſſections of inſects in the preſence of that prince, who was ſtruck with admiration at our author's great ſkill in managing them, eſpecially at his proving that the future butterfly lay with all its parts neatly folded up in a caterpillar, by actually removing the integuments that covered the former, and extricating and exhibiting all its parts, however minute, with incredible ingenuity, by means of inſtruments of inconceivable fineneſs. On this occaſion the duke offered our author 12,000 florins for his ſhare of the collection, on condition of his removing them himſelf into Tuſcany, and coming to live at the court of Florence; but Swammerdam, who hated a court life, declined his highneſs's propoſal. In 1663, he publiſhed a General Hiſtory of Inſects. About this time, his father began to take offence at his inconſiderately neglecting the practice of phyſic, which might have ſupported him in affluence; and would neither ſupply him with money nor clothes. This reduced him to ſome difficulties. In 1675 he publiſhed his Hiſtory of the Ephemeras; and his father dying the ſame year, left him a fortune ſufficient for his ſupport; but he did not long ſurvive him, for he died in 1682. Gaubius gave a tranſlation of all his works from the original Dutch into Latin, from which they were tranſlated into Engliſh, in folio, in 1758. The celebrated Boerhaave wrote his life. Swammerdam || Sweden.

SWAN. See ANAS, ORNITHOLOGY *Index*.

SWANPAN, or Chineſe ABACUS; an inſtrument for performing arithmetical operations. See ABACUS.

SWANEMOTE, SWAINMOTE, or SWEINMOTE. See *FOREST-Courts*.

SWEARING. See OATH.

SWEAT, a ſenſible moiſture iſſuing from the pores of the ſkins of living animals. See PHYSIOLOGY, N° 286.

SWEATING SICKNESS, a diſorder which appeared in England about the year 1481, and was by foreigners called the *Engliſh ſweat*. See MEDICINE, N° 51.

SWEDEN, the ſmalleſt of the northern ſtates of Europe, occupies the greater part of the north-weſtern corner of that portion of the globe, lying between Norway and the gulf of Bothnia. Before the treaty concluded in 1809, between Sweden and Ruſſia, the Swediſh territory extended over a conſiderable tract of country on the eaſt of the gulf of Bothnia; but by that treaty the whole of theſe provinces were ceded to Ruſſia. At preſent the boundaries of Sweden are Norway and Lapland to the north; to the weſt Norway, from which it is ſeparated by the mountains; the Baltic to the ſouth; and to the eaſt the gulf of Bothnia, the ſea of Aland, and the rivers of Tornea and Muonio, which ſeparate it from the Ruſſian empire. From north to ſouth it lies between the latitudes of 69° 30′ and 55° 20′; and it extends from the 12th degree to about the 24th degree of longitude eaſt from Greenwich. Formerly its extent in Britiſh miles was computed at 1150 in length, and 600 in breadth, and its area at about 210,000 ſquare miles. Its length continues undiminiſhed; but its breadth is probably leſſened at leaſt one half, and we can ſcarcely eſtimate its preſent extent at more than 110,000 ſquare miles. The following table will ſhew the preſent diviſions of the Swediſh territories. Situation and extent

Provinces.

Sweden.

2 Diviſion.

Provinces.	*Subdiviſions.*	*Chief Towns.*
SWEDEN PROPER.	Upland. Sudermanland. Nerike. Weſtmanland. Dalecarlia.	STOCKHOLM.
GOTHLAND.	Weſt Gothland. Eaſt Gothland. South Gothland.	Gottenburgh.
WEST NORLAND.	Jemtland. Angermanland. Medelpad. Halſingland. Gaſtrikland. Hergeadalen.	
WEST BOTHNIA.	- - -	Tornea.
SWEDISH LAPLAND.	Aſele Lappmark. Umea Lappmark. Pitea Lappmark. Lulea Lappmark. Tornea Lappmark. Kemi Lappmark.	
SWEDISH POMERANIA (A).	- - -	Stralſund.

The only colonial territory belonging to Sweden is the iſland of St Bartholomew, in the Weſt Indies.

3 Face of the country. Sweden is diverſified in a moſt picturesque manner, with extenſive lakes, large rivers, winding ſtreams, cataracts, gloomy foreſts, fertile vales, ſtupendous rocks, and cultivated fields. It poſſeſſes more navigable rivers than the neighbouring countries of Norway and Denmark.

4 Soil. Sweden is by no means remarkable for the fertility of its ſoil, moſt of the country being rocky and unproductive. The valleys and the banks of the rivers afford the beſt land for tillage.

5 Mountains. The principal mountains belonging to Sweden are thoſe of the elevated chain which divides it from Norway, and which branch off in a ſouth-eaſterly direction. One of the higheſt of theſe is Swucku.

6 Rivers. The chief rivers are the Gotha connecting Lake Wener with the Categat; the Motala, forming the outlet of Lake Weter; the Dahl riſing in the Norwegian mountains, and flowing through Dalecarlia into the gulf of Bothnia, and the Tornea forming the north-eaſtern boundary, and emptying itſelf into the gulf of Bothnia at the town of the ſame name.

7 Lakes. There are ſeveral conſiderable lakes in Sweden, chiefly in the province of Sweden Proper. The moſt remarkable are Wener, Weter, and Maela, on the banks of which laſt ſtands the city of Stockholm.

8 Foreſts. Sweden abounds with foreſts, eſpecially in Dalecarlia, and on the borders of the lakes.

9 Climate and ſeaſ. The climate and ſeaſons of Sweden nearly reſemble thoſe of the ſame latitudes in Ruſſia. The winters are in moſt places extremely ſevere, and the ſummers ſhort and ſudden. The gulf of Bothnia is generally frozen over during winter, ſo as to admit of travellers paſſing over into Finland, and Eaſt Bothnia. The ſummer, though ſhort, is generally hot, and ſeldom cloudy or inconſtant. In the higher latitudes the ſun of courſe is ſeen in the middle of ſummer for ſeveral days together, and the nights of winter are proportionably long. See LAPLAND.

10 Natural hiſtory. Much of the natural hiſtory of Sweden has been already given under the article LAPLAND. In the more ſouthern provinces there are found in the foreſts the bear, lynx, wolf, beaver, otter, glutton, and flying ſquirrel. The Swediſh horſes are commonly ſmall, but ſpirited, and are conſidered as ſuperior to thoſe of Germany for cavalry. The cattle and ſheep preſent little remarkable, being ſimilar to thoſe of the neighbouring nations. Seals are found in the gulf of Bothnia; and the lakes and rivers of Sweden produce pikes that are remarkably large, and which are ſalted and pickled for exportation.

The

(A) That diſtrict of Germany, called *Swediſh Pomerania*, was long in poſſeſſion of the Swediſh monarchs; till, in the conteſts with France and Ruſſia, it was taken poſſeſſion of by the former. By the late treaty (in 1809) between France and Sweden, Pomerania has been reſtored to its old maſter.

The map of Sweden is attached to that of Denmark and Norway, in Plate CLXX.

Sweden. The forefts produce a great variety of game, efpecially the large black cock, called in Scotland the cock of the foreft. Among the reptiles the *rana bombina*, and the *coluber cherfea*, are confidered as almoft peculiar to Sweden.

The principal vegetable productions of Sweden are its immenefe foreffs of pine and fir trees, though the country is not deftitute of a great variety of fhrubs and plants common to it with Denmark and Ruffia.

The principal riches of the natural hiftory of Sweden are to be found in the mineral kindom. It produces cryftals, amethyfts, topazes, porphyry, lapis lazuli, agate, cornelian, marble, and other foffils. The chief wealth of the country, however, arifes from her mines of filver, copper, lead, and iron. The laft mentioned metal employs not fewer than 450 forges, hammering-mills, and fmelting houfes. A kind of a gold mine has likewife been difcovered in Sweden, but fo inconfiderable, that from the year 1741 to 1747, it produced only 2398 ducats, each valued at 9s. 4d. fterling. The firft gallery of one filver mine is 100 fathoms below the furface of the earth; the roof is fupported by prodigious oaken beams, and from thence the miners defcend about 40 fathoms to the loweft vein. This mine is faid to produce 20,000 crowns a-year. The product of the copper mines is uncertain; but the whole is loaded with vaft taxes and reductions to the government, which has no other refources for the exigencies of the ftate. Thofe fubterraneous manfions are aftonifhingly fpacious, and at the fame time commodious for their inhabitants, fo that they feem to form a hidden world. The waterfalls in Sweden afford excellent conveniency for turning mills for forges; and for fome years the exports of iron from Sweden brought in 300,000l. fterling.

There are likewife in Sweden fome filver mines, of which that of Sahlberg is the richeft, as well as the moft ancient. It exifted fo early as 1188, and during the whole of the 14th century, it yielded 24,000 marks of filver per annum. In the 15th century the quantity was diminifhed to 20,000. In the reign of Charles X. it gave only 2000; and it furnifhes at prefent ftill lefs, the ore yielding only one ounce of pure metal per quintal. The chief gallery, where the pureft filver was obtained, having fallen in, is not yet cleared, notwithftanding their inceffant labour. They are alfo digging pits in a perpendicular direction, in order to arrive at the principal vein, which extends itfelf from the north to the fouth-eaft. Formerly lead employed in feparating the metal was imported from England; but the mine furnifhes at prefent a fufficient quantity for the purpofe. The moft remarkable mineral waters in Sweden are thofe of Medewi in Eaft Gothland.

11 rly hiftory uncertain. The early hiftory of Sweden is not lefs involved in fable than that of moft other nations. Some hiftorians have pretended to give regular catalogues of the princes who reigned in Sweden in very early times; but they differ fo much that no credit can be given to them. All indeed agree that ancient Scandinavia was firft governed by judges elected for a certain time by the voice of the people. Among thefe temporary princes the country was divided, until, in the year of the world 2054, according to fome, or 1951, according to others, Eric, or, if we believe Puffendorf, Sueno, was raifed to the fupreme power, with the prerogatives of all the temporary magiftrates united in his perfon for life, or until his conduct fhould merit depofition. Sweden.

From this very early period till the year 1366 of the Chriftian era, the hiftories of Sweden prefent us with nothing but what is common to all nations in their early periods, viz. the endlefs combats of barbarians, tending to no other purpofe than the effufion of blood. At the time juft mentioned, however, Albert of Mecklenburg, having concluded a peace between Sweden and Denmark, which had been at violent war for fome time before, was proclaimed king of Sweden. The peace was of fhort duration, being broken in 1368; on which Albert entered into an offenfive and defenfive league with the earl of Holftein, the Jutland nobility, the dukes of Slefwick, Mecklenburg, and the Hanfe-towns, againft the kings of Denmark and Norway. Albert proved very fucceffful againft Waldemar king of Denmark at that time, driving him entirely out of his dominions; but he himfelf was defeated by the king of Norway, who laid fiege to his capital. Soon after this, a new treaty was concluded, by which Albert was allowed to enjoy the crown of Sweden in peace. Having formed a defign however of rendering himfelf abfolute, he fo difpleafed his fubjects that Margaret of Norway was proclaimed queen of Sweden by the malecontents. A war immediately enfued, in which Albert was defeated and taken prifoner; but as the princes of Mecklenburg, the earls of Holftein, and the Hanfe-towns, entered into a league in his favour, the war raged with more fury than ever.

An. 1366.

12 Albert of Mecklenburg declared king.

13 War with Denmark and Norway.

14 Is defeated and taken prifoner by Margaret of Norway.

At length, in 1394, the contending parties were reconciled. Albert was fet at liberty, on condition that he fhould in three years give up to Margaret all pretenfions to the city of Stockholm; and the Hanfe-towns engaged to pay the fum of 60,000 marks of filver if Albert fhould break that treaty. Not long after this, Eric the fon of Albert died; and he, having no other child, did not think it worth his while to contend for the kingdom of Sweden: he therefore acquiefced in the pretenfions of Margaret, and paffed the remainder of his days at Mecklenburg.

15 Set at liberty. An. 1394.

Margaret died in 1415, and was fucceeded by Eric of Pomerania. This prince's reign was cruel and oppreffive. The confequence of this was a revolt; and Charles Canutfon, grand mareffchal of Sweden and governor of Finland, having joined the malecontents, was declared commander in chief of their army. Eric was now formally depofed: Canutfon was chofen regent; but beginning to oppreff the people, and afpiring openly to the crown, the Swedes and Danes revolted; in confequence of which a revolution took place, and Chriftopher duke of Bavaria, nephew to Eric, was chofen king of Denmark, Sweden, and Norway, in 1442.

16 Margaret is fucceeded by Eric, a cruel tyrant. An. 1415.

On the acceffion of the new prince, complaints againft Charles Canutfon were brought from all quarters; but, through the intereft of his friends, he efcaped punifhment; and in 1448, Chriftopher having died after a tyrannical reign of about five years, he was raifed to the throne to which he had fo long afpired. The kingdoms of Denmark and Norway however refufed allegiance to him; on which a war immediately commenced. In 1454 peace was concluded, and Denmark for the prefent freed from the Swedifh yoke. Nor did Canutfon long enjoy even the crown of Sweden. Having quarrelled with the

17 Charles Canutfon. An. 1448.

Sweden.

magiſtrates and the archbiſhop of Upſal, the latter formed ſuch a ſtrong party that the king could not reſiſt him. Canutſon died in 1470 after a long and turbulent reign.

An. 1520.

The Swediſh affairs continued to be involved in dreadful confuſion till the year 1520, when a great revolution was effected by Guſtavus Ericſon, a nobleman of the firſt rank, who reſtored the kingdom to its liberty, and laid the foundation of its future grandeur. The occaſion of this great revolution was as follows: In 1518, Chriſtiern king of Denmark invaded Sweden, with a deſign to ſubdue the whole country; but being defeated with great loſs by young Steen Sture, at that time regent, he ſet ſail for Denmark. But meeting with contrary winds, he made ſeveral deſcents on the Swediſh coaſt, which he ravaged with all the fury of an incenſed barbarian. The inhabitants, however, bravely defended themſelves, and Chriſtiern was reduced to the utmoſt diſtreſs; one half of his forces having periſhed with hunger, and the reſt being in the moſt imminent danger by the approach of a rigorous winter. He then thought of a ſtratagem, which had almoſt proved fatal to the regent; for having invited him to a conference, at which he deſigned either to aſſaſſinate or take him priſoner, Sture was about to comply, had not the ſenate, who ſuſpected the plot, interpoſed and prevented him. Chriſtiern then offered to go in perſon to Stockholm in order to confer with Sture, on condition that ſix hoſtages ſhould be ſent in his room. This was accordingly done; but the wind happening then to prove favourable, he ſet ſail for Denmark with the hoſtages, of whom Guſtavus Ericſon was one. Next year he returned; and having drawn Sture into an ambuſh, the regent received a wound of which he died ſome time after. The kingdom being thus left without a head, matters ſoon came to the moſt deſperate criſis. The army diſbanded itſelf; and the ſenate, inſtead of taking proper meaſures to oppoſe the enemy, ſpent their time in idle debates. Chriſtiern in the mean time advanced into the heart of the kingdom, deſtroying every thing with fire and ſword; but on his arrival at Stragnez, he granted a ſuſpenſion of arms, on condition that they would elect him king. This they accordingly did; and Chriſtiern proved one of the moſt bloody tyrants that ever ſat on the throne of any kingdom. Immediately after his coronation, he gave grand entertainments for three days; during which time he projected the diabolical deſign of extirpating at once all the Swediſh nobility, and thus for ever preventing the people from revolting, by depriving them of their proper leaders. As the tyrant had ſigned articles, by which he promiſed indemnity to all who had borne arms againſt him, it became neceſſary to invent ſome cauſe of offence againſt thoſe whom he intended to deſtroy. To accompliſh his purpoſe, Guſtavus Trolle, formerly archbiſhop of Upſal, but who had been degraded from that dignity, in an oration before his majeſty, lamented the demolition of Stecka, his place of reſidence, and the loſſes ſuſtained by the ſee of Upſal, amounting to near a million of money. He then proceeded in a bitter accuſation againſt the widow and the ſon-in-law of Sture the late regent, comprehending in the ſame accuſation about 15 of the principal nobility, the whole ſenate, and the burghers of Stockholm. In conſequence of this, about 60 of the principal nobility and people of firſt rank in Sweden were hanged as traitors. Innumerable other cruelties were committed; part of which are owned by the Daniſh hiſtorians, and minutely related by thoſe of Sweden. At laſt he departed for Denmark, ordering gibbets to be erected, and cauſing the peaſants to be hanged on them for the ſlighteſt offences.

18 Chriſtiern king of Denmark invades Sweden, but is defeated and driven out.

19 He treacherouſly carries off ſix hoſtages, of whom Guſtavus Ericſon is one. An. 1519.

20 Is choſen king, and proves a moſt bloody tyrant.

Sweden.

21 Maſſacres the nobility, and cauſes gibbets to be erected as he paſſes along.

This monſtrous cruelty, inſtead of ſecuring him on the throne, exaſperated the whole nation againſt him. It has already been mentioned, that Guſtavus Ericſon, or, as he is commonly called, *Guſtavus Vaſa*, was among the number of the hoſtages whom Chriſtiern had perfidiouſly carried to Denmark in 1519. Large promiſes had been made in order to reconcile him to Chriſtiern, and all means had been employed, but in vain. Secret orders were given to ſtrangle him in priſon; but the officer to whom the aſſaſſination was committed remonſtrated to the king about the conſequences of it, and prevailed on him to change the ſentence of death into cloſe confinement in the caſtle of Copenhagen. Some of the hoſtages periſhed in conſequence of the rigorous treatment they met with; but Guſtavus withſtood all hardſhips. At laſt one Banner, a Daniſh nobleman, prevailed on the king to put him into his hands, in order to try whether or not he could prevail on him to change his ſentiments. The king, however, told Banner, that he muſt pay 6000 crowns if the priſoner ſhould make his eſcape. Banner generouſly conſented; and having brought the noble priſoner to his fortreſs of Calo in Jutland, ſoon allowed him all the liberty he could deſire, and otherwiſe heaped favours on him. All this, however, could not extinguiſh his remembrance of the cruelties of Chriſtiern, and the deſire he had of being ſerviceable to his country. He therefore determined to make his eſcape; and the liberty he enjoyed ſoon put him in a capacity of effecting it. Having one day mounted his horſe, under pretence of hunting as uſual in the foreſt, when he got at a proper diſtance, he changed his dreſs to the habit of a peaſant: and quitting his horſe, travelled for two days on foot through by-paths, and over mountains almoſt impaſſable, arriving on the third at Flenſburgh. Here no one was admitted without a paſſport: and Guſtavus dreaded preſenting himſelf to the governor or the officer on guard, for fear of being diſcovered. Guſtavus hired himſelf to a cattle merchant; and in this diſguiſe eſcaped out of the Daniſh territories, and arrived at Lubec.

22 Adventures of Guſtavus Vaſa or Ericſon.

23 He eſcapes from Denmark.

24 Arrives at Lubec.

Banner was no ſooner acquainted with his eſcape, than he ſet out after him with the utmoſt diligence, found him at Lubec, and reproached him with great warmth as ungrateful and treacherous; but he was ſoon appeaſed by the arguments urged by Guſtavus, and eſpecially by a promiſe of indemnifying him in the loſs of his ranſom. On this Banner returned, giving out that he could not find his priſoner. Chriſtiern was enraged at his eſcape, apprehending that he might reverſe all his deſigns in Sweden; and gave orders to Otho his general to make the ſtricteſt ſearch, and leave no means untried to arreſt him. Guſtavus applied to the regency for a ſhip to convey him to Sweden, where he hoped he ſhould be able to form a party againſt the Danes. He likewiſe endeavoured to draw the regency of Lubec into his meaſures; and reaſoned with ſo much zeal and ability, that Nicholas Gemins, firſt conſul, was entirely gained; but the regency could never be prevailed on to declare for a party without friends, arms, money, or credit. Before his departure, however, the conſul gave him

25 Attempts in vain to draw the regency of Lubec over to his ſide.

him assurances, that if he could raise a force sufficient to make head against the enemy in the field, he might depend on the services of the republic, and that the regency would immediately declare for him. Gustavus desired to be landed at Stockholm; but the captain of the ship, either having secret orders to the contrary, or business elsewhere, steered a different course, and put him on shore near Calmar; a city then garrisoned by the troops of Christina widow of the regent. In fact, the governor held this place for his own purposes, and only waited to make the best terms he could with the Danes. When Gustavus arrived, he made himself known to him and the principal officers of the garrison, who were mostly Germans, and his fellow-soldiers in the late administrator's army; but the mercenary band, seeing him without troops and without attendants, regarded him as a desperate person devoted to destruction, refused to embrace his proposals, and even threatened to kill or betray him, if he did not instantly quit the city.

26 arrives Calmar, meets with an unfavourable reception.

Disappointed in his expectations, Gustavus departed; and his arrival being now publicly known, he was again forced to have recourse to his peasant's disguise to conceal him from the Danish emissaries dispersed over the country to search for him. In a waggon loaded with hay he passed through the Danish army, and at last repaired to an old family castle in Sudermania. Hence he wrote to his friends, intimating his return to Sweden, and beseeching them to assemble all their forces in order to break through the enemy's army into Stockholm, at that time besieged; but they refused to embark in so hazardous and desperate an attempt.

27 friends advise to assist him.

28 Applies in vain to the peasants.

Gustavus next applied himself to the peasants; but they answered, that they enjoyed salt and herrings under the government of the king of Denmark; and that any attempts to bring about a revolution would be attended with certain ruin, without the prospect of bettering their condition; for peasants they were, and peasants they should remain, whoever was king. At length, after several attempts to throw himself into Stockholm, after that city was surrendered to the king, after the horrid massacre of the senate, and after running a thousand dangers, and undergoing hardships and fatigues scarcely to be supported by human nature, he formed the resolution of trying the courage and affection of the Dalecarlians. While he was in the deepest obscurity, and plunged in almost insurmountable adversity, he never relinquished his designs nor his hopes. The news of the massacre had, however, nearly sunk him into despondency, as by it he lost all his friends, relations, and connections, and indeed almost every prospect of safety to himself or deliverance to his country. This suggested the thought of going to Dalecarlia, where he might live with more security in the high mountains and thick woods of that country, if he should fail in the attempt of exciting the inhabitants to revolt.

29 Arrives in Dalecarlia, disguised as a pedlar, and engaged to work in the mines.

Attended by a peasant, to whom he was known, he travelled in disguise through Sudermania, Nericia, and Westermania, and, after a laborious and painful journey, arrived in the mountains of Dalecarlia. Scarcely had he finished his journey, when he found himself deserted by his companion and guide, who carried off with him all the money which he had provided for his subsistence. Thus forlorn and destitute, he entered among the miners, without relinquishing his hopes of one day ascending the throne of Sweden. His whole object for the present was to live concealed, and gain a maintenance, till fortune should effect something in his favour: nor was it long before this happened. A woman in the mines perceived, under the habit of a peasant, that the collar of his shirt was embroidered. This circumstance excited curiosity; and the graces of his person and conversation, which had something in them to attract the notice of the meanest of the vulgar, afforded room for suspicion that he was some person of quality in disguise, forced by the tyranny of the government to seek shelter in these remote parts. The story came to the ears of a neighbouring gentleman, who immediately went to the mines to offer his protection to the unfortunate stranger; and was astonished on recognizing the features of Gustavus, to whom he had been known at the university of Upsal. Touched with compassion at the deplorable situation of so distinguished a nobleman, he could scarcely refrain from tears. At night he sent for Gustavus, made him an offer of his house, and gave him the strongest assurances of his friendship and protection. He told him, he would there meet with better accommodations, and as much security as in the mines; and that, should he chance to be discovered, he would, with all his friends and vassals, take arms in his defence.

30 Is discovered and relieved.

This offer was embraced by Gustavus with joy, and he remained for some time at his friend's house; but finding it impossible to induce him to take part in his designs, he quitted him, and fled to one Peterson, a gentleman whom he had formerly known in the service. This man received Gustavus with all the appearance of kindness; and, on the very first proposal, offered to raise his vassals. He even named the lords and peasants whom he pretended to have engaged in his service; but in a few days, he went secretly to a Danish officer, and gave him information of what had passed. The officer immediately caused the house to be surrounded with soldiers, in such a manner that it seemed impossible for Gustavus to escape. Being warned, by Peterson's wife of the treachery of her husband, he, by her direction, contrived to flee to the house of a clergyman, her friend, by whom he was received with all the respect due to his birth and merit; and left the domestic who conducted him should follow the treacherous example of his master, he removed him to the church, and conducted him to a small closet, of which he kept the key. Having lived for some time in this manner, Gustavus began to consult with his friend concerning the most proper method of putting their schemes in execution. The priest advised him to apply directly to the peasants themselves; told him that it would be proper to spread a report, that the Danes were to enter Dalecarlia in order to establish new taxes by force of arms; and as the annual feast of all the neighbouring villages was to be held in a few days, he could not have a more favourable opportunity: he also promised to engage the principal persons of the diocese in his interest.

31 Has a very narrow escape from the Danes.

In compliance with this advice, Gustavus set out for Mora, where the feast was to be held. He found the peasants already informed of his designs, and impatient to see him. Being already prepossessed in his favour, they were soon excited to an enthusiasm in his cause,

32 His cause espoused by the peasants of Dalecarlia.

Sweden. and inſtantly reſolved to throw off the Daniſh yoke. In this deſign they were more confirmed by their ſuperſtition; ſome of their old men having obſerved that the wind had blown from the north while Guſtavus was ſpeaking, which among them was reckoned an infallible omen of ſucceſs. Guſtavus did not allow their ardour to cool, but inſtantly led them againſt the governor's caſtle; which he took by aſſault, and put the garriſon to the ſword. This inconſiderable enterpriſe was attended with the moſt happy conſequences. Great numbers of the peaſants flocked to his ſtandard; ſome of the gentry openly eſpouſed his cauſe, and others ſupplied him with money. Chriſtiern was ſoon informed of what had paſſed; but deſpiſing ſuch an inconſiderable enemy, he ſent only a ſlender detachment to

33 The Danes defeated. aſſiſt his adherents in Dalecarlia. Guſtavus advanced with 5000 men, and defeated a body of Danes; but he was ſtrenuouſly oppoſed by the archbiſhop of Upſal, who raiſed numerous forces for Chriſtiern. The fortune of Guſtavus, however, ſtill prevailed, and the archbiſhop was defeated with great loſs. Guſtavus then laid ſiege to Stockholm; but his force being unequal to ſuch an undertaking, he was forced to abandon it with loſs.

This check did not prove in any conſiderable degree detrimental to the affairs of Guſtavus; the peaſants from all parts of the kingdom flocked to his camp, and he was joined by a reinforcement from Lubec. Chriſtiern, unable to ſuppreſs the revolt,

34 Horrid cruelty of King Chriſtiern. wreaked his vengeance on the mother and ſiſters of Guſtavus, whom he put to death. His barbarities ſerved only to make his enemies more reſolute. Guſtavus having aſſembled the ſtates at Wadſtena, he was unanimouſly choſen regent, the diet taking an oath of fidelity to him, and promiſing to aſſiſt him to the utmoſt. Having thus obtained the ſanction of legal authority, he purſued his advantages againſt the Danes. A body of troops appointed to throw ſuccours into Stockholm

35 Succeſs of Guſtavus. were cut in pieces; and the regent ſending ſome troops into Finland, ſtruck the Danes there with ſuch terror, that the archbiſhop of Upſal, together with the Daniſh governors, fled to Denmark. Chriſtiern then ſent expreſs orders to all his governors and officers in Finland and Sweden to maſſacre the Swediſh gentry without diſtinction. The Swedes made repriſals by maſſacring all the Danes they could find; ſo that the whole country was filled with ſlaughter.

In the mean time Guſtavus had laid ſiege to the towns of Calmar, Abo, and Stockholm; but Norby found means to oblige him to raiſe them with loſs. Guſtavus, in revenge, laid ſiege to the capital a third time, and applied to the regency of Lubec for a ſquadron of ſhips and other ſuccours for carrying on the ſiege. This was granted on condition that Guſtavus ſhould oblige himſelf, in the name of the ſtates, to pay 60,000 merks of ſilver as the expence of the armament; that, until the kingdom ſhould be in a condition to pay that ſum, the Lubec merchants trading to Sweden ſhould be exempted from all duties on imports or exports; that all other nations ſhould be prohibited from trading with Sweden, and that ſuch traffic ſhould be deemed illicit; that Guſtavus ſhould neither conclude a peace, nor even agree to a truce, with Denmark, without the concurrence of the regency of Lubec; and that if the republic ſhould be attacked by Chriſtiern, he ſhould enter Denmark at the head of 20,000 men. On theſe hard terms Guſtavus obtained aſſiſtance from the regency of Lubec; nor did his dear-bought allies prove very faithful. They did not indeed go over to the enemy; but in a ſea-fight, where the Danes were entirely in the power of their enemies, they ſuffered them to eſcape, when their whole force might have been entirely deſtroyed. This treachery had nearly ruined the affairs of Guſtavus; for Norby was now making preparations effectually to relieve Stockholm; in which he would probably have ſucceeded: but at this critical period news arrived that the Danes had unanimouſly revolted, and driven Chriſtiern from the throne; and that the king had retired into Germany, in hopes of being reſtored by the arms of his brother-in-law the emperor. On hearing this news, Norby retired with his whole fleet to the iſland of Gothland, leaving but a ſlender garriſon in Calmar. Guſtavus did not fail to improve this opportunity to his own advantage, and quickly made himſelf maſter of Calmar. Mean time Stockholm continued cloſely inveſted; but Guſtavus thought proper to protract the ſiege till he ſhould get himſelf elected king. Having for this purpoſe called a general diet, he firſt filled up the vacancy in the ſenate occaſioned by the maſſacres of Chriſtiern. Guſtavus had the addreſs to get ſuch nominated as were in his intereſt. The aſſembly was no ſooner met, than a ſpeech was made,

36 He is choſen king of Sweden. An. 1523 containing the higheſt encomiums on Guſtavus, ſetting forth in the ſtrongeſt light the many eminent ſervices he had done for his country, and concluded that the ſtates would ſhow themſelves equally ungrateful and blind to their own intereſt if they did not immediately elect him king. This propoſal was acceded to by ſuch tumultuous acclamations that it was impoſſible to collect the votes; ſo that Guſtavus himſelf acknowledged, that their affection exceed his merit, and was more agreeable to him than the effects of their gratitude. He was urged to have the ceremony of his coronation immediately performed: but this he delayed, in conſequence of ſome deſigns which he had formed to reduce the exorbitant power of the clergy. Guſtavus had himſelf embraced the doctrines of the reformed religion, and did all in his power to eſtabliſh the reformation in his new kingdom. His deſign could not fail to raiſe againſt him the enmity of the clergy, and of all the more ſuperſtitious part of his ſubjects. Accordingly, the firſt years of his reign were embittered by internal diſturbances and revolts, which were aided and fomented by the depoſed Chriſtiern, who was at one time very near regaining poſſeſſion of the Swediſh dominions.

37 Unſucceſsful attempt of Chriſtiern. Chriſtiern having eſtabliſhed a powerful intereſt in Norway, once more made an attempt to recover his kingdoms, and was joined by the Dalecarlians; but being defeated by the Swediſh forces, he was forced to return to Norway, where, being obliged to capitulate with the Daniſh generals, he was kept priſoner all his life.

38 Unſucceſsful negotiation for a marriage with Queen Elizabeth. An. 1542 In 1542, Guſtavus having happily extricated himſelf out of all his troubles, prevailed on the ſtates to make the crown hereditary in his family; after which he applied himſelf to the encouragement of learning and commerce. A treaty was ſet on foot for a marriage between his eldeſt ſon Eric and Elizabeth queen of England; but this negociation failed of ſucceſs.

Guſtavus Vaſa died in 1560, and was ſucceeded by his

his ſon Eric XIV. The new king was poſſeſſed of all the exterior ornaments which give an air of dignity to the perſon; but he had neither the prudence nor the penetration of his father. He created the firſt nobility that were ever known in Sweden; but this he had no ſooner done than he quarrelled with them, by paſſing ſome act, which they thought derogatory to their honour and dignity. The whole courſe of his reign was diſturbed by wars with Denmark, and diſputes with his own ſubjects. In the former he was unfortunate, and towards the latter he behaved with the greateſt cruelty. At laſt, he is ſaid to have become mad. He afterwards recovered his ſenſes, but was ſoon dethroned by his brothers: of whom Duke John ſucceeded him in the kingdom.

This revolution took place in the year 1568, but with no great advantage to Sweden. Diſputes about religion between the king and his brothers, and wars with Ruſſia, threw matters into the utmoſt confuſion. At laſt Prince Sigiſmund, the king's ſon, was choſen king of Poland, which proved the ſource of much trouble to the kingdom. In 1590 King John died; and as Sigiſmund was at a diſtance, every thing fell into the utmoſt confuſion: the treaſury was plundered, and the royal wardrobe quite ſpoiled, before even Duke Charles could come to Stockholm to take on himſelf the adminiſtration until King Sigiſmund ſhould return. This, however, was far from being the greateſt diſaſter which befel the nation at this time. It was known that the king had embraced the Popiſh religion, and it was with good reaſon ſuſpected that he would attempt to reſtore it upon his arrival in Sweden. Sigiſmund was alſo obliged, on leaving Poland, to promiſe that he would ſtay no longer in Sweden than was neceſſary to regulate his affairs. Theſe circumſtances ſerved to alienate the minds of the Swedes from their ſovereign even before they ſaw him; and the univerſal diſſatisfaction was increaſed, by ſeeing him attended, on his arrival in Sweden in 1593, by the pope's nuncio, to whom he made a preſent of 30,000 ducats to defray the expences of his journey to Sweden.

What the people had foreſeen was too well verified: the king refuſed to confirm the Proteſtants in their religious privileges, and ſhowed ſuch partiality on all occaſions to the Papiſts, that a party was formed againſt him; at the head of which was Duke Charles his uncle. Remonſtrances, accompanied with threats, took place on both ſides. Sigiſmund was apparently reconciled to his brother, and promiſed to comply with the inclinations of the people, though without any inclination to perform what he had promiſed. The agreement, indeed, was ſcarcely made, before Sigiſmund conceived the horrid deſign of murdering his uncle at the Italian comedy acted the night after his coronation. The duke, however, having notice of the plot, found means to avoid it. This enraged the king ſo much, that he had reſolved to accompliſh his deſigns by force; and therefore commanded a Poliſh army to march towards the frontiers of Sweden, where they committed all the ravages that could be expected from an enraged and cruel enemy. Complaints were made by the Proteſtant clergy to the ſenate: but no other reply was made them, than that they ſhould abſtain from thoſe bitter invectives and reproaches, which had provoked the Catholics, till the king's departure; at which time they would be at more liberty.

Sweden.

In 1595 Sigiſmund ſet ſail for Dantzic, leaving the adminiſtration in the hands of Duke Charles. The conſequence of this was, that the diſſenſions which had already taken place being continually increaſed by the obſtinacy of the king, Duke Charles aſſumed the ſovereign power; and in 1604 Sigiſmund was formally depoſed, and his uncle Charles IX. raiſed to the throne. He proved a wiſe and brave prince, reſtoring the tranquillity of the kingdom, and carrying on a war with vigour againſt Poland and Denmark. He died in 1611, leaving the kingdom to his ſon, the celebrated Guſtavus Adolphus.

45 Sigiſmund depoſed, and is ſucceeded by Charles IX. An. 1604.

Though Charles IX. by his wiſe and vigorous conduct had in a great meaſure retrieved the affairs of Sweden, they were ſtill in a very bad ſituation. The finances of the kingdom were entirely drained by a ſeries of wars and revolutions; powerful armies were preparing in Denmark, Poland, and Ruſſia, while not only the Swediſh troops were inferior in number to their enemies, but the government was deſtitute of reſources for their payment.

46 State of Sweden on the acceſſion of Guſtavus Adolphus. An. 1611.

Though the Swediſh laws required that the prince ſhould have attained his 18th year before he was of age, yet ſuch ſtriking marks of the great qualities of Guſtavus appeared, that he was allowed by the ſtates to take on him the adminiſtration even before this early period. His firſt act was to reſume all the crown-grants, that he might be the better able to carry on the wars in which he was engaged; and to fill all places, both civil and military, with perſons of merit. At the head of domeſtic and foreign affairs was placed Chancellor Oxenſtiern, a perſon every way equal to the important truſt, and the chooſing of whom impreſſed Europe with the higheſt opinion of the young monarch's penetration and capacity.

47 He is allowed to aſſume the adminiſtration while yet a minor.

Soon after his acceſſion, Guſtavus received an embaſſy from James I. of Britain, exhorting him to make peace with his neighbours. This was ſeconded by another from Holland. But as the king perceived that the Daniſh monarch intended to take every opportunity of cruſhing him, he reſolved to act with ſuch vigour, as might convince him that he was not eaſily to be overcome. Accordingly he invaded Denmark with three different armies at once; and though the enemy's ſuperiority at ſea gave them great advantages, and the number of the king's enemies diſtracted his attention, he carried on the war with ſuch ſpirit, that in 1613 a peace was concluded on good terms. This war being finiſhed, the king applied himſelf to civil polity, and made ſome reformation in the laws of Sweden. In 1615, hoſtilities were commenced againſt Ruſſia, on account of the refuſal of that court to reſtore ſome money which had been formerly lent them. The king entered Ingria, took Kexholm by ſtorm, and was laying ſiege to Pleſcov, when, by the mediation of James I. peace was concluded, on condition of the Ruſſians repaying the money, and yielding to Sweden ſome part of their territory. In this and the former war, notwithſtanding the ſhortneſs of their duration, Guſtavus learned the rudiments of the military art for which he ſoon became ſo famous. He is ſaid, indeed, to have taken every opportunity of improvement with a quickneſs of underſtanding ſeemingly more than human. In one campaign, he not only learned, but improved, all the military maxims of La Gardie, a celebrated general, brought the Swediſh army to a more ſteady and regular diſcipline, and formed an invincible

48 He invades Denmark, and obliges the king to conclude a peace.

49 Ruſſia invaded with ſucceſs.

50 Extraordinary military genius of the king.

Sweden.

invincible body of Finlanders, who had afterwards a very conſiderable ſhare in the victories of Sweden.

Peace was no ſooner concluded with Ruſſia, than Guſtavus was crowned with great ſolemnity at Upſal. Soon after this he ordered his general La Gardie to acquaint the Poliſh commander Codekowitz, that as the truce between the two kingdoms, which had been concluded for two years, was now expired, he deſired to be certainly informed whether he was to expect peace or war from his maſter. In the mean time, having borrowed money of the Dutch for the redemption of a town from Denmark, he had an interview on the frontiers with Chriſtiern the king of that country. At this interview, the two monarchs conceived the utmoſt eſteem and friendſhip for each other; and Guſtavus obtained a promiſe, that Chriſtiern would not aſſiſt Sigiſmund in any deſign he might have againſt Sweden. In the mean time, receiving no ſatisfactory anſwer from Poland, Guſtavus began to prepare for war. Sigiſmund entered into a negociation, and made ſome pretended conceſſions, with a view to ſeize Guſtavus by treachery; but the latter having intimation of his deſign, the whole negociation was changed into reproaches and threats on the part of Guſtavus.

51 Has a friendly interview with the king of Denmark, and prepares for war with Poland.

52 Marries Eleonora, daughter of the elector of Brandenburg.

Immediately after this, Guſtavus made a tour in diſguiſe through Germany, and married Eleonora the daughter of the elector of Brandenburg. He then reſolved to enter heartily into a war with Poland; and with this view ſet ſail for Riga with a great fleet, which carried 20,000 men. The place was well fortified, and defended by a body of veterans enthuſiaſtically attached to Sigiſmund; but after a vigorous ſiege, the garriſon being reduced to extremity, were obliged to capitulate, and were treated with great clemency.

53 Riga beſieged and taken.

After the reduction of Riga, the Swediſh monarch entered Courland, where he reduced Mittau; but ceded it again on the concluſion of a truce for one year. Sigiſmund, however, no ſooner had time to recover himſelf, than he began to form new enterpriſes againſt the Swedes in Pruſſia; but Guſtavus ſetting ſail with his whole fleet for Dantzic, where the king of Poland then reſided, ſo defeated his meaſures, that he was obliged to prolong the truce for another year. Sigiſmund, however, was not yet appriſed of his danger, and refuſed to liſten to any terms of accommodation: on which Guſtavus entering Livonia, defeated the Poliſh general, and took Derpt, Hockenhauſen, and ſeveral other places of leſs importance; after which, entering Lithuania, he took the city of Birſen.

54 The Poles defeated, and ſeveral places taken.

Notwithſtanding this ſucceſs, Guſtavus propoſed peace on the ſame equitable terms as before; but Sigiſmund was ſtill infatuated with the hopes that, by means of the emperor of Germany, he ſhould be able to conquer Sweden. Guſtavus finding him inflexible, reſolved to puſh his good fortune. His generals Horn and Thurn defeated the Poles in Semigallia. Guſtavus himſelf with 150 ſhips ſet ſail for Pruſſia, where he landed at Pillaw. This place was immediately delivered up to him; as were ſeveral other places. Sigiſmund, alarmed at the great progreſs of Guſtavus, ſent a body of forces to oppoſe him, and to prevent Dantzic from falling into his hands. In this he was attended with as little ſucceſs as before; and in May 1627, Guſtavus arrived with freſh forces before Dantzic, which he would probably have carried, had he not been wounded in the belly by a cannon-ſhot. The States of Holland ſent ambaſſadors to mediate a peace between the two crowns; but Sigiſmund, depending on the aſſiſtance of the emperor of Germany and king of Spain, determined to hearken to no terms, and reſolved to make a winter campaign. Guſtavus, however, was ſo well intrenched, and all his forts were ſo ſtrongly garriſoned, that the utmoſt efforts of the Poles were to no purpoſe. The city of Dantzic in the mean time made ſuch a deſperate reſiſtance as greatly irritated Guſtavus. In a ſea engagement the Swediſh fleet defeated that of the enemy; after which Guſtavus, having blocked up the harbour with his fleet, puſhed his advances on the land ſide with incredible vigour. He made a ſurpriſing march over a moraſs 15 miles broad, aſſiſted by bridges of a peculiar conſtruction, over which he carried a ſpecies of light cannon invented by himſelf. By this unexpected manœuvre he got the command of the city in ſuch a manner, that the garriſon were on the point of ſurrendering, when, by a ſudden ſwell of the Viſtula, the Swediſh works were ruined, and the king was obliged to raiſe the ſiege. In other reſpects, however, the affairs of Guſtavus went on with their uſual good fortune. His general Wrangel defeated the Poles before Brodnitz. At Stum the king gained another and more conſiderable victory in perſon. The emperor had ſent 5000 foot and 2000 horſe under Arnheim, who joined the main army commanded by the Poliſh general Coniecſpolſki, in order to attack the Swediſh army encamped at Quidzin. The enemy were ſo much ſuperior in number, that the friends of Guſtavus warmly diſſuaded him from attacking them. But the king being determined, the engagement began. The Swediſh cavalry charged with ſuch impetuoſity, contrary to their ſovereign's expreſs order, that they were almoſt ſurrounded by the enemy; but Guſtavus, coming up to their aſſiſtance, puſhed the enemy's infantry with ſo much vigour, that they gave way, and retreated to a bridge that had been thrown over the Werder. But here they were diſappointed; for the Swedes had already taken poſſeſſion of the bridge. On this a new action enſued more bloody than the former, in which the king was expoſed to great danger, and thrice narrowly eſcaped being taken priſoner; but at laſt the Poles were totally defeated, with immenſe loſs. The ſlaughter of the German auxiliaries was ſo great, that Arnheim ſcarcely carried off one half of the troops which he brought into the field. This defeat did not hinder the Poliſh general from attempting the ſiege of Stum; but here again he was attended by his uſual bad fortune. Arnheim was recalled, and ſucceeded by Henry of Saxe Lawenburg and Philip Count Mansfeldt. The change of general officers, however, produced no good conſequences to the Poles; a famine and plague raged in their camp, ſo that they were at laſt obliged to conſent to a truce for ſix years, to expire in the month of June 1635. Guſtavus kept the port and citadel of Memel, the harbour of Pillan, the town of Elbing, Brunſberg, and all that he had conquered in Livonia.

Sweden.

56 The Poles defeated third time An. 162

57 The Poles defeated by ſea, at Dantzic inveſted.

58 The king obliged to an inundation of the Viſtula to raiſe the ſiege.

59 The Poles and Germans defeated with great ſlaughter in two engagements.

60 They are again defeated, and obliged to conſent to a truce of ſix years.

Guſtavus having thus brought the war with Poland to an honourable concluſion, began to think of reſenting the conduct of the emperor in aſſiſting his enemies and oppreſſing the Proteſtant ſtates. Before embarking in ſuch an important undertaking, it was neceſſary that he ſhould conſult the diet. In this the propriety of engaging

61 Guſtavus reſolves on a war with the emperor.

ging in a war with Germany was warmly debated; but, after much altercation, Guſtavus in a very noble ſpeech determined the matter, and ſet forth in ſuch ſtrong terms the virtuous motives by which he was actuated, that the whole aſſembly wept, and every thing was granted which he could require.

It was not difficult for Guſtavus to begin his expedition. His troops amounted to 60,000 men, hardened by a ſucceſſion of ſevere campaigns in Ruſſia, Finland, Livonia, and Pruſſia. His fleet exceeded 70 ſail, carrying from 20 to 40 guns, and manned with 6000 ſeamen. Embarking his troops, he landed at Uſedom on the 24th of June 1630, the Imperialiſts having evacuated all the fortreſſes which they poſſeſſed there; and the iſle of Rugen had been before reduced by General Leſly, in order to ſecure a retreat if fortune ſhould prove unfavourable. Paſſing the frith, Guſtavus ſtormed Wolgaſt and another ſtrong fortreſs in the neighbourhood, leaving a garriſon for the defence of theſe conqueſts. He then proceeded to Stetin; which conſented to receive a Swediſh garriſon, and the king perſuaded the duke of Pomerania to enter into an alliance with him. In conſequence of this the Swediſh troops were received into ſeveral towns of Pomerania; and the moſt bitter enmity took place between the Imperialiſts and Pomeranians.

Theſe ſucceſſes of Guſtavus ſtruck the empire with conſternation; for being already overwhelmed with civil diſſenſions, they were in no condition to reſiſt ſo impetuous an enemy. At laſt Count Tilly was inveſted with the dignity of veldt mariſchal. In the mean time the king being reinforced by a conſiderable body of troops in Finland and Livonia under the conduct of Guſtavus Horn, defeated the Imperialiſts before Griffenhagen; taking the place ſoon after by aſſault. By this and ſome other conqueſts he opened a paſſage into Luſatia and Sileſia; but in the mean time Count Tilly cut off 2000 Swedes at New Brandenburg. This advantage, however, was ſoon overbalanced by the conqueſt of Franckfort on the Oder, which Guſtavus took by aſſault, making the whole garriſon priſoners. Thus he commanded the rivers Elbe and Oder on both ſides, and had a fair paſſage not only to the countries already mentioned, but alſo to Saxony and the hereditary dominions of the houſe of Auſtria. Soon after this, Guſtavus laid ſiege to Landſberg, which he took by aſſault.

About this time the Proteſtant princes held a diet at Leipſic; to which Guſtavus ſent deputies, and conducted his negociations with ſuch addreſs, as tended greatly to promote his intereſts. Immediately after this he reduced Gripſwald, and with it all Pomerania. Then marching to Guſtrow, he reſtored the dukes of Mecklenburg to their dominions.

All this time Count Tilly was employed in the ſiege of Magdeburg; but now, being alarmed at the repeated ſucceſſes of the Swedes, he left Pappenheim with part of the army before that city, while he marched with the reſt into Thuringia, to attack the landgrave of Heſſe-Caſſel and the elector of Saxony. After a moſt obſtinate defence, Magdeburg fell into the hands of Pappenheim, who committed there all imaginable cruelties. Guſtavus formed a plan of recovering the city; but was obliged to abandon it, by Pappenheim's throwing himſelf into the place with his whole army, and by the progreſs which Tilly was making in Thuringia. Relinquiſhing this enterpriſe, therefore, he ordered an attack on Havelſburg; which was done with ſuch reſolution, that the place was forced in a few hours, and all the garriſon made priſoners. Werben was next obliged to ſubmit after an obſtinate conflict, in which many fell on both ſides.—Theſe ſucceſſes obliged Count Tilly to attempt in perſon to check the progreſs of the Swedes. He detached the vanguard of his army, compoſed of the flower of the Imperial cavalry, within a few miles of the Swediſh camp. An action enſued, in which Bernſtein the Imperial general was defeated and killed, with 1500 of his men. Guſtavus, after this advantage, placed himſelf in a ſituation ſo much ſuperior to his enemies, that Count Tilly was fired with indignation, and marched up to the Swediſh lines to give him battle. Guſtavus kept within his works, and Tilly attacked his camp, though almoſt impregnably fortified, keeping up a moſt terrible fire from a battery of 32 pieces of cannon; which, however, produced no other effect, than obliging the Swediſh monarch to draw up his army behind the walls of Werben. Tilly had placed his chief hopes in being able to ſpike the enemy's cannon, or ſet fire to their camp; after which he propoſed making his grand attack. With this view he bribed ſome priſoners; but they betrayed him, and told his deſign to Guſtavus. The king ordered fires to be lighted in different parts of his camp, and his ſoldiers to imitate the noiſe of a tumultuous diſorderly rabble. This had the deſired effect. The count led his army to the breach made by the cannon; where he was received with ſuch a volley of grape ſhot as cut off the firſt line, and put the whole body in diſorder, ſo that they could never be brought back to the charge. In this confuſion the Imperial army was attacked, and, after an obſtinate conflict, obliged to quit the field.

Soon after this action the queen arrived at the camp with a reinforcement of 8000 men; at the ſame time a treaty was concluded with Charles I. of England, by which that monarch allowed the marquis of Hamilton to raiſe 6000 men for the ſervice of Guſtavus. Theſe auxiliaries were to be conducted to the main army by a body of 4000 Swedes; and were in every thing to obey the king while he was perſonally preſent, but in his abſence were to be ſubject to the orders of the marquis. With theſe troops the king had reſolved to make a diverſion in Bremen: but the marquis finding it impoſſible to effect a junction with the Swediſh army, reſolved, without debarking his troops, to ſteer his courſe for the Oder, and land at Uſedom. Guſtavus was very much diſpleaſed at finding his project thus diſconcerted; but, making the beſt of the preſent circumſtances, he commanded the Britiſh troops to act on the Oder inſtead of the Weſer. The number of this little army was magnified exceedingly by report, inſomuch that Count Tilly had ſome thoughts of marching againſt them with his whole force; but on the departure of the marquis for Sileſia, he reinforced the army in that country with a large detachment, which was thought to contribute not a little to the defeat he ſoon after received.

Since the late action Guſtavus had kept within his intrenchments, where his army was well provided with every thing. Tilly made ſeveral attempts to ſurpriſe or draw him to an engagement; but finding all his endeavours fruitleſs, he marched into Saxony, and laid ſiege

Sweden.

68 Havelſburg and Werben reduced, and the cavalry of the Imperialiſts defeated by the Swedes.

69 Count Tilly defeated by Guſtavus.

70 A body of Britiſh ſoldiers comes to the aſſiſtance of the Swedes.

to

Sweden.

to Leipſic. This precipitate meaſure proved highly advantageous to the Swediſh monarch. A treaty offenſive and defenſive was immediately concluded with Guſtavus: and the elector willingly promiſed every thing that was required of him. Tilly, in the mean time, carried fire and ſword into the electorate. At the head of an army of 44,000 veterans, he ſummoned the city of Leipſic to ſurrender; denouncing the ſame vengeance againſt it as had been executed on Magdeburg, in caſe of a refuſal. By this the governor was ſo much intimidated, that he inſtantly ſubmitted; and alſo ſurrendered the caſtle of Paſſenberg, which was in a condition to have ſtood out till the arrival of the Swediſh army. The elector, enraged at the loſs of theſe valuable places, ordered his army to join the Swedes with all expedition, and preſſed the king ſo warmly to engage, that at laſt he yielded to his deſire. On the 7th of September 1631, Guſtavus led out his army in the fineſt order, the Swedes forming one column on the right, and the Saxons another on the left; each amounting to 15,000 men. Tilly drew up his men in one vaſt column, probably with a view of ſurrounding the flanks of the king's army. Guſtavus led on his troops againſt that wing of the Imperialiſts commanded by Pappenheim, whom he drove back to a conſiderable diſtance. General Bannier in the mean time cut in pieces the troops of Holſtein, and mortally wounded the duke who commanded them. Pappenheim led on his troops ſeven times to the charge, but was as often repulſed by the Swedes. Tilly all this while was engaged with the Saxons; but having at laſt driven them off the field, the whole ſtrength of the Imperial army was turned againſt the Swediſh left wing. The Swedes ſuſtained the attack with the greateſt firmneſs, until the king detached the centre to aſſiſt them. The Imperialiſts then were no longer able to ſtand their ground; but gave way everywhere except in the centre, which was compoſed of 18 regiments of veterans accuſtomed to victory, and deemed invincible. They made incredible efforts to maintain their reputation; and, though ſwept off in great numbers by the Swediſh artillery, never ſhrunk or fell into confuſion. Four regiments, after their officers had been killed, formed themſelves, and retired to the ſkirt of a wood. Tilly retired at the head of 600 men, and eſcaped by the coming on of the night. Seven thouſand Imperialiſts lay dead on the field of battle; 4000 were taken priſoners; a fine train of artillery was loſt, with upwards of 100 ſtandards, enſigns, and other military trophies.

71 Saxony ravaged by Count Tilly, who takes Leipſic.

72 Battle of Leipſic. An. 1631.

73 The Imperialiſts defeated with great ſlaughter.

74 Conduct of Guſtavus cenſured.

Guſtavus now determined to penetrate into Franconia, where he reduced ſeveral places, eſpecially the fortreſs of Workburg. Tilly having collected his ſcattered troops, which formed an army ſtill ſuperior in number to that of Guſtavus, marched to the relief of this place; but came too late. He then directed his march towards Rottenberg, where four regiments were cut in pieces by a Swediſh detachment. After this the king reduced Hanau, Franckfort on the Maine, and Mentz; deſtroying a body of Spaniards, who had attempted to obſtruct his paſſage.

75 The Swedes take a number of towns, and cut off four regiments of the enemy.

The court of Vienna was now thrown into the utmoſt confuſion; and ſent everywhere begging aſſiſtance, and ſoliciting the Catholic princes to arm in defence of their religion. The emperor was moſt embarraſſed in finding out a general capable of oppoſing Guſtavus in the field; for the late misfortunes of Count Tilly had entirely ſunk his reputation. Walleſtein, an old experienced officer, was elected; but as he had formerly been diſgraced, it was apprehended that he would not accept of the command of which he had once been deprived. This objection, however, was got over; and Walleſtein not only accepted of the command, but, at his own expence, augmented the army to 40,000 men.

Sweden.

76 Walleſtein choſen general by the emperor.

77 A great number of towns taken by the Swedes.

During the whole winter the Swediſh army kept the field; and before the approach of ſummer had reduced a great number of places, while the landgrave William made great progreſs in Weſtphalia. Guſtavus Horn was repulſed before Bamberg; but ſoon had his revenge, by entirely deſtroying two regiments of Imperialiſts. To prevent the troops from being affected by the loſs before Bamberg, the king reſolved to give battle to Tilly, who was marching into Bavaria to prevent the Swedes from gaining a footing in that electorate. He purſued the Imperial general through a vaſt tract of country, defeated his rear-guard, and, having reduced a variety of towns and fortreſſes on the Danube, penetrated as far as Ulm. Advancing to the river Lech, Count Tilly poſted himſelf in a wood on the oppoſite ſide, to diſpute his paſſage. Guſtavus endeavoured to diſlodge him by a regular fire from 70 pieces of cannon. The ſlaughter was dreadful; and Tilly himſelf, being wounded by a cannon ball in the knee, died a few days before he was to have been ſuperſeded by Walleſtein. The following night the Imperial army evacuated the poſt. Guſtavus immediately croſſed the river, and ſeized the towns of Rain and Newburg, which the enemy had abandoned, and Augſburg next ſubmitted.

78 Count Tilly defeated and killed.

From Augſburg the Swedes advanced towards Ratiſbon; but were diſappointed in their deſign of getting poſſeſſion of that city, as the Bavarians had thrown a numerous garriſon into the place.—In the mean time, ambaſſadors arrived from Denmark, offering the mediation of that crown for obtaining a laſting peace between the contending parties. This negociation, however, failed of ſucceſs, as the ambaſſadors had not been inſtructed to offer terms favourable to the Proteſtants. Guſtavus now, reſolving to retort on themſelves the cruelties which the Bavarians had inflicted on the Proteſtants, laid the towns of Morzbourg, Frieſengen, and Landſhut, in aſhes. The inhabitants of Munich ſaved themſelves by ſubmiſſion; Guſtavus alſo defeated the forces of the elector, who had been joined by a conſiderable body of militia.

79 Three towns laid in aſhes by the Swedes.

While Guſtavus was thus employed, Walleſtein had aſſembled a vaſt army. He was ſtrongly ſolicited by the elector of Bavaria to come to his aſſiſtance; but, in revenge of the elector's having formerly obtained the command for Count Tilly in preference to himſelf, he drew off towards Bohemia to encounter the Saxons. Arnheim, who commanded the Saxon forces in that place, was an enemy to Guſtavus, who had formerly rallied him for his cowardice. He therefore permitted Walleſtein to gain an eaſy victory, in hopes that his maſter, the elector of Saxony, a prince entirely devoted to his pleaſures, might be induced to relinquiſh the friendſhip of ſuch a reſtleſs and warlike ally as Guſtavus; and indeed he uſed all the eloquence of which he was maſter to detach him from the Swediſh cauſe. Several advantages in the mean time, were gained by the Imperialiſts. Pappenheim defeated the archbiſhop of Bremen's cavalry at Werden; and three Swediſh regiments were

80 The Saxon troops defeated by Walleſtein.

weden.

were cut off near Kadingen. Pappenheim, however, was forced to retire, and withdraw his forces from Stade; of which the Swedes took poſſeſſion. Walleſtein and the elector of Bavaria, who had now joined their forces, threatened Guſtavus with greatly ſuperior numbers. At laſt, however, the king, being reinforced with 15,000 men, no longer declined the engagement; but Walleſtein was too wiſe to truſt the fate of the empire to a ſingle battle againſt ſuch an enemy as the king of Sweden. Guſtavus attacked his camp, but was repulſed with the loſs of 2000 men. Several other misfortunes happened to the Swedes; and at laſt, after various manœuvres, Walleſtein bent his courſe towards Miſnia, in order to oblige the elector of Saxony to declare againſt the Swedes, and to draw them out of Bavaria. Guſtavus, notwithſtanding the inconſtancy of Auguſtus, immediately ſet out to aſſiſt him. With incredible diligence he marched to Miſnia, where the Imperialiſts were aſſembling their whole ſtrength. Hearing that the enemy were encamped at Weſenfells, and that Pappenheim had been detached with a ſtrong corps, Guſtavus reſolved to engage them before they could effect a junction. With this view he marched to Lutzen, where he attacked Walleſtein with incredible fury. The Swediſh infantry broke the Imperialiſts in ſpite of their utmoſt efforts, and took all their artillery. The cavalry not being able to paſs the river ſo expeditiouſly as the king thought neceſſary, he led the way, attended only by a ſingle regiment and the duke of Saxe-Lauwenburg. Here, after charging impetuouſly, he was killed. The news of his death was in an inſtant ſpread over both armies. The courage of the Imperialiſts revived, and they now made themſelves ſure of victory. But the Swedes, eager to revenge the death of their beloved monarch, charged with ſuch fury that nothing could reſiſt them. The Imperialiſts were defeated a ſecond time, juſt as Pappenheim, with his freſh corps, came up to their aſſiſtance. On this the battle was renewed, but the Swedes were ſtill irreſiſtible. Pappenheim was mortally wounded, and his army finally routed, with the loſs of 9000 killed in the field and in the purſuit.

81 ſtavus acks his np, and epulſed th loſs.

82 ttle of ıtzen.

83 ıſtavus lled.

84 ne Impe- dliſts to- lly de- ated.

85 ariſtina, infant, oclaimed ueen of veden.

This victory proved more unfortunate to Sweden than the greateſt defeat. The crown devolved on Chriſtina the daughter of Guſtavus, an infant of ſix years old; the nation was engaged in an expenſive foreign war, without any perſon equal to the arduous taſk of commanding the armies, or regulating domeſtic affairs, as Guſtavus had done. Chriſtina was immediately proclaimed queen. The regency devolved on the grand bailiff, the mariſchal, the high admiral, the chancellor, and the treaſurer of the crown. Oxenſtiern was inveſted with the chief management of affairs, and conducted himſelf with the greateſt prudence. The reign and character of Chriſtina have been fully detailed under the article CHRISTINA, to which we may refer our readers.

86 harles uſtavus ppointed ir to the own of veden.

From the treaty of Weſtphalia, Sweden enjoyed ſome years of repoſe. Charles Guſtavus, Count Palatine, having gained the favour of Chriſtina, was appointed generaliſſimo of the forces, and heir-apparent to the crown. A marriage was propoſed between them; but the queen would never liſten to this or any other propoſal of the kind. In 1650, the ceremony of the queen's coronation was performed; but in four years after, ſhe reſigned the crown in favour of Guſtavus. (See the article CHRISTINA).

An. 1654.

Sweden.

87 State of Sweden on the acceſſion of Charles X.

The new king found himſelf involved in conſiderable difficulties on his acceſſion to the throne. The treaſury was quite exhauſted; great part of the revenue was appointed for the ſupport of Chriſtina's houſehold; the people were oppreſſed with taxes; and the nation having been diſarmed for ſeveral years, began to loſe its reputation among foreigners. To remedy theſe evils, Charles propoſed to reſume all the crown-lands which had been alienated by grants to favourites during the late reign; to repeal a duty which had been laid on ſalt; to put the kingdom in a poſture of defence; and to enter on a war with ſome neighbouring ſtate. Under a pretence that Caſimir king of Poland had queſtioned his title to the throne, he prepared to invade that kingdom. Several embaſſies were ſent from Poland to Stockholm; but ſome point of ceremony always diſappointed them of an audience of the king; ſo that they were obliged to return without their errand. As ſoon as matters were in readineſs, General Wittemberg made an irruption into Poland from the ſide of Pomerania. The Poles oppoſed him with an army of 15,000 men; but inſtead of fighting, they began to negociate, and in a ſhort time entirely diſperſed. Charles himſelf ſoon followed with a powerful army, and purſued his march without obſtruction, all the cities throwing open their gates to him as he approached. As he advanced to Cracow, Caſimir reſolved to make one effort to ſave his capital. His army amounted only to 10,000 men; and theſe were unfortunately ſuch as had never ſtood fire. After a feeble reſiſtance, they fled with precipitation, having loſt 1000 men killed and taken priſoners. A few days after this Charles defeated the Poles a ſecond time, about eight leagues from Cracow; on which Caſimir fled with his family to Oppelen in Sileſia. The capital was then inveſted; and though defended with the utmoſt valour, was in a ſhort time obliged to capitulate. Thus in leſs than three months Charles apparently became maſter of Poland; but it was ſoon evident that the Poles had no intention of abandoning their former ſovereign.

88 War with Poland reſolved on.

89 The Poles defeated, and the kingdom reduced.

In 1656, a war took place with the elector of Brandenburg. While Charles was employed in the conqueſt of Poland, that prince had invaded Royal and Ducal Pruſſia, and reduced the moſt conſiderable towns with little oppoſition. The king of Sweden took umbrage at his progreſs; and having marched againſt him, defeated his forces in ſeveral ſlight encounters, and obliged him to acknowledge himſelf a vaſſal of Sweden. Theſe rapid conqueſts alarmed all Europe; and the different powers ſought for means of driving the Swedes out of Poland, which they had ſo unexpectedly and unjuſtly ſeized. The Poles were no ſooner aſſured that they ſhould be aſſiſted, than they everywhere revolted and maſſacred the Swedes. Caſimir returned from Sileſia; and thoſe very troops and generals who had before ſubmitted to Charles without oppoſition, now ranged themſelves under the banners of his antagoniſt. Charles immediately marched from Pruſſia to chaſtiſe the inſolence of the Poles, and totally defeated a body of 12,000 men. This did not hinder all the Poles incorporated with his troops to deſert; which conſiderably reduced his army; and the campaign being performed in the depth of winter, he was at laſt obliged to retreat to Pruſſia. In his march he was haraſſed by the Poles; and a body of 4000 Swedes was ſurpriſed and defeated by them at Warka. This loſs, however, was ſoon after

90 War with the elector of Brandenburg. An. 1656.

91 The Poles revolt.

92 Charles gains a victory, but is obliged to retire.

Sweden.

recompenſed by a complete victory gained by Adolphus the king's brother and General Wrangel. In the mean time the king was taking meaſures for laying ſiege to Dantzic; but was prevented by the Dutch, who threatened to oppoſe him, unleſs a proper regard was paid to their intereſt. Charles accordingly granted them advantageous terms; and afterwards gained over the elector of Brandenburg, by ceding to him the ſovereignty of Pruſſia, that he might be at liberty to turn his whole ſtrength againſt Poland.

93 Concludes a treaty with the Dutch and the elector of Brandenburg.

By the treaty juſt concluded with the elector, the latter was to aſſiſt Charles in his war with Poland; but the elector had ſo procraſtinated matters, that the Poles, having obtained aſſiſtance from the Tartars, had reduced the city of Warſaw. The two princes, however, now marched in concert againſt their enemies, who were encamped in a ſtrong ſituation in the neighbourhood of the city above mentioned, their camp being fronted by the Viſtula. The Poles were driven from their entrenchments with prodigious ſlaughter. The Poles and Tartars then laboured to break the alliance; with which view they entered Ducal Pruſſia, and defeated the electoral army, taking many priſoners. The Swedes ſoon had their revenge. General Steinboek attacked the ſame Poliſh army at Philippowa, and overthrew it with ſuch ſlaughter as obliged the Poles for that ſeaſon to quit the field. A more formidable enemy than the Poles now began to make their appearance. The Ruſſians invaded the provinces of Carelia, Ingermania, and Livonia; while the elector of Brandenburg began to waver in his fidelity. To preſerve this only ally at ſuch a critical juncture, Charles was obliged to give him more advantageous terms than thoſe already mentioned; while the Ruſſians were repulſed in the provinces of Carelia and Ingermania. But in Livonia they had better ſucceſs. See RUSSIA. For ſeven months, however, they battered the walls of Riga, without venturing to paſs the ditch or ſtorm the practicable breaches.

94 The Poles and Tartars defeated with great ſlaughter.

95 The Ruſſians invade the Swediſh dominions.

Charles, notwithſtanding the number of his enemies, was now become ſo formidable by the valour and diſcipline of his troops, that whole armies often fled on his approach. At laſt, in 1657, the Poles, finding they could not reſiſt him in the field, contented themſelves with haraſſing the Swedes on their march, and cutting off the foragers and convoys. This proved much more deſtructive to the Swedes than their former method; ſo that Charles was obliged to enter into an alliance with Ragotſki prince of Tranſylvania, by aſſigning him certain provinces in his neighbourhood, in order to furniſh himſelf with irregular troops, who might fight the Poles in their own way. This, however, proved of no real advantage; for the confederates, after waſting a whole campaign in Lithuania, were obliged to return without accompliſhing more than the reduction of a ſingle fortreſs; on which Charles returned with the Swediſh army to Pruſſia.

An. 1657.

96 Charles enters into an alliance with Ragotſki prince of Tranſylvania.

97 Leopold king of Hungary declares againſt Sweden.

Leopold, the young king of Hungary, having long beheld the Swedes with a jealous eye, now reſolved to declare for Poland. The more effectually to curb the ambition of the Swediſh monarch, he ſolicited the king of Denmark to come to a rupture with him. This was inſtantly complied with, and the Danes invaded Bremen. Charles haſtened to oppoſe this new enemy; which gave ſuch offence to Ragotſki, that he neglected to take the proper meaſures for his own defence in the abſence of the Swedes, and ſuffered his army to be deſtroyed by the Poles and Tartars. At the ſame time the Turks invaded Tranſylvania, under pretence that Ragotſki, being a vaſſal of the Grand Signior, had no right to invade Poland without his leave. Ragotſki oppoſed them in the field; where he was defeated and killed, leaving Charles deſtitute of the only ally on whom he could depend.

98 Ragotſki's army deſtroyed by the Poles and Tartars.

99 He is defeated and killed by the Turks.

The king, however, not diſmayed by this misfortune, traverſed Pomerania and the duchy of Mecklenburg; after which he attacked Holſtein, while General Wrangel with another corps entered the duchy of Bremen. The latter executed his meaſures with the utmoſt vigour. In 15 days he retook all the towns which the enemy had reduced; defeated and drove the Daniſh army out of the country, killing 3000 of their beſt ſoldiers. In Holſtein the king reduced ſeveral fortreſſes, laid Itzehoe in aſhes, defeated a body of Danes, and laid ſiege to Frederic Udda, into which the Danes had thrown a ſtrong garriſon. The conduct of this ſiege he left to Wrangel, he himſelf retiring to Wiſmar in order to obſerve the ſituation of affairs in Poland; but no ſooner was he gone than Wrangel attacked the place with ſuch fury, that he became maſter of it in two hours. In the province of Halland the Swedes were defeated; but the enemy derived no advantage from their victory: at ſea the fleets met, and maintained an engagement for two days, without any conſiderable advantage on either ſide. In Poland affairs were not better conducted. The houſe of Auſtria had now declared for Caſimir; a German army entered Poland, and reduced Cracow, though not without great loſs to themſelves.

100 Bravery and ſucceſs of General Wrangel.

101 The houſe of Auſtria declares againſt Sweden.

The king of Sweden was now ſurrounded by enemies. The elector of Brandenburg had declared againſt him; and he had beſides to engage the armies of Auſtria, Poland, Ruſſia, and Denmark. In this dangerous ſituation he reſolved to attack Denmark, ſo as to oblige that power to come to a ſpeedy accommodation. His deſigns were forwarded by a very early froſt, which enabled him to tranſport his troops without ſhipping. Having paſſed over on the ice to the iſland of Funen, he cut in pieces a body of 4000 Daniſh ſoldiers and 500 peaſants. The whole iſland was reduced in a few days; after which he paſſed to Langland, then to Laaland, after that to Falſtre, and laſtly to Zealand. The Danes were terrified at this unexpected invaſion, and were giving themſelves up to deſpair, when Charles offered to conclude a peace on equitable terms. The king of Denmark gladly conſented; intending to renew the war as ſoon as he thought it could be done with ſafety.

102 Charles invades Denmark with great ſucceſs.

103 Peace concluded. An. 165

Charles was no ſooner retired, than the king of Denmark began to act ſecretly againſt him; on which, reſolving to anticipate him in his deſigns, he appeared unexpectedly with a fleet before Copenhagen. The Swediſh monarch laid ſiege to the capital, but with ſo little prudence that he made no progreſs, and was at length compelled to turn the ſiege into a blockade, which continued to the end of the war. Charles X. died of an epidemic fever, and was ſucceeded by his ſon Charles XI.

104 The war renewed and Copenhagen beſieged.

105 Charles An. 166

The new king Charles XI. was a minor at the time of his father's death; and as the kingdom was involved in a dangerous war with ſo many enemies, the regency determined to conclude a peace, if it could be obtained

on

on reaſonable terms. A treaty was accordingly concluded at Oliva; by which Caſimir renounced his pretenſions to the crown of Poland, and that republic gave up all pretenſions to Livonia. Bornholm and Drontheim were ceded to Denmark; and an equivalent in Schonen remained with Sweden. During the minority of the king, nothing remarkable occurs in the hiſtory of Sweden. In 1672 he entered into alliance with Louis XIV. which two years after involved him in a war with the elector of Brandenburg. At firſt the Swedes carried all before them. Almoſt all the towns in Brandenburg were reduced, when the elector arrived with an army to the relief of his diſtreſſed ſubjects. He retook ſeveral towns, defeated the Swedes in a general engagement, and ſoon after forced them to abandon all their conqueſts. In conjunction with the Danes, he then invaded the Swediſh dominions; many places of importance were reduced; and, in 1676, Sweden received a moſt deſtructive blow by the defeat of her fleet in an engagement with the combined fleets of Denmark and Holland. Soon after this the king took the government into his own hands, and in ſome degree reſtored the fortune of Sweden; but though matters went on in a more proſperous way where the king commanded in perſon, the ſame loſſes and diſgrace attended the Swediſh arms in every other quarter. In 1678, the Swediſh fleet was defeated in two engagements. At Landſcroon a moſt obſtinate battle was fought from ten in the morning till ſix at night; when both parties were obliged, by fatigue, to retire to their reſpective camps. At Oldeval in Norway, the Swedes were defeated; and the Danes laid deſolate the iſlands of Oeland, Smaaland, Unno, and Kuno; while the electoral troops and Imperialiſts reduced Count Konigſmark to the utmoſt diſtreſs in the neighbourhood of Stralſund.

In this deplorable ſituation of affairs Count Konigſmark found an opportunity of attacking his enemies to ſuch advantage, that he obtained a complete victory; after which he ravaged the duchy of Mecklenburg. Notwithſtanding this ſucceſs, he could not prevent the elector from reducing Stralſund; after which he was obliged to evacuate Pomerania; and, to complete his diſtreſs, the fleet which tranſported the Swediſh army from Pomerania was wrecked on the coaſt of Bornholm.

In this unproſperous ſituation of affairs a peace was concluded at St Germain's between France and her enemies, by which the Swedes and Danes were left to decide their quarrel by themſelves. Denmark was by no means a match for Sweden, even in the diſtreſſed ſituation to which ſhe was reduced; and therefore a treaty was concluded, on terms much more favourable to Sweden than could have been expected; and the peace was confirmed by a marriage between Charles and Ulrica Eleonora, daughter to the king of Denmark. From this time the Swediſh monarch applied himſelf to the reformation of the ſtate; and by artfully managing the diſputes between the nobility and peaſants, he obtained a decree empowering him to alter the conſtitution as he pleaſed. The proceedings of the king after this decree were ſuch as to exaſperate the nobility, and produce violent commotions. See PATKUL.

On the 15th of April 1697, died Charles XI. leaving his crown to his ſon, the celebrated Charles XII. at that time a minor. On his acceſſion he found himſelf under the tuition of his grandmother Eleonora, who had governed the kingdom during the minority of the late king. Though Charles was at that time only 15 years of age, he ſhowed a deſire of taking the government into his own hands. His counſellors, Count Piper and Axel Sparre, ſignified his deſire to the queen-regent. They were by her referred to the ſtates; and there all were unanimous: ſo that the queen, finding that oppoſition would be vain, reſigned her power with a good grace; and Charles was inveſted with abſolute authority in three days after he had expreſſed his deſire of reigning alone. He was ſcarcely ſeated on the throne when a powerful combination was formed againſt him. Auguſtus king of Poland formed deſigns on Livonia; the king of Denmark revived the diſputes he had with the duke of Holſtein, as a prelude to a war with Sweden; and Peter the Great of Ruſſia began to form deſigns on Ingria, formerly a province of Ruſſia. In 1699 the king of Denmark marched an army into Holſtein. Charles ſent a conſiderable body of troops to the duke's aſſiſtance; but before their arrival the Danes had ravaged the country, taken the caſtle of Gottorp, and laid cloſe ſiege to Tonningen. Here the king of Denmark commanded in perſon; and was aſſiſted by the troops of Saxony, Brandenburg, Wolfenbuttle, and Heſſe Caſſel. England and Holland, as guarantees of the laſt treaty with Denmark, in concert with Sweden, joined Charles againſt this confederacy, and ſent fleets to the Baltic. They propoſed a termination of the war on equitable terms; but theſe were haughtily refuſed by the Daniſh monarch, who deſpiſed the youth and inexperience of Charles, and relied too much on the alliance he had formed with Saxony, Brandenburg, Poland, and Ruſſia. Tonningen, however, reſiſted all his efforts; and when he ordered the place to be ſtormed, he had the mortification to ſee his troops driven headlong from the walls by a handful of Swedes.

In the year 1700, Charles, having entruſted the affairs of the nation with a council choſen out of the ſenate, ſet out on the 8th May from his capital, to which he never afterwards returned. He embarked at Carlſcroon, and defeated the fleet of the allies. Having made a deſcent on the iſland of Zealand, he defeated a body of cavalry that oppoſed his march, and then proceeded to inveſt Copenhagen by ſea and land. The king of Denmark then ſaw the neceſſity of either having his capital deſtroyed, or of doing juſtice to the duke of Holſtein. He choſe the latter; and a treaty was concluded on much the ſame terms as formerly. Charles, being thus at liberty to turn his arms againſt the other princes who had conſpired his deſtruction, reſolved to lead his army againſt Auguſtus king of Poland. On the road, however, he received intelligence that the tzar of Ruſſia was on his march to oppoſe him, and had laid ſiege to Narva with an army of 100,000 men. The conteſt that enſued between Charles and Peter, with the celebrated battles of Narva and Pultava, have been already related under RUSSIA, ſo that we ſhall here confine ourſelves chiefly to thoſe events in which Peter the Great was not immediately concerned.

The tzar Peter was the chief ſupport of Auguſtus, and he took the moſt active meaſures to oppoſe the progreſs of the Swediſh monarch. His want of ſucceſs, and the ſubſequent

Sweden.

112 Charles XI. dies, and is ſucceeded by his ſon Charles XII.

113 He takes the government into his own hands at the age of 15.

114 A powerful combination formed againſt him.

115 Holſtein ravaged by the Danes. An. 1699.

116 They are repulſed at Tonningen.

117 Charles ſets out from Stockholm, and defeats the fleet of the allies. An. 1700.

118 Obliges the Danes to make peace.

119 Marches againſt the Ruſſians.

Sweden.

sequent contests between him and Charles, till the decisive battle of Pultava are related in the article RUSSIA.

120 Charles marches against the Saxons, An. 1701.

In 1701, as early as the season permitted, Charles, having received a reinforcement from Sweden, took the field, and appeared suddenly on the banks of the Duna, along which the Saxon army was posted to receive him. The king of Poland being at that time sick, the army was commanded by Ferdinand duke of Courland, Marischal Stenau, and General Paykel, all officers of valour and experience. They had fortified certain islands in the mouth of the river, and taken every other precaution against an attack; the soldiers were hardy, well disciplined, and nearly equal to the Swedes in number; yet Charles, having passed the river in boats with high sides, to screen the men from the fire of the enemy, attacked them with such fury, that they were entirely defeated with great loss.

121 and entirely defeats them.

This victory was followed by the surrender of all the towns and fortresses in the duchy of Courland. Charles then passed into Lithuania, where every town opened its gates to him. At Birsen, an army of 20,000 Russians retired with the utmost precipitation on the news of his approach. Here Charles, perceiving that the kingdom of Poland was greatly disaffected to Augustus, began to project the scheme of dethroning him by means of his own subjects. This scheme he executed with more policy than he ever showed on any other occasion.

122 Forms a scheme for dethroning Augustus.

123 Makes a second application to no purpose.

Augustus, in the mean time, finding his scheme of peace frustrated, had recourse to the senate; but met with such a rough answer from them, that he determined to apply to Charles. To him therefore he sent his chamberlain; but a passport being forgotten, the ambassador was arrested. Charles continued his march to Warsaw, which surrendered on the first summons: but the citadel held out for some days. Augustus, finding at last that no dependence was to be placed on the Poles, determined to trust his fortune wholly to the Saxon army and the nobility of the palatinate of Cracow, who offered to support him to the utmost of their power. The Saxon army was now advanced to the frontiers, and Augustus immediately put himself at its head. Being joined by the nobility of Cracow, he found his forces to amount to 30,000 men, all brave and well-disciplined. With these he marched in quest of his enemy; who did not decline the combat, though he had with him only 12,000 men. Though the Saxons were strongly posted, having their front covered by a morass, besides being fortified with pallisadoes and chevaux de frise, they were attacked with irresistible impetuosity, and entirely defeated. This victory was followed by the loss of Cracow: after which Charles set out in pursuit of the flying army, with a design of preventing them from re-assembling; but his horse falling under him, he had the misfortune to break his thigh, by which he was confined six weeks; and thus Augustus obtained some respite. He improved this interval. Having convoked a diet first at Marienburg, and then at Lublin, he obtained the following resolutions; that an army of 50,000 men should be raised by the republic for the service of the prince; that six weeks should be allowed the Swedes to determine whether they were for war or peace; and that the same time should be granted to the turbulent and discontented nobles of Poland to make their concessions. To counteract the effects of these resolutions, Charles assembled another

124 Warsaw taken.

125 The Saxons entirely defeated.

126 Cracow taken.

diet at Warsaw; and while the two assemblies disputed concerning their rights and privileges, he recovered from his wound, received a strong reinforcement from Pomerania, and utterly defeated and dispersed the remains of the Saxon army.

Sweden.

127 Remains of the Saxon army entirely defeated. An. 1704.

The ill fortune of Augustus continued still to prevail. In 1704 he was formally deposed by the diet, and the crown conferred by Charles on Stanislaus Lecsinsky palatine of Posnania. Augustus, however, did not yet tamely give up his kingdom. His adherents daily skirmished with the Swedes; and Augustus himself, being reinforced by 9000 Russians, retook Warsaw, and was near surprising the new king, who lived in perfect security in the city while Charles fought in his cause. Count Horn, with 1500 Swedes, vigorously defended the citadel; but at last, finding it no longer tenable, he was obliged to surrender at discretion. The reduction of Warsaw was among the last advantages gained by Augustus in the course of this war. His troops were now composed of Saxon recruits and undisciplined Poles, who had no attachment to his person, and were ready on all occasions to forsake him. Charles and Stanislaus advanced with the victorious army; the Saxons fled before them, and the towns several miles round sent him their submissions. The Poles and Saxons were under the command of Schullemberg, a most sagacious and experienced general, who used every expedient to check the progress of the Swedes. With all his conduct and caution he found himself outwitted, and Charles in the neighbourhood of his camp ready to fall on him, while he thought him at 50 leagues distance. The Swedish monarch attacked him with a superior army, but entirely composed of horse. Schullemberg had posted his men in such a manner as rendered it impossible to surround them. His first rank being armed with pikes and fusees, presented a kind of rampart of bayonets; the second line stooping over the first who kneeled, fired over their heads, while the third rank, who stood upon their feet, kept up an incessant fire, by which the Swedish horse were exceedingly galled and put in disorder. Charles lost the opportunity of cutting off the whole Saxon army, by omitting to order his men to dismount. This was almost the first time that infantry had been regularly opposed to cavalry, and the superiority of the former was evident. After the engagement had continued about three hours, the Saxons retreated in good order; which no enemy had ever done before in any engagement with Charles. The Swedes pursued their enemies towards the Oder, and forced them to retreat through thick woods, almost impervious even to infantry. The Swedish horse, however, pushed their way, and at last inclosed Schullemberg between a wood and the river, where Charles had no doubt of obliging him to surrender at discretion, or die sword in hand, as having neither boats nor bridges; but the genius of Schullemberg supplied every defect. In the night he ordered planks and floats of trees to be fastened together; on which he carried over his troops, while the Swedes were employed in dislodging 300 men, whom he had placed in a windmill, for the purpose of defending his flank and keeping the enemy in play. Charles spoke of this retreat with admiration, and said he had been conquered by Schullemberg.

128 Augustus formally deposed, and Stanislaus raised to the throne.

129 Warsaw retaken by Augustus.

130 Excellent conduct of his general Schullemberg.

131 His engagement with the Swedes.

132 His fine retreat.

133 Augustus leaves Poland.

No material advantage, however, resulted from this to Augustus; who was again obliged to leave Poland, and fortify

Sweden.

fortify the capital of his hereditary dominions, which he expected every moment to see invested. In the mean time the Russians having recovered their spirits, attacked the Swedes in Livonia with the utmost fury. Narva, Dorpt, and several other towns, were taken, and the inhabitants and garrisons treated with great barbarity. Soon after, an army of 100,000 Russians entered Poland. Sixty thousand Cossacks under Mazeppa entered the country at the same time, and ravaged every thing with the fury of barbarians. Schullemberg, too, perhaps more formidable than either, advanced with 14,000 Saxons and 7000 Russians, disciplined in Germany, and reputed excellent soldiers. Could numbers have determined the event of war, the Swedes must certainly have been at this time overpowered. Instead of this, however, Charles seemed to triumph over his enemies with more ease the more numerous they were. The Russians were defeated so fast, that they were all dispersed before one party had notice of the misfortunes of another. The defeating an army of 40,000 men scarcely obstructed the march of the Swedes, while their astonished enemies looked on these actions as the effects of witchcraft, and imagined that the king of Sweden had dealings with infernal spirits. With these apprehensions they fled beyond the Dniepr, leaving the unhappy Augustus to his fate. Schullemberg, with all his skill and experience, succeeded no better. The Swedish general Renschild engaged and defeated him in half an hour, though the Swedes were vastly inferior in number, and their enemies posted in a most advantageous situation. Nothing could be more complete than this victory. This extraordinary victory, indeed, is said to have been owing to a panic which seized the troops of Schullemberg: but it was regarded with admiration, and thought to make the renown of Renschild equal to that of his sovereign. Charles himself was jealous, and could not help exclaiming, "Surely Renschild will not compare himself with me!"

Soon after this victory, which was gained on the 12th of February, 1706, Charles entered Saxony at the head of 24,000 men. The diet at Ratisbon declared him an enemy to the empire if he crossed the Oder. But to this declaration no regard was paid. Charles pursued his march; while Augustus was reduced to the condition of a vagrant in Poland, where he possessed not a single town except Cracow. Into this city he threw himself with a few Saxon, Polish, and Russian regiments, and began to erect some fortifications for its defence; but the approach of the Swedish general Meyerfeldt, and the news of the invasion of Saxony, disconcerted all his measures, and threw him into despair. The Russians indeed were his faithful allies; but he dreaded them almost as much as the Swedes: so that he was reduced to the necessity of writing a letter to Charles with his own hand, begging for peace on whatever terms he thought proper to grant. However, as he was then at the mercy of the Russians, this transaction was concealed with the greatest care. His emissaries were introduced to the Swedish court in the night-time; and being presented to Charles, received the following answer: That King Augustus should for ever renounce the crown of Poland, acknowledge Stanislaus, and promise never to reascend the throne, should an opportunity offer; that he should release the princes Sobieski, and all the Swedish prisoners made in the course of the war; surrender Patkul, at that time resident at his court as ambassador for the tzar of Russia, and stop proceedings against all who had passed from his into the Swedish service. These articles, Charles wrote with his own hand, and delivered to Count Piper, ordering him to finish them with the Saxon ambassadors.

After his defeat at Pultava by the Russians, Charles fled in a mean calash, attended by a little troop inviolably attached to his person, some on foot, and some on horseback. They were obliged to cross a sandy desert, where neither herb nor tree was to be seen, and where the burning heat and want of water were more intolerable than the extremities of cold they had formerly suffered. The whole had almost perished for want of water, when a spring was fortunately discovered; after which they reached Otchakoff, a town in the Turkish dominions, the bashaw of which supplied the king with every necessary. It was some time, however, before boats could be got ready for transporting the whole of the king's attendants; by which accident 500 Swedes and Cossacks fell into the hands of the enemy. This loss affected him more than all his other misfortunes. He shed tears at seeing, across the river Bog, the greater part of his few remaining friends carried into captivity, without having it in his power to assist them. The bashaw waited on him to apologise for the delay, and was severely reprimanded by Charles, as if he had been his own subject.

140 Charles arrives in Turkey after his defeat at Pultava.

The king remained but a few days at Otchakoff, when the seraskier of Bender sent an aga to compliment him on his arrival in the Turkish dominions, and to invite him to that city. Here he was treated with hospitality: the Turks practised to its full extent their generous maxim of regarding as sacred the persons of unfortunate princes who had taken shelter in their dominions: and perhaps regarded him, notwithstanding his misfortunes, as an ally that might be useful to themselves against the Russians. Every one, indeed, regarded him in his distress. The French king offered him a safe passage from the Levant to Marseilles, from whence he might easily return to his own dominions. But Charles was too obstinate to receive advice. Puffed up with the notion of imitating Alexander the Great, he disdained to return except at the head of a numerous army; and he yet expected, by means of the Turks, to dethrone his adversary the tzar. Negociations for this purpose were carried on in the Turkish divan; and it was proposed to escort Charles with a numerous army to the frontiers of Poland: but the revolution which took place there, put an end to all such projects. Augustus thought himself no longer bound to observe the treaty which he had made, than while Charles was at hand to compel him. After the battle of Pultava, he entered Poland, and took every measure, in concert with the tzar, for the recovery of his kingdom. Stanislaus was not able to stand before such enemies, but was obliged to leave his dominions and fly to Bender, in the disguise of a Swedish officer, in order to share the fortune of Charles.—It was not in Poland alone that the Swedish affairs began to suffer in consequence of the defeat at Pultava. The Danes invaded the province of Schonen with an army of 13,000 foot and 2500 horse. Only 13,000 Swedish forces remained to defend all the territories possessed by Charles in Germany; and of these only a small part was allotted for the defence of Schonen.

141 Is kindly received, and his hopes of conquering Russia begin to revive.

142 Augustus recovers the kingdom of Poland.

143 The Danes invade Sweden;

Sweden. nen. The regency of Sweden, however, exerted themſelves to the utmoſt to repel this ungenerous invaſion; and having collected an army of 12,000 militia and 8000 regulars, diſpatched them under General Steenboek into Schonen. Some Saxon troops were incorporated in this army; and among theſe a prodigious deſertion took place, which the general found it impoſſible to prevent; and thus the Danes gained ſeveral advantages, and at laſt took Chriſtianſtadt. Their inſolence on this ſucceſs was ſo great, that the Swedes demanded to be inſtantly led againſt them. Here the good fortune of Sweden ſeemed once more to revive. The Danes were driven from a very ſtrong ſituation, with the loſs of 8000 killed and taken priſoners, beſides a vaſt number wounded. The king received the intelligence of this victory with the greateſt exultation; and could not help exclaiming, "My brave Swedes, ſhould it pleaſe God that I once more join you, we ſhall conquer them all!"

144 but are utterly defeated.

In the mean time, Charles, by means of his agents the count Poniatoffſki and the ſieur Neugebar, uſed his utmoſt efforts to procure a rupture between the Porte and Ruſſia. For a long time the money beſtowed by Peter on the vizirs and janiſaries prevailed; but at laſt, in 1711, the grand ſignior, influenced by his mother, who was ſtrongly in the intereſt of Charles, and had been uſed to call him *her lion*, determined to ſupport his quarrel with Peter. He therefore gave orders to the vizir to fall on the Ruſſians with an army of 200,000 men. The vizir promiſed obedience; but at the ſame time profeſſed his ignorance in the art of war, and diſlike to the preſent expedition. The khan of Crim Tartary, who had been gained over by the reputation and preſents of the king of Sweden, had orders to take the field with 40,000 of his men, and had the liberty of aſſembling his army at Bender, that Charles might ſee that the war was undertaken on his account. See RUSSIA, N° 119.

145 The Turks declare war againſt the Ruſſians.

The treaty of the Pruth was moſt violently oppoſed by Count Poniatoffſki and the khan of Tartary. The former had made the king acquainted with the ſituation of both armies; on which he inſtantly ſet out from Bender, filled with the hopes of fighting the Ruſſians, and taking ample vengeance. Having ridden 50 leagues poſt, he arrived at the camp juſt as the tzar was drawing off his half-famiſhed troops. He alighted at Poniatoffſki's tent; and being informed of particulars, inſtantly flew in a rage to the vizir, whom he loaded with reproaches, and accuſed of treachery. Recollecting himſelf, however, he propoſed a method by which the fault might be remedied; but finding his propoſal rejected, he poſted back to Bender, after having by the groſſeſt inſults ſhowed his contempt of the vizir.

The violent behaviour of Charles did not promote his intereſt. The vizir perceived that his ſtay in Turkey might prove fatal to himſelf; and therefore determined to get him out of the country as ſoon as poſſible. Succeeding vizirs adopted the ſame plan; and at laſt the grand ſignior himſelf wrote a letter to Charles, in which he deſired him to depart by next winter, promiſing to ſupply him with a ſufficient guard, with money, and every thing elſe neceſſary for his journey. Charles gave an evaſive anſwer, and determined to procraſtinate his journey, as well to gratify his own ſtubborn temper, as becauſe he diſcovered a correſpondence between Auguſtus and the khan of Tartary, the object of which, he had reaſon to believe, was to betray him to the Saxons. When he was again preſſed to fix the day of his departure, he replied, that he could not think of going before his debts were paid. Being aſked how much was neceſſary for this purpoſe, he replied 1000 purſes (A). Twelve hundred purſes were inſtantly ſent to the ſeraſquier at Bender, with orders to deliver them to the king of Sweden, but not before he ſhould have begun his journey. By fair promiſes, Charles perſuaded him to part with the money; after which, inſtead of ſetting out, he ſquandered away his treaſure in preſents and gratifications, and then demanded 1000 purſes more before he would ſet out. The ſeraſquier was aſtoniſhed at this behaviour. He ſhed tears; and, turning to the king, told him, that his head would be the forfeit of having obliged him with the money. The grand ſignior, on being acquainted with the ſhameful behaviour of Charles, flew into a rage, and called an extraordinary divan, where he himſelf ſpoke, a thing very unuſual for the Turkiſh monarchs. It was unanimouſly agreed that ſuch a troubleſome gueſt ought to be removed by force, ſhould other means fail. Poſitive orders were therefore ſent to Charles to depart; and, in caſe of refuſal, to attack him in his quarters. Nothing could equal his obſtinacy on this occaſion: in ſpite of the menaces of his enemies, in ſpite of the intreaties of his friends, he perſiſted in his reſolution; and at laſt determined to reſiſt, with 300 Swedes, being all the attendants he had, an army of 20,000 janiſaries well armed and furniſhed with cannon. At length he was attacked in good earneſt; though it muſt be owned, that even in this extremity, the Turks ſhowed their regard to him, and were tender of his life, which the king did not return at all in a ſimilar manner. Moſt of the Swedes ſurrendered at once, perhaps as thinking it the only method of ſaving the king's life. This miſconduct, however, had a quite contrary effect. Charles became the more obſtinate, the more deſperate his affairs ſeemed to be. With 40 menial ſervants only, and the generals Hord and Dardorff, he determined to defend himſelf to the laſt extremity. Seeing his ſoldiers lay down their arms, he told the generals, "We muſt now defend the houſe. Come, (adds he with a ſmile), let us fight *pro aris et focis*." The houſe had been already forced by the Tartars, all but a hall which was near the door, and where his domeſtics had aſſembled. Charles forced his way through the janiſaries, attended by the generals Hord and Dardorff, joined his people, and then barricaded the door. The moment he entered, the enemy who were in the houſe, threw down their booty, and endeavoured to eſcape at the windows. Charles purſued them from room to room with much bloodſhed, and cleared the houſe in a few minutes. He then fired furiouſly from the windows, killed 200 of the Turks in a quarter of an hour, ſo that the baſhaw who commanded them was at length forced to ſet the houſe on fire. This

146 The grand ſignior diſmiſſes him to depart.

147 Mean and unjuſt behaviour of Charles.

148 The Turks reſolve to force him to depart.

149 His deſperate reſiſtance to his ſiſt.

150 Is abandoned by his followers exc 40.

151 Fights like a madman, but is taken priſoner with all his followers

(A) Each purſe contained 30 ſequins.

This was done by arrows with lighted matches ſhot into the roof; but Charles, inſtead of quitting it, gave orders for extinguiſhing the fire, in which he himſelf aſſiſted with great diligence. All efforts, however, were vain: the roof fell in; and Charles, with his few faithful companions, was ready to be buried in the ruins. In this extremity one called out, that there was a neceſſity for ſurrendering. "What a ſtrange fellow! (cries the king), who would rather be a priſoner with the Turks than mix his aſhes with thoſe of his ſovereign." Another had the preſence of mind to cry out, that the chancery was but 50 paces off, had a ſtone roof, and was proof againſt fire. Pleaſed with the thoughts of again coming to blows, the king exclaimed, "A true Swede! Let us take all the powder and ball we can carry." He then put himſelf at the head of his troops, and ſallied out with ſuch fury, that the Turks retreated 50 paces; but falling down in the hurry, they ruſhed in upon him, and carried him by the legs and arms to the baſhaw's tent.

This extraordinary adventure, which ſavours not a little of inſanity, happened on the 12th of February 1713. He was now kept priſoner, with all his retinue; and in this ſituation he was viſited by the unfortunate Staniſlaus.

Charles at laſt ſeemed inclined to ſubmit to his fate, and began ſeriouſly to think of returning to his kingdom, now reduced to the moſt deplorable ſituation. His habitation was now fixed at Demotica, a ſmall town about ſix leagues from Adrianople. Here he was allowed proviſions for his own table and thoſe of his retinue; but only 25 crowns a-day in money, inſtead of 500 which he had received at Bender. During his reſidence here he received a deputation from Heſſe Caſſel, ſoliciting his conſent to the marriage of the landgrave with Eleonora, princeſs royal of Sweden; to which he readily agreed: a deputation was alſo ſent him by the regency of Sweden, requeſting that he would prepare for returning to his own dominions, which were ready to ſink under a ruinous war in his abſence.

On the 14th of October 1714, Charles ſet out for Sweden. All the princes through whoſe territories he was to paſs, had given orders for his entertainment in the moſt magnificent manner; but the king, perceiving that theſe compliments only rendered his impriſonment and other misfortunes more conſpicuous, ſuddenly diſmiſſed his Turkiſh attendants, and aſſembling his own people, bid them take no care about him, but make the beſt of their way to Stralſund. After this he ſet out poſt, in the habit of a German officer, attended only by Colonel During. Keeping the bye-roads through Hungary, Moravia, Auſtria, Bavaria, Wirtemberg, the Palatinate, Weſtphalia, and Mecklenburg, he arrived on the 21ſt of November at midnight before the gates of Stralſund. Being unknown, he was admitted with difficulty; but being ſoon recogniſed by the governor, the greateſt tokens of joy were ſhown all over the town. In the midſt of the tumult Charles went to bed.

Sweden was now in the greateſt diſtreſs. On the news of the defeat at Pultava, the Danes had invaded Schonen, but were defeated by General Steenbock. This victory, however, did not put an end to the war. On the contrary, the kings of Denmark and Poland, with the tzar of Ruſſia, entered into ſtricter bonds of amity than ever. They dreaded the return of Charles to his own dominions, and apprehended that numberleſs victories would ſoon efface the remembrance of Pultava. They determined, therefore, to make the beſt uſe of their time; and perhaps Charles never took a more imprudent reſolution than obſtinately to remain ſo long in the Turkiſh dominions. The return of Charles ſeemed to give new life to the whole nation. Though the number of inhabitants was viſibly diminiſhed, the levies he had ordered were completed in a few weeks: but the hands left to cultivate the earth conſiſted of the infirm, aged, and decrepid; ſo that a famine was threatened in conſequence of the military rage which had ſeized all the youth of the kingdom. Sweden.

157 The king is unable to retrieve the Swediſh affairs. An. 1715.

The preſence of Charles did not now produce thoſe conſequences which the allies had feared. The kingdom was too much reduced to furniſh the neceſſary ſupplies of men and money; and though the king's courage and military ſkill were not in the leaſt diminiſhed, the efforts he made, inſtead of reſtoring Sweden to its ſplendour, ſerved more completely to ruin it. In 1715, Pruſſia declared againſt him, on account of his demanding back the town of Stetin, which that monarch had ſeized. To complete his embarraſſment, the elector of Hanover, George I. of Britain, alſo became his enemy.

158 Is encompaſſed on all ſides by enemies.

The forces of Denmark, Pruſſia, Saxony, and Hanover, joined to inveſt Wiſmar, while a body of 36,000 men formed the ſiege of Stralſund; at the ſame time that the tzar, with a fleet of 20 large ſhips of war, and 150 tranſports, carrying 30,000 men, threw every part of the Swediſh coaſt into the greateſt conſternation. The heroiſm of Charles could not prevail againſt ſo many enemies; yet he was ſtill ſo much dreaded, that the prince of Anhalt, with 12,000 brave troops, did not think himſelf a mateh for this furious enemy when at the head of only 2000, till he had entrenched his army behind a ditch, defended by chevaux de frize. It appeared, indeed, that his precaution was not unneceſſary: for in the night Charles with his men clambered up the ditch, and attacked the enemy in his uſual manner. Numbers, however, at laſt prevailed; and Charles was obliged to retire, after having ſeen his favourite Grothuſen, General Dardorff and During, the companions of his exile, killed by his ſide, he himſelf being wounded in the breaſt.

159 His deſperate valour.

160 Stralſund beſieged,

This raſh attempt was made in order to ſave Rugen, whence the town of Stralſund was ſupplied with proviſions. The place was well fortified, and garriſoned with 9000 men, with Charles himſelf at their head; but nothing could reſiſt the efforts of the enemy. By the 17th of December it was propoſed to give the aſſault. The attack on the horn-work was deſperate: the enemy was twice repulſed; but at laſt, by dint of numbers, affected a lodgment. The next day, Charles headed a ſally, in which he dealt terrible deſtruction among the beſiegers, but was at length overpowered and obliged to retreat into the town. At laſt his officers, apprehending that he muſt either fall into the hands of the enemy, or be buried in the ruins of the place, intreated him to retire. A retreat, however, was now almoſt as dangerous as to remain in the town, on account of the fleets of the enemy with which the ſea was covered; and it is thought that this very circumſtance induced the king to conſent to it. Setting out, therefore,

161 and taken, in ſpite of the utmoſt efforts of the king.

Sweden.

therefore, in a small boat with sails and oars, he passed all the enemy's ships and batteries, and arrived safe at Ystedt in Schonen.

162 Charles invades Norway to no purpose.

To revenge himself for these losses, Charles invaded Norway with an army of 25,000 men. The Danes were everywhere defeated and pursued with that vigour for which the king of Sweden was so remarkable; but strong reinforcements arriving from Denmark, and provisions failing, he was at last obliged to retire. Soon after this the Swedes lost Wismar; but when every thing seemed hopeless, Baron Goertz the chief minister and favourite of Charles contrived to set on foot a

163 A treaty with the tzar of Muscovy projected.

treaty with the tzar of Russia, by which the most formidable of all Charles's enemies was taken off. The minister found means to work on the inflexible temper of Charles, by representing to him that the cession of certain provinces to Peter would induce him to assist him in his projects of again dethroning Augustus, and of replacing James on the throne of Britain; which last scheme he had projected out of revenge for the elector of Hanover having seized on the duchies of Bremen and Verden. In consequence of the conferences between the tzar and Goertz, the former engaged to send into Poland an army of 80,000 men, in order to dethrone that prince whom he had so long defended. He engaged also to furnish ships for transporting 30,000 Swedes to Germany and 10,000 into Denmark. This treaty, however, was not ratified; and the king's death, which happened in 1718, put a final stop to all the great prospects of Sweden.

164 Charles invades Norway again, and lays siege to Frederickshall.

The king had resolved on the conquest of Norway before he dethroned Augustus; and as no difficulties ever deterred him, he marched his army into that cold and barren country in the month of October, when the ground was covered with frost and snow. With 18,000 men he formed the siege of Frederickshall, though the severity of the frost rendered it almost impossible to break ground. Charles resolved to form trenches; and his soldiers cheerfully obeyed, digging into the ground with the same labour as if they had been piercing a rock. On the 11th of December the king visited the

165 His extreme rashness, in consequence of which he is killed. An. 1718.

trenches in the midst of a terrible fire from the enemy, imagining that his men might be animated by his presence. He took his post in the most dangerous station he could choose, standing on a gabion and leaning with his arm over the parapet, while the enemy were firing chain shot at the very spot where he stood. He was intreated to change his station; but he remained obstinate. At last he was seen to fall on the parapet with a deep groan, and soon afterwards expired, having been mortally wounded, as is supposed, by a cannon ball. See CHARLES XII.

166 Account of the Swedish affairs from the death of Chas. XII. to the year 1771.

Charles XII. was succeeded by his sister the princess Ulrica Eleonora, wife to the hereditary prince of Hesse. On this occasion the states took care to make a previous stipulation for the preservation of their liberties, and obliged the princess to sign a paper to this purpose before entering on the government. Their first care was to make a peace with Great Britain, which the late king intended to have invaded. The Swedes then, to prevent their farther losses by the progress of the Russian, the Danish, the Saxon, and other arms, made many great sacrifices to obtain peace from those powers. The French, however, about the year 1738, formed a dangerous party in the kingdom, which not only broke its internal quiet, but led it into a ruinous war with Russia, by which it lost the province of Finland. Their Swedish majesties having no children, it was necessary to settle the succession; especially as the duke of Holstein was descended from the queen's eldest sister, and was, at the same time, the presumptive heir to the empire of Russia. Four competitors appeared; the duke of Holstein Gottorp, Prince Frederic of Hesse-Cassel nephew to the king, the prince of Denmark, and the duke of Deux-Ponts. The duke of Holstein would have carried the election, had he not embraced the Greek religion, that he might mount the throne of Russia. The tzarina interposed, and offered to restore all the conquests she had made from Sweden, excepting a small district in Finland, if the Swedes would receive the duke of Holstein's uncle, Adolphus Frederic bishop of Lubec, as their hereditary prince and successor to their crown. This was agreed to; and a peace concluded at Abo, under the mediation of his Britannic majesty. This peace was so firmly adhered to by the empress of Russia, that his Danish majesty thought proper to drop all resentment for the indignity done his son. The prince-successor married the princess Ulrica, third sister to the king of Prussia; and in 1751 entered into the possession of his new dignity, which proved to him a crown of thorns. The French had acquired vast influence in all the deliberations of the Swedish senate, who of late had been little better than pensioners to that crown. The intrigues of the senators forced Adolphus to take part in the war against Prussia: but as that war was disagreeable not only to the people, but also to the king of Sweden, the nation never made so mean an appearance; and on Russia's making peace with the king of Prussia, the Swedes likewise made peace. Adolphus died dispirited in 1771, after a turbulent reign of twenty years; and was succeeded by his son Gustavus. The most remarkable transaction of this reign is the revolution which took place in the government in the year 1772, by which the king, from being the most limited became one of the most despotic monarchs in Europe. Ever since the death of Charles XII. the whole power of the kingdom had been lodged in the states; and this power they had much abused. Gustavus therefore determined either to seize on that power of which they made such a bad use, or perish in the attempt. The revolution was effected in the following manner. On the morning of the 19th of August 1772, a considerable number of officers, as well as other persons known to be attached to the royal cause, had been summoned to attend his majesty. Before ten he was on horseback, and visited the regiment of artillery. As he passed through the streets he was more than usually courteous to all he met, bowing familiarly to the lowest of the people. On the king's return to his palace, the detachment which was to mount guard that day being drawn up together with that which was to be relieved, his majesty retired with the officers into the guard-room. He then addressed them with all that eloquence of which he is said to have been a perfect master; and after insinuating to them that his life was in danger, he exposed to them in the strongest colours the wretched state of the kingdom, the shackles in which it was held by means of foreign gold, and the dissensions and troubles arising from the same cause which had distracted the diet during the course of fourteen

Sweden. teen months. He assured them that his only design was to put an end to these disorders; to banish corruption, restore true liberty, and revive the ancient lustre of the Swedish name, which had been long tarnished by a venality as notorious as it was disgraceful. Then assuring them in the strongest terms that he disclaimed for ever all absolute power, or what the Swedes call *sovereignty*, he concluded with these words: "I am obliged to defend my own liberty and that of the kingdom, against the aristocracy which reigns. Will you be faithful to me, as your forefathers were to Gustavus Vasa and Gustavus Adolphus? I will then risk my life for your welfare and that of my country."

The officers, most of them young men, of whose attachment the king had been long secure, who did not thoroughly perhaps see into the nature of his majesty's request, were allowed no time to reflect, immediately consented to every thing, and took an oath of fidelity to him.

170 Only three refused. One of these, Frederic Cederstrom, captain of a company of the guards, alleged he had already, and very lately, taken an oath to be faithful to the states, and consequently could not take that which his majesty then exacted of him. The king, looking at him sternly, answered, "Think of what you are doing." "I do, (replied Cederstrom); and what I think to day, I shall think to-morrow: and were I capable of breaking the oath by which I am already bound to the states, I should be likewise capable of breaking that which your majesty now requires me to take."

The king then ordered Cederstrom to deliver up his sword, and put him in arrest.

His majesty, however, apprehensive of the impression which the proper and resolute conduct of Cederstrom might make on the minds of the other officers, shortly afterwards softened his tone; and again addressing himself to Cederstrom, told him, that as a proof of the opinion he entertained of him, and the confidence he placed in him, he would return him his sword without insisting on his taking the oath, and would only desire his attendance that day. Cederstrom continued firm; he answered, that his majesty could place no confidence in him that day, and that he begged to be excused from the service.

While the king was shut up with the officers, Senator Ralling, to whom the command of the troops in the town had been given two days before, came to the door of the guard-room, and was told that he could not be admitted. The senator insisted on being present at the distribution of the orders, and sent to the king to desire it; but was answered, he must go to the senate, where his majesty would speak to him.

The officers then received their orders from the king; the first of which was, that the two regiments of guards and of artillery should be immediately assembled, and that a detachment of 36 grenadiers should be posted at the door of the council-chamber to prevent any of the senators from coming out.

But before the orders could be carried into execution, it was necessary that the king should address himself to the soldiers; men wholly unacquainted with his designs, and accustomed to pay obedience only to the orders of the senate, whom they had been taught to hold in the highest reverence.

As his majesty, followed by the officers, was advancing from the guard room to the parade for this purpose, some of them more cautious, or perhaps more timid than the rest, became, on a short reflection, apprehensive of the consequences of the measure in which they were engaged: they began to express their fears to the king, that unless some persons of greater weight and influence than themselves were to take a part in the same cause, he could scarcely hope to succeed in his enterprise. The king stopped a while, and appeared to hesitate. A serjeant of the guards overheard their discourse, and cried aloud,—"It shall succeed—Long live Gustavus!" His majesty immediately said, "Then I will venture;"—and stepping forward to the soldiers, he addressed them in terms nearly similar to those which he had expressed to the officers, and with the same success. They answered him with loud acclamations: one voice only said, No; but it was not attended to. Sweden.

171 The king gains over the soldiers.

In the mean time some of the king's emissaries had spread a report about the town that the king was arrested. This drew the populace to the palace in great numbers, where they arrived as his majesty had concluded his harangue to the guards. They testified by reiterated shouts their joy at seeing him safe; a joy which promised the happiest conclusion to the business of the day.

172 The senators were now immediately secured. They had from the window of the council-chamber beheld what was going forward on the parade before the palace; and, at a loss to know the meaning of the shouts they heard, were coming down to inquire into the cause of them, when 30 grenadiers, with their bayonets fixed, informed them it was his majesty's pleasure they should continue where they were. They began to talk in a high tone, but were answered only by having the door shut and locked on them. Secures the senators, and becomes master of the whole power in the kingdom.

The moment the secret committee heard that the senate was arrested, they separated of themselves, each individual providing for his own safety. The king then mounting his horse, followed by his officers with their swords drawn, a large body of soldiers, and numbers of the populace, went to the other quarters of the town where the soldiers he had ordered to be assembled were posted. He found them all equally willing to support his cause, and to take to him an oath of fidelity. As he passed through the streets, he declared to the people, that he only meant to defend them, and save his country; and that if they would not confide in him, he would lay down his sceptre, and surrender up his kingdom. So much was the king beloved, that the people (some of whom even fell down on their knees) with tears in their eyes implored his majesty not to abandon them.

173 The king proceeded in his course, and in less than an hour made himself master of all the military force in Stockholm. In the mean time the heralds, by proclamation in the several quarters of the city, summoned an assembly of the States for the ensuing morning, and declared all members traitors to their country who should not appear. Thither his majesty repaired in all the pomp of royalty, surrounded by his guards, and holding in his hand the silver sceptre of Gustavus Adolphus. In a very forcible speech, he lamented the unhappy state to which the country was reduced by the conduct of a Summons an assembly of the states;

Sweden.

party ready to sacrifice every thing to its ambition, and reproached the states with adapting their actions to the views of foreign courts, from which they received the wages of perfidy. "If any one dare contradict this, let him rise and speak."—Conviction, or fear, kept the assembly silent, and the secretary read the new form of government, which the king submitted to the approbation of the states. It consisted of fifty-seven articles; of which the five following were the chief.

174 which accepts a new form of government.

1. The king has the entire power of convoking and dissolving the assembly of the states as often as he thinks proper. 2. His majesty alone has the command of the army, fleet, and finances, and the disposal of all offices civil and military. 3. In case of an invasion, or of any pressing necessity, the king may impose taxes, without waiting for the assembly of the states. 4. The diet can deliberate on no other subjects than those proposed by the king. 5. The king shall not carry on an offensive war without the consent of the states. When all the articles were gone through, the king demanded if the states approved of them, and was answered by a general acclamation. He then dismissed all the senators from their employments, adding, that in a few days he would appoint others; and concluded this extraordinary scene by drawing out of his pocket a small book of psalms, from which, after taking off the crown, he gave out Te Deum. All the members very devoutly added their voices to his, and the hall resounded with thanksgiving.

175 The king makes a good use of his power.

The power thus obtained was employed by the king for the good of his subjects. He took care that the law should be administered with impartiality to the richest noble and the poorest peasant, making a severe example of such judges as were proved to have made justice venal. He gave particular attention and encouragement to commerce, was a liberal and enlightened patron of learning and science, and laboured strenuously to introduce into his kingdom the most valuable improvements in agriculture that had been made in foreign countries.

176 Reforms the army and navy.

But while thus active in promoting the arts of peace, he was not inattentive to those of war. The fleet, which he found decayed and feeble, he in a few years restored to a respectable footing, and, besides changing the regulations of the navy, he raised a new corps of sailors, and formed them to the service by continual exercise. The army, which, as well as the navy, had been neglected during the aristocracy, was next to be reformed. The king began by giving cloaks, tents, and new arms to all the regiments. Afterwards, under the direction of Field Marshal Count de Hessenstein, a new exercise was introduced, and several camps were formed, in which the soldiery were manœuvred by the king himself. The sale of military offices, which had been permitted for many years, was entirely suppressed; and the king provided not only for the re-establishment of discipline and good order in the army, but for the future welfare of the individuals which composed it. These warlike preparations were necessary to a plan which he had formed for entirely abolishing the power of the aristocracy, and freeing Sweden from the factions which had long been formed in it by the court of St Petersburgh. The change which he had introduced was very inimical to the intrigues of that court; and the Russian ambassador exerted himself openly to bring about a rupture between the king and the discontented nobles. Gustavus ordered him to quit the kingdom in eight days, and immediately prepared for war with Russia. To this apparently rash enterprise he was incited by the Ottoman Porte, at that time unable to oppose the armies of the two empires; and his own ambition, together with the internal state of his kingdom, powerfully concurred to make him lend every assistance to his ancient ally. It is needless for us to enter into a detail of the particulars of that war, the principal circumstances of which have already been noticed under Russia, N° 157. Suffice it to say, that neither Gustavus Adolphus nor Charles XII. gave greater proofs of undaunted courage and military conduct in their long and bloody wars than were given by Gustavus the III. from the end of the year 1787 to 1790, when peace was restored between the courts of St Petersburgh and Stockholm. When the court of Copenhagen was compelled, by the means of England and Prussia, to withdraw its troops from the territories of Sweden, the king attacked Russia with such vigour both by sea and land, displayed such address in retrieving his affairs when apparently reduced to the last extremity, and renewed his attacks with such pertinacious courage, that the empress lowered the haughtiness of her tone, and was glad to treat with Gustavus as an equal and independent sovereign.

Sweden

177 His conduct in the war with Russia.

178 Not an arbitrary despot, though in some actions successful and dexterous.

The king of Sweden was now at liberty to cherish again the arts of peace, and to humble the haughty spirit of the nobles. For his attempting to deprive those men of that power which they had for many years employed against their country, he has been held up to the world as a despot who trampled on the liberties of his subjects; as a man without sincerity or patriotism; and, in one word, as a perjured tyrant, who overthrew the constitution which he had sworn to maintain. That he was not troubled with a scrupulous conscience, when so artfully conducting the revolution of 1772, must be acknowledged; nor can it be denied, that in his treaties with other powers, he sometimes endeavoured to overreach them; but if the necessities of state could in any case be an apology for falsehood, they would sufficiently apologise for the duplicity of Gustavus. He was engaged in the arduous enterprise of freeing his subjects from an aristocratic tyranny, supported by a foreign power the most formidable in the north; he had been forced into a war with that power, and, as there is reason to believe, promised assistance which he never received; and it cannot excite wonder nor great indignation, that, as soon as he could make an honourable peace, he embraced the opportunity without paying much regard to the interests of an alliance, which tamely looked on while he was struggling with difficulties apparently insurmountable. That the revolution which he effected in his own country was calculated to promote the general good of the people is unquestionable; and to gain such an object he might surely restore the crown to its ancient splendour, without bringing on his government the odious epithet of *despotism*.

179 The revolution beneficial.

180 Produces conspiracy against king's life. An. 1

The nobles, however, continued discontented, and a conspiracy was planned against Gustavus under his own roof. He had entered into the alliance that was formed against the revolutionary government of France; and to raise an army, which he was to lead in person to co-operate with the emperor and the king of Prussia, he was obliged to negociate large loans, and to impose on his subjects heavy taxes. The nobles took advantage of that circumstance to prejudice the minds of many of the people

people againſt the ſovereign who had laboured ſo long for their good. On the 16th of March 1792 he received an anonymous letter, warning him of his immediate danger from a plot that was laid to take away his life, requeſting him to remain at home, and avoid balls for a year; and aſſuring him that, if he ſhould go to the maſquerade for which he was preparing, he would be aſſaſſinated that very night. The king read the note with contempt, and at a late hour entered the ball-room. After ſome time he ſat down in a box with the compte d'Eſſen, and obſerved that he was not deceived in his contempt for the letter, ſince had there been any deſign againſt his life, no time could be more favourable than that moment. He then mingled, without apprehenſion, among the crowd; and juſt as he was preparing to retire in company with the Pruſſian ambaſſador, he was ſurrounded by ſeveral perſons in maſks, one of whom fired a piſtol at the back of the king, and lodged the contents in his body. A ſcene of dreadful confuſion immediately enſued. The conſpirators, amidſt the general tumult and alarm, had time to retire to other parts of the room; but one of them had previouſly dropped his piſtols and a dagger cloſe by the wounded king. A general order was given to all the company to unmaſk, and the doors were immediately cloſed; but no perſon appeared with any particular diſtinguiſhing marks of guilt. The king was immediately conveyed to his apartment; and the ſurgeon, after extracting a ball and ſome ſlugs, gave favourable hopes of his recovery.

181 king gerouſ- vound-

182 th of ſtavus 1792.

The favourable reports of his medical attendants ſoon appeared to be fallacious, and on the 28th of March a mortification was found to have taken place. He expired on the following day, and on opening his body there were found within the ribs a ſquare piece of lead and two ruſty nails.

The king had by his will appointed a council of regency; but convinced by recent experience how little dependence was to be placed on the attachment of his nobles, and aware of the neceſſity of a vigorous government in times of ſuch difficulty and danger, he appointed his brother, the duke of Sudermania, ſole regent, till his ſon, then a minor, ſhould attain the age of 18 years. In his dying moments he deſired that all the conſpirators, except the perpetrator of his murder, might be pardoned.

183 eſſion Guſtavus

The young king, who was about 14 at his father's death, was proclaimed by the name of Guſtavus IV. The regent ſoon took the moſt vigorous and active meaſures to apprehend and puniſh the projectors and perpetrators of the murder of his brother. A nobleman of the name of Ankerſtrom confeſſed himſelf the aſſaſſin, and gloried in the action, which he called liberating his country from a monſter and a tyrant. He was executed in a moſt cruel manner on the 17th of May. Two other noblemen, and two officers, alſo ſuffered death; but the reſt of the conſpirators were either pardoned, or puniſhed only by fine and impriſonment.

From the acceſſion of Guſtavus IV. till the revolution which has been recently effected in Sweden, few tranſactions of any importance have occurred. Soon after the king had taken on himſelf the adminiſtration of affairs, he engaged warmly in the war againſt France, and till the time of his depoſition, continued a moſt faithful ally of Britain. The efforts of the Swediſh monarch towards humbling the power of Bonaparte, have been already noticed under the articles BRITAIN and FRANCE; and the war with Ruſſia, in which his alliance with Britain had involved him, has been ſufficiently touched in the article RUSSIA. This prince ſeems to have been endowed with great and amiable qualities, but he was certainly raſh and imprudent in a high degree. He thus materially injured his kingdom, and alienated the affections of his principal nobles, eſpecially of his uncle the duke of Sudermania.

184 Revolution in favour of the duke Sudermania. An. 1809.

In the beginning of March 1809, the plan which appears to have been concerted between the duke of Sudermania and the principal nobility, was carried into effect. The king was arreſted; the duke aſſumed the reins of government, and iſſued the following proclamation.

"We, Charles, by the grace of God, Hereditary Prince of Sweden, the Goths, Vandals, &c. Duke of Sudermania, Grand Admiral, &c. &c. do declare, that under exiſting circumſtances, his majeſty is incapable of acting, or of conducting the important affairs of the nation. We have therefore (being the neareſt and only branch of the family of age) been induced, for the time being, as adminiſtrator of the kingdom, to take the reins of government into our hands, which, with the help of the Almighty, we will conduct ſo that the nation may regain peace, both at home and abroad, and that trade and commerce may revive from their languiſhing ſtate.

"Our inviolable intention is, to conſult with the ſtates on the means to be taken to render the future time happy to the people of Sweden. We invite and command, therefore, all the inhabitants of our nation, our forces by ſea and land, and alſo the civil officers of all degrees, to obey us, as our real intention, and their welfare demand.

"We recommend you all to the protection of God Almighty.

"Done at Stockholm palace,
the 13th March, 1809.

(Signed) { "Charles.
"C. Laberlering."

185 Depoſition of Guſtavus, and acceſſion of Charles XIII.

Soon after Guſtavus was prevailed on to abdicate the government, and the duke of Sudermania was declared king of Sweden, by the title of Charles XIII.

The new king ſoon made propoſitions to the emperors of France and Ruſſia for a ceſſation of hoſtilities between theſe powers and Sweden. Peace was ſpeedily obtained, but on terms the moſt humiliating and diſadvantageous to Sweden, as ſhe has been compelled to ſurrender to the emperor Alexander all her territory to the eaſtward of the gulf of Bothnia and the river Tornea. A new conſtitution has been promulgated by King Charles; but the particulars of this code, which, from the enfeebled ſtate of Sweden, reduced almoſt to the condition of a Ruſſian province, is not likely to be of long continuance, can ſcarcely be intereſting to our readers (B).

(B) It is underſtood that the health of the reigning monarch is in a declining ſtate, ſo that a new vacancy in the throne of Sweden may be expected ſoon to take place. It is not impoſſible, that on ſuch an event, the ambitious views

Sweden.

186 Population of Sweden.

The population of Sweden, even before the late treaty, was very inconſiderable, and is uſually ſuppoſed not to have exceeded 3,000,000, of which number Swediſh Lapland ſcarcely contained $\frac{1}{1000}$ part. As Finland appears to have been among the moſt populous diſtricts, we may conjecture that the loſs of that territory muſt have reduced the population by at leaſt 500,000; ſo that it is probable the preſent population of the countries ſubject to the crown of Sweden does not exceed 2,500,000. The moſt numerous part of this population is of courſe formed by peaſants, who have been computed at $\frac{3}{4}$ of the whole. Of the reſt the nobility was ſuppoſed to form $\frac{1}{100}$ part, comprehending at leaſt 2,500 families.

187 Government.

We have ſeen, that from the reign of Charles XII. to the revolution under Guſtavus III. in 1772, the government of Sweden was a limited monarchy, and that ſince that time, till the acceſſion of the preſent king (Charles XIII.) the power of the monarchs has been abſolute. The new conſtitution aims at bringing affairs back to their former ſtate; but how far it will be productive of that effect time alone can determine.

188 Revenues.

The revenue of Sweden, ſince the unfortunate reign of Charles XII. has been much reduced. Her gold and ſilver ſpecie, in the reign of Adolphus Frederick, aroſe chiefly from the king's German dominions. Formerly the crown lands, poll-money, tithes, mines, and other articles, are ſaid to have produced 1,000,000l. ſterling, and probably the whole preſent revenue does not amount to a million and a half. The national debt of this country, due chiefly to the moneyed men in Hamburgh, is ſuppoſed to amount to about 10,000,000 ſterling.

189 Military ſtrength.

The Swediſh army is compoſed of national troops, and of foreign auxiliaries; the latter being eſtimated at about 12,000, while the former do not amount to 40,000. The ſoldiers are of diſtinguiſhed valour, and very hardy, and ſtill retain the remembrance of the heroic deeds of their anceſtors.

Before the year 1792, the Swediſh fleet conſiſted of about 30 ſhips of the line; but at preſent it is reduced to not more than one-half, and theſe but ill-appointed.

190 Coins.

The only gold coin in Sweden is the ducat, worth about 9s. ſterling. Of the ſilver currency, the crown is valued at 4s. 6d. ſterling; and the ſhelling at about 1d. of Engliſh money. The copper coinage conſiſts chiefly of half and quarter ſhellings; but formerly the copper money conſiſted of heavy pieces nearly as large as tiles, ſo that a cart or barrow was ſometimes required to carry home a moderate ſum that had been received in payment for merchandiſe. Theſe large pieces are now rarely ſeen.

191 Religion.

Chriſtianity was introduced into Sweden in the 9th century. Their religion is Lutheran, which was propagated among them by Guſtavus Vaſa about the year 1523. The Swedes are ſurpriſingly uniform and unremitting in religious matters; and have ſuch an averſion to Popery, that if a Roman Catholic prieſt be diſcovered in the country, he is treated with the greateſt indignity.

Sweden.

The archbiſhop of Upſal had a revenue of 400l. a year, and had under him 13 ſuffragans with moderate ſtipends. No clergyman had the leaſt direction in the affairs of ſtate. Their morals, and the ſanctity of their lives, were ſuch as to endear them to the people. Their churches are neat, and often ornamented. A body of eccleſiaſtical laws and canons direct their religious economy. A converſion to Popery, or a long continuance under excommunication, which cannot paſs without the king's permiſſion, was puniſhment and exile.

192 Language and literature.

The language of Sweden is a dialect of the Gothic, and nearly allied to thoſe of Denmark, Norway, and Iceland. In the two grand diviſions of the Gothic, conſiſting of the German and Scandinavian dialects, the latter is diſtinguiſhed by greater brevity and force of expreſſion. In the ſouth of Sweden, which contains the chief maſs of population, ſome German and French words have been adopted; while the Dalecarlian, in the north-weſt, is eſteemed a peculiar dialect, perhaps only becauſe it contains more of the ancient terms and idiom.

In the antiquity of literature, Sweden cannot pretend to vie with Denmark, Norway, or Iceland; the moſt early native chronicle, or perhaps literary compoſition, being not more ancient than the 14th century. In return, while the Danes ſeem occupied with internal policy and public regulation, the Swedes have, in modern times, borne the palm of genius in many departments of literature and philoſophy.

But Swediſh literature can ſcarcely be ſaid to have dawned till the middle of the 17th century, when Queen Chriſtina, finding the country immerſed in ignorance, invited Grotius, Deſcartes, and other celebrated men, who, though they did not reſide long in the kingdom, ſowed the ſeed of letters, which gradually began to proſper in the wiſe and beneficent reign of Charles XI. In the ſucceeding or 18th century, the name of Linné alone might diſtinguiſh the national literature; and it is joined in natural hiſtory with thoſe of Scheele, Bergman, Tilas, Wallerius, Quiſt, Cronſtedt, and others. In hiſtory, Dalin and Lagerbring have diſtinguiſhed themſelves by a preciſion and force, which the Danes ſeem to ſacrifice to antiquarian diſcuſſions. Sweden alſo boaſts of native poets and orators; and the progreſs of the ſciences is ſupported by the inſtitution of numerous academies.

193 Produce and agriculture.

The Swedes, ſince the days of Charles XII. have been at incredible pains to correct the nature and barrenneſs of their country, by erecting colleges of agriculture, and in ſome places with great ſucceſs. Till of late, they had not ſufficient induſtry to remedy or improve the diſadvantages of their ſoil. The peaſants now follow the agriculture of France and England; and ſome late accounts ſay, that they rear almoſt as much grain as maintains the natives. Gothland produces wheat, rye, barley, oats, peaſe, and beans; and in caſes of deficiency, the people are ſupplied from Livonia and the Baltic provinces. In ſummer, the fields are verdant, and covered with flowers, and produce ſtrawberries, raſpberries, currants, and other ſmall fruits. The common

views of the emperors of the north and ſouth of Europe will ultimately deſtroy the ſmall remains of Swediſh independence.

common people know, as yet, little of the cultivation of apricots, peaches, nectarines, pine-apples, and other high-flavoured fruits; but melons are brought to the greatest perfection in dry seasons.

The Swedish commonalty subsists by agriculture, mining, hunting, grazing, and fishing. Their materials for traffic are the bulky and useful commodities of masts, beams, and other kinds of timber for shipping; tar, pitch, bark of trees, potash, wooden utensils, hides, flax, hemp, peltry, furs, copper, lead, iron, cordage, and fish.

Even the manufacturing of iron was introduced into Sweden so late as the 16th century; for till then they sold their own crude ore to the Hanse towns, and bought it back again manufactured into utensils. About the middle of the 17th century they set up some manufactures of glass, starch, tin, woollen, silk, soap, leather-dressing, and saw-mills. Bookselling was at that time unknown in Sweden. They have since had sugar-making, tobacco plantations, and manufactures of sail cloth, cotton, fustian, and other stuffs; also of linen, alum, brimstone, paper-mills, and gunpowder-mills. The iron mine of Dannemora is said to yield 60lbs. of metal in 100lbs. of ore, and others about 30lbs. The iron extracted from this is known in Europe by the name of *Oregrund*, which name is derived from a seaport on the Baltic. A large portion of it is employed by different nations for making the best steel. The mine was discovered in 1470. The unwrought ore was first sold to the merchants of Lubeck. It is said that the mine of Dannemora yields 40,000 stones of bar-iron per year, which is supposed to be $\frac{1}{10}$th of the quantity produced by all the iron mines of Sweden. Of this product of 400,000 stones, 300,000 are annually exported, and the remainder is manufactured at home. It is computed that not fewer than 25,600 men are employed in mining, and the branches immediately connected with it, viz. 4000 for breaking the rocks; 10,800 for hewing timber and burning it into charcoal; 2000 are employed in smelting; 1800 in transporting the metal from the furnaces to the forges; 600 in transporting sand, fuel, &c. 4000 for transporting the charcoal, and 2400 at forges. They have also founderies for cannon, manufactories for fire-arms and anchors, armories, wire and slatting mills, also mills for fulling, and for boring and stamping; and of late they have built many ships for sale.

Certain towns in Sweden, 24 in number, are called *staple-towns*, where the merchants are allowed to import and export commodities in their own ships. Those towns which have no foreign commerce, though lying near the sea, are called *land-towns*. A third kind are termed *mine-towns*, as belonging to mine districts. About the year 1752, the Swedes had greatly increased their exports, and diminished their imports, most part of which arrive or are sent off in Swedish ships; the Swedes having now a kind of navigation act like that of the English. According to the tables drawn up by Mr Coxe, the Swedish exports amounted, about 30 years ago, to 1,368,830l. while the imports amounted to 1,008,391l. leaving a balance in favour of Sweden of 360,000l. The imports are chiefly corn, hemp, tobacco, sugar, coffee, drugs, silk, wine, and brandy.

There is a great diversity of characters among the people of Sweden; and what is peculiarly remarkable among them, they have been known to have different characters in different ages. At present, their peasants seem to be a heavy plodding race of men, strong and hardy, but without any other ambition than that of subsisting themselves and their families as well as they can: they are honest, simple, and hospitable; and the mercantile classes are much of the same cast; but great application and perseverance is discovered among them all. One could form no idea that the modern Swedes are the descendants of those who, under Charles XII. and Gustavus Adolphus, carried terror in their names through the most distant countries, and shook the foundations of the greatest empires. The principal nobility and gentry of Sweden are naturally brave, polite, and hospitable; they have high and warm notions of honour, and are jealous of their national interests. The dress of the common people is almost the same with that of Denmark: the better sort are infatuated with French modes and fashions. The common diversions of the Swedes are skating, running races in sledges, and sailing in yachts upon the ice. They are not fond of marrying their daughters when young, as they have little to spare in their own life-time. The women go to plough, thresh out the corn, row upon the water, serve the bricklayers, carry burdens, and do all the common drudgeries in husbandry. Swedes, Swedenborg. 195 Character of the Swedes.

SWEDENBORG, Emanuel, was born at Stockholm in Sweden, in January 1689. His father was bishop of West Gothland; member of a society for the propagation of the gospel, formed on the plan of that of England; and president of the Swedish church in Pennsylvania and London. To this last office he was appointed by Charles XII. who seems to have had a great regard for the bishop, and to have continued that regard to his son.

Of the course of young Swedenborg's education we have procured no account; but from the character of the father, it may be supposed to have been pious; and by his appearing with reputation as an author, when but 20 years of age, it is proved to have been successful. His first work was published in 1709; and the year following he sent into the world a collection of pieces on different subjects, in Latin verse, under the title of *Ludus Heliconius, sive Carmina Miscellanea quæ variis in locis cecinit.* The same year he began his travels, first into England, afterwards into Holland, France, and Germany; and returning to Stockholm in 1714, he was two years afterwards appointed to the office of assessor in the Metallic College by Charles XII. who honoured him with frequent conversations, and bestowed upon him a large share of his favour. At this period of his life Swedenborg devoted his attention principally to physic and mathematical studies; and in 1718 he accompanied the king to the siege of Frederickshall, where he gave an eminent proof that he had not studied in vain. Charles could not send his heavy artillery to Frederickshall from the badness of the roads, which were then rendered much worse than usual by being deeply covered with snow. In this extremity Swedenborg brought the sciences to the aid of valour. By the help of proper instruments he cut through the mountains, and raised the valleys which separated Sweden from Norway, and then sent to his master two galleys, five large boats, and a sloop, loaded with battering pieces, to be employed in the siege. The length of this canal

Sweden-borg.

canal was about two miles and a half. The execution of this great work, however, did not occupy all his time. In 1716 he had begun to publiſh eſſays and obſervations on the mathematical and phyſical ſciences, under the title of *Dædalus Hyperboreus;* and he found leiſure during the ſiege to complete his intended collection, and alſo in the ſame year to publiſh an introduction to algebra, under the whimſical title of *The Art of the Rules.*

At the ſiege of Frederickſhall he loſt his patron Charles; but found another in Ulrica Eleonora, the ſiſter and ſucceſſor of that hero, by whom in 1719 he was ennobled, and took of courſe his ſeat among the ſenators of the equeſtrian order in the triennial aſſemblies of the ſtates. His promotion did not leſſen his ardour for the ſciences; for he publiſhed in the ſame year *A Method to fix the Value of Money, and to determine the Swediſh Meaſures in ſuch a way as to ſuppreſs all the Fractions and facilitate the Calculations.* About the ſame time he gave the public a treatiſe on *the Poſition and Courſe of the Planets;* with another on *the Height of the Tides, and Flux and Reflux of the Sea;* which, from information gathered in different parts of Sweden, appeared to have been greater formerly than when he wrote.

As Swedenborg continued, under the new ſovereign, to hold the office of aſſeſſor to the Metallic College, he thought it neceſſary, for the diſcharge of his duty, to make a ſecond journey into foreign countries, that he might himſelf examine their mines, particularly thoſe of Saxony and Harts. During theſe travels, which were undertaken for the improvement of the manufactures of his native country, he printed at Amſterdam, 1. *Prodromus principiorum Naturalium, ſive novorum tentaminum, Chemiam et Phyſicam experimentalem geometricè explicandi.* 2. *Nova obſervata et inventa circa Ferrum et Ignem, præcipue naturam Ignis Elementarum, una cum nova Camini inventione.* 3. *Methodus nova inveniendi Longitudines locorum terræ marique ope Lunæ.* 4. *Modus conſtruendi receptacula navalia, vulgo en Suedois, Dockybynadder.* 5. *Nova conſtructio aggeris aquatici.* 6. *Modus explorandi virtutes Navigiorum.* And at Leipſic and Hamburg, 7. *Miſcellanea obſervata circa res naturales, præſertim Mineralia, Ignem, et Montium ſtrata.*

European Magazine, 1787, July.

This journey was made, and theſe tracts publiſhed, in the compaſs of a year and a half; and perhaps there has not been another man, Linnæus excepted, who has done ſo much in ſo ſhort a time. After his return in 1722, Swedenborg divided his time ſo equally between the duties of his office and his private ſtudies, that in 1733 he finiſhed his grand work, entitled *Opera Philoſophica et Mineralia*, and had it printed under his own direction in 1734, part at Dreſden and part at Leipſic; in which year he alſo went to inſpect the mines of Auſtria and Hungary. This work is divided into three volumes folio; the title of the firſt is *Principia rerum Naturalium ſive novorum tentaminum, Phænomena Mundi elementaris philoſophicè explicandi.* The ſecond, *Regnum Subterraneum ſive Minerale de Ferro;* and the third, *Regnum Subterraneum ſive Minerale de Cupro, et Orichalco;* all of them written with great ſtrength of judgement, and ornamented with plates, to facilitate the comprehenſion of the text.

In the year 1729 he was enrolled among the members of the Society of Sciences at Upſal, and was, probably about the ſame time, made a Fellow of the Royal Academy of Sciences at Stockholm; nor were ſtrangers leſs willing than his own countrymen to acknowledge the greatneſs of his merit. Wolfius, with many other learned foreigners, was eager to court his correſpondence. The Academy of St Peterſburg ſent him, on the 17th of December 1734, a diploma of aſſociation as a correſpondent member; and ſoon afterwards the editors of the *Acta Eruditorum* at Leipſic found in his works a valuable ſupplement to their own collection.

Swed borg

By many perſons the approbation of learned academies would have been highly valued; but by Baron Swedenborg it was conſidered as of very little importance. "Whatever of worldly honour and advantage may appear to be in the things before mentioned, I hold them (ſays he) but as matters of low eſtimation, when compared to the honour of that holy office to which the Lord himſelf hath called me, who was graciouſly pleaſed to manifeſt himſelf to me, his unworthy ſervant, in a perſonal appearance, in the year 1743, to open in me a ſight of the ſpiritual world, and to enable me to converſe with ſpirits and angels; and this privilege has continued with me to this day. From that time I began to print and publiſh various unknown *Arcana*, which have been either ſeen by me or revealed to me, concerning heaven and hell, the ſtate of men after death, the true worſhip of God, the ſpiritual ſenſe of the Scriptures, and many other important truths tending to ſalvation and true wiſdom."

Short account of the Hea-nourab. E. Swedenborg

We ſhall not affront the underſtandings of our readers by making upon this account of the Baron's *call* ſuch reflections as every perſon of a ſound mind will make for himſelf; but it is rather remarkable, that a man who had devoted the better part of his life to the ſtudy of ſuch ſciences as generally fortify the mind againſt the deluſions of fanaticiſm, and who had even excelled in theſe ſciences, ſhould have fallen into ſuch a reverie as this. After this extraordinary call, the Baron dedicated himſelf wholly to the great work which, he ſuppoſed, was aſſigned him, ſtudying diligently the word of God, and from time to time publiſhing to his fellow-creatures ſuch important information as was made known to him concerning another world. Among his various diſcoveries concerning the ſpiritual world, one is, that it exiſts not in ſpace. "Of this (ſays he) I was convinced, becauſe I could there ſee Africans and Indians very near me, although they are ſo many miles diſtant here on earth; nay, that I could be made preſent with the inhabitants of other planets in our ſyſtem, and alſo with the inhabitants of planets that are in other worlds, and revolve about other ſuns. By virtue of ſuch preſence (i. e. without real ſpace), not of place, I have converſed with apoſtles, departed popes, emperors, and kings; with the late reformers of the church, Luther, Calvin, and Melancthon, and with others from diſtant countries."

Swedenborg's Univerſal Theology vol. i. p. 87.

Notwithſtanding the want of ſpace in the ſpiritual world, he tells us, "that after death a man is ſo little changed that he even does not know but he is living in the preſent world; that he eats and drinks, and even enjoys conjugal delight as in this world; that the reſemblance between the two worlds is ſo great, that in the ſpiritual world there are cities, with palaces and houſes,

Ibid. N° 734.

houſes, and alſo writings and books, employments and merchandiſes; that there is gold, ſilver, and precious ſtones there. In a word (he ſays), there is in the ſpiritual world all and every thing that there is in the natural world, but that in heaven ſuch things are in an infinitely more perfect ſtate."

Such was his zeal in the propagation of theſe whimſical and ſometimes ſenſual doctrines, that he frequently left his native country to viſit diſtant cities, particularly London and Amſterdam, where all his theological works were printed at a great expence, and with little proſpect or probability of a reimburſement. "Wherever he reſided when on his travels, he was (ſays one of his admirers) a mere ſolitary, and almoſt inacceſſible, though in his own country of a free and open behaviour. He affected no honour, but declined it; purſued no worldly intereſt, but ſpent his time in travelling and printing, in order to communicate inſtruction and benefit to mankind. He had nothing of the preciſe in his manner, nothing of melancholy in his temper, and nothing in the leaſt bordering on enthuſiaſm in his converſation or writings." This is too much. We believe he was an inoffenſive viſionary; of his converſation we cannot judge; but the ſpecimens that we have given of his writings are frantic enthuſiaſm. He died at London, March 29th, in the year 1772; and after lying in ſtate, his remains were depoſited in a vault at the Swediſh church, near Radcliff-Highway.

Though Baron Swedenborg's followers appear not to have been numerous during his life, they have increaſed ſince his death; and a ſect ſubſiſts at preſent in England which derives its origin from him, and is called *the New Jeruſalem Church*. The diſcriminating tenets of this ſect ſeem to be the following: "Holding the doctrine of one God, they maintain that this one God is no other than Jeſus Chriſt, and that he always exiſted in a human form; that for the ſake of redeeming the world, he took upon himſelf a proper human or material body, but not a human ſoul; that this redemption conſiſts in bringing the hells or evil ſpirits into ſubjection, and the heavens into order and regulation, and thereby preparing the way for a new ſpiritual church; that without ſuch redemption no man could be ſaved, nor could the angels retain their ſtate of integrity; that their redemption was effected by means of trials, temptations, or conflicts with evil ſpirits; and that the laſt of them, by which Chriſt glorified his humanity, perfecting the union of his divine with his human nature, was the paſſion of the croſs. Though they maintain that there is but one God, and one divine perſon, they hold that in this perſon there is a real Trinity; conſiſting of the divinity, the humanity, and the operation of them both in the Lord Jeſus; a Trinity which did not exiſt from all eternity, but commenced at the incarnation. They believe that the Scriptures are to be interpreted not only in a literal but in a ſpiritual ſenſe, not known to the world till it was revealed to B. Swedenborg; and that this ſpiritual ſenſe extends to every part of Scripture, except the Acts of the Apoſtles. They believe that there are angels attending upon men, reſiding, as B. Swedenborg ſays, in their affections; that temptation conſiſts in a ſtruggle between good and bad angels within men; and that by this means God aſſiſts men in theſe temptations, ſince of themſelves they could do nothing. Indeed B. Swedenborg maintains, that there is an univerſal influx from God into the ſouls of men, inſpiring them eſpecially with the belief of the divine unity. This efflux of divine light on the ſpiritual world he compares to the efflux of the light from the ſun in the natural world. Swedenborg || Swift.

"There are (ſays B. Swedenborg) two worlds, the natural and the ſpiritual, entirely diſtinct, though perfectly correſponding to each other; that at death a man enters into the ſpiritual world, when his ſoul is clothed with a body, which he terms *ſubſtantial*, in oppoſition to the preſent *material* body, which, he ſays, is never to riſe out of the grave."

SWEEP, in the ſea-language, is that part of the mould of a ſhip where ſhe begins to compaſs in the rung-heads; alſo when the hauſer is dragged along the bottom of the ſea to recover any thing that is ſunk, they call this action *ſweeping for it*.

SWEET, in the wine trade, denotes any vegetable juice, whether obtained by means of ſugar, raiſins, or other foreign or domeſtic fruit, which is added to wines with a deſign to improve them.

SWEIN-MOT. See *FOREST Courts*.

SWERTIA, MARSH GENTIAN, a genus of plants belonging to the claſs pentandria, and in the natural ſyſtem ranging under the 20th order, *rotaceæ*. See BOTANY *Index*.

SWIETENIA, MAHOGANY, a genus of plants belonging to the claſs decandria, and in the natural ſyſtem arranged under the 54th order, *miſcellaneæ*. See BOTANY and MATERIA MEDICA *Index*.

The firſt uſe to which mahogany was applied in England, was to make a box for holding candles. Dr Gibbons, an eminent phyſician in the latter end of the 17th and beginning of the 18th century, had a brother, a Weſt India captain, who brought over ſome planks of this wood as ballaſt. As the Doctor was then building a houſe in King-ſtreet, Covent Garden, his brother thought they might be of ſervice to him. But the carpenters, finding the wood too hard for their tools, they were laid aſide for a time as uſeleſs. Soon after, Mrs Gibbons, wanting a candle-box, the Doctor called on his cabinet-maker to make him one of ſome wood that lay in his garden. Wollaſton, the cabinet-maker alſo complained that it was too hard. The Doctor ſaid he muſt get ſtronger tools. The candle-box was made and approved; inſomuch, that the Doctor then inſiſted on having a bureau made of the ſame wood, which was accordingly done; and the fine colour, poliſh, &c. were ſo pleaſing, that he invited all his friends to come and ſee it. Among them was the ducheſs of Buckingham. Her Grace begged ſome of the ſame wood of Dr Gibbons, and employed Wollaſton to make her a bureau alſo; on which the fame of mahogany and Mr Wollaſton was much raiſed, and things of this ſort became general.

SWIFT, DR JONATHAN, ſo univerſally admired as a wit and claſſical writer of the Engliſh language, was born in Dublin on November 30th 1667. His father was an attorney, and of a good family; but dying poor, the expence of his ſon's education was defrayed by his friends. At the age of ſix young Swift was ſent to the ſchool of Kilkenny, whence he was removed in his 15th year to Trinity College, Dublin.

In his academical ſtudies (ſays Dr Johnſon) he was either not diligent or not happy. The truth appears to be,

Swift. be, that he deſpiſed them as intricate and uſeleſs. He told Mr Sheridan, his laſt biographer, that he had made many efforts, upon his entering the college, to read ſome of the old treatiſes on logic writ by Smegleſius, Keckermannus, Burgerſdicius, &c. and that he never had patience to go through three pages of any of them, he was ſo diſguſted at the ſtupidity of the work. When he was urged by his tutor to make himſelf maſter of this branch, then in high eſtimation, and held eſſentially neceſſary to the taking of a degree, Swift aſked him, What it was he was to learn from thoſe books? His tutor told him, The art of reaſoning. Swift ſaid, That he found no want of any ſuch art; that he could reaſon very well without it; and that, as far as he could obſerve, they who had made the greateſt proficiency in logic had, inſtead of the art of reaſoning, acquired the art of wrangling; and inſtead of clearing up obſcurities, had learned how to perplex matters that were clear enough before. For his own part, he was contented with that portion of reaſon which God had given him; and he would leave it to time and experience to ſtrengthen and direct it properly; nor would he run the riſk of having it warped or falſely biaſſed by any ſyſtem of rules laid down by ſuch ſtupid writers, of the bad effects of which he had but too many examples before his eyes in thoſe reckoned the moſt acute logicians. Accordingly, he made a firm reſolution, that he never would read any of thoſe books; which he ſo pertinaciouſly adhered to, that though his degree was refuſed him the firſt time of ſitting for it, on account of his not anſwering in that branch, he went into the hall a ſecond time as ill prepared as before; and would alſo have been ſtopped a ſecond time, on the ſame account, if the intereſt of his friends, who well knew the inflexibility of his temper, had not ſtepped in, and obtained it for him; though in a manner little to his credit, as it was inſerted in the College Regiſtry, that he obtained it *ſpeciali gratia*, "by ſpecial favour;" where it remains upon record. But this circumſtance is explained by others, that the favour was in conſequence of Swift's diſtinguiſhed talents.

"He remained in the college near three years after this, not through choice, but neceſſity, little known or regarded. By ſcholars he was reckoned a blockhead; and as the lowneſs of his circumſtances would not permit him to keep company with perſons of an equal rank with himſelf, upon an equal footing, he ſcorned to take up with thoſe of a lower claſs, or to be obliged to thoſe of a higher. He lived therefore much alone, and his time was employed in purſuing his courſe of reading in hiſtory and poetry, then very unfaſhionable ſtudies for an academic; or in gloomy meditations on his unhappy circumſtances. Yet, under this heavy preſſure, the force of his genius broke out, in the firſt rude draught of the Tale of a Tub, written by him at the age of 19, though communicated to nobody but his chamber-fellow Mr Waryng; who, after the publication of the book, made no ſcruple to declare, that he had read the firſt ſketch of it in Swift's hand-writing when he was of that age."

In 1688, being, by the death of Godwin Swift his uncle, who had chiefly ſupported him, left without ſubſiſtence, he went to conſult his mother, who then lived at Leiceſter, about the future courſe of his life; and, by her direction, ſolicited the advice and patronage of Sir William Temple, whoſe father had lived in great friendſhip with Godwin Swift. Temple received him with great kindneſs, and was ſo much pleaſed with his converſation, that he detained him two years in his houſe, and recommended him to King William, who offered to make him a captain of horſe. This not ſuiting his diſpoſition, and Temple not having it quickly in his power to provide for him otherwiſe, Swift left his patron (1694) in diſcontent; having previouſly taken his maſter's degree at Oxford, by means of a teſtimonial from Dublin, in which the words of diſgrace were omitted. He was reſolved to enter into the church, where his firſt preferment was only 100l. a-year, being the prebend of *Kilroot* in *Conner*; which ſome time afterwards, upon Sir William Temple's earneſtly inviting him back to his houſe at Moorpark, he reſigned in favour of a clergyman far advanced in years and burdened with a numerous family. For this man he ſolicited the prebend, to which he himſelf inducted him. Swift

In 1699 Swift loſt his patron Sir William Temple, who left him a legacy in money, with the property of his manuſcripts; and, on his death-bed, obtained for him a promiſe from the king of the firſt prebend that ſhould become vacant at Weſtminſter or Canterbury. That this promiſe might not be forgotten, Swift dedicated to the king the poſthumous works with which he was entruſted, and for a while attended the court; but ſoon found his ſolicitations hopeleſs. He was then invited by the earl of Berkeley to accompany him into Ireland, where, after ſuffering ſome cruel diſappointments, he obtained the livings of Laracor and Rathbeggin in the dioceſe of Meath; and ſoon afterwards invited over the unfortunate Stella, a young woman of the name of Johnſon, whoſe life he contrived to embitter, and whoſe days, though he certainly loved her, we may confidently affirm, he ſhortened by his caprice.

This lady is generally believed to have been the daughter of Sir William Temple's ſteward; but her niece, a Mrs Hearn, aſſured Mr Berkeley, the editor of a volume of letters intitled *Literary Relics*, that her father was a merchant, and the youngeſt brother of a good family in Nottingham-ſhire; that her mother was the intimate friend of Lady Gifford, Sir William's ſiſter; and that ſhe herſelf was educated in the family with his niece, the late Mr Temple of Moorpark by Farnham *. This ſtory would be intitled to the fulleſt credit, had not Mrs Hearn affirmed, in the ſame letter, that, before the death of Sir William Temple, Mrs Johnſon's little fortune had been greatly injured by the South ſea bubbles, which are known to have injured no perſon till the year 1720: (See COMPANY, II. 1.). When one part of a narrative is ſo palpably falſe, the remainder will always be received with heſitation. But whether Miſs Johnſon was the daughter of Temple's ſteward or of the friend of Lady Gifford, it is certain that Sir William left her 1000l.; and that, accompanied by Mrs Dingley, whoſe whole fortune amounted to an annuity of 27l. for life, ſhe went, in conſequence of Swift's invitation, to Laracor. With theſe two ladies he paſſed his hours of relaxation, and to them he opened his boſom; but they never reſided in the ſame houſe, nor did he ſee either without a witneſs.

* See *the life of Dean Swift, fixed to literary lics*, pr in 17 for El and K

In 1701, Swift publiſhed *A Diſcourſe of the Conteſts and Diſſenſions in Athens and Rome*. It was his firſt work, and indeed the only which he ever expreſsly acknowledged.

Swift. knowledged. According to his conſtant practice he had concealed his name; but after its appearance, paying a viſit to ſome Iriſh biſhop, he was aſked by him if he had read that pamphlet, and what its reputation was in London. Upon his replying that he believed it was very well liked in London; "Very well liked!" ſaid the biſhop with ſome emotion. "Yes, Sir, it is one of the fineſt tracts that ever was written, and Biſhop Burnet is one of the beſt writers in the world." Swift, who always hated Burnet with ſomething more than political rancour, immediately queſtioned his right to the work, when he was told by the biſhop that he was "a young man;" and ſtill perſiſting to doubt of the juſtice of Burnet's claim, on account of the diſſimilarity of the ſtyle of the pamphlet from that of his other works, he was told that he was "a very poſitive young man," as no perſon in England but Biſhop Burnet was capable of writing it. Upon which Swift replied, with ſome indignation, I am to aſſure your lordſhip, however, that Biſhop Burnet did *not* write the pamphlet, for I wrote it myſelf. And thus was he forced in the heat of argument to avow what otherwiſe he would have for ever concealed.

Early in the enſuing ſpring King William died; and Swift, on his next viſit to London, found Queen Anne upon the throne. It was generally thought, upon this event, that the Tory party would have had the aſcendant; but, contrary to all expectation, the Whigs had managed matters ſo well as to get entirely into the queen's confidence, and to have the whole adminiſtration of affairs in their hands. Swift's friends were now in power; and the Whigs in general, knowing him to be the author of the Diſcourſe on the Conteſts, &c. which was written in defence of King William and his miniſters againſt the violent proceedings of the houſe of commons, conſidered themſelves as much obliged to him, and looked upon him as faſt to their party. But Swift thought with the Whigs only in the ſtate; for with reſpect to the church his principles were always thoſe of a Tory. He therefore declined any intimate connection with the leaders of the party, who at that time profeſſed what was called *low church principles*. But what above all ſhocked him, ſays Mr Sheridan, was their inviting Deiſts, Freethinkers, Atheiſts, Jews, and Infidels, to be of their party, under pretence of moderation, and allowing a general liberty of conſcience. As Swift was in his heart a man of true religion, he could not have borne, even in his private character, to have mixed with ſuch a motley crew. But when we conſider his principles in his political capacity, that he looked upon the church of England, as by law eſtabliſhed, to be the main pillar of our newly erected conſtitution, he could not, conſiſtently with the character of a good citizen, join with thoſe who conſidered it more as an ornament than a ſupport to the edifice; and could therefore look on with compoſure while it was undermining, or could even open the gate to a blind multitude, to try, like Sampſon, their ſtrength againſt it, and conſider it only as ſport. With ſuch a party, neither his religious nor political principles would ſuffer him to join; and with regard to the Tories, as is uſual in the violence of factions, they had run into oppoſite extremes, equally dangerous to the ſtate. He was therefore during the earlier part of the queen's reign of no party, but employed himſelf in diſcharging the duties of his function, and in publiſhing from time to time ſuch tracts as he thought might be uſeful. In the year 1704 he publiſhed the *Tale of a Tub*, which, conſidered merely as a work of genius, is unqueſtionably the greateſt which he ever produced; but the levity with which religion was thought to be there treated, raiſed up enemies to him among all parties, and eventually precluded him from a biſhopric. From that period till the year 1708, he ſeems to have employed himſelf in ſolitary ſtudy; but he then gave ſucceſſively to the public *The Sentiments of a Church of England man*, the ridicule of aſtrology under the name of *Bickerſtaff*, the *Argument againſt aboliſhing Chriſtianity*, and the defence of the *Sacramental Teſt*.

Soon after began the buſy and important part of Swift's life. He was employed (1710) by the primate of Ireland to ſolicit the queen for a remiſſion of the firſt fruits and twentieth parts to the Iriſh clergy. This introduced him to Mr Harley, afterwards earl of Oxford, who, though a Whig himſelf, was at the head of the Tory miniſtry, and in great need of an auxiliary ſo able as Swift, by whoſe pen he and the other miniſters might be ſupported in pamphlets, poems, and periodical papers. In the year 1710 was commenced the *Examiner;* of which Swift wrote 33 papers, beginning his firſt part of it on the 10th of November 1711. The next year he publiſhed *the Conduct of the Allies* ten days before the parliament aſſembled; and ſoon afterwards, *Reflections on the Barrier Treaty*. The purpoſe of theſe pamphlets was to perſuade the nation to a peace, by ſhowing that "mines had been exhauſted and millions deſtroyed" to ſecure the Dutch and aggrandize the emperor, without any advantage whatever to Great Britain. Though theſe two publications, together with his *Remarks on the Biſhop of Sarum's Introduction to the third Volume of his Hiſtory of the Reformation*, certainly turned the tide of popular opinion, and effectually promoted the deſigns of the miniſtry, the beſt preferment which his friends could venture to give him was the deanery of St Patrick's, which he accepted in 1713. In the midſt of his power and his politics he kept a journal of his viſits, his walks, his interviews with miniſters, and quarrels with his ſervant, and tranſmitted it to Mrs Johnſon and Mrs Dingley, to whom he knew that whatever befel him was intereſting: but in 1714 an end was put to his power by the death of the queen, which broke down at once the whole ſyſtem of Tory politics, and nothing remained for him but to withdraw from perſecution to his deanery.

In the triumph of the Whigs, Swift met with every mortification that a ſpirit like his could poſſibly be expoſed to. The people of Ireland were irritated againſt him beyond meaſure; and every indignity was offered him as he walked the ſtreets of Dublin. Nor was he inſulted by the rabble only; for perſons of diſtinguiſhed rank and character forgot the decorum of common civility to give him a perſonal affront. While his pride was hurt by ſuch indignities, his more tender feelings were alſo often wounded by baſe ingratitude. In ſuch a ſituation he found it in vain to ſtruggle againſt the tide that oppoſed him. He ſilently yielded to it, and retired from the world to diſcharge his duties as a clergyman, and attend to the care of his deanery. That no part of his time might lie heavy on his hands, he employed his leiſure hours on ſome hiſtorical attempts relating to the change of the miniſters and the conduct of the miniſtry;

Swift. and completed the hiſtory of the four laſt years of the queen, which had been begun in her lifetime, but which he never publiſhed. Of the work which bears that title, and is ſaid to be his, Dr Johnſon doubts the genuineneſs; and it certainly is not ſuch as we ſhould have expected from a man of Swift's ſagacity and opportunities of information.

In the year 1716 he was privately married to Mrs Johnſon by Dr Aſhe biſhop of Clogher; but the marriage made no change in their ſituation, and it would be difficult to prove (ſays Lord Orrery) that they were ever afterwards together but in the preſence of a third perſon. The dean of St Patrick's lived in a private manner, known and regarded only by his friends, till about the year 1720 that he publiſhed his firſt political pamphlet relative to Ireland, intitled *A Propoſal for the Univerſal Uſe of Iriſh Manufactures;* which ſo rouſed the indignation of the miniſtry that they commenced a proſecution againſt the printer, and thus drew the attention of the public to the pamphlet, and at once made its author popular.

Whilſt he was enjoying the laurels which this work had wreathed for him, his felicity, as well as that of his wife, was interrupted by the death of Mrs Van Homrigh, and the publication of his poem called *Cadenus and Vaneſſa*, which brought upon him much merited obloquy. With Mrs Van Homrigh he became acquainted in London during his attendance at court; and finding her poſſeſſed of genius and fond of literature, he took delight in directing her ſtudies, till he got inſenſibly poſſeſſion of her heart. From being proud of his praiſe, ſhe grew fond of his perſon; and deſpiſing vulgar reſtraints, ſhe made him ſenſible that ſhe was ready to receive him as a huſband. She had wit, youth, beauty, and a competent fortune to recommend her; and for a while Swift ſeems to have been undetermined whether or not he ſhould comply with her wiſh. She had followed him to Ireland, where ſhe lived in a houſe about twelve miles diſtant from Dublin; and he continued to viſit her occaſionally, and to direct her ſtudies as he had done in London; but with theſe attentions ſhe was not ſatisfied, and at laſt ſent to him a letter written with great ardour and tenderneſs, inſiſting that he ſhould immediately accept or refuſe her as a wife. His anſwer, which probably contained the ſecret of his marriage, he carried himſelf; and having indignantly thrown it on the lady's table, inſtantly quitted the houſe, we believe without ſpeaking to her, and returned to Dublin to reflect on the conſequences of his own conduct. Theſe were dreadful. Mrs Van Homrigh ſurvived her diſappointment but a few weeks; during which time ſhe cancelled a will that ſhe had made in his favour, and ordered the poem to be publiſhed in which Cadenus had proclaimed her excellence and confeſſed his love.

His patriotiſm again burſt forth in 1724 to obſtruct the currency of Wood's halfpence; and his zeal was crowned with ſucceſs. Wood had obtained a patent to coin 180,000l. in halfpence and farthings for the kingdom of Ireland; and was about to turn his braſs into gold, when Swift, finding that the metal was debaſed to an enormous degree, wrote letters under the name of *M. B. Drapier* to ſhow the folly of giving gold and ſilver for coin not worth a third part of its nominal value. A proſecution was carried on againſt the printer; and Lord Carteret, then lord-lieutenant, iſſued a proclamation, offering 300l. for diſcovering the author of the fourth letter. The day after it was publiſhed there was a full levee at the caſtle. The lord-lieutenant was going round the circle, when Swift abruptly entered the chamber, and puſhing his way through the crowd, never ſtopped till he got within the circle; where, with marks of the higheſt indignation in his countenance, he addreſſed the lord-lieutenant with the voice of a Stentor, that re-echoed through the room, "So, my lord-lieutenant, this is a glorious exploit that you performed yeſterday, in iſſuing a proclamation againſt a poor ſhopkeeper, whoſe only crime is an honeſt endeavour to ſave his country from ruin. You have given a noble ſpecimen of what this devoted nation is to hope for from your government. I ſuppoſe you expect a ſtatue of copper will be erected to you for this ſervice done to Wood." He then went on for a long time, inveighing in the bittereſt terms againſt the patent, and diſplaying in the ſtrongeſt colours all the fatal conſequences of introducing that execrable coin. The whole aſſembly were ſtruck mute with wonder at this unprecedented ſcene. For ſome time a profound ſilence enſued. When Lord Carteret, who had liſtened with great compoſure to the whole ſpeech, made this fine reply, in a line of Virgil's: Swift.

Res dura, et regni novitas me talia cogunt
Moliri.

From this time Swift was known by the name of *the Dean*, and was acknowledged by the populace as the champion, patron, and inſtructor of Ireland.

In 1727 he returned to England; where, in conjunction with Pope, he collected three volumes of miſcellanies; and the ſame year he ſent into the world his *Gulliver's Travels*, a production which was read by the high and the low, and filled every reader with a mingled emotion of merriment and amazement. Whilſt he was enjoying the reputation of this work, he was ſuddenly called to a home of ſorrow. Poor Stella was ſinking into the grave; and after a languiſhing decay of about two months, died in her 44th year, on January 28. 1728. How much he wiſhed her life is ſhown by his papers; nor can it be doubted that he dreaded the death of her whom he loved moſt, aggravated by the conſciouſneſs that himſelf had haſtened it. With her vaniſhed all his domeſtic enjoyments, and of courſe he turned his thoughts more to public affairs; in the contemplation of which he could ſee nothing but what ſerved to increaſe the malady. The advances of old age, with all its attendant infirmities; the death of almoſt all his old friends; the frequent returns of his moſt diſpiriting maladies, deafneſs and giddineſs; and, above all, the dreadful apprehenſions that he ſhould outlive his underſtanding, made life ſuch a burden to him, that he had no hope left but a ſpeedy diſſolution, which was the object of his daily prayer to the Almighty.

The ſeverity of his temper increaſing, he drove his acquaintance from his table, and wondered why he was deſerted. In 1732, he complains, in a letter to Mr Gay, that "he had a large houſe, and ſhould hardly find one viſitor if he was not able to hire him with a bottle of wine:" and, in another to Mr Pope, "that he was in danger of dying poor and friendleſs, even his female friends having forſaken him; which," as he ſays, "vexed

Swift. ed him moſt." Theſe complaints were afterwards repeated in a ſtrain of yet greater ſenſibility: "All my friends have forſaken me.

"*Vertiginoſus, inops, ſurdus, male gratus amicis.*

"Deaf, giddy, helpleſs, left alone,
"To all my friends a burden grown."

The fits of giddineſs and deafneſs to which he had been ſubjected from his boyiſh years, and for which he thought walking or riding the beſt remedy, became more frequent and violent as he grew old; and the preſentiment which he had long entertained of that wretchedneſs which would inevitably overtake him towards the cloſe of life, clouded his mind with melancholy and tinged every object around him. How miſerable he was rendered by that gloomy proſpect, we may learn from the following remarkable anecdote mentioned by Mr Faulkner in his letter to Lord Cheſterfield. "One time, in a journey from Drogheda to Navan, the dean rode before the company, made a ſudden ſtop, diſmounted from his horſe, fell on his knees, lifted up his hands, and prayed in the moſt devout manner. When his friends came up, he deſired and inſiſted on their alighting; which they did, and aſked him the meaning. "Gentlemen," ſaid he, "pray join your hearts in fervent prayers with mine, that I may never be like this oak-tree, which is decayed and withered at top, while the other parts are ſound." In 1736, while he was writing a ſatire called the *Legion Club* againſt the Iriſh parliament, he was ſeized with ſo dreadful a fit of his malady, that he left the poem unfiniſhed; and never after attempted a compoſition that required a courſe of thinking. From this time his memory gradually declined, his paſſions perverted his underſtanding, and, in 1741, he became utterly incapable of converſation; and it was found neceſſary to appoint legal guardians to his perſon and his fortune. He now loſt all ſenſe of diſtinction. His meat was brought to him cut into mouthfuls; but he would never touch it while the ſervant ſtaid; and at laſt, after it ſtood perhaps an hour, would eat it walking; for he continued his old habit, and was on his feet ten hours a day. During next year a ſhort interval of reaſon enſuing, gave hopes of his recovery; but in a few days he ſunk into lethargic ſtupidity, motionleſs, heedleſs, and ſpeechleſs. After a year of total ſilence, however, when his houſekeeper told him that the uſual illuminations were preparing to celebrate his birth, he anſwered, "It is all folly; they had better let it alone." He at laſt ſunk into a perfect ſilence, which continued till the 29th of October 1745, when he expired without a ſtruggle, in his 78th year. The behaviour of the citizens on this occaſion gave the ſtrongeſt proof of the deep impreſſion he had made on their minds. Though he had been ſo many years to all intents and purpoſes dead to the world, and his departure from that ſtate ſeemed a thing rather to be wiſhed than deplored, yet no ſooner was his death announced, than they gathered from all quarters, and forced their way in crowds into the houſe, to pay the laſt tribute of grief to their departed benefactor. Nothing but lamentations were heard all around the quarter where he lived, as if he had been cut off in the vigour of his years. Happy were they who firſt got into the chamber where he lay, to procure, by bribes to the ſervants, locks of his hair, to be handed down as ſacred relics to their poſterity; and ſo eager were numbers to obtain at any price this precious memorial, that in leſs than an hour, his venerable head was entirely ſtripped of all its ſilver ornaments, ſo that not a hair remained. By his will, which was dated in May 1740, juſt before he ceaſed to be a reaſonable being, he left about 1200l. in ſpecific legacies; and the reſt of his fortune, which amounted to about 11,000l. to erect and endow an hoſpital for lunatics and idiots. He was buried in the moſt private manner, according to directions in his will, in the great aiſle of St Patrick's cathedral, and, by way of monument, a ſlab of black marble was placed againſt the wall, on which was engraved the following Latin epitaph, written by himſelf: Swift.

Hic depoſitum eſt corpus
JONATHAN SWIFT, S. T. P.
Hujus Eccleſiæ Cathedralis
Decani:
Ubi ſæva indignatio
Ulterius cor lacerare nequit.
Abi, viator,
Et imitare, ſi poteris,
Strenuum pro virili libertatis vindicem.
Obiit anno (1745)
Menſis (Octobris) die (29.)
Ætatis anno 78.

Swift undoubtedly was a man of native genius. His fancy was inexhauſtible; his conceptions were lively and comprehenſive; and he had the peculiar felicity of conveying them in language equally correct, free, and perſpicuous. His penetration was as quick as intuition; he was indeed the critic of nature; and no man ever wrote ſo much, and borrowed ſo little.

As his genius was of the firſt claſs, ſo were ſome of his virtues. The following anecdote will illuſtrate his filial piety. His mother died in 1710, as appears by a memorandum in one of the account-books which Dr Swift always made up yearly, and on each page entered minutely all his receipts and expences in every month, beginning his year from November 1. He obſerved the ſame method all his lifetime till his laſt illneſs. At the foot of that page which includes his expences of the month of May 1710, at the glebe houſe of Laracor in the county of Meath, where he was then reſident, are theſe remarkable words, which ſhow at the ſame time his filial piety, and the religious uſe which he thought it his duty to make of that melancholy event. "*Mem.* On Wedneſday, between ſeven and eight in the evening, May 10. 1710, I received a letter in my chamber at Laracor (Mr Percival and Jo. Beaumont being by) from Mrs F—, dated May 9, with one incloſed, ſent by Mrs Worral at Leiceſter to Mrs F—, giving an account that my dear mother, Mrs Abigail Swift, died that morning, Monday April 24. 1710, about ten o'clock, after a long ſickneſs: being ill all winter, and lame; and extremely ill about a month or ſix weeks before her death. I have now loſt my barrier between me and death. God grant I may live to be as well prepared for it as I confidently believe her to have been! If the way to heaven be through piety, truth, juſtice, and charity, ſhe is there. J. S." He always treated his mother, during her life, with the utmoſt duty and affection; and ſhe ſometimes came to Ireland to viſit him after his ſettlement at Laracor.

The liberality of the dean hath been a topic of juſt

Swift. encomium with all his admirers; nor could his enemies deny him this praiſe. In his domeſtic affairs, he always acted with ſtrict economy. He kept the moſt regular accounts; and he ſeems to have done this chiefly with a view to increaſe his power of being uſeful. "His income, which was little more than 700l. per annum, he endeavoured to divide into three parts, for the following purpoſes. Firſt, to live upon one-third of it. Secondly, to give another third in penſions and charities, according to the manner in which perſons who received them had lived: and the other third he laid by, to build an hoſpital for the reception of idiots and lunatics." "What is remarkable in this generous man, is this (ſays Mr F.), that when he lent money upon bond or mortgage, he would not take the legal intereſt, but one per cent. below it."

His charity appears to have been a ſettled principle of duty more than an inſtinctive effort of good nature: but as it was thus founded and ſupported, it had extraordinary merit, and ſeldom failed to exert itſelf in a manner that contributed moſt to render it beneficial. He did not laviſh his money on the idle and the worthleſs. He nicely diſcriminated characters, and was ſeldom the dupe of impoſition. Hence his generoſity always turned to an uſeful account; while it relieved diſtreſs, it encouraged induſtry, and rewarded virtue. We dwell with great pleaſure on this truly excellent and diſtinguiſhing part of the dean's character: and for the ſake of his charity we can overlook his oddities, and almoſt forgive his faults. He was a very peculiar man in every reſpect. Some have ſaid, "What a man he would have been, had he been without thoſe whims and infirmities which ſhaded both his genius and his character!" But perhaps the peculiarities complained of were inſeparable from his genius. The vigour and fertility of the root could not fail now and then of throwing out ſuperfluous ſuckers. What produced theſe, produced alſo the more beautiful branches, and gave the fruit all its richneſs.

It muſt be acknowledged, that the dean's fancy hurried him into great abſurdities and inconſiſtencies, for which nothing but his extraordinary talents and noble virtues, diſcovered in other inſtances, could have atoned. The rancour he diſcovered on all occaſions towards the diſſenters is totally unjuſtifiable. No ſect could have merited it in the degree in which he always ſhowed it to them; for, in ſome inſtances, it bordered on downright perſecution. He doubtleſs had his reaſons for expoſing their principles to ridicule, and might perhaps have ſufficient grounds for ſome of his accuſations againſt their principal leaders in Ireland; but nothing could juſtify his virulence againſt the whole body. In a ſhort poem on one claſs of diſſenters he beſtowed a ſtricture upon Betteſworth, a lawyer eminent for his inſolence to the clergy, which, from a very conſiderable reputation, brought him into immediate and univerſal contempt. Betteſworth, enraged at his diſgrace and loſs, went to the dean, and demanded whether he was the author of that poem? "Mr Betteſworth (anſwered he), I was in my youth acquainted with great lawyers, who, knowing my diſpoſition to ſatire, adviſed me, if any *ſcoundrel* or *blockhead* whom I had lampooned ſhould aſk, 'Are you the author of this paper?' to tell him that I was not the author; and therefore, I tell *you*, Mr Betteſworth, that I am not the author of theſe lines." Swift.

Swift has been accuſed of irreligion and miſanthropy, on account of his Tale of a Tub, and his Yahoos in Gulliver's Travels; but both charges ſeem to be ill-founded, or at leaſt not ſupported by that evidence. The *Tale of a Tub* holds up to ridicule ſuperſtitious and fanatical abſurdities; but it never attacks the eſſentials of religion: and in the ſtory of the *Yahoos*, diſguſting we confeſs, there appears to us as little evidence that the author hated his own ſpecies, as in the poems of *Strephon and Chloe*, and the *Ladies Dreſſing Room*, that he approved of groſſneſs and filth in the female ſex. We do not indeed, with his fondeſt admirers, perceive the moral tendency of the Voyage to the Houyhnhnms, or conſider it as a ſatire admirably calculated to reform mankind; but neither do we think that it can poſſibly corrupt them, or lead them to think meanly of their rational nature. According to Sheridan, "the deſign of this apologue is to place before the eyes of man a picture of the two different parts of his frame, detached from each other, in order that he may the better eſtimate the true value of each, and ſee the neceſſity there is that the one ſhould have an abſolute command over the other. In your merely animal capacity, ſays he to man, without reaſon to guide you, and actuated only by a blind inſtinct, I will ſhow you that you would be degraded below the beaſts of the field. That very form, that very body, you are now ſo proud of, as giving you ſuch a ſuperiority over all other animals, I will ſhow you, owe all their beauty, and all their greateſt powers, to their being actuated by a rational ſoul. Let that be withdrawn, let the body be inhabited by the mind of a brute, let it be prone as theirs are, and ſuffered like theirs to take its natural courſe, without any aſſiſtance from art, you would in that caſe be the moſt deformed, as to your external appearance, the moſt deteſtable of all creatures. And with regard to your internal frame, filled with all the evil diſpoſitions and malignant paſſions of mankind, you would be the moſt miſerable of beings, living in a continued ſtate of internal vexation, and of hatred and warfare with each other.

"On the other hand, I will ſhow another picture of an animal endowed with a rational ſoul, and acting uniformly up to the dictates of right reaſon. Here you may ſee collected all the virtues, all the great qualities, which dignify man's nature, and conſtitute the happineſs of his life. What is the natural inference to be drawn from theſe two different repreſentations? Is it not evidently a leſſon to mankind, warning them not to ſuffer the animal part to be predominant in them, leſt they reſemble the vile Yahoo, and fall into vice and miſery; but to emulate the noble and generous Houyhnhnm, by cultivating the rational faculty to the utmoſt; which will lead them to a life of virtue and happineſs."

Such *may* have been the author's intention; but it is not ſufficiently obvious to produce the proper effect, and is indeed hardly conſiſtent with that incapability under which he repreſents the Yahoos of ever acquiring, by any culture, the virtues of the noble Houyhnhnms.

With reſpect to his religion, it is a fact unqueſtionable, that while the power of ſpeech remained, he continued conſtant in the performance of his private devotions; and in proportion as his memory failed, they were

were gradually ſhortened, till at laſt he could only repeat the Lord's prayer, which he continued to do till the power of utterance for ever ceaſed. Such a habit as this could not have been formed but by a man deeply impreſſed with a conviction of the truth and importance of revelation.

The moſt inexcuſable part of Swift's conduct is his treatment of Stella and Vaneſſa, for which no proper apology can be made, and which the vain attempts of his friends have only tended to aggravate. One attributes his ſingular conduct to a peculiarity in his conſtitution; but if he knew that he was incapable of fulfilling the duties of the married ſtate, how came he to tie one of the ladies to himſelf by the marriage ceremony, and in the moſt explicit terms to declare his paſſion to the other? And what are we to think of the ſenſibility of a man who, ſtrongly attached as he ſeems to have been to both, could, without ſpeaking, fling a paper on the table of the one, which "proved (as our author expreſſes it) her death-warrant," and could throw the other, his beloved Stella, in her laſt illneſs, into unſpeakable agonies, and "never ſee her more, for only adjuring him, by their friendſhip, to let her have the ſatisfaction of dying at leaſt, though ſhe had not lived, his acknowledged wife?" Another apologiſt inſinuates, upon ſomething like evidence, that Stella bore a ſon to Swift, and yet labours to excuſe him for not declaring her his wife, becauſe ſhe had agreed at the marriage that it ſhould remain a ſecret from all the world unleſs the diſcovery ſhould be called for by *urgent neceſſity*; but what could be meant by the term *urgent neceſſity*, unleſs it alluded to the birth of children, he confeſſes that it would be hard to ſay. The truth we believe to be what has been ſaid by Johnſon, that the man whom Stella had the misfortune to love was fond of ſingularity, and deſirous to make a mode of happineſs for himſelf, different from the general courſe of things and the order of Providence; he wiſhed for all the pleaſures of perfect friendſhip, without the uneaſineſs of conjugal reſtraint. But with this ſtate poor Stella was not ſatisfied; ſhe never was treated as a wife, and to the world ſhe had the appearance of a miſtreſs. She lived ſullenly on, hoping that in time he would own and receive her. This, we believe, he offered at laſt to do, but not till the change of his manners and the depravation of his mind made her tell him, that "it was too late."

The natural acrimony of Swift's temper had been increaſed by repeated diſappointments. This gave a ſplenetic tincture to his writings, and amidſt the duties of private and domeſtic life it too frequently appeared to ſhade the luſtre of his more eminent virtues.—The dean hath been accuſed of avarice, but with the ſame truth as he hath been accuſed of infidelity. In detached views, no man was more liable to be miſtaken. Even his genius and good ſenſe might be queſtioned, if we were only to read ſome paſſages of his writings. To judge fairly and pronounce juſtly of him as a man and as an author, we ſhould examine the uniform tenor of his diſpoſition and conduct, and the general nature and deſign of his productions. In the latter he will appear great, and in the former good; notwithſtanding the puns and puerilities of the one, and the abſurdities and inconſiſtencies of the other.

SWIFT, a ſpecies of ſwallow. See HIRUNDO, ORNITHOLOGY *Index*.

SWIMMING, the art of ſuſpending one's ſelf on water, and at the ſame time making a progreſſive motion through it. Swimming.

1 Swimming not natural to man.

As ſwimming is not natural to man, it is evident that at ſome period it muſt have been unknown among the human race. Nevertheleſs there are no accounts of its origin to be found in the hiſtory of any nation; nor are there any nations ſo barbarous but that the art of ſwimming is known among them, and that in greater perfection than among civilized people. It is probable, therefore, that the art, though not abſolutely natural, will always be acquired by people in a ſavage ſtate from imitating the brute animals, moſt of whom ſwim naturally. Indeed ſo much does this appear to be the caſe, that very expert ſwimmers have recommended it to thoſe who wiſhed to learn the art, to keep ſome frogs in a tub of water conſtantly beſide them, and to imitate the motions by which they move through that element.

2 Depends on a ſimple principle.

The theory of ſwimming depends upon one very ſimple principle; namely, that if a force be applied to any body, it will always move towards that ſide where there is the leaſt reſiſtance. Thus, if a perſon ſtanding in a boat puſhes with a pole againſt the ſide or any other part of the veſſel in which he ſtands, no motion will enſue; for as much as he preſſes in one direction with the pole, juſt ſo much does the action of his feet, on which the preſſure of the pole muſt ultimately reſt, puſh the veſſel the other way: but if, inſtead of the ſide of the veſſel, he puſhes the pole againſt the ſhore, then only one force acts upon it, namely, that of the feet; which being reſiſted only by the fluid water, the boat begins to move from the ſhore. Now the very ſame thing takes place in ſwimming, whether the animal be man, quadruped, bird, or fiſh. If we conſider the matter ſimply, we may ſuppoſe an animal in ſuch a ſituation that it could not poſſibly ſwim: thus, if we cut off the fins and tail of a fiſh, it will indeed float in conſequence of being ſpecifically lighter than the water, but cannot make any progreſſive motion, or at leaſt but very little, in conſequence of wriggling its body; but if we allow it to keep any of its fins, by ſtriking them againſt the water in any direction, the body moves the contrary way, juſt as a boat moves the contrary way to that in which the oars ſtrike the water. It is true, that as the boat is but partly immerged in the water, the reſiſtance is comparatively leſs than when a frog or even any other quadruped ſwims; but a boat could certainly be rowed with oars though it was totally immerged in water, only with leſs velocity than when it is not. When a man ſwims, he in like manner ſtrikes the water with his hands, arms, and feet; in conſequence of which the body moves in a direction contrary to the ſtroke. Upon this principle, and on this only, a man may either aſcend, deſcend, or move obliquely in any poſſible direction, in the water. One would think, indeed, that as the ſtrength of a man's arms and legs is but ſmall, he could make but very little way by any ſtroke he could give the water, conſidering the fluidity of that element. Nevertheleſs it is incredible what expert ſwimmers will perform in this way; of which Mr Forſter gives a moſt remarkable inſtance in the inhabitants of Otaheite; whoſe agility, he tells us, was ſuch, that when a nail was thrown overboard, they would jump after it into the ſea, and never fail to catch it before it reached to the bottom.

As to the practice of ſwimming, there are but few directions

Swimming. directions which can be given. The great obſtacle is the natural dread which people have of being drowned; and this it is impoſſible to overcome by any thing but accuſtoming ourſelves to go into the water. With regard to the real danger of being drowned, it is but little; and on innumerable occaſions ariſes entirely from the terror above mentioned, as will appear from the following obſervations by Dr Franklin.

3 Obſervations by Dr Franklin.

"1ſt, That though the legs, arms, and head, of a human body, being ſolid parts, are ſpecifically ſomewhat heavier than freſh water, yet the trunk, particularly the upper part, from its hollowneſs, is ſo much lighter than water, as that the whole of the body, taken together, is too light to ſink wholly under water, but ſome part will remain above until the lungs become filled with water; which happens from drawing water into them inſtead of air, when a perſon in the fright attempts breathing while the mouth and noſtrils are under water.

"2dly, That the legs and arms are ſpecifically lighter than ſalt water, and will be ſupported by it; ſo that a human body would not ſink in ſalt water though the lungs were filled as above, but from the greater ſpecific gravity of the head.

"3dly, That therefore a perſon throwing himſelf on his back in ſalt water, and extending his arms, may eaſily lie ſo as to keep his mouth and noſtrils free for breathing; and by a ſmall motion of his hands may prevent turning, if he ſhould perceive any tendency to it.

4thly, That in freſh water, if a man throws himſelf on his back near the ſurface, he cannot long continue in that ſituation, but by a proper action of his hands on the water. If he uſes no ſuch action, the legs and lower part of the body will gradually ſink till he comes into an upright poſition; in which he will continue ſuſpended, the hollow of the breaſt keeping the head uppermoſt.

5thly, But if in this erect poſition the head is kept upright above the ſhoulders, as when we ſtand on the ground, the immerſion will, by the weight of that part of the head that is out of the water, reach above the mouth and noſtrils, perhaps a little above the eyes; ſo that a man cannot long remain ſuſpended in water with his head in that poſition.

"6thly, The body continued ſuſpended as before, and upright, if the head be leaned quite back, ſo that the face looks upwards, all the back part of the head being then under water, and its weight conſequently in a great meaſure ſupported by it, the face will remain above water quite free for breathing, will riſe an inch higher every inſpiration, and ſink as much every expiration, but never ſo low as that the water may come over the mouth.

"7thly, If therefore a perſon unacquainted with ſwimming, and falling accidentally into the water, could have preſence of mind ſufficient to avoid ſtruggling and plunging, and to let the body take this natural poſition, he might continue long ſafe from drowning, till perhaps help would come; for as to the clothes, their additional weight while immerſed is very inconſiderable, the water ſupporting it; though when he comes out of the water, he would find them very heavy indeed."

4 His method of learning to ſwim.

The method of learning to ſwim is as follows: The perſon muſt walk into water ſo deep that it will reach to the breaſt. He is then to lie down gently on the belly, keeping the head and neck perfectly upright, the breaſt advancing forward, the thorax inflated, and the back bent; then withdrawing the legs from the bottom, and ſtretching them out, ſtrike the arms forwards in uniſon with the legs. Swimming on the back is ſomewhat ſimilar to that on the belly; but with this difference, that although the legs are employed to move the body forwards, the arms are generally unemployed, and the progreſſive motion is derived from the movement of the legs. In diving, a perſon muſt cloſe his hands together, and, preſſing his chin upon his breaſt, make an exertion to bend with force forwards. While in that poſition, he muſt continue to move with rapidity under the ſurface; and whenever he chooſes to return to his former ſituation, he has nothing to do but bend back his head, and he will immediately return to the ſurface.

Swimm

It is very common for novices in the art of ſwimming to make uſe of corks or bladders to aſſiſt in keeping the body above water. Some have utterly condemned the uſe of theſe; however, Dr Franklin allows that they may be of ſervice for ſupporting the body while one is learning what is called the *ſtroke*, or that manner of drawing in and ſtriking out the hands and feet that is neceſſary to produce progreſſive motion. "But (ſays he) you will be no ſwimmer till you can place confidence in the power of the water to ſupport you: I would therefore adviſe the acquiring that confidence in the firſt place, eſpecially as I have known ſeveral who, by a little of the practice neceſſary for that purpoſe, have inſenſibly acquired the ſtroke, taught as it were by nature.

5 and of a quiring fidence.

"The practice I mean is this: Chooſing a place where the water deepens gradually, walk coolly into it till it is up to your breaſt: then turn round your face to the ſhore, and throw an egg into the water, between you and the ſhore; it will ſink to the bottom, and be eaſily ſeen there, if the water is clear. It muſt lie in the water ſo deep as that you cannot reach it to take it up but by diving for it. To encourage yourſelf in order to do this, reflect that your progreſs will be from deeper to ſhallower water; and that at any time you may, by bringing your legs under you, and ſtanding on the bottom, raiſe your head far above the water: then plunge under it with your eyes open, throwing yourſelf towards the egg, and endeavouring, by the action of your hands and feet againſt the water, to get forward till within reach of it. In this attempt you will find that the water buoys you up againſt your inclination; that it is not ſo eaſy a thing to ſink as you imagined; that you cannot but by active force get down to the egg. Thus you feel the power of the water to ſupport you, and learn to confide in that power; while your endeavours to overcome it, and to reach the egg, teach you the manner of acting on the water with your feet and hands; which action is afterwards uſed in ſwimming to ſupport your head higher above water, or to go forward through it."

6 Swimm a pleaſa and uſef exerciſe

As ſwimming is a healthy exerciſe and a pleaſant amuſement, and as a dexterity in it may frequently put it in a man's power to ſave his own life and the lives of his fellow-creatures, perhaps of his deareſt friends, it can neither be uſeleſs nor unintereſting to conſider a few of the evolutions which a ſwimmer muſt be maſter of, that he move in any direction without difficulty, without danger, and without being unneceſſarily fatigued.

There

There are ſeveral different ways of turning one's ſelf in ſwimming. You may do it in this way: Turn the palm of the right hand outwards, extend the arm in the ſame manner, and make a contrary movement with the left hand and left arm; then, by a gradual motion, incline your head and whole body to the left ſide, and the evolution will be finiſhed. There is another way which is eaſier ſtill: Bend your head and body toward that ſide to which you are going to turn. If you wiſh to turn to the left, incline the thumb and the right hand toward the bottom, bend the fingers of the right hand, ſtretch it out, and uſe it for driving away the water ſidewiſe, or, which is the ſame thing, for puſhing yourſelf the contrary way. At the ſame time, with your left hand, the fingers being cloſe, puſh the water behind you, and all at once turn your body and your face to the left, and the manœuvre will be accompliſhed. If you wiſh to turn to the right, you muſt do with your right hand what you did with your left, and with your left what you did with your right. You muſt be careful when turning yourſelf never to ſtretch out your legs, and be ſure that the water be ſo deep that you be in no danger of hurting yourſelf. Swimming.

When you are ſwimming on your belly, and wiſh to turn on your back, draw your feet in quickly, and throw them before you; ſtretch out your hands behind you, and keep your body firm and ſteady. When you wiſh to turn from ſwimming on your back, fold your feet at once under your body as if you were throwing them to the bottom, and at the ſame inſtant dart your body forwards, that you may fall upon your belly.

In ſwimming, the eyes ought to be turned towards heaven. This is a moſt important rule, and to the neglect of it many of the accidents which befal ſwimmers are owing. For when they bend their eyes downwards, they inſenſibly bend their head too, and thus the mouth being too deep in the water, may admit a quantity of it in breaking; beſides, the more the body is ſtretched, it covers a greater part of the ſurface of the water, and conſequently its ſpecific gravity is leſs. Any perſon who will make the experiment will find it impoſſible to dive while he keeps his head erect and his eyes fixed on the heavens (A).

The eaſieſt poſture in ſwimming is lying on the back. When you wiſh to ſwim in this poſture, lay yourſelf ſoftly on your back, and raiſe your breaſt to the ſurface of the water, keeping your body extended in the ſame line. Put your hands eaſily over the upper part of your thighs, and throw out your legs and draw them in alternately, keeping them within two feet of the ſurface. In this way you may advance in any direction you pleaſe. You may perhaps not like having ſo much of your head under water; there is, however, no way of ſwimming ſo eaſy, ſo ſafe, and ſo little fatiguing. If you wiſh to ſwim with great rapidity, you may uſe your arms as well as your feet; and you will find this the eaſieſt way of breaking the force of the waves.

11 And advance forwards.

In ſwimming on the back, one may advance forward as well as backward. For this purpoſe the body muſt be kept ſtraight and extended; the breaſt inflated, ſo that the hollow of the back may aſſume a ſemicircular form. The hands muſt recline over the upper parts of the thighs. It is alſo neceſſary to raiſe the legs one after another, and draw them in ſtrongly towards the hams, and then leave them ſuſpended in the water. This way of ſwimming is not only pleaſant, but may ſerve to reſt you when fatigued.

12 How to ſwim on one ſide.

When you are tired with ſwimming on your back and belly, you may ſwim on one ſide. When you wiſh to do this, ſink a little your left ſide and raiſe your right; you will immediately find yourſelf on your left ſide. Move then your left hand without either raiſing or ſinking it; you have only to ſtretch it and draw it back, as in a ſtraight line, on the ſurface of the water. Independent of the pleaſure which this kind of motion will give you, you will have the ſatisfaction of ſeeing both ſides of the river.

13 How to ſwim on the belly without the aſſiſtance of the hands.

It is poſſible to ſwim on the belly without the aſſiſtance of the hands. For this purpoſe you muſt keep your breaſt erect, your neck ſtraight, and fix your hands behind your head, or upon your back, while you move forward by employing your feet. This way is not without its advantages. It is an excellent reſource when the arms are ſeized with a cramp, or with any indiſpoſition which makes it painful to exert them. This in ſome caſes may be preferable to ſwimming on the back; for while in that attitude, one cannot ſee before them without turning every inſtant. If one of your legs be ſeized with a cramp, take hold of it with the hand oppoſite to it, and uſe the other hand and leg to advance or ſupport yourſelf.

14 How to ſwim with the hands joined.

A very ancient and graceful mode of ſwimming, is that of ſwimming with the hands joined. When you wiſh to put this in practice, join your hands, keeping the thumbs and fingers towards heaven, ſo that they may appear above the water; then draw them back and puſh them forwards alternately from your breaſt. This method of ſwimming may be uſeful in ſeveral circumſtances, but above all if you are entangled with graſs or weeds. Your hands will then open a paſſage for you.

15 With the hands elevated.

As a perſon may ſometimes have occaſion to carry ſomething in his hand in ſwimming, which he is anxious to preſerve from the water, he may ſwim eaſily with one hand and hold a parcel in the other, as Cæſar ſwam with his Commentaries at Alexandria; or one may ſwim with both hands elevated. To perform this well, the ſwimmer muſt raiſe his breaſt, and keep it as much inflated as

(A) An intereſting queſtion occurs here, which deſerves to be conſidered. Since the body, when ſpread upon the ſurface, can be ſupported with ſo little exertion, and frequently without any at all, as in ſwimming on the back, how comes it to paſs that a perſon when drowned ſinks and frequently riſes again ſome time afterwards? The reaſon is this: In the act of drowning, the lungs are filled with water, and conſequently the body, being ſpecifically heavier, ſinks. It is well known that the human body contains a great quantity of air: this air is at firſt compreſſed by the water; and while this is the caſe the body remains at the bottom: but as ſoon as the air by its elaſticity endeavours to diſengage itſelf from the compreſſion, the body is ſwelled and expanded, becomes ſpecifically lighter than the water, and conſequently riſes to the top.

Swimming as he can, at the ſame time that he ſupports the arms above the water. It muſt not be concealed, that this method of ſwimming is attended with ſome danger to one who is not dexterous at the art; for if one ſhould imprudently draw in his breaſt, when his arms are raiſed, he would immediately ſink to the bottom.

Switzerland.

16 How to riſe to the ſurface after diving.

When a man plunges into the water, and has reached the bottom, he has only to give a ſmall ſtroke with his foot againſt the ground, in order to riſe; but an experienced ſwimmer, if he miſſes the ground, has recourſe to another expedient, which is very pretty, and which has not been much conſidered. Suppoſe him at a conſiderable depth, when he perceives that he cannot reach the bottom. In ſuch a caſe, he firſt puts his hands before his face, at the height of his forehead, with the palms turned outwardly; then holding the fore part of his arm vertically, he makes them move backwards and forwards from right to left; that is to ſay, theſe two parts of his arms, having the elbow as a kind of pivot, deſcribe very quickly, both the hands being open, and the fingers joined, two ſmall portions of a circle before the forehead, as if he would make the water retire, which he in fact does; and from theſe ſtrokes given to the water, there reſults an oblique force, one part of which carries the ſwimmer upwards.

There are many artificial methods of ſupporting one's ſelf in water, but we have not room to deſcribe them.—Thoſe who wiſh to ſee a full account of them may conſult the *Encyclopédie Methodique*.

SWIMMING of Fiſh. A great proportion of the inhabitants of the waters have an air-bladder, by which they poiſe themſelves. Their movements chiefly depend upon their tail. See ANATOMY, Part II.; and ICHTHYOLOGY.

SWINDLER, a word which has been lately adopted into the Engliſh language, derived from the German word *ſchwindel*, "to cheat." Swindling has now become ſo common in ſeveral of the great towns of this country, that it is unfortunately too well known to require any deſcription.

SWINE. See SUS, MAMMALIA *Index*.

SWINE-Stone. See MINERALOGY *Index*.

SWINGING, a kind of exerciſe ſtrongly recommended to perſons in conſumption by ſome phyſicians, and diſapproved of by others. See MEDICINE *Index*.

SWING-TREE of a waggon, is the bar faſtened acroſs the fore-guide, to which the traces of the horſes are faſtened.

SWING-Wheel, in a royal pendulum, that wheel which drives the pendulum. In a watch or balance clock it is called the crown-wheel.

SWINGLE, in the fireworks in England, the wooden ſpoke which is fixed to the barrel that draws the wire, and which, by its being forced back by the cogs of the wheel, is the occaſion of the force with which the barrel is pulled.

SWITZ, or SCHWEITS, the capital of one of the cantons of Switzerland, to which it gives name, ſeated on the eaſt ſide of the lake Lucerne, in N. Lat. 46. 55. E. Long. 8. 30.

1 Situation.

SWISSERLAND, or SWITZERLAND, a mountainous diſtrict of the ſouth of Europe, which at the latter end of the 18th century, formed a republic compoſed of ſeveral independent ſtates or cantons, but which may now be regarded as a province of France.

Switzerland.

Switzerland is bounded on the north and eaſt by Germany, on the ſouth by Italy, and on the weſt by the departments of the Higher and Lower Alps, and the mouths of the Rhone. Its extent from eaſt to weſt is computed at about 200 Britiſh miles, and its breadth from north to ſouth at about 130 Britiſh miles. Its contents in ſquare miles are eſtimated at 14,960.

2 Boundaries and extent.

3 Diviſion.

Before it was reduced to the condition of a French province, Switzerland contained 13 independant cantons, and a number of ſmall diſtricts, which were dependent on the cantons. The independent cantons were, 1. Berne, including the *Pays de Vaud*; 2. FRIBURG; 3. BASIL; 4. SOLEURE; 5. SCHAFFHAUSEN; 6. ZURICH; 7. APPENZEL; 8. LUCERNE; 9. ZUG; 10. SCHWEITZ; 11. UNDERWALDEN; 12. URI; 13. GLARIS. The diſtricts dependent on theſe cantons were, the principality of *Neufchatel*; the biſhopric of *Baſil*; county of *Baden*; the free *Baillages*; *Turgovia*; *Tokenburg*; the *Rheinthal*; lands of the Abbey of *St Gal*; country of the *Griſons*; *Valteline*; Italian *Baillages*; the *Vallais*. Since its ſubjection to France, the country has been divided into the following 19 cantons; viz. Appenzel, Argovia, Baſil, Friburg, Glaris, Griſons, Lucerne, St Gal, Schaffhauſen, Schweitz, Soleure, Teſſin, Thurgovia, Underwald, Uri, Vaud, Zug, and Zurich. An account of the moſt important of theſe cantons, and of their capitals, will be found under their proper heads in this work.

4 Air, ſoil, produce, &c.

With reſpect to the air, ſoil, and produce, that part of the canton of Berne to the eaſt of the lake of Geneva, together with the cantons of Uri, Schweitz, Underwalden, Glaris, and Appenzel, and part of the canton of Lucerne, conſiſt of ſtupendous mountains, whoſe ſummits are ſaid to be from 9000 to 12000 feet above the level of the ſea, conſiſting of inacceſſible rocks, of which ſome are quite bare, while others are always covered with ice and ſnow. Among the mountains are many excellent medicinal and other ſprings, cold and warm baths, water-falls, precipices, deep narrow valleys, and caverns. The higheſt are thoſe in the canton of Uri. Many of the valleys are covered with lakes, or watered by brooks and rivers.

In ſome of them are towns, villages, woods, vineyards, and corn-lands. Both on the mountains and in the valleys the air is extremely cold in winter; but in ſummer it is very pleaſant, cool, and refreſhing in the former, but exceſſively hot in the latter. Sometimes it is winter on the north ſide of a mountain when it is ſummer on the other; nay, flowers may be gathered ſometimes with one hand and ſnow with the other. Prodigious maſſes of ice and ſnow often fall from them in winter, and do a great deal of damage; and moſt of the ſtreams and rivers take their riſe from the thawing of the ice and ſnow on their ſides and tops. From the riſing or deſcending of the clouds, with which they are commonly enveloped, the inhabitants can, for the moſt part, pretty exactly foretel the changes of the weather; ſo that they ſerve them inſtead of weather glaſſes.

The other and lower parts of Switzerland are very pleaſant and fertile, being diverſified with vineyards, cornfields, meadows, and paſture-grounds. The mountains in theſe are but mole-hills in compariſon of the others; there is neither ſnow nor ice on them in ſummer; and they frequently afford not only good paſturage, but arable ground. Many petrifactions are found both among

these and the others, with a variety of foſſils. The ſands of the rivers yield gold duſt, particularly thoſe of the Rhine, the Emmet, and the Aar, the Reuſs, the Arve, and the Inn.

The metals of this country being generally found to be brittle, the only mines that are worked are a few of iron. In the lower parts of Switzerland they ſow rye, oats, barley, ſpelt, flax, hemp. Wines of various ſorts are alſo produced by ſome of them, with a variety of fruits. Of wood for fuel and other uſes there is generally plenty; in ſome places, however, they are obliged to burn ſheep's dung, and in others a kind of heath and ſmall ſhrubs. In the valleys they cultivate ſaffron with ſucceſs. The Swiſs derive their principal ſubſiſtence from their flocks and herds of cattle, which in ſummer graze on the mountains. Their cheeſe is much eſteemed, eſpecially that of Berne and Griers in the canton of Friburg. Great numbers of horſes are alſo bred here, and bought up for the French cavalry. Beſides the above-mentioned rivers, the Rhone and the Teſin have their ſources in this country. The lakes are very numerous; but the chief are thoſe of Geneva, Neufchatel, Biel, Zurich, Thun, Brien, Conſtance, and Lucerne. Both rivers and lakes abound with fiſh, and afford a cheap water-carriage. Switzerland is not ſo populous as many other countries in Europe; and the Popiſh cantons leſs ſo than the Proteſtant. The total number of the inhabitants is computed at 2,000,000.

The language generally ſpoken here is the German, in which alſo public affairs are tranſacted; but in thoſe parts of the country that border on Italy or France, a corrupt French or Italian prevails. The two predominant religions are Calviniſm and Popery. Of the former are the cantons of Zurich and Berne, the towns of St Gal, Geneva, Muhlhauſen, and Biel, the principality of Neufchatel, the greater part of Baſle, Schaffhauſen, the country of the Griſons, the Thurgau, Toggenburg, Glaris, and the Rhine valley; the frontiers of Appenzel, with a ſmall part of Solothurn, and ſome places in the mountains of Baden and Sargans. The reſt of the Swiſs cantons, allies, and dependents, are Popiſh. For the education of youth there is an univerſity at Baſle, and academies at Zurich, Berne, Lauſanne, and Geneva; beſides gymnaſiums and ſcholæ illuſtres, both in the Popiſh and Proteſtant cantons. There are alſo ſocieties among them for the improvement of the German language, and the ſciences.

The principal manufactures are ſnuff and tobacco, linen of ſeveral ſorts, lace, thread, ſilk, and worſted ſtockings, neckcloths, cotton ſtuffs, gloves, handkerchiefs, ſilks of ſeveral ſorts, gold and ſilver brocades, a variety of woollen manufactures, hats, paper, leather of all ſorts, earthen wares, porcelain, toys, watches, clocks, and other hardwares, &c. The trade of Switzerland is generally promoted by many navigable lakes and rivers. In ſome of the above manufactures, and in cheeſe, butter, ſheep, horſes, black cattle, hides, and ſkins, the exports are conſiderable; and as the imports are chiefly grain and ſalt, with ſome American and Aſiatic goods, there is probably a large balance in their favour. In ſome parts of Switzerland dreſs is reſtrained by ſumptuary laws.

The Swiſs are a brave, honeſt, hoſpitable, hardy people; very true to their engagements, friendly and humane. In ſhort, there is not a people in Europe whoſe national character is better. In their perſons they are generally tall, robuſt, and well-made; but their complexions are none of the beſt, and thoſe that live in the neighbourhood of the mountains are ſubject to wens. The women are ſaid to be generally handſome and well-ſhaped, ſenſible and modeſt, yet frank, eaſy, and agreeable in converſation. Few of the peaſants are miſerably poor; many of them are rich, eſpecially in the Proteſtant cantons, and that of Berne in particular. Switzerland.

9 Outline of the hiſtory of Switzerland.

In the very confined limits to which we are now reduced, we cannot give more than a faint outline of the hiſtory of Switzerland. In the firſt century before the Chriſtian era, we find the natives involved in frequent wars with the Romans, by whom the Helvetii and the Rhætii, two of the moſt powerful tribes, were entirely ſubjugated. In the beginning of the 4th century of the Chriſtian era, the Allemanni, a German tribe, made an irruption into Switzerland, occupied the country, and, as is ſuppoſed, extirpated the Helvetii. Soon after we find the weſtern part of Switzerland, as far as the Reuſs, occupied by the Franks, by whom it was annexed to Burgundy, while the eaſtern part, or the Griſons, was ſubject to Theodoric the Goth, and other Italian princes. In the beginning of the 7th century, Chriſtianity was introduced, chiefly by two Iriſh monks, Columbanus and Gallus. In the beginning of the 10th century, that part of Switzerland which was occupied by the Allemanni, was invaded by the Huns or Ugurs, who in particular ravaged the abbey of St Gal, at that time famous for its power and its literature. The Huns were defeated by Conrad king of Burgundy, about the year 928. Soon after the commencement of the 11th century, the diſtricts of Switzerland began to be regarded as a part of the German empire, and in the two following centuries they gradually became ſubject to the houſe of Hapſburgh. In 1307 commenced the ſtruggles of the Swiſs with the houſe of Auſtria, thoſe glorious ſtruggles which finally terminated in the complete emancipation of that brave people, and in the formation of a confederacy which continued to be the admiration of Europe for nearly five centuries. The tranſactions which mark this conteſt between the inhabitants of a ſmall diſtrict and a mighty monarch, and in particular the heroiſm of their great champion William Tell, are familiar to moſt of our readers. We ſhall therefore only give a ſhort account of the government and inſtitutions of the Swiſs cantons, as they exiſted previous to the late revolution, and ſhall conclude this article with a brief narrative of the proceedings of the French, when they entered Switzerland in 1797.

10 Conſtitution of the Swiſs cantons before the late revolution.

With reſpect to the government and conſtitution of the Swiſs cantons, it muſt be remarked that ſome of them were ariſtocracies and ſome democracies. In the former, both the legiſlative and executive power were lodged in the burghers or citizens of the capital of each canton; and of thoſe there were ſeven, viz. Zurich, Berne, Baſle, Friburg, Soleure, and Schaffhauſen; an account of the moſt important of which may be ſeen under their reſpective names. In the others, the legiſlative power was lodged in the whole body of the people, and every male above 16, whether maſter or ſervant, had a vote in making laws and in the choice of magiſtrates. For what concerned the whole Helvetic body, there were diets ordinary and extraordinary; the former were held

Switzerland.

held annually, and the others on particular emergencies; and both were ſummoned by the city of Zurich, which appointed the time and place of their meetings. Beſides the general diets, ſince the Reformation there were particular diets of the two religions, at which all public affairs of conſequence that regarded the two parties were treated ſeparately; for though a ſenſe of their common intereſt obliged them to ſtudy the maintaining the league and union, yet it is certain that the mutual confidence between the cantons was in ſome meaſure loſt through the zeal of each party for their particular opinions, eſpecially of the Roman Catholics. The annual general diets were held always at Frauenfield or Baden, principally to regulate the affairs of the common baillages. Lucerne took the lead of the Roman Catholic cantons, being the moſt powerful of that denomination; but Zurich, though leſs powerful than that of Berne, took the precedence of all the other cantons, both Proteſtant and Popiſh. Theſe cantons did not make one commonwealth, but were ſo many independent ſtates, united together by ſtrict allianees for their mutual defence. The extraordinary diets or congreſſes were held at Aldorf. Each canton uſually deputed two envoys, both to the ordinary and extraordinary, to which alſo the abbot and the town of St Gal, and the town of Biel, ſent repreſentatives. To the 13 cantons belonged in common 21 baillages, 2 towns, and 2 lordſhips. The allies, as they were called, were the abbot and town of St Gal, the three Griſon leagues, the republic of the Valais, the towns of Muhlhauſen and Biel, the principality of Neuenburg, Geneva, and the biſhop of Baſle. Of theſe, the abbot and town of St Gal, and the town of Biel, were regarded as members of the Helvetic body, but the reſt only as allies.

The public revenues were in general very inconſiderable, though they have been computed at about 1,000,000l. ſterling, ariſing chiefly from the uſual regalia, appropriated every where to the ſovereign, the demeſnes, and public granaries, voluntary contributions, the ſale of ſalt, and a land-tax; in the Proteſtant cantons, from the church lands alſo that were ſeized at the reformation. Except in Zurich, Bern, Baſle, and Schaffhauſen, where the people are more induſtrious, have a greater trade, and are richer than in the others, they defrayed only the ordinary charges.

The cantons never kept any ſtanding troops except for a few garriſons; but their militia was reckoned to be the beſt regulated of any in Europe. Every male from 16 to 60 was enrolled, and about one-third of them formed into regiments. They were all obliged to provide themſelves with arms, clothing, accoutrements, and to appear on the ſtated days for exerciſe; and the ſeveral cantons and diſtricts were obliged to furniſh themſelves with a ſufficient train of artillery, and all the other implements of war. The Swiſs of the ſeveral cantons were allowed to engage in the ſervice of ſuch foreign princes and ſtates as were in alliance with thoſe cantons, or with whom they had made a previous agreement. Such ſtates paying an annual ſubſidy to the reſpective cantons, were allowed to make levies. Every man enliſted voluntarily, for what number of years he pleaſed, at the expiration of which he was at liberty to return home. Many thus always returning from foreign ſervice, Switzerland was never unprovided with able and experienced officers and ſoldiers.

Switzerland.

11 Origin of the diſtinction between the canton and the French public.

It was ſcarcely to be expected that a country ſo long and ſo intimately connected with France, by its poſition, by perpetual alliance, by commerce, and partly by language, ſhould eſcape the influence of the principles of its revolution, when ſtates far more remote and diſtinct were ſtrongly imbued with their ſpirit. But previous to the epoch of the French revolution, various parts of the Swiſs confederation had been the ſeat of civil diſcord, and popular murmurs. In ſome cantons the indignant ſpirit of the ſubject had led him to revolt againſt what he deemed the oppreſſive adminiſtration of the ruler; in others, the diſtinctions which exiſt in ſociety, and which form the different claſſes of privileged and unprivileged individuals, were ſtrangely and inverſely diſtributed. The French revolution, declaring the principle of equality, found a wide prediſpoſition among the ſubjects of the Swiſs confederacy to embrace the cauſe, and as ſtrong a reſiſtance on the part of the governors, who were deeply intereſted in oppoſing the progreſs of opinions ſo immediately ſubverſive of authority. Conſcious that with ſuch a ſyſtem no brotherhood could be cheriſhed, many of the leading cantons kept themſelves in a ſtate of watchfulneſs, bordering on hoſtility, againſt the principles eſtabliſhed by the French national aſſembly. But with ſo powerful a ſanction, the frowns of power were ineffectual to calm the murmurs of diſcontent; and claims, which fear or policy had hitherto ſhut up in ſilence, were now produced, with confidence that they would be admitted from the ſentiment of fear, if not of juſtice.

Among thoſe who were moſt active in demanding a review of their grievances were the inhabitants of the French part of the canton of Berne, known by the name of the Pays-de-Vaud. The nobles and the higher claſſes of this province had long tranſmitted to their children a hereditary hatred of the government of Berne. This diſaffection was not concealed; nor is it ſingular that the deſire of change ſhould operate on the titled and the rich, while they ſaw their political exiſtence depending on the will of a ſelf-elected ſovereign, and their provinces ſubjected to the adminiſtration of an emiſſary of thoſe whom they conſidered as uſurpers of their rights.

But however ſtrongly the ſenſibility of the ſubject inhabitants of the Pays-de-Vaud was excited by this political degradation, they were compelled to ſubmit, or brood over their grievances in ſilence. They were incapable of procuring redreſs by force; and the ſovereign burghers of Berne were too firmly ſeated to regard the remonſtrances of impotent claimants, or to liſten to the murmurs of diſcontent. Partial inſurrections againſt the governments of certain cantons had often taken place in Switzerland. Theſe diſorders had ſometimes been ſuppreſſed and puniſhed with the interpoſition of the neighbouring cantons, where the danger was not exceſſive; but when theſe inſurrections wore the ſerious characters of rebellion or revolt, the whole confederation marched againſt the conſpirators. France before the revolution had even lent its aid to the ſuppreſſion of thoſe domeſtic quarrels, and had become the inſtrument of vengeance to the inſulted ſovereign; ſo that, whatever was the degree of oppreſſion, or whatever the deſire of reſiſtance, redreſs was become hopeleſs, and change impoſſible.

It was chiefly among the claſſes of burghers and artizans who inhabited the towns, that diſcontent againſt the

Switzerland.

the ruling power prevailed. The peaſants, leſs oppreſſed, becauſe more ignorant of their rights and privileges, not only did not themſelves oppoſe the aggreſſions of the chief men in power, but even aſſiſted them in quelling inſurrections which aroſe among their rival claſſes.

All writers agree in the exiſtence of vexatious and oppreſſive abuſes among all the governments of the Swiſs cantons, at the time of which we are now writing. The deſpotiſm of their inſtitutions; the abuſes of election to ſovereign councils; the daily and encroaching ſpirit of authority; the overgrown influence of patrician families; the ſtriking inequality which prevailed, even on this baſis, of ariſtocratical power; the monopoly of places of profit to the excluſion of worth and talent; the undefined limits of proconſular adminiſtration; the want of encouragement to the arts and ſciences; the neglect of education among thoſe who were deſtined to rule, the void of which was filled up by idleneſs, arrogance, ignorance, and diſſipation,—are ſo many features preſented by writers of different characters and diſcordant ſentiments, to fill up the picture of this vaunted region of happineſs and liberty.

The ſeverity exerciſed by the government of Berne over thoſe inhabitants of the Pays-de-Vaud who had aſſembled on the 14th of July 1791, to commemorate the taking of the Baſtile at Paris, and expreſs their approbation of the French revolution, had created in the minds of the French people ſenſations of jealouſy towards their Swiſs neighbours; while the diſbanding and diſmiſſal of the Swiſs regiments in the ſervice of France, had contributed to exaſperate the government of the cantons againſt the new republic.

All the cantons, except that of Berne, appeared for a long time diſpoſed to preſerve a neutrality towards revolutionary France; but that canton, under pretence of ſupporting the people of Geneva againſt the aggreſſions of the French, firſt diſplayed an avowed hoſtility, and marched a body of 15,000 troops towards the frontiers of the French republic. The true cauſe of this movement in the canton of Berne, has been by others ſtated to be the hopes entertained by ſome individuals of that government, of ſharing in the plans of emolument and preferment which were expected to ariſe on the re-eſtabliſhment of monarchy in France. The mutual jealouſy ſubſiſting between the Swiſs cantons and the ruling power in France, was heightened by the protection given by ſome of the cantons to the French emigrants, and by the correſpondence which others of the cantons had held with the bloody tribunal of Robeſpierre. After the retreat of the allied armies from the frontiers of France, the Swiſs found it politic to make at leaſt a ſhow of amity towards the victorious republic; and accordingly recogniſed the exiſting government of the republic, and openly received M. Barthelemy as its *charge d'affaires*. Still, however, the ſincerity of the cantons was juſtly doubted by the French directory, who appear to have long formed deſigns againſt the independence of Switzerland.

1798. The directory, confirmed in power, and relieved from the controul of a popular legiſlature, haſtened, towards the cloſe of the year 1797, to put in force their project of ſubjugating the Swiſs republics. The firſt hoſtile movement on the part of the French, was to take poſſeſſion of the Helvetic part of the biſhopric of Baſle, under ſome frivolous pretence, and contrary to an expreſs treaty concluded with the Swiſs in the year 1792. Either too weak or too prudent to reſent this infraction of their rights, the Helvetic body ſtill flattered themſelves with an amicable termination of their difference with France; when an inſurrection, which broke out in the *Pays-de-Vaud*, probably through French inſtigation, or at leaſt through the influence of French principles, afforded a fuller pretext for the overthrow of the government. In the month of December, the French directory thought proper to interfere in this domeſtic diſpute, and demanded from the government of Berne, what they termed the reſtoration of the rights of that people, and the aſſembling of the ſtates of the Pays-de-Vaud in their ancient form. This demand they immediately prepared to enforce by arms; and General Menard was ordered to march, with a body of 15,000 men, to ſupport the claims of the petitioning party in the Pays-de-Vaud. The deſigns of the French were for the moment fruſtrated by the timidity or generoſity of the ſupreme council of Berne. On the 5th of January, 1798, they iſſued a proclamation, enjoining the citizens of the Pays-de-Vaud to aſſemble in arms, to renew the oath of allegiance, to proceed immediately to the reform of every abuſe in the government, and to aſſert and re-eſtabliſh all their ancient rights. A commiſſion had been previouſly appointed at Lauſanne, for determining on the claims of the petitioners, and for reinſtating the country in its former tranquillity. From what cauſes it happened, we have not as yet been correctly informed, but the proceedings of the commiſſion ſeemed involved altogether in embarraſſment and delay. The people became impatient, and the inſurrection at once broke out into actual hoſtility. The caſtle of Chillon was ſeized by the inſurgents; and the commotions which took place in the ſouthern diſtricts of the province appeared no leſs formidable. The government of Berne now determined to reduce the inſurgents by force; and a body of 20,000 troops, under the command of Colonel Weiſs, was diſpatched to diſperſe them. Whether the lenient meaſures purſued by this general, were conſiſtent with ſound policy or not, it is impoſſible, from the materials which have hitherto fallen under our inſpection, to determine. Suffice it to ſay, that though it is not certain that more precipitate movements would have ſaved the country, yet his inactivity undoubtedly ſerved to increaſe at once the power and the audacity of the inſurgents. Thus ſituated, the approach of the French decided the conteſt. On paſſing the boundary, Menard diſpatched an aide-de-camp, attended by two huſſars, to General Weiſs, at Yverdun; on their return, a fatal affray took place at the village of Thierens, in which one of the huſſars was killed. Who were the aggreſſors in this unfortunate buſineſs is not correctly aſcertained, but it was regarded by Menard as a declaration of war. His troops immediately advanced, while thoſe of Weiſs retreated, and the whole of the Pays-de-Vaud was, by the beginning of February, in the poſſeſſion of the French.

The government of Berne ſtill hoped, it appears, to avert the deſtruction which now ſeemed to await them; the centinels who had killed the huſſar at Thierens were delivered up, and freſh negotiations were entered on. In the mean time, however, new inſurrections were planned in different parts, and the revolutionary mania appeared to increaſe. In the ſeditious aſſemblages

Switzerland.

on these occasions, the French envoy, Mengaud, was observed to take a decided part; and, on the 2d of January, he formally reclaimed some persons who had been arrested for treasonable practices by the government of Berne, as the friends and allies of the French republic. To this reclamation the government of Berne paid little attention; and the standard of revolt having been erected at Arau, they determined on effective measures for its suppression and their own defence. The Argovian militia marched to Arau; the town and province were immediately reduced, and the leaders of the insurrection were taken into custody.

13 Preparations for war on the part of the cantons.

War now appeared inevitable. To conciliate the minds of the people, and induce them more freely to lend their assistance, the government of Berne decreed, that 52 deputies from the principal towns and communes should be added to the supreme council; and, on the 2d of February, these new deputies took their seats. A general reform of all the abuses of the government was the first resolution agreed on in their deliberations; and the example of Berne was followed by the cantons of Lucerne, Fribourg, Soleure, Schaffhausen, and Zurich.

While, in this state of things, fresh negotiations were commenced with the French directory, a defensive force of about 20,000 men was collected. The other Swiss cantons dispatched their quotas to the defence of Berne, which amounted to about 5500 men. A truce had been concluded with the French general in the Pays-de-Vaud, where an officer of the name of Brune had succeeded Menard in the command. The truce was to have expired on the 1st of March; but General d'Erlach, fearful lest the spirit of his troops should slacken, demanded, on the 26th of February, positive orders to put his army in motion, and the council immediately made a decree to that effect. The plan of the campaign was now arranged by M. d'Erlach, and notice had been given to the posts that hostilities were to commence on the evening of the 1st of March; when the movements of the Swiss general were frustrated by the repeal of the decree which had been so hastily passed, and the negotiation was renewed with the French commander.

M. Mallet du Pan asserts, that the French general Brune, had agreed to prolong the truce for 30 hours; but, on the 2d March, the castle of Dornach, at the northern extremity of the canton of Soleure, was attacked and carried by the French; and at the same time, 13,000 men were marched under the walls of Soleure, which capitulated to General Schawenbourg on the first summons. Fribourg was immediately after reduced by General Brune, and the Swiss army was forced to retreat.

While disaffection prevailed in the army of General d'Erlach, the inhabitants of Berne saw the rapid approach of the victorious army. On the 3d of March, the levy of the *Landsthurm*, or the rising of the people in a mass, was proclaimed. The expedient did not succeed in favour of the magistrates; the people were no sooner assembled in arms, than they of themselves dissolved the government; a provisional regency was elected for the occasion; the event was notified to General Brune; and to facilitate a pacification, an order was issued to dismiss the army, on condition that the French would keep the posts they at present occupied.

Unsatisfied with this concession, the French general insisted on the town receiving a French garrison. In the mean time all was confusion, both in Berne and in the army; the left division of which had mutinied, deserted their posts, and put to death some of their officers. By desertion, the Swiss army was now reduced to 14,000, to which might be added the undisciplined rabble which the Landsthurm had called forth. About 8000 of the regular forces were stationed at Neweneg, and 6400 held the position of Frauenbrun, against which General Schawenbourg advanced from Soleure, at the head of 18,000 men. On the morning of the 5th March, both posts were attacked by the French, and a momentary success seemed to crown the valorous efforts of the division at Neweneg; but those stationed at Frauenbrun were, after a vigorous resistance, obliged to retreat; M. d'Erlach rallied his men at Uteren, where a second engagement took place, but with no better success on the part of the Swiss. At Grouholtz, however, they again made a stand, whence they were driven to the gates of the capital, where they were completely routed. The Swiss, in this engagement, lost 2000 in killed and wounded; while the loss of the French was about 1800.

On the evening of the 5th, General Brune entered the city of Berne by capitulation. The divisions of the Swiss army stationed at Neweneg and Guminen retreated; the soldiers of this last column, in despair, put their officers to death; and the unfortunate d'Erlach, in flying from the field of battle, was murdered by his countrymen and soldiers.

The submission of nearly the whole of Switzerland followed the defeat of the Bernese. The democratic republics, however, still made a glorious stand, defeated General Schawenbourg, and forced him to retire with the loss of 3000 men.

The Swiss confederacy, after this revolution, changed its constitution, and even its name. Provisional governments, under the direction of the French generals, were established in the different districts, and the whole assumed the name of the Helvetic republic. Contributions were levied as usual, by the French commissioners; and some shocking enormities are reported to have been committed, chiefly by the army of the Rhine; for the divisions which belonged to the army of Italy are said to have conducted themselves with superior humanity and justice *.

In the beginning of 1802, a new constitution was framed for the Helvetic republic, under the direction of Bonaparte. Its leading features are as follows.

The Helvetic republic is one. Every citizen has a right of settling in any canton of the republic, and of exercising all the civil and political rights in the same manner as the citizens of the canton.

Berne is the capital of Helvetia. The Helvetic territory is divided into 21 cantons. The ecclesiastical property, in general, can be employed only for establishments of religious instruction, or of charity.

There is a central administration of the republic for the exercise of the national sovereignty, and an administration of the cantons. The administration of the cantons is composed of a diet and a senate. The diet is formed by the union of representatives from all the cantons, in the following proportions.—Berne, six; Zurich, two; Lucerne, five; Uri, one; Schweitz, three; Underwalden,

Sword ‖ Syene.

Underwalden, one; Zug, one; Glaris, one; Soleure, two; Fribourg, three; Baſle, two; Schaffhauſen, one; Appenzel, one; St Gal, four; Turgovia, two; Argovia, two; Baden, two; Vaud, four; Griſons, one; Teſſin, three; Valais, two. The members of the diet remain five years in office. The diet is to aſſemble regularly every year on the 1ſt of March. It ſhall be extraordinarily convoked by the ſenate when the majority of the cantons require it, or when itſelf ſhall judge that meaſure neceſſary. The preſident of the diet ſhall be the landamtman who is not in office. He has a caſting vote, in caſe the votes ſhall be equally divided. A deputation of four members from the ſenate ſhall aſſiſt at the diet, and ſhall take part in its deliberations, but without having a right to vote.

The ſenate is compoſed of two landamtmans, two ſtadtholders or lieutenants, and 26 counſellors. Each canton muſt have at leaſt one member in it. The ſenate forms the projects of laws and regulations, and ſubmits them to the ſanction of the cantons. The two landamtmans and their lieutenants have the direction of foreign affairs. The ſenate names and recalls diplomatic agents, on a propoſition from the landamtmans. The landamtman in office is to receive a ſalary of 16,000 livres, Swiſs currency; the ſecond landamtman, his two lieutenants, and the members of the petty council, 6000 livres; thoſe of the ſenate 4000. The ſenate may adjourn for three months. During this interval, the petty council exerciſes the executive power.

SWIVELS, a kind of ring made to turn round in a ſtaple, or other ring. Theſe are uſed when a ſhip lies at her moorings; alſo in tedders for cattle, that they may turn round without unwarping the tedder.

SWIVEL-Cannon, is a ſmall piece of artillery belonging to a ſhip of war, which carries a ſhot of half a pound, and is fixed in a ſocket on the top of the ſhip's ſide, ſtern, or bow, and alſo in her tops. The trunnions of this piece are contained in a fort of iron crotch, of which the lower end terminates in a cylindrical pivot reſting in the ſocket, ſo as to ſupport the weight of the cannon. The ſocket is bored in a ſtrong piece of oak, reinforced with iron hoops, in order to enable it to ſuſtain the recoil. By means of this frame, which is called the *ſwivel*, and an iron handle on its caſcable, the gun may be directed by the hand to any object. It is therefore very neceſſary in the tops, particularly when loaded with muſket-balls, to fire down on the upper decks of the adverſary in action.

SWOONING. See MEDICINE, N° 274.

SWORD, an offenſive weapon worn at the ſide, and ſerving either to cut or ſtab. Its parts are, the handle, guard, and blade; to which may be added the bow, ſcabbard, pummel, &c.

SWORD of State, which is borne before the king, lords, and governors of counties, cities, or boroughs, &c. For or before the king, it ought to be carried upright; the hilt as low as the bearer's waiſt, the blade up between his eyes. For or before a duke, the blade muſt decline from the head, and be carried between the neck and the right ſhoulder. For or before an earl, the blade is to be carried between the point of the ſhoulder and the elbow: and for or before a baron, the blade is to be borne in the bend of the arm. This ceremonial form no leſs denotes the dignity of a governor than the coronet ſet on his coat of arms.

SWORD-Fiſh. See XIPHIAS, ICHTHYOLOGY *Index*.

SWORN BROTHERS (*fratres juruti*), perſons who, by mutual oath, covenanted to ſhare each other's fortune. Formerly, in any notable expedition to invade and conquer an enemy's country, it was the cuſtom for the more eminent ſoldiers to engage themſelves by reciprocal oaths to ſhare the rewards of their ſervice. This practice gave occaſion to the proverb of *ſworn brothers* or *brethren in iniquity*, becauſe of their dividing plunder and ſpoil.

SYCAMORE-TREE. See ACER, BOTANY *Index*.

SYCOPHANT, an appellation given by the ancient Athenians to thoſe who informed of the exportation of figs contrary to law; and hence it is ſtill uſed in general for all informers, paraſites, flatterers, cheats, &c.

SYDENHAM, DR THOMAS, an excellent Engliſh phyſician, was the ſon of William Sydenham of Winford Eagle in Dorſetſhire, and was born there about the year 1624. He ſtudied at Magdalen-hall, Oxford; but left that univerſity when Oxford was garriſoned for King Charles I. and went to London: where, becoming acquainted with Dr Thomas Cox, an eminent phyſician, that gentleman perſuaded him to apply himſelf to the ſtudy of phyſic; accordingly, after the garriſon was delivered up to the parliament, he retired again to Magdalen-hall, entered on the ſtudy of medicine, and in 1648 was created bachelor of phyſic. Soon after, he was made a fellow of All-Souls college, and continued there ſeveral years: when leaving the univerſity, he ſettled at Weſtminſter, became doctor of his faculty at Cambridge; grew famous for his practice; and was the chief phyſician in London from the year 1660 to 1670; at which period he began to be diſabled by the gout. He died in 1689. His works are highly eſteemed both at home and abroad. He was famous for his cool regimen in the ſmall-pox; for giving the bark after the paroxyſm in agues; and for his uſe of laudanum. He regulated his practice more by his own obſervations and inquiries, than by the method either of his predeceſſors or contemporaries.

SYENE, an ancient city of Egypt, ſituated, according to Mr Bruce, in north latitude 24° 0′ 45″. Pliny and Strabo both ſay that it lay directly under the tropic of Cancer. Whether Mr Bruce's authority be ſufficient to overturn the evidence of Pliny and Strabo, we ſhall leave to others to determine.

Syene is remarkable for being the place where the firſt attempt was made to meaſure the circumference of the earth. This was done by Eratoſthenes, whom Ptolemy Euergetes had invited from Athens to Alexandria. In this attempt two poſitions were aſſumed, viz. that Alexandria and Syene were exactly 5000 ſtadia diſtant from each other, and that they were preciſely under the ſame meridian; but both theſe are denied by Mr Bruce, who has made many obſervations on the ſubject which our limits will not allow us to take notice of at preſent. He tells us, that there is at Aſum an obeliſk erected by Ptolemy Euergetes, the patron of Eratoſthenes, without hieroglyphics, directly facing the ſouth, with its top firſt cut into a narrow neck, then ſpread out like a fan into a ſemicircular form, with

Syene, Sylla.

with pavements curiouſly levelled to receive the ſhade, and make the ſeparation of the true ſhadow from the penumbra as diſtinct as poſſible. This is ſuppoſed by Mr Bruce to have been conſtructed with a deſign to vary the experiment of Eratoſthenes with a larger radius; and the inquiry concerning the dimenſions of the earth, in our author's opinion, was the occaſion of many obeliſks being erected in this kingdom; a demonſtration of which is, that the figure of the top is varied; being ſometimes very ſharp, and ſometimes a portion of a circle, in order to get rid of the great impediment ariſing from the penumbra, which makes it difficult to determine the length of the ſhadow with preciſion. It is now called *Aſſouan*.

SYLLA, Lucius Cornelius, was deſcended from the illuſtrious family of the Scipios. His behaviour in his younger years by no means correſponded with the excellent education which he had received. But debauchery, inſtead of bringing along with it infamy and ruin, its uſual attendants, ſerved only to increaſe the wealth of this fortunate Roman; for Nicopolis, a rich courtezan, whoſe affections he had gained, left him heir to her great eſtate.—He learned the art of war under Marius, whom he attended to Numidia in quality of queſtor. Though hitherto unaccuſtomed to arms, he became in a ſhort time the moſt ſkilful ſoldier in the army, while by his polite and obliging behaviour he gained the love and eſteem of every body. His courage and dexterity contributed a great deal towards the ſucceſs of the war; it was his eloquence in particular that perſuaded Bocchus to deliver up Jugurtha. He ſerved afterwards in the Social war, where his actions entirely eclipſed thoſe of every other commander. As a reward for this conduct he was raiſed to the prætorſhip. It is pretended by ſome that Sylla purchaſed this dignity; and that when he threatened one day to make uſe of the powers of *his* office againſt Strabo the father of Pompey, that Roman replied with a ſmile, "You are in the right to ſay ſo; your office is certainly *yours*, ſince you purchaſed it." Be this as it may, after the concluſion of the Social war he was made conſul, and ſoon after declared general of the army which was to be ſent againſt Mithridates king of Pontus. Marius, at that time the moſt renowned of the Roman generals, expected that the management of this war would have been committed to him, and was therefore much exaſperated at the diſappointment. The people were perſuaded by his intrigues to reverſe the former decree, and ſubſtitute him in place of Sylla. Upon this he ſent down officers to take the command of the army; but Sylla by this time had gained over the ſoldiers; who, inſtead of obeying the decree of the people, ſlew Marius's officers, and intreated Sylla to lead them inſtantly to Rome. Accordingly he entered the city ſword in hand, ſlew Sulpicius the conſul, obliged Marius to flee, new-modelled the laws, and afterwards marched into the Eaſt, and immediately laid ſiege to Athens; for that city, together with the reſt of Greece, had fallen into the power of Mithridates. He wrote to the Amphictyons, who were aſſembled at Delphi, to ſend him all the gold which was depoſited in the temple of Apollo, becauſe he ſtood in need of money; promiſing, at the ſame time, to reſtore it again at the end of the war. When he received this treaſure, he obſerved, with an air of raillery, that he now no longer deſpaired of victory, ſince the gods themſelves furniſhed him with money to pay his troops. Famine ſoon obliged the Athenians to think of a ſurrender. Their ambaſſadors waited on Sylla, and began to harangue about Theſeus and Codrus, and Marathon and Salamis,—when he interrupted them, and exclaimed, "Go, repeat theſe fine orations in your ſchools; I have come hither, not to learn your hiſtory, but to chaſtiſe rebels." Athens was at laſt taken by aſſault, and Sylla was upon the point of deſtroying it, when he recollected its ancient glory, and ſpared (as he ſaid) the living for the ſake of the dead. After burning the Piræus, he gained two deciſive victories over the generals of Mithridates. In the ſecond battle, which was fought at Orchomenus, he was almoſt defeated; his troops began to flee, when, leaping from his horſe, he ſnatched up a ſtandard, and advanced againſt the enemy, crying out, "I will die here glorioufly; and, ſoldiers, when you are aſked where you abandoned your general, anſwer, At Orchomenus." This reproach recalled the courage of the Romans; they followed him to the charge, and gained a complete victory. Mithridates, humbled by theſe diſaſters, ſent ambaſſadors to ſue for peace. Sylla

Mean time Cinna had declared againſt Sylla in Italy; and Marius returning from baniſhment, had taken the moſt ſevere vengeance on all his enemies. Sylla was declared a traitor; his laws were reverſed, his friends murdered, and the government new-modelled. The news of theſe tranſactions induced Sylla to conclude a treaty with Mithridates, and march directly to Rome. His approach terrified the Romans. Marius and Cinna were both dead; but the conſuls made vigorous preparations to oppoſe him. A civil war was begun; but Sylla in the end ſubdued all his enemies, and entirely ruined the Marian faction. He entered Rome at the head of his victorious army, and publicly aſſumed the ſurname of *Happy*. Happy, indeed, had he ceaſed to live when he ceaſed to conquer. The remainder of his life contains nothing elſe but a catalogue of the moſt abominable cruelties. He declared that every one who expected a pardon for their late offences, muſt gain it by deſtroying the enemies of the ſtate. The ſword of the aſſaſſin was thus unſheathed, and murder encouraged as the path to power and diſtinction. The nobleſt of the Romans were everywhere maſſacred; ſlaves were rewarded for cutting off their maſters; children were ſeen dragging their parents to execution; and brothers claiming a recompenſe for the murder of brothers. Sylla ordered 8000 wretches, who had thrown themſelves upon his clemency, to be butchered in the Campus Martius. In the mean time he entered the ſenate-houſe, and began to talk with great coolneſs about his exploits. The ſenate, alarmed at the horrid outcries of the ſufferers, at firſt thought that the city was given up to be plundered; but Sylla informed them, with an unembarraſſed air, that it was only ſome criminals puniſhing by his orders, and that they needed not be apprehenſive about their own fate.

To carry on theſe cruelties with the appearance of juſtice, he commanded the people to elect him dictator. He kept this office for more than two years; and then, to the amazement of all, laid it down, and offered to ſtand his trial before the people. Soon afterwards he retired into the country, and plunged headlong into every kind of debauchery. Nor did he relinquiſh his

cruelty

Sylla || Sylvia.

cruelty together with his power: His wife falling ill in the midſt of a ſumptuous feaſt, he divorced her immediately; and ordered her to be carried away, leſt her death ſhould interrupt the feſtivity of his houſe.

He died of the morbus pedicularis, in the 60th year of his age. His body, according to his orders, was burnt. A little before his death he wrote his epitaph; the tenor of which was, that no man had ever exceeded him in doing good to his friends or injury to his enemies.

His perſon was elegant, his air noble, his manners eaſy and apparently ſincere. He was fond of pleaſure, but fonder of glory; indulging without ſcruple in ſenſual delights, but never ſuffering them to interrupt his ſerious buſineſs: He was eloquent, liberal, crafty, inſinuating; a profound maſter of diſſimulation; he ſpoke of himſelf with modeſty, while he laviſhed praiſes on every other perſon: He ſtooped even to an acquaintance with the meaneſt ſoldier, and conſtantly adapted himſelf to the humours, purſuits, and opinions, of thoſe with whom he converſed. Such was his character during the earlier part of his life; but when ſucceſs had raiſed him above the neceſſity of diſſimulation, he diſplayed a hideous train of vices, which his ambition had formerly taught him to conceal.—It was Sylla who recovered the works of Ariſtotle at the taking of Athens.

SYLLABLE, in *Grammar*, one or more letters pronounced by a ſingle impulſe of the voice, forming a complete ſound, and conſtituting a word or a part of a word. No ſingle letter can form a ſyllable except a vowel. The longeſt ſyllable in the Engliſh language is the word *ſtrength*.

The moſt natural way of dividing words into ſyllables is, to ſeparate all the ſimple ſounds of which any word conſiſts, ſo as not to divide thoſe letters which are joined cloſe together according to the moſt accurate pronunciation.

SYLLABUB, a kind of compound drink, moſt uſed in the ſummer ſeaſon; ordinarily made of white wine, ſugar, and nutmeg, into which is milked a quantity of new milk from the cow. Sometimes it is made of canary in place of white wine; in which caſe the ſugar is ſpared, and a little lemon and nutmeg are added inſtead of it. To prepare it the beſt way, the wine and other ingredients, except the milk, are to be mixed over night, and the milk or cream added in the morning. The proportion, is a pint of wine to three of milk. For

SYLLABUB, *Whipt*. To half a pint of white wine or Rheniſh is put a pint of cream, with the whites of three eggs. This they ſeaſon with ſugar, and beat with birchen rods, or work with a ſyringe. The froth is taken off as it riſes, and put into a pot; where, after ſtanding to ſettle two or three hours, it is fit to eat.

SYLLABUS, in matters of literature, denotes a table of contents, or an index of the chief heads of a book or diſcourſe.

SYLLOGISM, in *Logic*, an argument or term of reaſoning, conſiſting of three propoſitions; the two firſt of which are called *premiſes;* the laſt, the *concluſion*. See LOGIC, Part III.

SYLVIA, a genus of birds, belonging to the order of paſſeres, formed by Dr Latham by limiting the motacilla to the wagtail, and arranging the other ſpecies, formerly claſſed under that genus, under the ſylvia. He makes 13 ſpecies of the motacilla, and 174 ſpecies of the ſylvia. See MOTACILLA, ORNITHOLOGY *Index*.

Sylvia || Sympathy.

SYMBOL, a ſign or repreſentation of ſomething moral, by the figures or properties of natural things. Hence ſymbols are of various kinds; as hieroglyphics, types, engimas, parables, fables, &c.

SYMMACHUS, a citizen and ſenator of ancient Rome, and conſul in the year 391, has left us ten books of epiſtles; from which, as well as from other things, we collect, that he was a warm oppoſer of the Chriſtian religion. He was baniſhed from Rome by Valentinian on ſome account or other, but afterwards recalled and received into favour by Theodoſius. Ammianus Marcellinus ſpeaks of him as a man of great learning and modeſty. Scioppius, Pareus, and other learned men, have written notes upon the epiſtles of Symmachus: we know of no later edition of them than that of Frankfort, 1642, 8vo. Ambroſe biſhop of Milan wrote againſt Symmachus, and ſo did the Chriſtian poet Prudentius.

SYMMETRY, the juſt proportion of the ſeveral parts of any thing, ſo as to compoſe a beautiful whole.

SYMMETRY, in *Painting*. See PAINTING, Part I. Sect. III.

SYMONDSBOROUGH, a remarkable large barrow of flints, near Wellington in Devonſhire, in the northern extremity of Hemyock. The common people have a notion that a king called *Symon* was buried here. The tradition of the country plainly ſhows that it was the burial-place of ſome perſon or perſons of eminence.

SYMPATHETIC, ſomething that acts or is acted upon by ſympathy. Thus we ſay, ſympathetic diſeaſes, inks, &c.

SYMPATHETIC Inks. See *Sympathetic* INK.

SYMPATHY, an agreement of affections and inclinations, or a conformity of natural qualities, humours, temperaments, which make two perſons delighted and pleaſed with each other.

SYMPATHY, alſo denotes the quality of being affected by the affection of another; and may ſubſiſt either between different perſons or bodies, or between different parts of the ſame body. It is either ſimilar or diſſimilar; ſimilar, when the affection or action in the ſympathiſer is ſimilar to the affection or action in the ſympathant; and diſſimilar, when thoſe are different.—Sympathy too, is often an imitative faculty, ſometimes involuntarily, frequently without conſciouſneſs: thus we yawn when we ſee others yawn, and are made to laugh by the laughing of another.

Sympathy, according to Dr Jackſon *, relates to the operations of the affections of the mind, to the operations of the imagination, and to the affections of the external ſenſes.

* *Treatiſe on Sympathy.*

1. The paſſions and affections of the mind produce in the body different ſenſations and impreſſions, and, as ſympathies of conſciouſneſs, determine in general the ſpirits to thoſe parts which labour moſt, or are moſt apt to be affected. Thus fear and anger determine to the heart; luſt to the eyes, &c.; joy, pity, wonder, and the like, to the head. See PASSION, page 14.

The affections of the mind of one perſon will often work upon the ſpirits of many. Thus whole companies are ſometimes diſpoſed to be ſad and melancholy, or merry and jovial, when any one is preſent much inclined to either of thoſe ſtates of mind; and it has been obſerved,

Sympathy. obſerved, that old people, who have loved the company of the young, and have been converſant continually with them, have generally lived long. But young people muſt not conclude from this, that the company and converſation of the grave and old will operate upon the living and ſenſitive principle, through the affections of their mind, and diſpoſe them to be ſhort-lived. On the contrary, by thus improving their underſtanding, they will be more enabled to fortify their conſtitution and reſiſt the ravages of youthful indulgence.

It may alſo be further obſerved, that thoſe tender ſympathetic affections which lay hold of the mind, at the repreſentation of theatrical performances, originate from the ſame principle, while they are to be conſidered as the ſureſt teſt of juſt execution in the actor, and of the expreſſive language of the author. Indeed all ſtage effect depends on ſympathy.

It has been ſaid, that the paſſions of the mind are occaſionally infectious, particularly ſome of them. Thus *fear* and *ſhame* are ſometimes very ſuddenly ſo. We frequently may have occaſion to ſee, that the ſtarting of one will make another ready to ſtart. Again, when one man is out of countenance in company, others will often bluſh in his behalf. However, the ſerious paſſions may ſurely be ſo under the controul of reaſon as to reſiſt infection, whatever may be the caſe of temporary, muſcular, or nervous attraction.

2. Our author is inclined to think, that a connection between the affections and ſenſations of the female mind and uterus, is very materially concerned in the proceſs of generation, and probably can alone give efficacy to thoſe actions and impreſſions ſubſervient to conception, through the ſympathizing affections of the mind. But this is a ſubject of which we know ſo little, that the ſpeculations of even the moſt diſtinguiſhed philoſophers reſpecting it have been nothing but the wild ravings of imagination.

With reſpect to the depravity and force of the imagination in the production of ſympathies, they always operate moſt upon "weak minds and ſpirits, and therefore moſt on women, ſuperſtitious and fearful perſons, ſick people, children, and young creatures." Their effects, however, ſometimes fail to appear, becauſe they are encountered and overcome by the mind and ſpirit before they work any manifeſt effects.

Such effects are obviated upon the ſame principle which eſtabliſhes the prevention of bodily diſeaſe: "for in infection and contagion from body to body (as, for example, during the plague), the miaſma may be received; but from the ſtrength and good diſpoſition of the body, it is expelled and wrought out before it has had ſufficient time to form the diſeaſe."

It has been ſaid, and many are of the opinion, that the force of imagination doth often forward the end propoſed. Thus, for inſtance, it has been put as a queſtion, "Whether a man, when he conſtantly and ſtrongly believes that ſuch a thing ſhall be (as that ſuch a one will love him, and the like), helps any thing to the effecting the thing deſired?" Certainly not in the manner which has been advanced, namely, "by a ſecret operation on the ſpirit of another." If he ſucceeds, it is either becauſe he perſevered, or becauſe his perſeverance and earneſtneſs (and not any occult operation) makes him at length be attended to.

There is not a doubt but the force of imagination often gives energy to our actions. It may, however, unleſs we are much on our guard, eaſily delude us aſide from reaſon. It has been the tree which has yielded the fruits of ſuperſtition in former times, and which has often fed the human mind with the moſt extravagant notions of ſympathy. Sympathies of this kind, ſuch as the power of charms, and the like, are now pretty generally exploded. Sympa

3. The five ſenſes, *hearing*, *taſting*, *ſmelling*, *feeling*, and *ſeeing*, are conſcious of a ſympathetic impreſſion from odious objects. "1. A diſagreeable ſound will ſet the teeth on edge, and make all the body ſhiver. 2. The ſwallowing of a nauſeous medicine will be attended with a ſhaking of the head and neck. 3. Diſagreeable ſmells produce nearly the ſame effect, which are leſs perceived, becauſe there is a remedy at hand by ſtopping the noſe. 4. If you come ſuddenly out of the ſun into the ſhade, the ſenſe of feeling is diſturbed by a chillneſs or ſhivering of the whole body. 5. And even ſudden darkneſs produces a propenſity to ſhivering.

There is a very apparent reaſon why a ſympathy ſhould take place between the eyes. Hence their motions are ſynchronous. It may be ſaid, that cuſtom and habit diſpoſe the eyes to move one and the ſame way; "for when one moveth towards the noſe, the other eye moveth from the noſe."

Though the eyes are by nature prone to move in concert, cuſtom will, however, deſtroy this natural concert, and produce the contrary effect. Thus ſome people can ſquint when they will. Our author therefore gives this caution to mothers and nurſes: "Let them not ſuffer infants to ſit with a candle placed behind them; for both their eyes will be diſpoſed to move outwards, as affecting to ſee the light of the candle, which may bring on the habit of ſquinting."

It appears as a quality in the ſenſes of hearing and ſeeing, "that the inſtrument of each ſeparate ſenſe has a ſympathy and ſimilitude to that which giveth the reflection." Thus it has been obſerved, "that the eye will ſympathize with a cryſtal glaſs or water, and the ear with caves and ſuch hollow places as are ſuited to report echo."

Sympathies have been compared to uniſons of ſound in muſic. Uniſons of ſound produce agreeable ſympathetic feelings; the reverſe produce diſagreeable feelings. "All concords and diſcords of muſic are (no doubt) ſympathies and antipathies of ſound." Moreover, "they are ſaid to work as well by report of ſound as by motion."

The moſt agreeable as well as odious objects operate in a ſecondary way, in producing thoſe ſympathetic impreſſions and actions which they commonly give riſe to. An increaſed ſecretion of ſaliva often takes place at the ſight of a favourite diſh; and the running of water from a bottle, or otherwiſe, will ſometimes affect individuals of a particular temperature, with an involuntary propenſity to void urine.

Many have attempted to account for the remarkable ſympathy which takes place between parts of the body ſeemingly unconnected with each other; but as theſe attempts are merely conjectures, without any ſolid principles to reſt on, we paſs them over as the dreams of ingenious men. It would be fortunate for ſcience, if men would confine themſelves to thoſe ſubjects which can be known,

npathy
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Synagogue.

known, and never draw concluſions till they have eſtabliſhed principles. See PHYSIOLOGY, chap. ii.

SYMPHONIA, a genus of plants belonging to the claſs of monadelphia. See BOTANY *Index*.

SYMPHONY, in *Muſic*, properly denotes a conſonance or concert of ſeveral ſounds agreeable to the ear, whether vocal or inſtrumental, called alſo *harmony*. See HARMONY.

SYMPHYSIS, in *Anatomy*, one of the kinds of junctures or articulations of the bones. See ANATOMY, N° 2.

Cutting the SYMPHYSIS *of the Pubes*. See MIDWIFERY, N° 136.

SYMPHYTUM, COMFREY, a genus of plants belonging to the claſs pentandria; and in the natural ſyſtem ranging under the 41ſt order aſperifoliæ. See BOTANY *Index*.

SYMPLOCE, συμπλοκη, in *Rhetoric*, a figure, where the ſame word is repeated ſeveral times in the beginning and end of a ſentence, including the ANAPHORA and EPITROPHE: thus, *Quis legem tulit? Rullus. Quis majorem populi partem ſuffragiis privavit? Rullus. Quis comitiis præfuit? Idem Rullus.*

SYMPLOCOS, a genus of plants belonging to the claſs polydelphia. See BOTANY *Index*.

SYMPOSIARCH, in antiquity, the director or manager of an entertainment. This office was ſometimes performed by the perſon at whoſe charge the entertainment was provided; ſometimes by another named by him; and at other times, eſpecially in entertainments provided at the common expence, he was elected by lot, or by the ſuffrages of the gueſts.

SYMPTOM, in *Medicine*, any circumſtance which indicates the exiſtence, nature, or ſtage of a diſeaſe. Pain, waking, drowſineſs, convulſions, ſuppreſſion of urine, difficulty of breathing and ſwallowing, coughs, diſtaſtes, nauſeas, thirſts, ſwoonings, faintings, looſeneſs, coſtiveneſs, dryneſs and blackneſs of the tongue, are the principal *ſymptoms* of diſeaſes. See MEDICINE, N° 41. and 58.

SYMPTOMATICAL, in *Medicine*, is a term often uſed to denote the difference between the primary and ſecondary cauſes in diſeaſes: thus a fever from pain is ſaid to be ſymptomatical, becauſe it riſes from pain only.

SYNÆRESIS, CONTRACTION, in *Grammar*, a figure whereby two ſyllables are united in one; as *vemens* for *vehemens*.

SYNAGOGUE, among the Jews, is a place where that people met to worſhip God. Authors are not agreed about the time when the Jews firſt began to have ſynagogues:—Some ſuppoſe them as old as the ceremonial law, and others fix their beginning to the times after the Babyloniſh captivity. They erected ſynagogues not only in towns and cities, but alſo in the country, eſpecially near rivers, that they might have water for their purifications and ceremonious waſhings. No ſynagogue was built in any town unleſs there were ten perſons of leiſure in it; but there might be many in one town, or in one quarter of a town, provided it was very populous. Jeruſalem is ſaid to have contained 480. The chief things belonging to a ſynagogue were, 1. The ark or cheſt, made after the model of the ark of the covenant, containing the Pentateuch. 2. The pulpit and deſk in the middle of the ſynagogue, in which he that was to read or expound the law ſtood. 3. The ſeats or pews for the people. 4. The lamps to give light at evening ſervice, and the feaſt of dedication. 5. Rooms or apartments for the utenſils and alms cheſts. The ſynagogue was governed by a council or aſſembly, over whom was a preſident, called *The Ruler of the Synagogue*. Theſe are ſometimes called *Chiefs of the Jews*, *The Rulers*, *The Prieſts* or *Elders*, *The Governors*, *The Overſeers*, *The Fathers of the Synagogue*. Their buſineſs was to puniſh the diſobedient, by cenſures, by excommunication, or by penalties, ſuch as fines and ſcourging; to take care of the alms, which are frequently called by the name of righteouſneſs. The chief ruler, or one of the rulers, gave leave to have the law read and expounded, and appointed who ſhould do it. In every ſynagogue, there were ſeveral miniſters who had different offices aſſigned to them. Service was performed three times a-day, viz. in the morning, in the afternoon, and at night; at the time of morning ſacrifice, evening ſacrifice, and after the evening ſacrifice on Mondays, Thurſdays, and Saturdays, there was a more forcible obligation upon the people to attend than upon the other days. There are ſynagogues at London, Amſterdam, Rotterdam, Avignon, Metz, &c.

Synagogue
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Syncopation.

SYNALOEPHA, in *Grammar*, a contraction of ſyllables, performed principally, by ſuppreſſing ſome vowel or diphthong at the end of a word, on account of another vowel or diphthong at the beginning of the next. As, *ill' ego*, for *ille ego*, &c.

Conticuer' omnes intentiqu' ora tenebant. VIRG.

It is called by the Latins *colliſio*.

SYNARTHROSIS. } See ANATOMY, N° 2.
SYNCHONDROSIS. }

SYNCELLUS, or SINCELLUS, an ancient officer in the family of the patriarchs, and other prelates of the eaſtern church. The word, in the corrupt Greek, συγκηλλος, ſignifies a perſon who lies in the chamber with another; a *chamber-fellow*, or *chum*. The ſyncellus was an eccleſiaſtic, who lived with the patriarch of Conſtantinople, to be a witneſs of his conduct; whence it is, that the ſyncellus was alſo called the *patriarch's eye*, becauſe his buſineſs was to obſerve and watch. The other prelates had alſo their ſyncelli, who were clerks living in the houſe with them, and even lying in the ſame chamber, to be witneſſes of the purity of their manners. Afterwards the office degenerated into a mere dignity; and there were made ſyncelli of churches.—At laſt, it became a title of honour, and was beſtowed by the emperor on the prelates themſelves; whom they called *pontifical ſyncelli*, and *ſyncelli Auguſtales*.

SYNCHRONISM denotes the happening of ſeveral things at the ſame time. See CHRONOLOGY.

SYNCOPATION, in *Muſic*, denotes a ſtriking or beating of time, whereby the diſtinction of the ſeveral times or parts of the meaſure is interrupted. However, it is more properly uſed for the connecting the laſt note of any meaſure, or bar, with the firſt of the following meaſure, ſo as only to make one note of both. A ſyncope is ſometimes alſo made in the middle of a meaſure. Syncopation is alſo uſed when a note of one part ends or terminates on the middle of a note of the other part. This is otherwiſe denominated *binding*. It is likewiſe uſed for a driving note; that is, when ſome ſhorter note at the beginning of a meaſure, or half meaſure, is followed

Wilſon's Archæological Dictionary.

Syncopation || Synodals.

lowed by two, three, or more longer notes before another short note occurs, equal to that which occasioned the driving, to make the number even, e. gr. when an odd crotchet comes before two or three minims, or an odd quaver before two, three, or more crotchets. In syncopated or driving notes, the hand or foot is taken up, or put down, while the note is sounding.

SYNCOPE, FAINTING; a deep and sudden swooning, during which the vital functions are suspended. See MEDICINE, N° 98. and 272.

SYNCOPE, in *Grammar*, an elision or retrenchment of a letter or syllable out of the middle of a word, as *caldus* for *calidus*,

SYNDIC, in government and commerce, an officer, in divers countries, intrusted with the affairs of a city or other community, who calls meetings, makes representations and solicitations to the ministry, magistracy, &c. according to the exigency of the case.

SYNECDOCHE, in *Rhetoric*, a kind of trope frequent among orators and poets. See ORATORY, N° 56.

SYNECPHONESIS, in *Grammar*, a coalition, whereby two syllables are pronounced as one; being much the same as SYNALOEPHA and SYNÆRESIS.

SYNEUROSIS. See ANATOMY, N° 2.

SYNGENESIA, (συν and γενεσις, "congeneration)," the name of the 19th class in Linnæus's artificial system. See *Classification*, BOTANY *Index*.

SYNGNATHUS, PIPE-FISH, a genus of fishes belonging to the cartilaginous order. See ICHTHYOLOGY, page 104.

SYNOCHA, and SYNOCHUS, in *Medicine*, the names of two species of continued fever. See MEDICINE, N° 164.

SYNOD, in *Astronomy*, a conjunction or concourse of two or more stars or planets, in the same optical place of the heavens.

SYNOD signifies also a meeting or assembly of ecclesiastical persons to consult on matters of religion.

Of these there are four kinds, viz. 1. *General*, or *œcumenical*, where bishops, &c. meet from all nations. These were first called by the emperors, afterwards by Christian princes; till in later ages the pope usurped to himself the greatest share in this business, and by his legates presided in them when called. 2. *National*, where those of one nation only come together, to determine any point of doctrine or discipline. The first of this sort which we read of in England, was that of Herudford or Hertford, in 673, and the last was that held by Cardinal Pole, in 1555. 3. *Provincial*, where those only of one province meet, now called the *convocation*. 4. *Diocesan*, where those of but one diocese meet, to enforce canons made by general councils, or national and provincial *synods*, and to consult and agree upon rules of discipline for themselves. These were not wholly laid aside, till by the act of submission, 25 Hen. VIII. c. 19. it was made unlawful for any *synod* to meet, but by royal authority. See COUNCIL and CONVOCATION.

SYNODS, *Provincial, in the Government of the Church of Scotland*. See PRESBYTERIANS, N° 14.

SYNODALS, or SYNODIES, were pecuniary rents (commonly of two shillings), paid to the bishop, or archdeacon, at the time of their Easter visitation, by every parish priest. They were thus called, because usually paid in synods: because anciently bishops used to visit and hold their diocesan synods once.—For the same reason, they are sometimes also denominated *synodalica*; but more usually, *procurations*. Synod || Syracu

SYNODICAL, something belonging to a synod. Thus, synodical epistles are circular letters written by the synods to the absent prelates and churches; or even those general ones directed to all the faithful, to inform them of what had passed in the synod.

SYNOECIA, in Grecian antiquity, a feast celebrated at Athens in memory of Theseus's having united all the petty communities of Attica into one single commonwealth; the seat whereof was at Athens, where all the assemblies were to be held. This feast was dedicated to Minerva; and, according to the scholiast on Thucydides, it was held in the month *Metagitnion*.

SYNONYMOUS, is applied to a word or term that has the same import or signification with another.

Several works have been composed for the express purpose of explaining synonymous words. In 1777 a work was published on the Latin synonyma at Paris by M. Gardin Dumesnil. The abbe Girard published one on the synonymous terms of the French language many years ago. Another was published on the same subject in the year 1785 by the abbé Roubaud. An account of the English synonyma was published by an anonymous author in 1766; which is a close imitation, and in some parts a literal translation, of the abbé Girard's *Synonymes François*. Mrs Piozzi has written some essays on the same subject.

SYNOVIA, in *Medicine*, a term used by Paracelsus and his school for the nutritious juice proper and peculiar to each part. Thus they talk of the synovia of the joints, of the brain, &c.

SYNTAX, in *Grammar*, the proper construction or due disposition of the words of a language into sentences and phrases. See GRAMMAR and LANGUAGE.

SYNTHESIS, in *Logic*, denotes a branch of method, opposite to analysis.

In the synthesis or synthetic method, we pursue the truth by reasons drawn from principles before established or assumed, and propositions formerly proved: thus proceeding by a regular chain, till we come to the conclusion. Such is the method in Euclid's Elements, and most demonstrations of the ancient mathematicians, which proceed from definitions and axioms, to prove propositions, &c. and from those propositions proved to prove others. This method we also call *composition*, in opposition to *analysis* or *resolution*. See ANALYSIS.

SYPHILIS. See MEDICINE, N° 350.

SYPHON. See HYDRODYNAMICS. Some uncommon phenomena in nature may be accounted for upon the principles of the syphon; as, for instance, that of reciprocating springs. See PNEUMATICS, N° 373.

SYRACUSE, a celebrated city of Sicily, and once the capital of the island. It was built, according to Thucydides and Strabo, by Archias, one of the Heraclidæ, who came from Corinth into Sicily in the second year of the 11th Olympiad, and derived its name from a neighbouring marsh named *Syraco*. What form of government first prevailed in the city is not known. Many have supposed it originally to have been governed by kings: but if this were the case, the monarchical government continued only for a very short time; since Aristotle, Diodorus Siculus, and Justin, mention it as being very early subject to a democracy. The history is At that time

Syracuſe. is obſcure and unimportant till the time of Gelon, when Syracuſe firſt began to make a conſpicuous figure.

2 Gelon was born in the city of Gela in Sicily, of the family of Telines, who had been created prieſt of the infernal gods. He ſignalized himſelf in a war carried on againſt the Syracuſans, by Hippocrates tyrant of Gela, whom he defeated in a pitched battle. Having thus become very powerful among his countrymen, he ſoon found means to ſeize on the ſovereignty for himſelf. In a ſhort time, having put himſelf at the head of ſome Syracuſan exiles, he marched towards that place, where he was received with loud acclamations and obtained poſſeſſion of the city.

Gelon, in order to people the capital of his new dominions, firſt demoliſhed the neighbouring city of Camarina, and tranſplanted the inhabitants to Syracuſe. Soon after, entering into a war with the Megareans, he defeated them, took and raſed their cities, and in like manner tranſplanted the people. Syracuſe thus became powerful, and full of inhabitants; and the friendſhip of Gelon was courted both by Athens and Lacedæmon at the time of the Perſian invaſion. In the mean time the Carthaginians had entered into a treaty with the Perſians; by which it was agreed, that the former ſhould attack thoſe of the Greek name in Sicily and Italy, in order to divert them from aſſiſting each other. Sicily was accordingly invaded by the Carthaginians with a vaſt army; but they were utterly overthrown by Gelon, as is related under the article CARTHAGE, N° 7—9. After this victory, the people out of gratitude obliged him to aſſume the title of king; which till that time he had refuſed. A decree alſo paſſed by which the crown was ſettled on his two brothers Hiero and Thraſybulus after his death.

3 feats the rthagi- ns, and ces the le of ig.

4 s excel- at reign. The new king, inſtead of keeping his ſubjects in greater awe, ſtudied to make them happy, and was the firſt man who became more virtuous by being raiſed to a throne. He was particularly famous for his honeſty, truth, and ſincerity; is ſaid never to have wronged the meaneſt of his ſubjects, and never to have promiſed a thing which he did not perform.

5 elon dies, nd is ſuc- eeded by iero. n. 471. . C. Gelon died in the year 471 B. C. after having reigned three or four years; and was ſucceeded by his brother Hiero, whoſe character is differently drawn by different hiſtorians. He is highly celebrated in the odes of Pindar; and it is certain that his court was the reſort of men of wit and learning, to whom he behaved in the moſt courteous manner and with the greateſt liberality.

6 Thraſybu- us, a ty- ant. an. 459. . C. In 459 B. C. Hiero was ſucceeded by Thraſybulus; who proving a tyrant, was in ten months driven out, and a popular government reſtored; which continued for the ſpace of 55 years.

7 The Siculi ubdued. About this time the Syracuſans entered into a war with the Siculi, which terminated in the total ſubjection of the latter; after which Syracuſe became ſo powerful, that it in a manner gave law to the whole iſland. The Greek cities indeed enjoyed a perfect liberty; but they all acknowledged Syracuſe as their metropolis: by degrees, however, the latter began to aſſume ſuch an authority over them as was totally inconſiſtent with liberty; and this occaſioned many wars, which involved them in much diſtreſs and danger. They began with the Leontines, whoſe territory they laid waſte, and reduced their city to great ſtraits. Leontini was an Athenian colony: and this furniſhed the Athenians, who had already meditated the conqueſt of Sicily, with a pretence to attack the Syracuſans with their whole force. Under colour of aſſiſting their countrymen, therefore, they ſent a fleet of 250 ſail to Sicily; but the Leontines, ſenſible that their pretended allies aimed at nothing leſs than the conqueſt of the whole iſland, concluded a peace with Syracuſe; and the diſappointed Athenians vented their rage on thoſe who had adviſed and conducted the expedition. Syracuſe.

8 Syracuſe in- vaded by the Athe- nians with- out ſucceſs.

During the continuance of the popular government, the Syracuſans took part in the long war between Athens and Sparta. The circumſtances which took place in this conteſt are ſufficiently detailed under ATTICA, N° 126—150.

9 New inva- ſion by the Carthagi- nians. This war was ſcarcely ended, when a new and formidable invaſion by the Carthaginians took place; but the event of that expedition was as unfortunate to the Carthaginians as the former had been, as has been particularly related under the article CARTHAGE, N° 12. *et ſeq.*

10 Riſe of Dionyſius. In the mean time, a conſiderable revolution had happened in Syracuſe. The city of Agrigentum had been taken by the Carthaginians, and of the few inhabitants who eſcaped, ſome fled to Syracuſe, where they accuſed the Syracuſan commanders of having betrayed the city into the hands of the enemy. Dionyſius, a man of great valour and addreſs, but who had become very obnoxious to the populace, took this opportunity of attempting to retrieve his credit. He therefore ſupported the accuſations brought againſt his countrymen by the Agrigentines, and even impeached the magiſtrates as having a ſecret intelligence with the enemy, and attempting to introduce an oligarchy. As his ſpeech was entirely levelled againſt the more wealthy citizens, it was very agreeable to the lower claſs: the commanders were inſtantly degraded; and others, among whom was Dionyſius, were appointed. Having once gained this point, he began to conſider how he might get all his colleagues turned out. For this purpoſe he never joined in any council of war with the other commanders, nor imparted to them his reſolutions, giving out that he could not truſt them, and that they had more regard for their own intereſt than the welfare of their country. But while he was proceeding in this manner, the more prudent part of the citizens, perceiving what he aimed at, complained of him to the ſenate and magiſtrates, and fined him as a diſturber of the public peace. According to the laws, the fine was to be paid before he could ſpeak in public, and the circumſtances of Dionyſius did not allow him to diſcharge it. In this dilemma he was aſſiſted by Philiſtus the hiſtorian, a man of great wealth, who not only paid this fine for him, but encouraged him to ſpeak his mind freely, as it became a zealous citizen to do, promiſing to pay all the fines that ſhould be laid upon him.

Being extricated out of this difficulty, Dionyſius next proceeded to inveigh, with all the eloquence of which he was maſter, againſt thoſe who by means of their power or intereſt were able to oppoſe his deſigns, and by degrees brought them into diſcredit. His next ſcheme was to get thoſe exiles recalled whom the nobility had baniſhed at different times; as thinking that they would ſupport him with all their power, as well out of gratitude as out of hatred to the oppoſite party. Having gained this point alſo, he next found means to ingratiate himſelf

Syracuſe.

ſelf with the ſoldiery to ſuch a degree, that, under pretence of taking proper meaſures for reſiſting the Carthaginians, he was choſen commander in chief, with abſolute and unlimited power. This was no ſooner done, than, pretending his life was in danger, he choſe out 1000 men for his guard, whom he attached to his intereſt by great promiſes. As no perſon durſt now oppoſe him, he poſſeſſed himſelf of the citadel, where all the arms and proviſions were kept; after which he

11 who becomes king of Syracuſe. An. 404. B. C.

publicly took the title of king of Syracuſe in the year 404 B. C.

The Syracuſans did not tamely ſubmit to their new maſter: but Dionyſius managed matters ſo well, that their frequent revolts anſwered no other purpoſe than more certainly to entail ſlavery on themſelves; and he was allowed to poſſeſs the throne without much oppoſition till his death, which happened in the year 366 B. C.

12 Dionyſius II. An. 366. B. C.

On the death of Dionyſius, he was ſucceeded by his ſon, called alſo Dionyſius. He was naturally of a mild and peaceable temper, averſe to cruelty, and inclined to learning; but his father, to whom all merit, even in his own children, gave umbrage, ſtifled as far as poſſible his good qualities by a mean and obſcure education. He no ſooner aſcended the throne, than Dion, brother to Ariſtomache the other wife of Dionyſius the Elder, undertook to correct the faults of his education, and to inſpire him with thoughts ſuitable to the high ſtation in which he was placed. For this purpoſe he ſent for the philoſopher Plato, under whoſe care he immediately put the young king. This inſtantly produced a reformation on Dionyſius; but the courtiers, dreading the effects of the philoſopher's inſtructions, prevailed on him to baniſh Dion, and to keep Plato himſelf in a kind of impriſonment in the citadel. At laſt, however, he ſet him at liberty; upon which Plato returned to his own country.

13 Put under the care of Plato by his uncle Dion, whom he baniſhes.

Dion, in the mean time, viſited ſeveral of the Grecian cities, and at laſt took up his reſidence in Athens; but the honours which were everywhere paid him, raiſed ſuch jealouſies in the breaſt of the tyrant, that he ſtopped his revenue, and cauſed it to be paid into his own treaſury. In a ſhort time Dionyſius again ſent for Plato; but finding it impoſſible to diſſolve the friendſhip between him and Dion, diſgraced, and placed him in a very dangerous ſituation, in the midſt of aſſaſſins who hated him. Not daring, however, to offer him any violence, he allowed him ſoon after to depart; revenging himſelf on Dion, whoſe eſtate he ſold, and gave his wife Arete in marriage to Timocrates one of his one flatterers.

Dion now reſolved to revenge himſelf on the tyrant for the many injuries he had ſuſtained, and at once to deliver his country from the oppreſſion under which it groaned. He began with raiſing foreign troops privately, by proper agents, for the better execution of his deſign. Many Syracuſans of diſtinction entered into his ſcheme, and gave him intelligence of what paſſed in the city; but of the exiles, of whom there were upwards of 1000 diſperſed up and down Greece, only 25 joined him; ſo much were they awed by the dread of the tyrant. The troops were aſſembled at the iſland of Zacynthus, in number only about 800; but who had all been tried on many occaſions, were well diſciplined, and capable of animating by their example the forces which

14 Dion raiſes troops for dethroning the tyrant.

Dion hoped to find in Sicily. When they were about to ſail, Dion acquainted them with his deſign, the boldneſs of which at firſt occaſioned among them no ſmall conſternation; but Dion ſoon removed their fears, by telling them that he did not lead them as ſoldiers, but as officers, to put them at the head of the Syracuſans and all the people of Sicily, who were ready to receive them with open arms. Having then embarked in two ſmall trading veſſels, they arrived in 12 days at Cape Pachynum near Syracuſe. At laſt they arrived at the port of Minoa, not far from Agrigentum. Here they received intelligence that Dionyſius had ſet ſail for Italy, attended by a fleet of 80 galleys. On this Dion reſolved to take advantage of the tyrant's abſence, and immediately ſet ſail for Syracuſe. On his march he prevailed on the inhabitants of Agrigentum, Gela, Camarina, and other cities, to join him. As ſoon as he entered the territories of Syracuſe, multitudes flocked to him; and as nobody appeared to oppoſe him, he boldly entered the city, where he quickly found himſelf at the head of 50,000 men. As ſoon as he had landed in Sicily, Timocrates, to whom his wife Arete had been given by Dionyſius, and to whom the care of the city had been left, diſpatched a courier to let the tyrant know the danger in which he was. Dionyſius was, however, accidentally prevented from receiving a timely account of Dion's arrival; ſo that when he entered the citadel by ſea, ſeven days after Dion's arrival, he found his affairs in a deſperate ſituation. Upon this he had recourſe to artifice; and having amuſed the Syracuſans by a feigned negociation, until he obſerved that they kept a negligent guard, he attacked them all at once with ſuch fury, that he had almoſt taken the city. But Dion encouraged the ſoldiers by his example ſo much, that he at laſt obtained a complete victory; for which they preſented him with a crown of gold.

Syracuſ

15 Enters Syracuſe without oppoſitio

16 Dionyſi arrives, is totall defeate

It was not long, however, before the ungrateful Syracuſans began to think of conferring quite different rewards on their benefactor. Dionyſius had the addreſs to render him ſuſpected by the multitude; at the ſame time that Heraclides, an excellent officer, but a ſecret enemy to Dion, did all that lay in his power to ſink his credit. Dionyſius was ſoon obliged to fly into Italy, but left Heraclides to oppoſe Dion.

17 Ingratit of the S cuſans t Dion.

At length Dion got poſſeſſion of the city, Heraclides ſubmitted to him, and was received into favour; but as his ſeditious and turbulent behaviour ſtill continued, Dion at laſt gave orders to put him to death. This action, however neceſſary, ſo affected the mind of Dion, that he became melancholy; and ever after imagined himſelf haunted by a frightful ſpectre, reſembling a woman of gigantic ſtature, with the haggard looks and air of a fury. In a ſhort time after he loſt his life, through the baſe treachery of Calippus, or Gylippus, who pretended to be his intimate friend, and who immediately after cauſed his wife and ſiſter to be carried to priſon.

18 Dion be come m lancho and is m dered.

Calippus having removed Dion, ſoon made himſelf maſter of Syracuſe, where he committed all manner of cruelties; but was driven out, and forced to fly to Rhegium, where he was murdered with the ſame dagger which had killed Dion. In 350 B. C. Dionyſius again made himſelf maſter of Syracuſe; and being exaſperated by his paſt misfortunes, tyrannized worſe than ever. The Syracuſans firſt had recourſe to Icetas tyrant of Leontini; but as the Carthaginians took this opportunity to invade

19 Dionyſ reſtore

vade them with a powerful fleet and army, they were obliged to apply to the Corinthians. By them Timoleon, a celebrated commander, was ſent to the aſſiſtance of the Syracuſans, whom he found in a very diſtreſſed ſituation; Icetas being maſter of the city, the Carthaginians of the harbour, and Dionyſius of the citadel. As all parties were equally the enemies of Dionyſius, he found it impoſſible to hold out, and therefore ſurrendered himſelf to Timoleon, by whom he was ſent to Corinth; where at laſt he was reduced to the neceſſity of teaching a ſchool for his ſupport.

After the expulſion of the tyrant, Timoleon withdrew to Catana, leaving only 400 Corinthians, under the command of an experienced officer named *Leon*, to guard the citadel. Theſe were immediately beſieged by Icetas and the Carthaginians, but Timoleon found means to relieve them in ſpite of all oppoſition; and having diſperſed emiſſaries through the army of Mago the Carthaginian general, exhorting the mercenary Greeks to forſake him, he was ſo much intimidated, that in ſpite of all the remonſtrances Icetas could make, he ſet ſail for Africa, leaving his colleague to carry on the war in the beſt manner he could.

The day after the departure of Mago, Timoleon aſſaulted the city ſo briſkly, that the troops of Icetas were driven from the walls, and the Corinthians became maſters of the place. Timoleon, by ſound of trumpet, invited the inhabitants to come and aſſiſt in demoliſhing the citadel and other caſtles, which he called the *neſts of tyrants*: after which he cauſed edifices to be erected in the place where the citadel had ſtood, for the adminiſtration of juſtice. He found the city in a moſt miſerable ſituation: for many having periſhed in the wars and ſeditions, and others having fled to avoid the oppreſſion of tyrants, Syracuſe, once ſo wealthy and populous, was now become almoſt a deſert; inſomuch that the horſes were fed on the graſs which grew on the market-place. Timoleon ſupplied the city with inhabitants from Corinth and other cities of Greece, at the ſame time that great multitudes from Italy and the other parts of Sicily reſorted thither. Timoleon diſtributed the lands among them *gratis*; but ſold the houſes, and with the money ariſing from the ſale eſtabliſhed a fund for the ſupport of the poor. Having thus reſtored Syracuſe, he in like manner delivered all the Greek cities of Sicily from the tyrants who had taken poſſeſſion of them, all of whom he put to death. After this he reſigned his authority, and led a retired life, honoured in the higheſt degree by the Syracuſans, and by all the cities in Sicily. After his death, he was honoured as a god; the expence of his funeral was defrayed by the public; ſports, with horſe-races and gymnaſtic exerciſes, were held annually on the day of his death; and it was decreed, that whenever the Syracuſans were at war with the barbarians, they ſhould ſend to Corinth for a general.

For 20 years the Syracuſans enjoyed the fruits of Timoleon's victories; but new diſturbances ariſing, in a ſhort time another tyrant ſtarted up, who exceeded all that had gone before him in cruelty and other vices. This was the celebrated Agathocles, of whoſe exploits againſt the Carthaginians a full account is given under the article CARTHAGE, N° 33—53. He was poiſoned by one Mœnon in the year 289 B. C. after having reigned 28 years, and lived 95.—A ſucceſſion of tyrants followed, till at laſt the city, being held by two rivals, Tœnion and Soſiſtratus, who made war within the very walls, Pyrrhus king of Epirus was invited into Sicily, in order to put an end to theſe diſtractions. He willingly complied with the invitation; and was every where received with loud acclamations, as the deliverer not only of Syracuſe, but of all Sicily. As he had a fine army of 30,000 foot and 5000 horſe, with a fleet of 200 ſail, he drove the Carthaginians from place to place, till he left them only the two ſtrong poſts of Eryx and Lilybæum. The former of theſe he took by aſſault, and was himſelf the firſt man who mounted the walls, after having killed a great number of Africans with his own hand. The Mamertines likewiſe, who had conquered a conſiderable part of the iſland, were every where defeated and driven out, till at laſt they were ſhut up in the city of Meſſana. The Carthaginians, alarmed at the rapidity of his conqueſts, ſent ambaſſadors with propoſals of peace upon very advantageous terms; but Pyrrhus, puffed up with the expectation of reducing the whole iſland, refuſed to hearken to any terms unleſs they would inſtantly abandon it. So firm was he in the belief of this, that he cauſed his ſon to aſſume the title of *king of Sicily*; but in the mean time, having diſpleaſed the Sicilians by his arbitrary behaviour, they deſerted from him in ſuch numbers that he was glad to ſet out for Italy, for which retreat the embaſſies he received from the Samnites, Tarentines, and other Italians, furniſhed him with an honourable pretext. He embarked in the ſhips which he had brought with him from Italy; but was met at ſea by the Carthaginians, who ſunk 70 of his veſſels, and diſperſed or took the reſt; ſo that he ſaved himſelf in Italy with only 12 veſſels, the poor remains of a fleet of 200 ſail. No ſooner were the Mamertines appriſed of his departure, than they diſpatched a body of 18,000 men to haraſs him after his landing. Theſe, having paſſed the ſtraits before him, poſted themſelves in the road which Pyrrhus muſt take in marching by land to Tarentum; and concealing themſelves among woods and rocks, attacked him unexpectedly, and with great reſolution. But Pyrrhus behaved on this occaſion with his uſual bravery. The attack being made on his rear, he haſtened thither, and made a dreadful ſlaughter of the enemy, till a wound on his head obliged him to retire.

After the departure of Pyrrhus, Hiero the ſon of Hierocles, a deſcendant of Gelon, the firſt king of Syracuſe, was choſen general of the forces, along with another named *Artemidorus*. The two generals had nothing more at heart than to put an end to the confuſion and diſorder which reigned in the city; for which reaſon they entered it at the head of their forces. On this occaſion Hiero diſcovered extraordinary talents for government. By mere dint of inſinuation and addreſs, without ſhedding blood, or hurting a ſingle citizen, he calmed the minds of the people; reconciled the factions; and ſo gained the affections of all, that he was inveſted with the whole civil as well as military power in the ſtate. Soon after this, he married the daughter of one of the firſt citizens; and having diſtinguiſhed himſelf by his exploits againſt the Mamertines, was unanimouſly elected king of Syracuſe, in the year 265 B. C.

Some time after Hiero's acceſſion to the throne, he again defeated the Mamertines, and reduced them to ſuch ſtraits, that they were obliged to call in the Romans.

Syracuſe.

26 Pyrrhus king of Epirus invited into Sicily.

27 Syracuſe haraſſed by the Mamertines.

28 Hiero choſen general of the Syracuſan forces.

29 Is elected king of Syracuſe. An. 265. B. C.

Syracuſe.

mans to their aſſiſtance. The conſequences of this have been fully related under the articles ROME and CARTHAGE. Hiero, who had allied himſelf with the Carthaginians, being himſelf defeated by the Romans, and finding his allies unable to protect him againſt the power of that republic, concluded an alliance with them; and continued faithful to them even in the time of the ſecond Punic war, when they were in the greateſt diſtreſs. In his reign flouriſhed the celebrated mathematician Archimedes, whoſe genius he employed in fortifying the city of Syracuſe, by innumerable machines, in ſuch a manner as rendered it abſolutely impregnable to every method of attack known at that time.

30 Hieronymus allies with the Carthaginians.

Hiero died about 211 B. C. and was ſucceeded by his grandſon Hieronymus: but he imprudently forſook the counſels of his grandfather, and entered into an alliance with the Carthaginians. Soon after this he was murdered, in conſequence of his tyranny and cruelty, and the greateſt diſorders took place in the city; which Hannibal, though then in Italy, found means to foment, in hopes of keeping the Syracuſans in his intereſt. This indeed he effected; but as his own affairs in Italy began to decline *, he could not prevent Marcellus from landing in Sicily with a formidable army, which the Sicilians could by no means reſiſt. Syracuſe was ſoon inveſted; but the machines invented by Archimedes baffled all attempts to take it by aſſault. The immenſe preparations which the conſul had made for taking the city by ſtorm, could not have failed to accompliſh his purpoſe, had the place been otherwiſe defended than by the contrivance of Archimedes. The Roman fleet conſiſted of 60 quinqueremes, beſides a far greater number of other ſhips. The decks were covered with ſoldiers armed with darts, ſlings, and bows, to drive the beſieged from the ramparts, which on one ſide were waſhed by the ſea, and to facilitate the approach to the walls. But a machine of Marcellus's own invention, called a *ſambuca*, was what he chiefly depended on. The conſul's deſign was to bring his ſambuca to the foot of the walls of Acradina; but, while it was at a conſiderable diſtance (and it advanced very ſlowly, being moved only by two ranks of rowers), Archimedes diſcharged from one of his engines a vaſt ſtone, weighing, according to Plutarch's account, 1250 pounds, then a ſecond, and immediately after a third; all which, falling upon the ſambuca with a dreadful noiſe, broke its ſupports, and gave the galleys upon which it ſtood ſuch a violent ſhock that they parted, and the machine which Marcellus had raiſed upon them at a vaſt trouble and expence was battered to pieces. At the ſame time, ſeveral other machines, which were not viſible without the walls, and conſequently did not leſſen the confidence of the Romans in the aſſault, played inceſſantly upon their ſhips, and overwhelmed them with ſhowers of ſtones, rafters, and beams pointed with iron; inſomuch that Marcellus, being at a loſs what to do, retired with all poſſible haſte, and ſent orders to his land-forces to do the ſame; for the attack on the land-ſide was attended with no better ſucceſs, the ranks being broken and thrown into the utmoſt confuſion by the ſtones and darts, which flew with ſuch noiſe, force, and rapidity, that they ſtruck the Romans with terror, and daſhed all to pieces before them.

* See *Carthage*, N° 123.

31 Syracuſe inveſted.

32 Incredible effects of the machines of Archimedes.

Marcellus, ſurpriſed, though not diſcouraged, at this artificial ſtorm, which he did not expect, held a council of war, in which it was reſolved, the next day before ſunriſe, to come up cloſe under the wall, and keep there. They were in hopes by this means to ſecure themſelves againſt the terrible ſtorm of ſtones and darts which fell on the ſhips when at a diſtance. But Archimedes had prepared engines which were adapted to all diſtances. When the Romans therefore had brought their ſhips cloſe under the wall, and thought themſelves well covered, they were unexpectedly overwhelmed with a new ſhower of darts and ſtones, which fell perpendicularly on their heads, and obliged them to retire with great precipitation. But they were no ſooner got at ſome diſtance, than a new ſhower of darts overtook them, which made a dreadful havock of the men, while ſtones of an immenſe weight, diſcharged from other machines, either diſabled or broke in pieces moſt of their galleys. This loſs they ſuſtained, without being able to revenge it in the leaſt on the enemy. For Archimedes had placed moſt of his engines behind the walls, and not only out of the reach, but even out of the ſight, of the enemy; ſo that the Romans were repulſed with a dreadful ſlaughter, without ſeeing the hand that occaſioned it. What moſt haraſſed the Romans in the attack by ſea, was a ſort of crow with iron claws, faſtened to a long chain, which was let down by a kind of lever. The weight of the iron made it fall with great violence, and drove it into the planks of the galleys. Then the beſieged, by a great weight of lead at the other end of the lever, weighed it down, and conſequently raiſed up the iron of the crow in proportion, and with it the prow of the galley to which it was faſtened, ſinking the poop at the ſame time into the water. After this the crow letting go its hold all of a ſudden, the prow of the galley fell with ſuch force into the ſea, that the whole veſſel was filled with water, and ſunk. At other times, the machines, dragging ſhips to the ſhore by hooks, daſhed them to pieces againſt the points of the rocks which projected under the walls. Other veſſels were quite lifted up into the air, there whirled about with incredible rapidity, and then let fall into the ſea, and ſunk, with all that were in them. How theſe ſtupendous works were effected, few, if any, have hitherto been able to comprehend.

The troops under the command of Appius ſuffered no leſs in this ſecond attack than the fleet. In the whole ſpace of ground which the army, when formed, took up, the laſt files as well as the firſt were overwhelmed with ſhowers of darts and flints, againſt which they could not poſſibly defend themſelves. When they had with infinite trouble brought the mantlets and covered galleries, under which they were to work the rams, near the foot of the wall, Archimedes diſcharged ſuch large beams and ſtones upon them as cruſhed them to pieces. If any brave Roman ventured to draw too near the wall, iron hooks were immediately let down from above, which, taking hold of his clothes or ſome part of his body, lifted him up in the air and daſhed out his brains with the fall. Marcellus, though at a loſs what to do, could not however forbear expreſſing himſelf with pleaſantry: Shall we perſiſt, ſaid he to his workmen, in making war upon this Briareus, upon this giant with an hundred hands? But the ſoldiers were ſo terrified, that if they ſaw upon the walls only a ſmall cord, or the leaſt piece of wood, they immediately turned their backs and fled, crying out, that Archimedes was going to diſcharge ſome dreadful machine upon them.

The

The conſuls, finding themſelves thus defeated in every attempt, turned the ſiege into a blockade, reduced moſt of the other places in the iſland, and defeated the forces which were ſent againſt them; and at laſt Marcellus made himſelf maſter of Syracuſe itſelf. He took the opportunity of a feſtival, when the ſoldiers and citizens had drunk plentifully, to make a detachment ſcale the walls of Tyche, in that part of it which was neareſt to Epipolæ, and which was ill guarded. He preſently after poſſeſſed himſelf of Epipolæ; whereupon the inhabitants of Neapolis, as well as Tyche, ſent deputies to him, and ſubmitted. Marcellus granted life and liberty to all of free condition, but gave up thoſe quarters of the city to be plundered. The ſoldiers had orders to ſpare the lives of the citizens; but they were cruel in their avarice, ſlew many of them, and among the reſt the incomparable Archimedes. He was very intent on a demonſtration in geometry, and calmly drawing his lines, when a ſoldier entered the room, and clapped a ſword to his throat. "Hold! (ſaid Archimedes) one moment, and my demonſtration will be finiſhed." But the ſoldier, equally regardleſs of his prayer and his demonſtration, killed him inſtantly. There are different accounts of the manner of his death; but all agree that Marcellus regretted it extremely, and ſhowed a ſingular favour to his relations for his ſake.

The city of Syracuſe continued ſubject to the weſtern empire till its declenſion, when the iſland of Sicily, being ravaged by different barbarians, the capital alſo underwent various revolutions; till at laſt, in the 9th century, it was ſo deſtroyed by the Saracens, that very few traces of its ancient grandeur are now to be ſeen. "The ancient city of Syracuſe was of a triangular form, and conſiſted of five parts or towns. The circuit, according to Strabo, amounted to 180 ſtadia, or 22 Engliſh miles, and four furlongs. An account which Mr Swinburne once ſuſpected of exaggeration; but, after ſpending two days in tracing the ruins, and making reaſonable allowances for the encroachments of the ſea, he was convinced of the exactneſs of Strabo's meaſurement.

At preſent it is ſtrongly fortified towards the land, and the ditches of the baſtions form the communications between the two havens. It is very weak towards the ſea, but the ſhelves render it hazardous to debark on that ſide. The garriſon is one of the beſt appointed in the kingdom, but the heights of Acradina command the works.

About eighteen thouſand inhabitants are now contained in it. The dwellings are far from being memorials of ancient Syracuſan architecture or opulence. In any other ſituation they might be thought tolerable; but to obſervers who reflect on the ſtyle of thoſe buildings that probably once covered the ſame ground, the preſent edifices muſt have a mean appearance. The ancient temple of Minerva is now turned into a cathedral. The walls of the cella are thrown down, and only as much left in pillars as is neceſſary to ſupport the roof; the intercolumniations of the periſtyle are walled up. This temple is built in the old Doric proportions uſed in the reſt of Sicily; its exterior dimenſions are 185 feet in length and 75 in breadth. There are alſo ſome remains of Diana's temple, but now ſcarcely diſcernible. Beſides theſe, there are few ruins in the iſland; and one is ſurpriſed that any ſhould exiſt in a place which had been ſo often laid waſte by enemies, and ſo often ſhaken by earthquakes. E. Long. 25. 27. N. Lat. 37. 3. Syracuſe; Syria.

SYRIA, a very ancient kingdom of Aſia, lying between the Mediterranean on the weſt, the Euphrates on the eaſt, and Arabia Deſerta, Phœnicia and Paleſtine, on the ſouth.

1 Names, diviſions, &c. of ancient Syria.

In ancient times this country was called *Aram*, probably from Aram the youngeſt ſon of Shem. At firſt it was parcelled out into ſeveral petty ſtates; all of which ſeem afterwards to have been reduced under ſubjection to the four principal ones, Zobah, Damaſcus, Hamath, and Geſhur. Afterwards the whole country was divided into two parts only, viz. Cœleſyria and Phœnicia; though the Phœnicians, Idumeans, Jews, Gazites, and Azotites, or the whole country of the Philiſtines, was included. After the death of Alexander, Syria, in the great extent of the word, was divided, according to Strabo, into Comagene, Seleucis of Syria, Cœleſyria, Phœnice on the ſea coaſt, and Judea in the midland. Ptolemy, however, ſubdivides theſe; and in the Proper Syria reckons only Comagene, Pieria, Cyrrhiſtica or Cyrrheſtica, Seleucis, Caſſiotis or Caſiotis, Chalybonitis, Chalcidice or Chalcidene, Apamene, Laodicene, Phœnicia Mediterranea, Cœleſyria, and Palmyrene.

The hiſtory of the ancient Syrians, till the time of their being carried away by the kings of Aſſyria, is totally unknown, excepting a few particulars which may be gathered from Scripture, and which it is needleſs here to repeat. During the continuance of the Aſſyrian, Babylonian, and Perſian monarchies, the hiſtory of this country affords nothing remarkable; but after the death of Alexander, it gave name to a very conſiderable empire, which makes a conſpicuous figure in ancient hiſtory. At this time, however, it was not confined to Syria properly ſo called, but comprehended all thoſe vaſt provinces of the Upper Aſia which formed the Perſian empire; being, in its full extent, bounded by the Mediterranean upon one ſide, and the river Indus on the other. The firſt king was Seleucus, one of the generals of Alexander the Great; who, after the death of that conqueror, being made governor of Babylon, was tempted, by the example of Alexander's other captains, to ſet up for himſelf. Eumenes, who had ſincerely at heart the intereſt of Alexander's family, ſolicited his aſſiſtance againſt Antigonus, who had openly revolted; but Seleucus not only refuſed his aſſiſtance, but attempted to deſtroy Eumenes himſelf with his whole army. Eumenes, however, found means to eſcape the danger without the loſs of a man. On this Seleucus endeavoured to gain over his troops: but finding that impoſſible, he made a truce with Eumenes, and granted him a ſafe paſſage through his province; but at the ſame time ſent an expreſs to Antigonus, deſiring him to fall upon him, before he was joined by the governors of Upper Aſia. Antigonus did not fail to follow his advice; but having prevailed againſt Eumenes through treachery, he next thought of bringing Seleucus himſelf under ſubjection. On his return to Babylon, therefore, after having been feaſted with his whole army by Seleucus, he demanded of him an account of the revenues of his province. Receiving an unfavourable anſwer to this requiſition, Antigonus was ſo much exaſperated, that Seleucus, not thinking himſelf a match for him at that time, thought proper to fly into Egypt.

2 Seleucus the firſt king of Syria after Alexander the Great.

3 Obliged by Antigonus to fly into Egypt.

By

Syria.

By the flight of Seleucus, Antigonus was left maſter of all his provinces; but his ſon Demetrius being afterwards defeated by Ptolemy at Gaza, Seleucus began to think of recovering what he had loſt. Having received from Ptolemy a very ſlender force, he ſet out towards Babylon, and procured reinforcements as he proceeded.

4 Becomes maſter of Babylon. An. 312. B. C.

As he approached the city, thoſe who favoured Antigonus retired into the citadel, but were ſoon obliged to ſurrender; and in that fortreſs Seleucus found his children, friends, and domeſtics, whom Antigonus had kept priſoners ever ſince his flight into Egypt.

Seleucus having made himſelf maſter of Babylon, in the year 312 B. C. began to prepare for encountering Antigonus, who he knew would ſoon attack him with all his force. Nicanor, governor of Media under Antigonus, firſt advanced againſt him at the head of 10,000 foot and 7000 horſe; but Seleucus, with only 3000 foot and 400 horſe, having drawn him into an ambuſh, cut off almoſt the whole of his army, and ſuch of the ſoldiers as had eſcaped the ſlaughter willingly enliſted under his banner.

5 Defeats Nicanor, and reduces Media and Suſiana.

The conſequence of this victory was the ſubmiſſion of all Media and Suſiana; but during his abſence from the capital, Demetrius advanced towards it, and made himſelf maſter of it.

On the return of Seleucus to Babylon, he eaſily drove out the troops left by Demetrius, recovered the caſtle which he had garriſoned, and ſettled his authority on ſuch a firm foundation, that it could never afterwards be moved. Having then marched again into Media, he defeated and killed with his own hand Nicanor or Nicator, whom Antigonus had ſent againſt him; after which, having ſettled the affairs of Media, he reduced all Perſia, Bactria, and Hyrcania, ſubjecting to his new empire theſe and all the other provinces on this ſide the Indus which had been conquered.

Seleucus being now maſter of all the countries which lie between the Euphrates and the Indus, took the title of king of Babylon and Media. But, not ſatisfied with theſe poſſeſſions, ample as they were, he croſſed the Indus, in order to conquer thoſe regions which had ſubmitted to Alexander beyond that river. In this expedition, however, he was unſucceſsful; but returning weſtward againſt his old enemy Antigonus, he defeated and killed him at Ipſus, and reduced his ſon Demetrius to a very dependent ſtate. Seleucus now betook himſelf to the building of a city, which he called *Seleucia*, and which ſtood on the place where the city of Bagdad now ſtands. Beſides theſe, he built a great many others; 16 of which he called *Antioch*, from the name of his brother Antiochus; nine *Seleucia*, from his own name; three *Apamea*, from Apama his firſt wife; one *Stratonicea*, from his ſecond wife Stratonice; and ſix *Laodicea*, from his mother Laodice.

In 284 Seleucus entered into a war with Lyſimachus, with whom he had hitherto lived in ſtrict amity. Out of 36 general officers left by Alexander the Great, they two ſurvived, and both were upwards of 70 years old. Nevertheleſs they were both filled with the ambition and animoſity of young men. The two armies met at a place called *Curopedion* in Phyrgia, where an obſtinate engagement took place. Victory was long doubtful: but at laſt Lyſimachus was run through with a ſpear, and died on the ſpot; on which his troops betook themſelves to flight. This victory added to the poſſeſſions of Seleucus all thoſe provinces which had formerly been ſubject to Lyſimachus, and from this victory he is generally called *Nicator*, or *the conqueror*.

6 Defeats and kills Lyſimachus.

Syri

His triumph, however, on this occaſion, was but ſhort-lived; for ſeven months after, he was marching towards Macedon to take poſſeſſion of that kingdom, he was treacherouſly murdered by Ptolemy Ceraunus, on whom he had conferred innumerable favours.

7 Is him treach ouſly n dered.

8 Antio Soter. An. 2 B. C.

Seleucus was ſucceeded by his ſon Antiochus Soter, who held the empire 19 years. He reſigned to Antigonus Gonatus all pretenſions to the crown of Macedon; and having engaged in a war with Eumenes king of Pergamus, he was defeated by him, and obliged to yield up part of his dominions. He died in 261 B. C. and was ſucceeded by his ſon Antiochus Theos; who having engaged in a war with Ptolemy Philadelphus king of Egypt, the Parthians and Bactrians took that opportunity to revolt, and could never afterwards be reduced. In 246 B. C. he was poiſoned by his wife Laodice, who raiſed to the throne her own ſon, named *Seleucus Callinicus*. He was ſucceeded by his eldeſt ſon Seleucus Ceraunus, a weak prince, who was poiſoned by a conſpiracy of two of his officers, when he had reigned one year; after which his brother Antiochus, ſurnamed the *Great*, aſcended the throne in 225 B. C.

9 Antio Theos An. 2 B. C.

1 Seleu Calli An. B. C.

In the very beginning of his reign, two of his generals, Alexander and Molo, rebelled againſt him. The former had been appointed governor of Perſia, and the latter of Media. Antiochus marched againſt the rebels, whom he defeated in a pitched battle; on which their chiefs laid violent hands on themſelves. On his return he received the ſubmiſſion of the Atropatii, a barbarous people in Media; and put to death his prime miniſter Hermias, whom he had found hatching treacherous deſigns againſt him. During his lifetime, however, the traitor, by accuſing Achæus of treaſon, had obliged him to revolt in his own defence; ſo that the king had ſtill two important wars on his hands, viz. one with Ptolemy king of Egypt, and the other againſt Achæus. After ſome deliberation, he reſolved to march firſt againſt the king of Egypt; and was at firſt very ſucceſsful, reducing many cities in Cœleſyria and Paleſtine, and defeating the Egyptians in a pitched battle; but in the year 217 B. C. being worſted in the battle of Raphia, he was obliged to abandon all his conqueſts; of which Ptolemy immediately took poſſeſſion, and Antiochus was obliged to cede them to him, that he might be at leiſure to purſue the war againſt Achæus.

Anti the C An. B. C.

Supp one lion, emb fed the othe

Antiochus having made vaſt preparations for his expedition, ſoon reduced Achæus to ſuch diſtreſs, that he was obliged to ſhut himſelf up in the city of Sardis, which he defended for ſome time with great bravery; till at laſt, being betrayed by two Cretans, he was delivered up to the king, and by his order put to death. Antiochus then undertook an expedition againſt the Parthians, whom he obliged to conclude a peace on very advantageous terms. He then turned his arms againſt the king of Bactria, whom he alſo compelled to agree to his terms. He then croſſed Mount Caucaſus, and entered India; where he renewed his alliance with the king of that country. From India he marched into Arachoſia, Drangiana, and Carmania, eſtabliſhing order and diſcipline in all thoſe countries: then paſſing through Perſia, Babylonia, and Meſopotamia, he returned to Antioch, after an abſence of ſeven years.

Hi fes ea

In

Syria.

In the year 204 B. C. Antiochus entered into a league with Philip of Macedon, on purpose to deprive Ptolemy Epiphanes, the infant king of Egypt, of all his dominions. He defeated the Egyptian general, recovered all Palestine and Cœlesyria; after which he invaded Asia Minor, in hopes of reducing it also, and restoring the Syrian empire to the same extent it had in the time of Seleucus Nicator. The free cities in Asia Minor immediately had recourse to the Romans, who sent an embassy to Antiochus on the occasion; but as both parties put on those haughty and imperious airs to which they thought the greatness of their power gave them a right, no satisfaction was given, but every thing tended to an open rupture. While matters were in this situation, Hannibal the Great being obliged to leave his own country, fled to Antiochus: from whom he met with a gracious reception. As Hannibal had, while a child, sworn perpetual enmity against the Romans, he used all his eloquence to persuade Antiochus to make war with them; and as the many victories which he had gained over them left no room to doubt of his capacity, Antiochus doubted nothing of being able, by his assistance, to conquer that haughty people. Several embassies passed between the two nations; but chiefly with a design, on the part of Antiochus, to gain time. Hannibal endeavoured to draw his countrymen into the confederacy against Rome, but without effect. Antiochus having strengthened himself by several alliances, at last resolved to begin the war in earnest. The king imprudently became the aggressor, by falling on a body of 500 Romans before war had been declared. He also made King Philip his enemy, by entertaining the regent of Athamania, who was a pretender to the crown of Macedon. To complete all, he himself fell in love, though above 50 years of age, with a beautiful young woman of Chalcis, whom he married; and became so great a slave to this passion, that he entirely neglected his affairs; the army gave themselves up entirely to dissipation and debauchery, and every trace of military discipline vanished.

In the year 191 B. C. Antiochus was roused from his lethargy by a declaration of war against him at Rome, and set out for Ætolia. His army at this time amounted to no more than 10,000 foot and 500 horse. He had been made to believe that he would receive a vast reinforcement in Ætolia: but when he came to make the experiment, he soon found his mistake; all the troops he could raise there amounted to no more than 4000 men. With this force, so exceedingly inadequate to the purpose, he was obliged to oppose the Roman army, who were advancing in conjunction with the Macedonians, and had already made surprising progress. Antiochus seized the straits of Thermopylæ; but was driven from them by the Romans, the king himself being the first that fled. Almost his whole army was destroyed in the battle or in the pursuit, and Antiochus returned with disgrace into Asia.

Soon after his return, Antiochus equipped a fleet of 200 sail; on which he immediately embarked for the Thracian Chersonesus, now Crim Tartary. He fortified the cities of Lysimachia, Sestus, and Abydos, with others in that neighbourhood, to prevent the Romans from crossing the Hellespont. In the mean time Polyxenidas the Syrian admiral sent intelligence to the king that the Roman fleet had appeared off Delos; upon which he desired him to seek them out and engage them at all events. He did so, and was defeated with the loss of 40 ships taken or sunk in the engagement. This was soon after revenged by the destruction of the Rhodian fleet by the artifice of Polyxenidas; but in the end the king's affairs went everywhere to wreck. Having laid siege to the city of Pergamus, he was obliged to raise it with loss; the Phœnician fleet commanded by Hannibal was defeated by the Rhodians; and soon after the Syrian fleet under Polyxenidas was utterly defeated by the Romans. Antiochus was so much disheartened by these repeated defeats, that he appeared like one infatuated. Instead of fortifying more strongly those cities which lay on the frontiers of his kingdom, he entirely deserted them: and thus Lysimachia and Abydos, the two keys to Asia, fell into the hands of the Romans without the least resistance.

20 His fleet defeated by that of the Romans.

21 Meets with two other defeats, and becomes like one infatuated.

The arrival of the Romans in Asia struck Antiochus with such terror, that he instantly sued for peace. The terms he offered were indeed very advantageous, but by no means agreeable to the expectations of the Romans. They therefore gave him this final answer: 1. That since he had drawn upon himself the war, he should defray the whole expence of it; 2. That he should restore liberty in general to all the Greek cities in Asia; and, 3. That to prevent future hostilities, he should relinquish all Asia on this side Mount Taurus. These terms, however, still appeared to him so intolerable, that he resolved to continue the war; and determined also to take the most imprudent method of carrying it on, namely, by hazarding all on the event of a general engagement. The king encamped near Magnesia, and strongly fortified his camp. The Romans insulted him in his trenches, and proposed to attack his fortifications if he continued to decline an engagement. At last the king, thinking it would be shameful for him longer to refuse an engagement, being at the head of an army far more numerous than that of the enemy, in a friend's country, and in the midst of his allies, resolved at all events to accept the challenge, and accordingly prepared for a decisive battle.

22 Sues for peace, but is refused.

On the day of the battle the weather proved very favourable to the Romans; for a thick fog rising in the morning, the day was almost turned into night, so that the Syrian commanders could not have all the corps under their command in view, on account of their great extent, nor send them proper orders in time; whereas the fog was not thick enough to prevent the Roman generals from seeing their several bodies at the greatest distance, as they took up but little ground. Besides, the damp which was occasioned by the fog slackened the strings of the enemy's bows, so that the Asiatics who used them could shoot their darts and arrows but faintly. The whole dependence of Antiochus in the first attack was on his armed chariots, which were to cut their way into the Roman army. But Eumenes, king of Pergamus, undertook to render them useless, and even fatal, to the enemy. After this advantage, the Roman cavalry advanced, and fell on those whom the chariots had put in disorder. The Syrians being already intimidated, after a faint resistance gave way; and the Romans made a great slaughter of their men and horses, both being borne down with the weight of their heavy armour. Eumenes charged the left-wing, in which Seleucus commanded, with such vigour, that he put it to flight; and

23 Battle of Magnesia.

24 The Syrians defeated.

Syria.

and the fugitives flying to the phalanx for protection, put that body likewiſe in diſorder; which Domitius obſerving, advanced againſt it at the head of his legionaries, but could not break it till he ordered his men to attack the elephants which the Syrians had placed in the ſpaces between the companies. The Romans had learned, in their wars with Pyrrhus and Hannibal, not to fear thoſe monſters which were once ſo terrible to them. They attacked them, therefore, with great reſolution; and driving them againſt the phalanx, put that body into diſorder, by means of thoſe very animals which had been poſted there for its defence.

After a long and bloody conteſt, the Syrians were totally routed, and the Romans walking over heaps of dead bodies, marched up to the Syrian camp, attacked, and plundered it. The riches they found in it are not to be deſcribed; but the taking of it coſt the Romans a new battle, which proved more fatal to the Syrians than that in the field; for the Romans having, in ſpite of a moſt deſperate reſiſtance, forced the intrenchments, gave no quarter, but put all to the ſword without diſtinction. There fell this day in the battle, in the purſuit, and in the plunder of the camp, 50,000 foot and 4000 horſe; 1500 were taken priſoners, and 15 elephants. In the conſular army there were but 300 foot killed and 25 horſe. Eumenes had only 15 of his men killed; ſo that this victory, as we are told by the ancients, ſeemed a prodigy to all nations both of the eaſt and weſt.

25 And their camp taken.

Antiochus retired to Sardis with as many of his forces that had eſcaped the ſlaughter as he could draw together. From Sardis he ſoon marched to rejoin his ſon Seleucus, who had fled to Apamea. As for the conſul, he took advantage of the king's defeat and flight, making himſelf maſter of all the neighbouring countries. Deputies haſtened to him from all parts; the cities of Thyatira, Magneſia, Trallis, Magneſia in Caria, all Lydia, and Epheſus itſelf, though highly favoured by Antiochus, declared for the Romans. Polyxenidas, upon the news of the king's defeat, left the port of Epheſus, and ſailed to Patara, where he landed with a very ſmall guard, and returned by land into Syria. The conſul took the road to Sardis, which opened its gates to him.

Antiochus finding his affairs in a bad ſituation both by ſea and land, and not daring to appear before the conſular army in the field, ſent Antipater his brother's ſon, and Zeuxis, who had been governor of Lydia and Phrygia, to ſue for a peace. They were ordered to treat chiefly with the elder Scipio, of whoſe clemency and good nature Antiochus entertained a high opinion. Accordingly, on their arrival at Sardis, where the conſul then was with his brother, they addreſſed the latter, and were by him preſented to the conſul. Their ſpeech was very ſubmiſſive, and ſuch as became a vanquiſhed people.

26 Antiochus obtains peace on very hard terms.

Hereupon a council was ſummoned, and after long debates the ambaſſadors were called in; and Scipio Africanus propoſed terms that were very humiliating.

The ambaſſadors of Antiochus had been ordered to refuſe no terms; and therefore theſe were accepted and the whole affair concluded. So that the Syrian ambaſſadors now, prepared to ſet out for Rome, to get the conditions of peace propoſed by Scipio ratified there. L. Aurelius Cotta was ſent with the ambaſſadors to Rome, to acquaint the ſenate with the particulars of the treaty. When they appeared before the conſcript fathers, they ſpoke with great ſubmiſſion, and only deſired them to ratify the articles which the Scipios had offered to their maſter. The ſenate, after examining them, ordered that a treaty of peace ſhould be concluded with Antiochus, and the articles of it engraved on braſs, and fixed up in the Capitol. They only added one clauſe, which was, That the Syrians ſhould change every year all their hoſtages, except the ſon of King Antiochus, who ſhould continue at Rome as long as the republic thought fit. The peace being thus ratified, and all Aſia on this ſide Mount Taurus delivered into the hands of the Romans, the Greek cities were by them reſtored to their liberty, the provinces of Caria and Lydia given to the Rhodians, and all the reſt that had belonged to Antiochus beſtowed upon Eumenes.

Syria.

Antiochus did not long ſurvive his misfortune at Magneſia. He died in 187, and with him fell the glory of the Syrian empire. The Romans now gave laws to the kings of Syria, inſomuch, that when Antiochus Epiphanes the grandſon of Antiochus the Great heſitated at obeying the commands of the ſenate, one of the ambaſſadors drew a circle round him with a rod on the floor, and told him that he ſhould not go out of that ſpot before he had told him what he was to do. The moſt remarkable tranſactions of this prince are his wars with the Jews, and perſecutions of them; of which a full account is given under the article JEWS. After a variety of uſurpers and tyrants, the kingdom of Syria fell under Tigranes king of Armenia in the year 83 B. C.; and upon his overthrow by the Romans, it became a province of the dominions of the republic. From them it was taken by the Saracens in the reign of the caliph Omar, and is now a province of Turkey in Aſia. See ACRE.

27 His death An. 187. B. C.

28 Syria becomes a Roman province.

Syria is in ſome meaſure only a chain of mountains, varying in their levels, ſituation, and appearances. The part of the country, however, next the ſea is in general low, and beſides this there are ſeveral extenſive valleys. The climate on the ſea-coaſt and in theſe valleys is very hot, but in the higher parts of the country it bears a good deal of reſemblance to that of France. Syria is exceedingly fertile, and the variety of its productions is very great. Beſides wheat, rye, barley, beans, and the cotton plant, which is cultivated everywhere, Paleſtine abounds in ſeſamum, from which oil is procured, and doura as good as that of Egypt. Maize thrives in the light ſoil of Balbec, and even rice is cultivated with ſucceſs on the borders of the marſhy country of Havula. They have lately begun to plant ſugarcanes in the gardens of Saide and of Bairout, and they find them equal to thoſe of the Delta. Indigo grows without cultivating on the banks of the Jordan, in the country of Biſan, and only requires care to make it of an excellent quality. The hill-ſides of Latakia produce tobacco. Gaza produces dates like Mecca, and pomegranates like Algiers; Tripoli affords oranges equal to thoſe of Malta; Bairout figs like thoſe of Marſeilles, and bananas not inferior to thoſe of St Domingo; Aleppo enjoys the excluſive advantage of producing piſtachios; and Damaſcus juſtly boaſts of poſſeſſing all the fruits known in France. Its ſtony ſoil ſuits equally the apples of Normandy, the plums of Touraine, and the peaches of Paris.

29 Climate, ſoil, &c. the country.

Volney's Travels, vol. i.

Paris. Twenty ſorts of apricots are reckoned there, the ſtone of one of which contains a kernel highly valued through all Turkey. The cochineal plant, which grows on all that coaſt, contains perhaps that precious inſect in as high perfection as it is found in Mexico and St Domingo.

The inhabitants may be divided into three principal claſſes: the deſcendants of the Greeks of the Lower Empire; the Arabs, their conquerors; and the Turks, the preſent ruling power: and theſe again, the firſt into three, the ſecond into four, claſſes; beſides three wandering tribes of Turkomans, Curds, and Bedouin Arabs. The ancient inhabitants before the Greeks under Alexander are entirely loſt. The inhabitants are in general of a middling ſtature, and the eyes of the women almoſt everywhere beautiful, and their ſhape correct and well proportioned. The general language is Arabic.

SYRINGA, the LILAC, a genus of plants belonging to the claſs diandria, and in the natural ſyſtem ranging under the 44th order, *Sepiariæ*. See BOTANY *Index*.

SYRINGE, a well-known inſtrument, ſerving to imbibe or ſuck in a quantity of fluid, and to ſquirt or expel the ſame with violence. The word is formed from the Greek συριγξ, or the Latin *ſyrinx*, "a pipe."—A ſyringe is only a ſingle pump, and the water aſcends in it on the ſame principle as in the common ſucking-pump. See HYDRODYNAMICS.

SYRUP, in *Pharmacy*, a ſaturated ſolution of ſugar, made in vegetable decoctions or infuſions. See MATERIA MEDICA.

SYSTEM, in general, denotes an aſſemblage or chain of principles and concluſions, or the whole of any doctrine, the ſeveral parts whereof are bound together, and follow or depend on each other; in which ſenſe we ſay a *ſyſtem of philoſophy*, *ſyſtem of divinity*, &c. The word is formed from the Greek συστημα, "compoſition, compages." Syſtem || Syzygy.

SYSTEM, in the animal economy, the *vaſcular*, the *nervous*, and the *cellular*. See ANATOMY.

SYSTEM, in *Muſic*, an aſſemblage of the rules for harmony, deduced from ſome common principle by which they are reunited; by which their connection one with another is formed; from whence, as from their genuine ſource, they natively flow; and to which, if we would account for them, we muſt have recourſe. See the articles CHROMATIC, DIATONIC, ENHARMONIC, HARMONY, INTERVAL, and MUSIC.

SYSTEM, in *Botany*. See BOTANY.

SYSTEM, in *Aſtronomy*. See ASTRONOMY.

SYSTOLE, in *Anatomy*, the contraction of the heart, whereby the blood is drawn off its ventricles into the arteries; the oppoſite ſtate to which is called the *diaſtole*, or *dilatation of the heart*. See ANATOMY *Index*.

SYSTYLE, in *Architecture*, that manner of placing columns where the ſpace between the two ſhafts conſiſts of two diameters or four modules.

SYZYGY, SYZYGIA, in *Aſtronomy*, a term equally uſed for the conjunction and oppoſition of a planet with the ſun. The word is formed from the Greek συζυγια, which properly ſignifies *conjunctio*. On the phenomena and circumſtances of the ſyzygies a great part of the lunar theory depends. See ASTRONOMY.

T.

T or t, the 19th letter and 16th conſonant of our alphabet; the ſound whereof is formed by a ſtrong expulſion of the breath through the mouth, upon a ſudden drawing back of the tongue from the fore-part of the palate, with the lips at the ſame time open. The proper ſound of *t* is expreſſed in moſt words beginning or ending with that letter; as in *take*, *tell*, *hot*, *put*. *Ti* before a vowel has the ſound of *ſi*, or rather of *ſhi*, as in *creation*, except when *ſ* precedes, as in *queſtion*; and in derivatives from words ending in *ty*, as *mighty*, *mightier*. *Th* has two ſounds; the one ſoft, as *thou*, *father*; the other hard, as *thing*, *think*. The ſound is ſoft in theſe words, *then*, *thence*, and *there*, with their derivatives and compounds; and in the words *that*, *this*, *thus*, *thy*, *they*, *though*; and in all words in which *th* comes between two vowels, as, *whether*, *rather*; and between *r* and a vowel, as *burthen*.

In abbreviations, amongſt the Roman writers, T. ſtands for *Titus*, *Titius*, &c.; Tab. for *Tabularius*; Tab. P. H. C. *Tabularius Provinciæ Hiſpaniæ Citerioris*; Tar. *Tarquinius*; Ti. *Tiberius*: Ti. F. *Tiberii filius*; Ti. L. *Tiberii libertus*: Ti. N. *Tiberii Nepos*; T. J. A. V. P. V. D. *tempore judicem arbitrumve poſtulat ut det*; T. M. P. *terminum poſuit*; T. M. D. D. *terminum dedicavit*; Tr. *trans*, *tribunus*; Tr. M. or Mil. *tribunus militum*; TR. PL. DES. *tribunus plebis deſignatus*; TR. AER. *tribunus ærarii*; TRV. CAP. *triumviri capitales*; T. P. or TRIB. POT. *tribunicia poteſtate*; Tul. H. *Tullus Hoſtilius*. T || Tabaſheer.

Amongſt the ancients, T, as a numeral, ſtood for *one hundred and ſixty*; and with a daſh at top, thus $\bar{T}$, it ſignified *one hundred and ſixty thouſand*. In muſic, T ſtands for *tutti*, "all, or altogether."

TABANUS, the BREEZE-FLY; a genus of inſects belonging to the order of diptera. See ENTOMOLOGY *Index*.

TABARCA, a ſmall iſland lying oppoſite to a town of the ſame name, which divides the maritime coaſts of Tunis and Algiers, in Africa. It is two miles from the land, and is in poſſeſſion of the noble family of the Lamellini of Genoa, who have here a governor and a garriſon of 200 men to protect the coral fiſhery. N. Lat. 36. 50. E. Long. 9. 16.

TABASHEER, a Perſian word, ſignifying a hard ſubſtance found in the cavities of the bamboo or Indian reed, and highly valued as a medicine in the Eaſt Indies.

Tabaſheer. Though ſome account was given of the tabaſheer by the Arabian phyſicians, no accurate knowledge of it was obtained till Dr Ruſſel favoured the public with his obſervations on it.

The tabaſheer is produced from the female bamboo, which is diſtinguiſhed from the male by a larger cavity. The bamboos containing it make a rattling noiſe when ſhaken. Dr Ruſſel having examined a bamboo brought from Vellore, conſiſting of ſix joints, found no tabaſheer in two of them: all the reſt contained ſome, but of various quality and quantity; the whole amounting to about 27 grains. The beſt was of a bluiſh white, reſembling ſmall fragments of ſhells, harder alſo than the reſt, but which might be eaſily crumbled between the fingers into a gritty powder; and when applied to the tongue and palate, had a ſlight ſaline and teſtaceous taſte; the weight not exceeding four grains. The colour of the reſt was cineritious, rough on the ſurface, and more friable; having ſome particles of a larger ſize intermized, but light, ſpongy, and ſomewhat reſembling pumice ſtones; which appearance, our author ſuppoſes, led the Arabians to think that fire was concerned in the production. The two middle joints were of a pure white colour within, and lined with a thin film. In theſe the tabaſheer was principally found. The other joints, particularly the two upper ones, were diſcoloured within; and in ſome parts of the cavity was found a blackiſh ſubſtance in grains or in powder, adhering to the ſides, the film being there obliterated. In two or three of the joints a ſmall round hole was found at top and bottom, which ſeemed to have been perforated by ſome inſect.

Garzius informs us, that it is not found in all bamboos, or in all the branches indiſcriminately, but only in thoſe growing about Biſnagur, Batecala, and one part of the Malabar coaſt. Dr Ruſſel was informed by a letter from a medical gentleman attending the embaſſy to the Nizam, that though tabaſheer bears a high price at Hydrabad, it is never brought thither from Biſnagur; and that ſome of what is ſold in the markets comes from the paſs of Atcour in Canoul; and ſome from Emnabad, at the diſtance of about 80 miles to the north-weſt; but that the moſt part comes from Maſulipatam. That ſold in the markets is of two kinds; one the rate of a rupee per dram, but the other only half that price; the latter, however, is ſuppoſed to be factitious, and made up moſtly of burnt teeth and bones. Dr Ruſſel himſelf alſo, is perſuaded that the tabaſheer met with in commerce is greatly adulterated. The above-mentioned gentleman likewiſe informed the doctor that tabaſheer was produced in great quantities at Sylhat, where it is ſold by the pound, from one rupee to one and a half; forming a conſiderable article of trade from Bengal to Perſia and Arabia. There is, however, a third kind, much ſuperior in quality, being whiter, purer, and alſo harder and heavier.

Dr Ruſſel ſuppoſes that the tabaſheer is the juice of the bamboo thickened and hardened. The following obſervations on its medical effects were taken from a Perſian work, intitled the "Tofut ul Monein of Mahommed Monein Hoſeiny," by Mr Williams a ſurgeon in the ſervice of the Eaſt India company. The tabaſheer puts a ſtop to bilious vomitings and to the bloody flux. It is alſo of ſervice in caſes of palpitation of the heart, in faintings, and for ſtrengthening thoſe members of the body that are weakened by heat. It is uſeful alſo for the piles, and for acute or burning fevers, and for puſtules in the mouth (thruſh); and, given with oxymel, is of ſervice againſt reſtleſſneſs, melancholy, and hypochondriacal affections. The habitual internal uſe of it is prejudicial to the virile powers. It is alſo ſaid to be prejudicial to the lungs. Its correctives are the gum of the pine and honey. The doſe of it is to the weight of two d'herems, or ſeven maſhás. Tabaſheer || Taberæmontana

TABBY, in *Commerce*, a kind of rich ſilk which has undergone the operation of tabbying.

TABBYING, the paſſing a ſilk or ſtuff under a callender, the rolls of which are made of iron or copper variouſly engraven, which bearing unequally on the ſtuff renders the ſurface thereof unequal, ſo as to reflect the rays of light differently, making the repreſentation of waves thereon.

TABELLIO, in the Roman law, an officer or ſcrivener, much the ſame with our notaries public, who are often called *tabelliones*.

TABERNACLE, among the Hebrews, a kind of building, in the form of a tent, ſet up, by expreſs command of God, for the performance of religious worſhip, ſacrifices, &c. during the journeying of the Iſraelites in the wilderneſs: and, after their ſettlement in the land of Canaan, made uſe of for the ſame purpoſe till the building of the temple of Jeruſalem. It was divided into two parts; the one covered, and properly called the *tabernacle;* and the other open, called the *court*. The curtains which covered the tabernacle were made of linen, of ſeveral colours, embroidered. There were ten curtains, 28 cubits long and four in breadth. Five curtains faſtened together made up two coverings, which covered up all the tabernacle. Over theſe there were two other coverings; the one of goat's hair, the other of ſheep's ſkins. The holy of holies was parted from the reſt of the tabernacle by a curtain made faſt to four pillars, ſtanding ten cubits from the end. The length of the whole tabernacle was 32 cubits, that is, about 50 feet; and the breadth 12 cubits or 19 feet. The court was a ſpot of ground 100 cubits long, and 50 in breadth, encloſed by 20 columns, each 20 cubits high and 10 in breadth, covered with ſilver, and ſtanding on copper baſes, five cubits diſtant from one another; between which there were curtains drawn, and faſtened with hooks. At the eaſt end was an entrance, 20 cubits wide, covered with a curtain hanging looſe.

Feaſt of TABERNACLES, a ſolemn feſtival of the Hebrews, obſerved after harveſt, on the 15th day of the month Tiſri, inſtituted to commemorate the goodneſs of God, who protected the Iſraelites in the wilderneſs, and made them dwell in booths, when they came out of Egypt. On the firſt day of the feaſt they began to erect booths of the boughs of trees, and in theſe they were obliged to continue ſeven days. The boughs were placed in the open air, and were not to be covered with cloths, nor made too cloſe by the thickneſs of the boughs; but ſo looſe that the ſun and the ſtars might be ſeen, and the rains deſcend through them. For further particulars of the celebration of this feſtival, ſee Levit. ch. xxiii.

TABERNÆ, in *Ancient Geography*. See *TRES Tabernæ*.

TABERNÆMONTANA, in *Botany*, a genus of plants belonging to the claſs of pentandria, and order of monogynia; and in the natural ſyſtem arranged under the

the 30th order, *Contortæ*. There are two horizontal follicles, and the ſeeds are immerſed in pulp. There are eight ſpecies, all of foreign growth.

TABLE, a moveable piece of furniture, uſually made of wood or ſtone, and ſupported on pillars or the like, for the commodious reception of things placed thereon.

TABLE is alſo uſed for the fare or entertainment ſerved up.

TABLE, in *Mathematics*, ſyſtems of numbers calculated to be ready at hand for the expediting aſtronomical, geometrical, and other operations.

TABLE-Book. See WRITING.

TABLE-Mountain, a mountain of Africa, being the moſt weſterly cape or promontory in that part of the world, and near the Cape of Good Hope. The bay which is formed thereby is called the *Table-bay*.

Laws of the Twelve TABLES, were the firſt ſet of laws of the Romans: thus called either becauſe the Romans then wrote with a ſtyle on thin wooden tablets covered with wax; or rather, becauſe they were engraved on tables or plates of copper, to be expoſed in the moſt noted part of the public forum. After the expulſion of the kings, as the Romans were then without any fixed or certain ſyſtem of law, at leaſt had none ample enough to take in the various caſes that might fall between particular perſons, it was reſolved to adopt the beſt and wiſeſt laws of the Greeks. One Hermodorus was firſt appointed to tranſlate them, and the decemviri afterwards compiled and reduced them into ten tables. After a world of care and application, they were at length enacted and confirmed by the ſenate and an aſſembly of the people, in the year of Rome 303. The following year they found ſomething wanting therein, which they ſupplied from the laws of the former kings of Rome, and from certain cuſtoms which long uſe had authoriſed: all theſe being engraven on two other tables, made the law of the twelve tables, ſo famous in the Roman juriſprudence, the ſource and foundation of the civil or Roman law.

TABLES of the Law, in Jewiſh antiquity, two tables on which were written the decalogue, or ten commandments, given by GOD to Moſes on Mount Sinai.

TABOO, a word uſed by the South ſea iſlanders, nearly of the ſame import as prohibited or interdicted. It applies equally to perſons and things, and is alſo expreſſive of any thing ſacred, devoted, or eminent.

TABOR, a mountain of Galilee, about 12 miles from the city of Tiberias. It riſes in the form of a ſugar loaf, in the midſt of an extenſive plain, to the height of 30 ſtadia, according to Joſephus. The aſcent is ſo eaſy, that one may aſcend on horſeback. On the top there is a plain two miles in circumference.

The ſituation of Mount Tabor is moſt delightful. Riſing amidſt the plains of Galilee, it exhibits to the enchanted eye a charming variety of proſpects. On one ſide there are lakes, rivers, and a part of the Mediterranean; and on the other a chain of little hills, with ſmall valleys, ſhaded by natural groves, and enriched by the hands of the huſbandman with a great number of uſeful productions. Here you behold an immenſity of plains interſperſed with hamlets, fortreſſes, and heaps of ruins; and there the eye delights to wander over the fields of Jezrael or Mageddon, named by the Arabs *Ebn-Aamer*, which ſignifies "the field of the ſons of Aamer." A little farther you diſtinguiſh the mountains of Hermon, Gilboa, Samaria, and Arabia the Stony. In ſhort, you experience all thoſe ſenſations which are produced by a mixture and rapid ſucceſſion of rural, gay, gloomy, and majeſtic objects. Tabor ‖ Tacitus.

It was upon this enchanting mount that the apoſtle Peter ſaid to Chriſt, "It is good for us to be here: and let us make three tabernacles; one for thee, and one for Moſes, and one for Elias."

Flavian Joſephus, governor of Galilee, cauſed the ſummit of this mountain, for the ſpace of two miles and a half, to be ſurrounded with walls. The inhabitants of Tabor long braved the power of the Roman armies; but being deprived of water in conſequence of the great heats, they were forced to ſurrender at diſcretion to Placidus, the general of Veſpaſian.

Several churches were built upon this mountain by St Helen, who founded here alſo ſome monaſteries. Of the two moſt remarkable, one was dedicated to Moſes, and inhabited by Cenobites of the order of St Benedict, who followed the Latin rites: the other was dedicated to the prophet Elias by monks of the order of St Baſil, attached to the Greek rites. The kings of Hungary erected here alſo a pretty ſpacious convent for ſome monks belonging to that nation, of the order of St Paul the firſt hermit. Tabor was alſo the ſeat of a biſhop, dependant on the patriarchate of Jeruſalem.

When Godfrey of Bouillon ſeized on this mountain, he repaired the ancient churches, which were beginning to fall into ruins. Under Baldwin I. in 1113, the Saracen troops retook Tabor; and their ſanguinary fury gained as many victories as there were prieſts and Cenobites. This mountain again fell into the hands of the Chriſtians; but the Catholic ſtandard was not long diſplayed on it. Saladin pulled it down the year following, and deſtroyed all the churches. The Chriſtians retook it once more in 1253; and their zeal made them rebuild all the ſacred places. At this time Rome being accuſtomed to give away empires, Pope Alexander IV. granted Tabor to the Templars, who fortified it again. At length, in the courſe of the year 1290, the ſultan of Egypt deſtroyed and laid waſte the buildings of this mountain, which could never be repaired afterwards; ſo that at preſent it is uninhabited.

TACAMAHACA, in *Pharmacy*, a gum reſin, obtained from the fagara octandra and populus balſamifera; and having a fragrant ſmell, a bitteriſh nauſeous taſte, and ſuppoſed to be ſtimulant and tonic in its effects.

TACCA, a genus of plants belonging to the claſs dodecandria. See BOTANY *Index*.

TACHYGRAPHY, from ταχυς, *ſhort*, and γραφω, *I write*, or the art of writing ſhort-hand. See STENOGRAPHY.

TACITUS, CAIUS CORNELIUS, a celebrated Roman hiſtorian, and one of the greateſt men of his time, appears to have been born about the year of Rome 809 or 810, and applied himſelf early to the labours of the bar, in which he gained very conſiderable reputation. Having married the daughter of Agricola, the road to public honours was laid open to him in the reign of Veſpaſian; but during the ſanguinary and capricious tyranny of Domitian, he, as well as his friend Pliny, appears to have retired from the theatre of public affairs. The reign of Nerva reſtored theſe luminaries of Roman literature to the metropolis, and we find Tacitus engaged, in A. U. C. 850, to pronounce the funeral oration *Murphy's Tranſlation of Tacitus.*

Tacitus.

oration of the venerable Virginius Rufus, the colleague of the emperor in the conſulſhip, and afterwards ſucceeding him as conſul for the remainder of the year.

The time of his death is not mentioned by any ancient author, but it is probable that he died in the reign of Trajan.

His works which ſtill remain are, 1. Five books of his Hiſtory. 2. His Annals. 3. A Treatiſe on the different Nations which in his time inhabited Germany: and, 4. The Life of Agricola his father-in-law. There is alſo attributed to him a Treatiſe on Eloquence, which others have aſcribed to Quintilian. The Treatiſe on the Manners of the Germans was publiſhed in 851.—In the year 853, Pliny and Tacitus were appointed by the ſenate to plead the cauſe of the oppreſſed Africans againſt Marius Priſcus, a corrupt proconſul, who was convicted before the fathers; and the patriot orators were honoured with a declaration that they had executed their truſt to the entire ſatisfaction of the houſe. The exact time when Tacitus publiſhed his hiſtory is uncertain, but it was in ſome period of Trajan's reign, who died ſuddenly, A. U. C. 870, A. D. 117.—The hiſtory compriſes a period of 27 years, from the acceſſion of Galba, 822, to the death of Domitian, 849. The hiſtory being finiſhed, he did not think he had completed the tablature of ſlavery; he went back to the time of Tiberius: and the ſecond work, which, however, comes firſt in the order of chronology, includes a period of 54 years, from the acceſſion of Tiberius, 767, to the death of Nero, 821: this work is his "Annals."

Biographical Dictionary.

It is remarkable, that princes and politicians have always held the works of Tacitus in the higheſt eſteem; which looks as if they either found their account in reading them, or were pleaſed to find courts, and the people who live in them, ſo exactly deſcribed after the life as they are in his writings. Part of what is extant was found in Germany by a receiver of Pope Leo X. and publiſhed by Beroaldus at Rome in 1515. Leo was ſo much charmed with Tacitus, that he gave the receiver a reward of 500 crowns; and promiſed not only indulgences, but money alſo and honour, to any one who ſhould find the other part; which it is ſaid was afterwards brought to him. Pope Paul III. as Muretus relates, wore out his Tacitus by much reading it; and Coſmo de Medicis, who was the firſt great duke of Tuſcany, and formed for governing, accounted the reading of him his greateſt pleaſure. Muretus adds, that ſeveral princes, and privy-counſellors to princes, read him with great application, and regarded him as a ſort of oracle in politics. A certain author relates, that Queen Chriſtina of Sweden, though extremely fond of the Greek tongue, which ſhe made "the diverſion of her leiſure hours, was not reſtrained by that from her ſerious ſtudies; ſo ſhe called among others Tacitus's Hiſtory, ſome pages of which ſhe read conſtantly every day." Laſtly, Lord Bolingbroke, an authority ſurely of no mean rank, calls him, "a favourite author," and gives him manifeſtly the preference to all the Greek and Roman hiſtorians.

Baillet Vie de Des Cartes, tom. ii. *Study of Hiſtory*, Letter v.

No author has obtained a more ſplendid reputation than Tacitus. He has been accounted, and with good reaſon, the moſt cultivated genius of antiquity; and we muſt not ſeek for his parallel in modern times. It is impoſſible not to admire and recommend his intimate knowledge of the human heart, the ſpirit of liberty which he breathes, and the force and vivacity with which he perpetually expreſſes himſelf. The reader of taſte is ſtruck by the greatneſs of his thoughts and the dignity of his narration; the philoſopher by the comprehenſive powers of his mind; and the politician by the ſagacity with which he unfolds the ſprings of the moſt ſecret tranſactions. Civil liberty and the rights of mankind never met with a bolder or a more able aſſertor: ſervitude, debaſement, and tyranny, appear not in the writings of any other author in juſter or more odious colours. He has been cenſured as obſcure; and indeed nothing can be more certain than that he did not write for the common maſs of men. But to thoſe who are judges of his compoſitions, it is no matter of regret that his manner is his own, and peculiar. Never were deſcription and ſentiment ſo wonderfully and ſo beautifully blended; and never were the actions and characters of men delineated with ſo much ſtrength and preciſion. He has all the merits of other hiſtorians, without their defects. He poſſeſſes the diſtinctneſs of Xenophon without his uniformity; he is more eloquent than Livy, and is free from his ſuperſtition; and he has more knowledge and judgment than Polybius, without his affectation of reaſoning on every occaſion.

One of the beſt editions of the works of Tacitus was publiſhed at Paris by Brotier, in 4 vols. 4to. There have been four tranſlations of his works into Engliſh; the firſt by Greenway and Sir Henry Saville, in the reign of Elizabeth; the ſecond by Dryden and others; the third by Gordon, which is remarkable for affectation of ſtyle, though ſome think it bears a ſtriking reſemblance to the original; and the fourth and beſt by Murphy, in 1793, in 4 vols. 4to.

TACK, a rope uſed to confine the foremoſt lower corners of the courſes and ſtay-ſails in a fixed poſition, when the wind croſſes the ſhip's courſe obliquely. The ſame name is alſo given to the rope employed to pull out the lower corner of a ſtudding-ſail or driver to the extremity of its boom.

The main-ſail and fore-ſail of a ſhip are furniſhed with a tack on each ſide, which is formed of a thick rope tapering to the end, and having a knot wrought upon the largeſt end, by which it is firmly retained in the clue of the ſail. By this means one tack is always faſtened to windward, at the ſame time that the ſheet extends the ſail to the leeward.

TACK, is alſo applied, by analogy, to that part of any ſail to which the tack is uſually faſtened.

A ſhip is ſaid to be on the ſtarboard or larboard tack, when ſhe is cloſe-hauled, with the wind upon the ſtarboard or larboard ſide; and in this ſenſe the diſtance which ſhe ſails in that poſition is conſidered as the length of the tack; although this is more frequently called *board*. See that article.

To TACK, to change the courſe from one board to another, or turn the ſhip about from the ſtarboard to the larboard tack, in a contrary wind. Thus a ſhip being cloſe-hauled on the larboard tack, and turning her prow ſuddenly to windward, receives the impreſſion of the wind on her head-ſails, by which ſhe falls off upon the line of the ſtarboard-tack. Tacking is alſo uſed in a more enlarged ſenſe, to imply that manœuvre in navigation by which a ſhip makes an oblique progreſſion to the windward, in a zig-zag direction. This, however, is more uſually called *beating*, or *turning to windward*.

Falconer's Marine Dict.

ward. See NAVIGATION, SAILING, and *Naval Tactics*, under WAR.

TACK, in *Scots Law.* See LAW, N° clxvii.

TACKLE, among ſeamen, denotes all the ropes or cordage of a ſhip uſed in managing the ſails, &c.

TACKSMAN. See TENURE.

TACTICS, in the art of war, is the method of diſpoſing forces to the beſt advantage in order of battle, and of performing the ſeveral military motions and evolutions. See WAR.

TADCASTER, a town in the weſt riding of Yorkſhire, noted for the great plenty of limeſtone dug up near it; and for being one of the firſt places in which a building was erected for Sunday ſchools. It is nine miles from York, and 188 from London.

TADMOR. See PALMYRA.

TADPOLE, a young frog before it has diſengaged itſelf from the membranes that envelope it in its firſt ſtage of life. See ERPETOLOGY, p. 281.

TÆNIA, a genus of animals belonging to the claſs of *vermes*. See HELMINTHOLOGY, N° 29, 30.

TAFFETY, or TAFFETA, in *Commerce*, a fine ſmooth ſilken ſtuff, remarkably gloſſy. There are taffeties of all colours, ſome plain, and others ſtriped with gold, ſilver, &c. others chequered, others flowered, &c. according to the fancy of the workmen.

TAGANROK, or TAGANROG, a ſea-port town ſituated at the head of the ſea of Azof, and forming one of the principal ports of the Ruſſian empire. It ſtands on a ſmall promontory, at the extremity of which is a fortreſs of conſiderable ſtrength, and capable of accommodating a numerous garriſon. The ſtreets are wide but unpaved, and from the lightneſs of the ſoil, are either intolerably duſty, or ankle-deep in mud. The houſes, which do not exceed a thouſand, are ſmall, built chiefly of wood, plaiſtered with mud, and roofed with bark. It is in north latitude 46°.

Taganrok is remarkable only as a place of trade, but in this view is highly reſpectable. When Mr M'Gill viſited it in 1805, he found there upwards of 200 veſſels of various ſizes, waiting for cargoes. From its advantageous ſituation, at the head of the ſea of Azof, and near the mouths of the rivers Don and Volga, and from its being in the vicinity of a very fertile country, it has become the centre of commerce for many ſtaple articles. Hither are brought, for exportation, vaſt quantities of grain, wool, hides, butter, tallow, bees-wax, and honey from the ſouthern provinces of Ruſſia; iron, timber, pitch, and tar from Siberia; caviar to the amount of 50,000 puds annually from the Don and the Volga; hemp and flax from the neighbouring diſtricts. Cordage and canvas are manufactured here, and form a conſiderable article of traffic. The trade is carried on chiefly by Raguſan and Greek ſupercargoes, who remain only till their commodities are collected and ſhipped. For the beſt accounts of this place, ſee Pallas's *Travels in the Ruſſian Empire*, and M'Gill's *Travels in Turkey, Italy, and Ruſſia.*

TAGARA, a city of ancient India, the metropolis of a large diſtrict called *Ariaca*, which comprehended the greateſt part of the Subah of Aurungabad, and the ſouthern part of Concan. Arrian ſays, that it was ſituated about ten days journey to the eaſtward of Pultanah; which, according to the rate of travelling in that country with loaded carts, might be about 100 Britiſh miles. This fixes its ſituation at Deoghir, a place of great antiquity, and famous through all India on account of the pagodas of Elouſa. It is now called *Doulet-abad.* Tagara || Tail.

TAGETES, MARYGOLD, a genus of plants belonging to the claſs ſyngeneſia; and in the natural ſyſtem ranking under the 49th order, *Compoſitæ.* See BOTANY *Index.*

TAGUS, the largeſt river of Spain; which, taking its riſe on the confines of Arragon, runs ſouth-weſt through the provinces of New Caſtile and Eſtremadura; and paſſing by the cities of Aranjuez, Toledo, and Alcantara, and then croſſing Portugal, forms the harbour of Liſbon, at which city it is about three miles broad; and about eight or ten miles below this it falls into the Atlantic ocean.

TAHOEREWA, one of the Sandwich iſlands, is ſmall, deſtitute of wood, the ſoil ſandy and unfertile; is ſituated in north latitude 20° 38′, in eaſt longitude 203° 27′.

TAHOORA, one of the Sandwich iſlands in the South ſea. It is uninhabited, and lies in north latitude 21° 43′, and in eaſt longitude 199° 36′. See *SANDWICH-Iſlands.*

TAJACU, or PECCARY, in *Zoology*, a ſpecies of hog. See SUS, MAMMALIA *Index.*

TAI-OUAN, the Chineſe name of the iſland of Formoſa. See FORMOSA.—Tai-ouan is alſo the name of the capital of the iſland.

TAIL, the train of a beaſt, bird, or fiſh; which in land animals, it is ſaid, ſerves to drive away flies, &c. and in birds and fiſhes to direct their courſe, and aſſiſt them in aſcending or deſcending in the air or water. But the tail in all animals is of great uſe in directing their motions.

TAIL, or FEE-TAIL, in *Law*, is a conditional eſtate or fee, oppoſed to *fee-ſimple.* See FEE.

A conditional fee, at the common law, was a fee reſtrained to ſome particular heirs excluſive of others; as to the heirs of a man's body, by which only his lineal deſcendants were admitted, in excluſion of collateral heirs; or to the heirs male of his body, in excluſion both of collaterals and lineal females alſo. It was called a *conditional fee*, by reaſon of the condition expreſſed or implied in the donation of it, that if the donee died without ſuch particular heirs, the land ſhould revert to the donor. For this was a condition annexed by law to all grants whatſoever, that on failure of the heirs ſpecified in the grant, the grant ſhould be at an end, and the land return to its ancient proprietor. Such conditional fees were ſtrictly agreeable to the nature of feuds, when they firſt ceaſed to be mere eſtates of life, and were not yet arrived to be abſolute eſtates in fee-ſimple.

With regard to the condition annexed to theſe fees by the common law, it was held, that ſuch a gift (to a man and the heirs of his body) was a gift upon condition that it ſhould revert to the donor if the donee had no heirs of his body; but if he had, it ſhould then remain to the donee. They therefore called it a *fee-ſimple* on condition that he had iſſue. Now we muſt obſerve, that when any condition is performed, it is thenceforth entirely gone; and the thing to which it was before annexed becomes abſolute and wholly unconditional. So that as ſoon as the grantee had any iſſue born, his

Tail. his eſtate was ſuppoſed to become abſolute by the performance of the condition; at leaſt for theſe three purpoſes: 1. To enable the tenant to alienate the land, and thereby to bar not only his own iſſue, but alſo the donor, of his intereſt in the reverſion. 2. To ſubject him to forfeit it for treaſon: which he could not do till iſſue born longer than for his own life, leſt thereby the the inheritance of the iſſue and reverſion of the donor might have been defeated. 3. To empower him to charge the land with rents, commons, and certain other encumbrances, ſo as to bind his iſſue. And this was thought the more reaſonable, becauſe, by the birth of iſſue, the poſſibility of the donor's reverſion was rendered more diſtant and precarious: and his intereſt ſeems to have been the only one which the law, as it then ſtood, was ſolicitous to protect, without much regard to the right of ſucceſſion intended to be veſted in the iſſue. However, if the tenant did not in fact alienate the land, the courſe of deſcent was not altered by this performance of the condition; for if the iſſue had afterwards died, and then the tenant or original grantee had died, without making any alienation, the land, by the terms of the donation, could deſcend to none but the heirs of his body; and therefore, in default of them, muſt have reverted to the donor. For which reaſon, in order to ſubject the lands to the ordinary courſe of deſcent, the donees of theſe conditional fee-ſimples took care to alienate as ſoon as they had performed the condition by having iſſue; and afterwards repurchaſed the lands, which gave them a fee-ſimple abſolute, that would deſcend to the heirs general, according to the courſe of the common law. And thus ſtood the old law with regard to conditional fees: which things, ſays Sir Edward Coke, though they ſeem ancient, are yet neceſſary to be known, as well for the declaring how the common law ſtood in ſuch caſes, as for the ſake of annuities, and ſuch-like inheritances, as are not within the ſtatutes of entail, and therefore remain as the common law. The inconveniences which attended theſe limited and fettered inheritances were probably what induced the judges to give way to this ſubtle fineſſe (for ſuch it undoubtedly was), in order to ſhorten the duration of theſe conditional eſtates. But, on the other hand, the nobility, who were willing to perpetuate their poſſeſſions in their own families, to put a ſtop to this practice, procured the ſtatute of Weſtminſter the ſecond (commonly called the ſtatute *de donis conditionalibus*) to be made; which paid a greater regard to the private will and intentions of the donor, than to the propriety of ſuch intentions, or any public conſiderations whatſoever. This ſtatute revived in ſome ſort the ancient feodal reſtraints which were originally laid on alienations, by enacting, that from thenceforth the will of the donor be obſerved; and that the tenements ſo given (to a man and the heirs of his body) ſhould at all events go to the iſſue, if there were any; or if none, ſhould revert to the donor.

Upon the conſtruction of this act of parliament, the judges determined that the donee had no longer a conditional fee-ſimple, which became abſolute and at his own diſpoſal the inſtant any iſſue was born; but they divided the eſtate into two parts, leaving the donee a new kind of particular eſtate, which they denominated a *fee-tail;* and veſting in the donor the ultimate fee-ſimple of the land, expectant on the failure of iſſue; which expectant eſtate is what we now call a *reverſion.* And hence it is that Littleton tells us, that tenant in fee-tail is by virtue of the ſtatute of Weſtminſter the ſecond. The expreſſion *fee-tail*, or *feodum talliatum*, was borrowed from the feudiſts (ſee Crag. *l. ſ. t.* 10. § 24, 25.), among whom it ſignified any mutilated or truncated inheritance, from which the heirs general were cut off; being derived from the barbarous verb *taliare*, to cut; from which the French *tailler* and the Italian *tagliare* are formed, (Spelm. *Gloſſ.* 531.).

Having thus ſhown the original of eſtates tail, we now proceed to conſider what things may or may not be entailed under the ſtatute *de donis*. Tenements is the only word uſed in the ſtatute: and this Sir Edward Coke expounds to comprehend all corporeal hereditaments whatſoever: and alſo all incorporeal hereditaments which ſavour of the reality, that is, which iſſue out of corporeal ones, or which concern or are annexed to or may be exerciſed within the ſame; as rents, eſtovers, commons, and the like. Alſo offices and dignities, which concern lands, or have relation to fixed and certain places, may be entailed. But mere perſonal chattels, which ſavour not at all of the reality, cannot be entailed. Neither can an office, which merely relates to ſuch perſonal chattels; nor an annuity, which charges only the perſon, and not the lands of the granter. But in theſe laſt, if granted to a man and the heirs of his body, the grantee hath ſtill a fee conditional at common law as before the ſtatute, and by his alienation may bar the heir or reverſioner. An eſtate to a man and his heirs for another's life cannot be entailed; for this is ſtrictly no eſtate of inheritance, and therefore not within the ſtatute *de donis*. Neither can a copyhold eſtate be entailed by virtue of the ſtatute; for that would tend to encroach upon and reſtrain the will of the lord; but, by the ſpecial cuſtom of the manor, a copyhold may be limited to the heirs of the body; for here the cuſtom aſcertains and interprets the lord's will.

As to the ſeveral ſpecies of eſtates-tail, and how they are reſpectively created; they are either general or ſpecial. Tail-general is where lands and tenements are given to one, and the heirs of his body begotten: which is called *tail-general;* becauſe, how often ſoever ſuch donee in tail be married, his iſſue in general, by all and every ſuch marriage, is, in ſucceſſive order, capable of inheriting the eſtate-tail *per formam doni.* Tenant in *tail-ſpecial* is where the gift is reſtrained to certain heirs of the donee's body, and does not go to all of them in general. And this may happen ſeveral ways. We ſhall inſtance in only one; as where lands and tenements are given to a man and the heirs of his body, on Mary his now wife to be begotten. Here no iſſue can inherit but ſuch ſpecial iſſue as is engendered between them two; not ſuch as the huſband may have by another wife; and therefore it is called *ſpecial tail.* And here we may obſerve, that the words of inheritance (to him and his heirs) give him an eſtate in fee; but they being heirs to be by him begotten, this makes it a fee tail; and the perſon being alſo limited, on whom ſuch heirs ſhall be begotten (viz. Mary his preſent wife), this makes it a fee-tail ſpecial.

Eſtates in general and ſpecial tail are farther diverſified by the diſtinction of ſexes in ſuch entails; for both of them may either be in tail male or tail female. As

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if lands be given to a man, and his heirs-male of his body begotten, this is an eſtate in tail male general; but if to a man, and the heirs-female of his body on his preſent wife begotten, this is an eſtate in tail female ſpecial. And in caſe of an entail male, the heirs-female ſhall never inherit, nor any derived from them; nor, *è converſo*, the heirs-male in caſe of a gift in tail female. Thus, if the donee in tail male hath a daughter, who dies leaving a ſon, ſuch grandſon in this caſe cannot inherit the eſtate tail; for he cannot deduce his deſcent wholly by heirs-male. And as the heir-male muſt convey his deſcent wholly by males, ſo muſt the heir-female wholly by females. And therefore if a man hath two eſtates-tail, the one in tail male and the other in tail female, and he hath iſſue a daughter, which daughter hath iſſue a ſon; this grandſon can ſucceed to neither of the eſtates, for he cannot convey his deſcent wholly either in the male or female line.

As the word *heirs* is neceſſary to create a fee, ſo, in farther imitation of the ſtrictneſs of the feodal donation, the word *body*, or ſome other words of procreation, are neceſſary to make it a fee-tail, and aſcertain to what heirs in partieular the fee is limited. If, therefore, either the words of inheritance or words of procreation be omitted, albeit the others are inſerted in the grant, this will not make an eſtate-tail. As if the grant be to a man and the iſſue of his body, to a man and his ſeed, to a man and his children or offspring; all theſe are only eſtates for life, there wanting the words of inheritance, "his heirs." So, on the other hand, a gift to a man, and his heirs male or female, is an eſtate in fee-ſimple and not in fee-tail; for there are no words to aſcertain the body out of which they ſhall iſſue. Indeed, in laſt wills and teſtaments, wherein greater indulgence is allowed, an eſtate-tail may be created by a deviſe to a man and his ſeed, or to a man and his heirs-male, or by other irregular modes of expreſſion.

There is ſtill another ſpecies of entailed eſtates, now indeed grown out of uſe, yet ſtill capable of ſubſiſting in law; which are eſtates *in libero maritagio*, or FRANK-MARRIAGE. See that article.

The incidents to a tenancy in tail, under the ſtatute Weſtminſter 2. are chiefly theſe: 1. That a tenant in tail may commit waſte on the eſtate-tail, by felling timber, pulling down houſes, or the like, without being impeached or called to account for the ſame. 2. That the wife of the tenant in tail ſhall have her dower, or thirds, of the eſtate-tail. 3. That the huſband of a female tenant in tail may be tenant by the curteſy of the eſtate-tail. 4. That an eſtate-tail may be barred, or deſtroyed, by a fine, by a common recovery, or by lineal warranty deſcending with aſſets to the heir. See ASSETS.

Thus much for the nature of eſtates-tail: the eſtabliſhment of which family law (as it is properly ſtyled by Pigott) occaſioned infinite difficulties and diſputes. Children grew diſobedient when they knew they could not be ſet aſide: farmers were ouſted of their leaſes made by tenants in tail; for if ſuch leaſes had been valid, then, under colour of long leaſes, the iſſue might have been virtually diſinherited: creditors were defrauded of their debts; for, if a tenant in tail could have charged his eſtate with their payment, he might alſo have defeated his iſſue, by mortgaging it for as much as it was worth: innumerable latent entails were produced to deprive purchaſers of the lands they had fairly brought; of ſuits in conſequence of which, our ancient books are full: and treaſons were encouraged, as eſtates-tail were not liable to forfeiture longer than for the tenant's life. So that they were juſtly branded as the ſource of new contentions and miſchiefs unknown to the common law; and almoſt univerſally conſidered as the common grievance of the realm. But as the nobility were always fond of this ſtatute, becauſe it preſerved their family-eſtates from forfeiture, there was little hope of procuring a repeal by the legiſlature; and therefore, by the connivance of an active and politic prince, a method was deviſed to evade it. Tail.

About 200 years intervened between the making of the ſtatute *de donis*, and the application of common recoveries to this intent, in the 12th year of Edward IV.; which were then openly declared by the judges to be a ſufficient bar of an eſtate-tail. For though the courts had, ſo long before as the reign of Edward III. very frequently hinted their opinion that a bar might be effected upon theſe principles, yet it was never carried into execution; till Edward IV. obſerving (in the diſputes between the houſes of York and Lancaſter) how little effect attainders for treaſon had on families whoſe eſtates were protected by the ſanctuary of entails, gave his countenance to this proceeding, and ſuffered Taltarum's caſe to be brought before the court: wherein, in conſequence of the principles then laid down, it was in effect determined, that a common recovery ſuffered by tenant in tail ſhould be an effectual deſtruction thereof. Theſe common recoveries are fictitious proceedings, introduced by a kind of *pia fraus*, to elude the ſtatute *de donis*, which was found ſo intolerably miſchievous, and which yet one branch of the legiſlature would not then conſent to repeal; and that theſe recoveries, however clandeſtinely begun, are now become by long uſe and acquieſcence a moſt common aſſurance of lands; and are looked upon as the legal mode of conveyance, by which a tenant in tail may diſpoſe of his lands and tenements: ſo that no court will ſuffer them to be ſhaken or reflected on, and even acts of parliament have by a ſide-wind countenanced and eſtabliſhed them.

This expedient having greatly abridged eſtates-tail with regard to their duration, others were ſoon invented to ſtrip them of other privileges. The next that was attacked was their freedom from forfeitures for treaſon. For, notwithſtanding the large advances made by recoveries, in the compaſs of about threeſcore years, towards unfettering theſe inheritances, and thereby ſubjecting the lands to forfeiture, the rapacious prince then reigning, finding them frequently reſettled in a ſimilar manner to ſuit the convenience of families, had addreſs enough to procure a ſtatute, whereby all eſtates of inheritance (under which general words eſtates-tail were covertly included) are declared to be forfeited to the king upon any conviction of high-treaſon.

The next attack which they ſuffered, in order of time, was by the ſtatute 32 Hen. VIII. c. 28. whereby certain leaſes made by tenants in tail, which do not tend to the prejudice of the iſſue, were allowed to be good in law, and to bind the iſſue in tail. But they received a more violent blow in the ſame ſeſſion of parliament, by the conſtruction put upon the ſtatute of fines, by the ſtatute 32 Hen. VIII. c. 36. which declares a fine duly levied by tenant in tail to be a complete bar to him and his heirs, and all other perſons claiming under ſuch

Tail || Talapoins.

entail. This was evidently agreeable to the intention of Henry VII. whoſe policy it was (before common recoveries had obtained their full ſtrength and authority) to lay the road as open as poſſible to the alienation of landed property, in order to weaken the overgrown power of his nobles. But as they, from the oppoſite reaſons, were not eaſily brought to conſent to ſuch a proviſion, it was therefore couched, in his act, under covert and obſcure expreſſions. And the judges, though willing to conſtrue that ſtatute as favourably as poſſible for the defeating of entailed eſtates, yet heſitated at giving fines ſo extenſive a power by mere implication, when the ſtatute *de donis* had expreſsly declared that they ſhould not be a bar to eſtates-tail. But the ſtatute of Henry VIII. when the doctrine of alienation was better received, and the will of the prince more implicitly obeyed than before, avowed and eſtabliſhed that intention. Yet, in order to preſerve the property of the crown from any danger of infringement, all eſtates-tail created by the crown, and of which the crown has the reverſion, are excepted out of this ſtatute. And the ſame was done with regard to common recoveries, by the ſtatute 34 and 35 Hen. VIII. c. 28. which enacts, that no feigned recovery had againſt tenants in tail, where the eſtate was created by the crown, and the remainder or reverſion continues ſtill in the crown, ſhall be of any force and effect. Which is allowing, indirectly and collaterally, their full force and effect with reſpect to ordinary eſtates-tail, where the royal prerogative is not concerned.

Laſtly, by a ſtatute of the ſucceeding year, all eſtates-tail are rendered liable to be charged for payment of debts due to the king by record or ſpecial contract; as ſince, by the bankrupt laws, they are alſo ſubjected to be ſold for the debts contracted by a bankrupt. And, by the conſtruction put on the ſtatute 43 Eliz. c. 4. an appointment by tenant in tail of the lands entailed to a charitable uſe is good without fine or recovery.

Eſtates-tail being thus by degrees unfettered, are now reduced again to almoſt the ſame ſtate, even before iſſue born, as conditional fees were in at common law, after the condition was performed by the birth of iſſue. For, firſt, the tenant in tail is now enabled to alienate his lands and tenements by fine, by recovery, or by certain other means; and thereby to defeat the intereſt as well of his own iſſue, though unborn, as alſo of the reverſioner, except in the caſe of the crown: ſecondly, he is now liable to forfeit them for high treaſon: and, laſtly, he may charge them with reaſonable leaſes, and alſo with ſuch of his debts as are due to the crown on ſpecialties, or have been contracted with his fellow-ſubjects in a courſe of extenſive commerce.

TAILZIE, in *Scots Law*, the ſame with TAIL. See LAW, N° clxxx. 9.

TALAPOINS or TALOPINS, prieſts of Siam.—They enjoy great privileges, but are enjoined celibacy and auſterity of life. They live in monaſteries contiguous to the temples: and what is ſingular, any one may enter into the prieſthood, and after a certain age may quit it to marry, and return to ſociety. There are talapoineſſes too, or nuns, who live in the ſame convents, but are not admitted till they have paſſed their fortieth year. The talapoins educate children; and at every new and full moon explain the precepts of their religion in their temples; and during the rainy ſeaſon they preach from ſix in the morning till noon, and from one in the afternoon till five in the evening. They dreſs in a very mean garb, go barefooted and barefooted; and no perſon is admitted among them who is not well ſkilled in the Baly language. Tala || Tale

They believe that the univerſe is eternal; but admit that certain parts of it, as this world, may be deſtroyed and again regenerated. They believe in a univerſal pervading ſpirit, and in the immortality and tranſmigration of the ſoul; but they extend this laſt doctrine, not only to all animals, but to vegetables and rocks. They have their good and evil genii, and particular deities, who preſide over foreſts and rivers, and interfere in all ſublunary affairs.

For the honour of human nature, we are happy to find ſo pure a ſyſtem of morality prevail among theſe people: It not only forbids its followers to do ill, but enjoins the neceſſity of doing good, and of ſtifling every improper thought or criminal deſire.

Thoſe who wiſh to peruſe a more particular account of the talapoins, may conſult *Voyage de M. de la Loubere;* and Sketches relating to the Hiſtory, &c. of the Hindoos.

TALC, a ſpecies of mineral arranged under the magneſian earths. See MINERALOGY *Index*.

TALENT, ſignifies both a weight and a coin very common among the ancients, but very different among different nations.

The common Attic talent of weight contains 60 Attic minæ, or 6000 Attic drachmæ; and weighed, according to Dr Arbuthnot, 59 lbs. 11 oz. $17\frac{1}{7}$ gr. Engliſh Troy weight. There was another Attic talent, by ſome ſaid to conſiſt of 80, by others of 100 minæ. The Egyptian talent was 80 minæ; the Antiochian alſo 80; the Ptolemaic of Cleopatra $86\frac{2}{3}$; that of Alexandria 96; and the Inſular talent 120. In the valuation of money, the Grecian talent, according to Dr Arbuthnot, was equal to 60 minæ, or, reckoning the mina at 3l. 4s. 7d. equal to 193l. 15s. The Syrian talent, in this valuation, conſiſted of 15 Attic minæ; the Ptolemaic of 20; the Antiochian of 60; the Euboic of 60; the Babylonic of 70; the Greater Attic of 80; the Tyrian of 80; the Eginean of 100; the Rhodian of 100; and the Egyptian of 80 minæ.

There is another talent much more ancient, which Dr Arbuthnot calls the *Homeric talent* of gold, which ſeems to have weighed ſix Attic drachms or three darics, a daric weighing very little more than a guinea. According to this talent, ſome reckon the treaſure of King David, particularly that mentioned 1 Chron. xxii. 14. which, according to the common reckoning, would amount in gold talents to the value of 547,500,000l. and the ſilver to above 342,000,000l.; or, reckoning according to the decuple proportion of gold to ſilver, the two ſums would be equal. As David reigned in Judæa after the ſiege of Troy, it is not improbable but Homer and he might uſe the ſame numeral talent of gold.

Among the Romans there were two kinds of talents, the *little* and the *great* talent: the little was the common talent; and whenever they ſay ſimply *talentum*, they are to be underſtood of this. The little talent was 60 minæ or Roman pounds; the mina or pound eſtimated at 100 drachmæ or denarii: it was alſo eſtimated at 24 great ſeſterces, which amounted to 60 pounds.

The great talent exceeded the leſs by one-third part. Budæus.

Talent Budæus computes, that the little talent of ſilver was worth 75l. ſterling, and the greater 99l. 6s. 8d. ſterling. The greater of gold was worth 1125l. ſterling.

TALENT, as a ſpecies or money, among the Hebrews, was ſometimes uſed for a gold coin, the ſame with the ſhekel of gold, called alſo *ſtater*, and weighing only four drachms. The Hebrews reckoned by theſe talents as we do by pounds, &c. Thus a million of gold, or million of talents of gold, among them, was a million of ſhekels or nummi; the nummus of gold being the ſame weight with the ſhekel, viz. four drachms.

But the Hebrew talent weight of ſilver, which they called *cicar*, was equivalent to that of 3000 ſhekels, or 113 lb. 10 oz. 1 dwt. 10$\frac{7}{10}$ gr. Engliſh Troy weight, according to Arbuthnot's computation.

TALIACOTIUS, GASPAR, chief ſurgeon to the great duke of Tuſcany, was born at Bononia in Italy in 1553. He wrote a Latin treatiſe entitled *Chirurgia Nota de Curtis Membris*, in which he teaches the art of engrafting noſes, ears, lips, &c. giving repreſentations of the inſtruments and proper bandages; many, however, are of opinion that he never put his art in practice. But his doctrine is not ſingular; for Alexander Benedictus, a famous chirurgical writer, has deſcribed a ſimilar operation.

TALIO, (*lex talionis*), a ſpecies of puniſhment in the Moſaic law, whereby an evil is returned ſimilar to that committed againſt us by another; hence that expreſſion, "Eye for eye, tooth for tooth." This law was at firſt inſerted in the 12 tables amongſt the Romans; but afterwards ſet aſide, and a power given to the prætor to fix upon a ſum of money for the damage done.

TALISMANS, magical figures cut or engraved with ſuperſtitious obſervations on the characteriſms and configurations of the heavens, to which ſome aſtrologers have attributed wonderful virtues, particularly that of calling down celeſtial influences. The taliſmans of Samothrace, ſo famous of old, were pieces of iron formed into certain images, and ſet in rings; theſe were eſteemed preſervatives againſt all kinds of evils. There were likewiſe taliſmans taken from vegetables, and others from minerals.

TALLAGE, (*tallagium*), from the French *taillé*, is metaphorically uſed for a part or ſhare of a man's ſubſtance carved out of the whole, paid by way of tribute, toll, or tax.

TALLOW, in *Commerce*, the fat of certain animals melted and clarified. It is procured from moſt animals, but chiefly from bullocks, ſheep, hogs, and bears. Some kinds of tallow are uſed as unguents in medicine, ſome for making ſoap and dreſſing leather, and ſome for making candles. See FAT, CHEMISTRY *Index*.

TALLOW Tree. See CROTON, BOTANY *Index*.

TALLY, is a ſtick cut in two parts, on each whereof is marked, with notches or otherwiſe, what is due between debtor and creditor, as now uſed by brewers, &c. And this was the ancient way of keeping all accounts, one part being kept by the creditor, the other by the debtor, &c. Hence the tallier of the exchequer, whom we now call the *teller*. But there are two kinds of tallies mentioned in our ſtatutes to have been long uſed in the exchequer. The one is termed *tallies of debt*, which are in the nature of an acquittance for debts paid to the king, on the payment whereof theſe tallies are delivered to the debtors, who carrying them to the clerk of the pipe-office, have there an acquittance in parchment for their full diſcharge. The other are *tallies of reward* or allowance, being made to ſheriffs of counties as a recompenſe for ſuch matters as they have performed to their charge, or ſuch money as is caſt upon them in their accounts of courſe, but not leviable, &c. In the exchequer there is a tally-court, where attend the two deputy-chamberlains of the exchequer and the tally-cutter: and a tally is generally the king's acquittance for money paid or lent, and has written on it words proper to expreſs on what occaſion the money is received. Tally || Talmud.

TALLY-Man, a perſon that ſells or lets goods, clothes, &c. to be paid by ſo much a-week.

TALMUD, a collection of Jewiſh traditions. There are two works which bear this name, the Talmud of Jeruſalem, and the Talmud of Babylon. Each of theſe is compoſed of two parts; the Miſhna, which is the text, and is common to both, and the Gemara or commentary. See MISHNA and GEMARA.

The Miſhna, which comprehends all the laws, inſtitutions, and rules of life which, beſide the ancient Hebrew ſcripture, the Jews thought themſelves bound to obſerve, was compoſed, according to the unanimous teſtimony of the Jews, about the cloſe of the ſecond century. It was the work of Rabbi Jehuda (or Juda) Hakkadoſh, who was the ornament of the ſchool at Tiberias, and is ſaid to have occupied him forty years. The commentaries and additions which ſucceeding Rabbis made were collected by Rabbi Jochanan Ben Eliezer, ſome ſay in the 5th, others ſay in the 6th, and others in the 7th century, under the name of *Gemara*, that is, *completion*; becauſe it completed the Talmud. A ſimilar addition was made to the Miſhna by the Babyloniſh doctors in the beginning of the 6th century according to Enfield, and in the 7th according to others.

The Miſhna is divided into ſix parts, of which every one which is entitled *order* is formed of treatiſes, every treatiſe is divided into chapters, and every chapter into miſhnas or aphoriſms. In the *firſt* part is diſcuſſed whatever relates to ſeeds, fruits, and trees: in the *ſecond* feaſts: in the *third* women, their duties, their diſorders, marriages, divorces, contracts, and nuptials: in the *fourth* are treated the damages or loſſes ſuſtained by beaſts or men, of things found, depoſits, uſuries, rents, farms, partnerſhips in commerce, inheritance, ſales and purchaſes, oaths, witneſſes, arreſts, idolatry; and here are named thoſe by whom the oral law was received and preſerved: in the *fifth* part are noticed what regards ſacrifices and holy things: and the *ſixth* treats on purifications, veſſels, furniture, clothes, houſes, leproſy, baths, and numerous other articles. All this forms the Miſhna.

As the learned reader may wiſh to obtain ſome notion of rabbinical compoſition and judgment, we ſhall gratify his curioſity ſufficiently by the following ſpecimen: "Adam's *body* was made of the earth of Babylon, his *head* of the land of Iſrael, his other *members* of other parts of the world. R. Meir thought he was compact of the earth gathered out of the whole earth; as it is written, *thine eyes did ſee my ſubſtance*. Now it is elſewhere written, *the eyes of the Lord are over all the earth*. R. Aha expreſsly marks the twelve hours in which his various parts were formed. His ſtature was from one end of the world to the other; and it was for his tranſgreſſion that the Creator, laying his hand in anger on him, leſ-

Talmud ‖ Tambourin.

fened him; for before (ſays R. Eleazar), 'with his hand he reached the firmament.' R. Jehuda thinks his ſin was hereſy; but R. Iſaac thinks that 'it was nouriſhing his foreſkin.'

The Talmud of Babylon is moſt valued by the Jews; and this is the book which they mean to expreſs when they talk of the Talmud in general. An abridgement of it was made by Maimonides in the 12th century, in which he rejected ſome of its greateſt abſurdities. The Gemara is ſtuffed with dreams and chimeras, with many ignorant and impertinent queſtions, and the ſtyle very coarſe. The Miſhna is written in a ſtyle comparatively pure, and may be very uſeful in explaining paſſages of the New Teſtament where the phraſeology is ſimilar. This is indeed the only uſe to which Chriſtians can apply it; but this renders it valuable. Lightfoot had judiciouſly availed himſelf of ſuch information as he could derive from it. Some of the popes, with a barbarous zeal, and a timidity of ſpirit for the ſucceſs of the Chriſtian religion, which the belief of its divinity can never excuſe, ordered great numbers of the Talmud to be burned. Gregory IX. burned about 20 cart-loads, and Paul IV. ordered 12,000 copies of the Talmud to be deſtroyed.

The laſt edition of the Talmud of Babylon, printed at Amſterdam, is in 12 vols folio. The Talmud of Jeruſalem is in one large folio.

TALPA, the MOLE; a genus of quadrupeds belonging to the order of *feræ*. See MAMMALIA *Index*.

TAMANDAU. See MYRMECOPHAGA, MAMMALIA *Index*.

TAMARINDUS, the TAMARIND-TREE; a genus of plants; according to Linnæus belonging to the claſs of triandria; but Woodville, Schreber, and other botaniſts, have arranged it under the claſs of monadelphia. See BOTANY *Index*.

TAMARIX, the TAMARISC, a genus of plants belonging to the claſs pentandria; and in the natural ſyſtem ranging under the 13th order, *Succulentæ*. See BOTANY *Index*.

TAMBOUR, in *Architecture*, a term applied to the Corinthian and Compoſite capitals, as bearing ſome reſemblance to a drum, which the French call *tambour*. Some chooſe to call it the *vaſe*, and others *campana* or the bell.

TAMBOUR is alſo uſed for a little box of timber work, covered with a ceiling, withinſide the porch of certain churches; both to prevent the view of perſons paſſing by, and to keep off the wind, &c. by means of folding-doors, &c.

TAMBOUR, alſo denotes a round courſe of ſtone, ſeveral whereof form the ſhaft of a column, not ſo high as a diameter.

TAMBOUR, in the arts, is a ſpecies of embroidery. The tambour is an inſtrument of a ſpherical form, upon which is ſtretched, by means of a ſtring and buckle, or other ſuitable appendage, a piece of linen or thin ſilken ſtuff; which is wrought with a needle of a particular form, and by means of ſilken or gold and ſilver threads, into leaves, flowers, or other figures.

TAMBOURIN, is the name of a dance performed on the French ſtage. The air is lively, and the movements are quick.

The ſame name is applied to a muſical inſtrument, formed of a hoop, over which is ſtretched a piece of parchment or vellum, while bells and hollow hemiſpheres of braſs are looſely hung in holes cut in the hoop. The tambourin is uſed only as an accompaniment to other inſtruments.

Tambo ‖ Tam

TAMERLANE, or TIMUR BEK, a celebrated prince and conqueror. At the age of 25 he attained the higheſt dignities, with ſurpriſing courage, and an ambition aſtoniſhing to all the world. Endeavouring to perfect the great talents which he had received from nature, he ſpent nine years in different countries; where his great ſenſe and elevated genius appeared in councils and aſſemblies, while his intrepidity and valour, whether in perſonal combats or pitched battles, drew upon him the admiration of all mankind. He made himſelf maſter of the three empires of Jagatay Khân, Tuſhi Khân, and Hûlâkû Khân; ſo that his power, riches, and magnificence, were immenſe. There remain vaſt monuments of his grandeur in the cities, towns, caſtles, and walls, which he built: in the rivers and canals which he dug, as well as the bridges, gardens, palaces, hoſpitals, moſques, and monaſteries, which he erected in divers parts of Aſia in ſo great a number, that a king might be accounted very powerful and magnificent, who ſhould have employed 36 years only in building the great edifices which Timûr cauſed to be founded.

Timûr, according to the hiſtorian Arabſhâh, was in his perſon very corpulent and tall. He had a large forehead and big head. His countenance was agreeable, and his complexion fair. He wore a large beard, was very ſtrong, and well limbed; had broad ſhoulders, thick fingers, and long legs. His conſtitution was amazingly vigorous; but he was maimed in one hand and lame of the right ſide. His eyes appeared full of fire; his voice was loud and piercing; he feared nothing; and when far advanced in years, his underſtanding was found and perfect, his body vigorous and robuſt, his mind conſtant and unſhaken like a rock.

He did not like raillery, and could not bear a lie. There was no joking or fooling before him; for he loved the naked truth, even although it was to his own diſadvantage. He neither grieved if he miſcarried in any attempt, nor appeared overjoyed on any great ſucceſs. The device of his ſeal was, "I am ſincere and plain." He had a clear and ſolid underſtanding, was ſurpriſingly happy in his conjectures; vigilant, active, and unſhaken in his reſolutions. He took great delight in reading hiſtory, and was well verſed in the ſtate of countries, provinces, and cities. He was penetrating, ſubtle, cloſe, and diſſembling; juſt by inclination, liberal from diſpoſition; but ambition had in a great meaſure extinguiſhed his humanity; war had familiarized him to blood; and his religious zeal had inſpired him with the moſt cruel, implacable, and pernicious fanaticiſm.

He died on the 1ſt of April 1405, in the 71ſt year of his age and 36th of his reign. When he found death approaching, he ſent for his principal officers, declared his grandſon his heir, and made them ſwear to execute his will. Having recommended brotherly love and concord to the princes his children, he ordered one of the doctors to read the Koran at his bed's head, and often repeat the unity of God. At night he ſeveral times made profeſſion of his belief, "That there is no other God than God," and then expired. See MOGULS, N° 15, &c.

TAMTAM, a flat drum uſed by the Hindoos, reſembling a tabor, but it is larger, and ſounds louder.

TAMUS, BLACK BRIONY, a genus of plants belonging

ing to the claſs dicœcia; and in the natural ſyſtem ranking under the 11th order, *Sarmentaceæ*. See BOTANY *Index*.

TAN, the bark of the oak after it has been ground and uſed by the tanner. The ſmalleſt ſort is generally made up in little ſquare cakes called *turf*, and ſold for firing. The coarſer ſort is ſometimes dried in the ſun, and uſed by bakers for heating their ovens, &c. but its chief uſe is for making hot-beds to raiſe pine-apples and other plants.—William III. introduced the uſe of it from Holland, for the purpoſe of raiſing orange trees; after which it was diſcontinued for many years: but about 1719, when *ananas* were firſt brought into England, it came into general uſe, and has ever ſince been in great eſtimation with gardeners for all the purpoſes of forcing, &c. on account of its ſtrong and laſting fermentation. The ſmaller the tan the quicker it heats; but the larger ſort acquires heat more gradually and retains it longer: the ſkilful gardener therefore uſes the one or the other, or a mixture of both, according to the time and purpoſe for which it is wanted. It is ſome time after the tan comes out of the tanner's pit before it begins to heat, and therefore it is not fit for immediate uſe; but having lain a week or two, it enters into a ſtate of fermentation, and if put into hot-beds properly prepared, will retain a moderate heat for three or four months. When it becomes uſeleſs for the hot-houſe, it is ſaid by Miller and others to be an excellent manure for ſome kinds of land.

The word *tan* is ſometimes, though improperly, uſed for the *bark* itſelf, which is the chief ingredient in the tanning of leather. Oak bark, on account of its great aſtringency and gummy-reſinous properties, is preferred to all other ſubſtances for the purpoſe of tanning, as it not only preſerves the leather from rotting, but alſo, by condenſing the pores, renders it impervious to water. See TANNING.

For an account of tan or *tannin*, conſidered as a chemical principle, ſee CHEMISTRY, N° 2504.

TANACETUM, TANSY, a genus of plants belonging to the claſs ſyngeneſia; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. See BOTANY *Index*.

TANÆCIUM, a genus of plants belonging to the didynamia claſs; and in the natural method ranking under the 25th order, *Putamineæ*. See BOTANY *Index*.

TANAGRA, TANAGER, a genus of birds belonging to the order of *paſſeres*. See ORNITHOLOGY *Index*.

TANAIS, or DON. See DON.

TANGENT *of an* ARCH, is a right line drawn perpendicularly from the end of a diameter, paſſing to one extremity of the arch, and terminated by a right line drawn from the centre through the other end of that arch, and called the *ſecant*. See GEOMETRY.

TANGIER, a port-town of Africa, in the empire of Morocco and kingdom of Fez, ſituated at the entrance of the ſtraits of Gibraltar, in W. Long. 5. 50. N. Lat. 38. 49. In 1662, this place belonged to the Portugueſe, and was given to King Charles II. upon his marriage with the Infanta of Portugal; but, he growing weary of the charge of keeping it, cauſed it to be blown up and deſtroyed in 1684; ever ſince which time it has been only a poor fiſhing town. Anciently it was called *Tingis*, and gave name to the province of Mauritania Tingitana.

TANK, in the language of Indoſtan, a place incloſed for receiving and retaining rain water. During the periodical rains the tanks are filled, and thus in the dry ſeaſon furniſh water for the rice fields and cattle. Some of them are of great extent, meaſuring 300 or 400 feet on the ſide; they are of a quadrangular form, and lined with granite, deſcending in regular ſteps from the margin to the bottom. Tank || Tanning.

TANNER, one who dreſſes hides by tanning them. See TANNING.

TANNER, *Dr Thomas*, an Engliſh prelate and celebrated antiquarian, born in 1674. He was admitted of Queen's college Oxford, where a ſimilarity of taſte for antiquities produced a cloſe friendſhip between him and Edmund Gibſon afterwards biſhop of London. In 1697, he was choſen fellow of his college; and having already publiſhed ſome ſpecimens of his antiquarian reſearches; ſoon after became known to Dr Moore biſhop of Norwich, who made him chancellor of his dioceſe. In 1722, he was made archdeacon of Norwich, and in 1731 biſhop of St Aſaph. He died at Oxford in 1735; and after his death was publiſhed an elaborate work, in which he is ſaid to have been employed for 40 years, under this title, *Bibliotheca Britannica Hibernica, ſive de Scriptoribus qui in Anglia, Scotia, et Hibernia, ad ſæculi* XVII. *initium floruerunt*, &c.

TANNING, the art of converting hides and ſkins into leather. This art has been practiſed for many centuries in Britain; but ſome improvements have been made on it, eſpecially in France, ſuggeſted by the diſcoveries of modern chemiſtry. Theſe improvements we ſhall briefly notice after having deſcribed the method lately practiſed in the neighbourhood of London, where the beſt Britiſh leather is manufactured. The general principles on which the improvements are founded, will naturally come to be conſidered, after deſcribing the proceſſes themſelves.

1 Different kinds of leather.

The leather tanned in England is generally divided by the manufacturers into three kinds, *butts* or *backs*, *hides*, and *ſkins*. *Butts* are made from the ſtouteſt and heavieſt ox hides, and are uſed chiefly for the ſoles of ſtout ſhoes and boots. *Hides*, or *crop-hides*, are made from cow hides, or the lighter ox hides, and are employed for ordinary ſoles. The term *ſkins* is applied to all the other kinds of leather, comprehending that made from the ſkins of calves, ſeals, dogs, kids, &c.

2 Method of tanning butts.

Butts are tanned as follows. After the horns are taken off, the hides are laid ſmooth in heaps for two days in ſummer, and five or ſix in winter; they are then hung on poles in a cloſe room, called a ſmoke-houſe, in which is kept a ſmouldering fire of wet tan; this occaſions a ſmall degree of putrefaction, by which means the hair more eaſily comes off, by ſpreading the hide on a ſort of wooden horſe or beam, and ſcraping it with a crooked knife. The hair being taken off, the hide is thrown into a pool of water, to cleanſe it from the dirt, &c. which being done, it is again ſpread on the wooden beam, and the greaſe, looſe fleſh, extraneous filth, &c. carefully taken off: the hides are then put into a pit of ſtrong liquor, called *ooze*, prepared in pits kept for the purpoſe, by infuſing ground oak bark in water, which is termed *colouring*. The hides are then removed into another pit, called a *ſcouring*, which conſiſts of water ſtrongly impregnated with vitriolic or ſulphuric acid, or a vegetable acid prepared from rye or barley. This operation

Tanning. operation is called *raiſing*. The hides are then taken out of the ſcouring, and ſpread ſmooth in a pit uſually filled with water, called a *binder*, with a quantity of ground bark ſtrewed between each. After lying a month or ſix weeks, they are taken up, and the decayed bark and liquor being drawn out of the pit, it is again filled with ſtrong ooze, when they are put in as before, with bark between each hide. They now lie two or three months, at the expiration of which the ſame operation is repeated; they then remain four or five months, when they again undergo the ſame proceſs, and after being three months in the laſt pit, are completely tanned, unleſs the hides are ſo remarkably ſtout as to require an additional pit or layer. The whole proceſs requires from 11 to 18 months, and ſometimes two years, according to the ſubſtance of the hide, and diſcretion of the tanner. When taken out of the pit to be dried, they are hung on poles; and after being compreſſed by a ſteel pin, and beaten out ſmooth by wooden beetles, the operation is completed.

3 Of tanning hides. Hides are thus managed. After the horns are taken off, and the hide is waſhed, they are put into a pit of water, ſaturated with lime, and having mixed with it a quantity of the ſame ſubſtance, where they remain a few days, when they are taken out, and the hair ſcraped off on a wooden beam, as before deſcribed; they are then waſhed in a pit or pool of water, and the looſe fleſh, &c. being taken off, they are removed into a pit of weak ooze, where they are taken up and put down two or three times a day, for the firſt week; every ſecond or third day they are ſhifted into a pit of freſh ooze, ſomewhat ſtronger than the former, till at the end of a month or ſix weeks they are put into a ſtrong ooze, in which they are handled once or twice a week with freſh bark for two or three months. They are then removed into another pit, called a *layer*, in which they are laid ſmooth, with bark ground very fine, ſtrewed above each hide. After remaining here two or three months, they are generally taken up, when the ooze is withdrawn, and the hides put in again with freſh ooze and freſh bark, where, after lying two or three months more, they are completely tanned; except a very few ſtout hides which may require an extra layer. They are then taken out, and hung on poles, and being ſmoothed by a ſteel pin, are, when dry, ready for ſale.

4 Of tanning ſkins. Skins are to be waſhed in water, &c. and put into lime pits as before mentioned, where they are taken up and put down every third or fourth day for two or three weeks, in order to deſtroy the ſcarf-ſkin. The hair is then ſcraped off, and the excreſcences being removed, they are put into a pit of water impregnated with pigeons dung, called a *grainer*, which in a week or 10 days ſoaking out the lime, greaſe, and ſaponaceous matter, ſoftens the ſkins, and prepares them for the reception of the ooze. They are then put into a pit of weak ooze, in the ſame manner as the hides, and being frequently handled, are by degrees removed into a ſtronger, and ſtill ſtronger liquor, for a month or ſix weeks, when they are put into a very ſtrong ooze, with freſh bark ground very fine, and at the end of two or three months, according to their ſubſtances, are ſufficiently tanned; when they are taken out, hung on poles, and dried.

The lighter ſorts of hides, called *dreſſing hides*, as well as horſe hides, are managed nearly in the ſame manner as ſkins, and are uſed for coach work, harneſs work, &c. Tanning

The principal objections to this old method of tanning are, that it is extremely tedious, and very expenſive. Various means have been ſuggeſted for introducing a cheaper and more expeditious method of tanning. Among the earlieſt of theſe we may notice that of Dr Macbride. This method conſiſts chiefly in the uſe of ſulphuric inſtead of acetous acid, for raiſing or diſtending the pores of the leather, and in ſubſtituting lime water, or a ſolution of lime, for what has been called the *milk* of lime, or a conſiderable quantity of lime diffuſed in water. According to a report made to the committee of commerce of the Dublin ſociety, it appeared that Dr Macbride's method produced a ſaving of more than 20 per cent. to the manufacturer, while the hides were completely tanned in a much ſhorter time. It does not appear, however, that this method ever came into general uſe. 4 Objection to the old methods. 5 Dr Macbride's improvement

The experiments of M. Seguin, made in the end of the 18th century, on the nature of the tanning principle, led him to ſuggeſt a method of tanning which is certainly much more expeditious than the old method. It has been adopted in England by Mr William Deſmond, and by his directions has been practiſed with conſiderable ſucceſs, by ſome of the principal tanners in Warwickſhire, Staffordſhire, and ſome of the neighbouring counties. The following directions, communicated by Mr Deſmond to the editor of the Philoſophical Magazine, will ſufficiently explain this new proceſs.

6 Mr Deſmond's method. Provide five veſſels, called *digeſters*, of any convenient materials and dimenſions, with an aperture at the bottom of each. Let them be placed near each other, and elevated on ſtillages or otherwiſe; ſo that a ſmall veſſel may be placed under them. Fill the digeſters with tan, viz. the bark of certain trees, ſuch as of oak, cut ſmall, or ground to a coarſe powder. Pour water on the tan in the firſt digeſter, where it may ſtand ſome time, or be immediately drawn off. This liquor is to be poured on the tan in the ſecond digeſter; from that to the third, and ſo on, until it comes through the tan in the laſt digeſter. The liquor is then highly coloured, and marks from 6° to 8° on the hydrometer for ſalts. This liquor is to be uſed for tanning the thickeſt hides, and may be called the *tanning lixivium*. If you take a ſmall quantity of it in a glaſs, and pour on it a few drops of a ſolution of animal glue, the clear liquor becomes turbid, and a whitiſh ſubſtance falls to the bottom. The precipitate thus obtained, is a ſure indication that the liquor contains the tanning principle; for this reaſon, that glue being of the ſame nature with the ſkins or hides of which it is made, whatever ſubſtance unites itſelf indiſſolubly with the former, will do ſo likewiſe with the latter.

This ſolution is made by diſſolving a little common glue in water over a moderate fire; by means of it, not only oak bark, but alſo the bark of ſeveral other trees, as well as different ſhrubs, and plants, all which may be called *tan*, are found to contain the tanning principle; and by employing the ſolution as before, it will be always eaſy to aſcertain whether any given ſubſtance contains this principle.

In the courſe of theſe lixiviations it may be obſerved, 1. That the liquor running from the firſt digeſter, at length

Tanning. length loſes its colour. If in this ſtate a little of it be put into a glaſs, and the former experiment be repeated, the liquor no longer becomes turbid, but remains clear, which ſhews that it contains no more of the tanning principle; but if a few drops of a ſolution of ſulphate of iron be poured into the ſame glaſs, the liquor becomes thick and black, which is not to be poured on the tan in the ſecond digeſter, but afterwards uſed for taking off the hair or wool. It is known by the name of *gallic lixivium*, as it appears to contain the ſame principles with galls.

The liquid ſulphate of iron is obtained by diſſolving a ſmall quantity of iron in diluted ſulphuric acid, or by diſſolving green copperas in water. This ſolution ſerves to aſcertain ſuch ſubſtances as contain the gallic principle. Lime water will alſo produce this effect.

When the liquor ceaſes to grow black by the mixture of the ſulphate of iron, it will be in vain to pour any more water on the tan in the firſt digeſter. This tan being thus exhauſted, muſt be removed, and new tan put in its place.

The liquor, after running through all the digeſters, at laſt grows weak. All the liquor that marks from 6° to 8° on the hydrometer, muſt be added to the ſtock of tanning lixivium. What proceeds afterwards from the laſt digeſter is to be poured on the new tan in the firſt. Then the freſh water is to be conveyed on the tan in the ſecond digeſter, and the liquor of the firſt ſet aſide, while it marks 6° or 8° on the hydrometer, and added to the tanning lixivium, which muſt always be carefully ſeparated from the gallic. In this manner, the tan in all the digeſters may be renewed, and the lixiviations continued.

The number of theſe lixiviations, as well as the mode of making them, may be varied at pleaſure; the eſſential point is to repeat them ſo as to give the liquor a ſufficient degree of concentration, which may be determined by the hydrometer, and proportioned to the quickneſs required in the operation, and the thickneſs of the hides and ſkins to be tanned; all which experience will ſoon teach. As all kinds of tan are not equally good, it will ſometimes happen that ſix or more filtrations will be neceſſary to obtain a lixivium of 6° or 8°, in which caſe the number of digeſters muſt be increaſed, and the ſame method purſued as above; and when a weaker lixivium is wanted, three or four filtrations will be ſufficient.

The perſon directing theſe lixiviations ſhould be provided with the ſolution of glue and ſulphate of iron, already deſcribed, in order to aſcertain the qualities of the different lixivia, as well as with a hydrometer properly graduated, to determine their degree of concentration or ſpecific gravity.

In tanning cow and ox hides with this lixivium, they ſhould firſt be waſhed in running water, well cleaned, and fleſhed in the uſual way. For removing the hair, the hides are to be ſteeped for two or three days in a vat filled with the gallic lixivium, and a mixture of ſulphuric acid, marking 66° on the hydrometer for acids, and in the proportion of one to a thouſand, or one pint to 125 gallons. During this ſteeping, the hair is ſeparated from the hides in ſuch a manner, that it may be eaſily known when they are to be taken out of the vat, that is, when the hair is quite looſe. It is to be ſcraped off with a round knife on the horſe or beam.

When raiſing is neceſſary, the hides are immerſed for 10 or 12 hours in a vat filled with water, and $\frac{1}{300}$ of its volume of mineral acid, of the ſame quality with the former, and the operation of raiſing is finiſhed. The hides are repeatedly waſhed, and the round knife is uſed, after which they are prepared for tanning.

The reſt of the proceſs conſiſts in tanning, properly ſo called; for which purpoſe, the hides are to be ſteeped ſome hours in a weak lixivium of only 1° or 2°; to obtain which, that is to be taken which runs from the ſecond digeſter, or ſome already uſed for tanning. They are next put into a ſtronger lixivium, where in a few days they will be brought to the ſame degree of ſaturation with the liquor in which they are immerſed. The ſtrength of the liquor being then much diminiſhed, it muſt be renewed; and when the hides are completely ſaturated, or fully tanned, which is known by cutting off a bit of the edge, remove the leather, and let it dry ſlowly in a ſhady place.

For calf ſkins, goat ſkins, &c. theſe are firſt fleſhed with the knife, and worked in running water like the others. They are then ſteeped in lime water, in which there ſhould be more lime than the water can diſſolve at once. What is not diſſolved will ſubſide, but muſt be mixed with the water, by ſtirring it ſeveral times a-day. In two or three days the ſkins are to be removed; when the hair is found quite looſe, it is ſcraped off on the horſe. They are then waſhed and preſſed well, till the water running from them is perfectly clear, and the lime totally extracted. They are firſt ſteeped in a weak lixivium, then tanned as above; but the tanning lixivium muſt not be nearly ſo ſtrong as that for hides.

Lime is uſed for theſe ſoft ſkins inſtead of a mixture of gallic lixivium and ſulphuric acid, becauſe the acid always ſwells the leather more or leſs, and becauſe the lime may be more eaſily extracted from them, by waſhing and compreſſing them, than from the thick hides, which, when limed, are harſh and apt to crack, if the lime be not wholly extracted before they are tanned.

Among the different methods of immerſion which may be practiſed in the courſe of theſe operations, the beſt way ſeems to be that of ſuſpending the hides and ſkins vertically in the lixivia, by means of tranſverſe rods or bars, and at ſuch a diſtance aſunder as not to touch each other in any one point. If they are laid out the one over the other, they will require frequent *handling*, in order that all the parts may be equally ſaturated, and to prevent the folds or plaits that would otherwiſe be formed in them. In ſome caſes it will be found expedient to mix freſh tan from time to time with the lixivium, which will depend on the ſtate and quality of the hides and ſkins to be tanned, as well as on the purpoſes for which they are intended. All theſe conſiderations muſt be left to the judgment of the manufacturer; but they do not change the principle on which this mode of tanning is founded.

Mr Deſmond aſſerts, that beſides the very great ſavings in point of time and labour, the leather tanned according to the above method being more completely ſaturated, will be found to weigh heavier, to wear better, and to be leſs ſuſceptible of moiſture, than the leather tanned in the uſual way *.

* *Philoſ. Mag.* xi. 20.

7 Principles of tanning.

In explaining the principles on which the ſeveral parts of the tanning proceſs depend, we muſt firſt remark, that the principal object of tanning is, to combine

Tanning. bine the gelatinous part of the hides with the tanning principle of aſtringent vegetables as intimately as poſſible, and thus produce that compound which we call leather, and which is inſoluble in water. The chief part of the proceſs therefore conſiſts in ſteeping the hides in a ſolution of tannin till they are ſufficiently impregnated with the tanning principle; and to this operation the others are ſubſervient, only as they prepare the hides to be more eaſily acted on by the tanning principle.

The infuſions of oak bark, when chemically examined, are found to contain two principal ſubſtances, one precipitable by ſolution of gelatine made from glue or iſinglaſs, and this gives a denſe black, with ſolution of common ſulphate of iron; the other not precipitable by ſolution of gelatine, but precipitating the ſalts of iron of a browniſh black, and the ſalts of tin of a fawn colour.

The former of theſe is the tanning principle, or the tannin of Seguin; it is eſſential to the converſion of ſkin into leather. The latter is the colouring or extractive matter; it is capable of entering into union with ſkin, and it gives to it a brown colour; but it does not render it inſoluble in boiling water.

It has been generally ſuppoſed that the infuſion of oak bark contains a peculiar acid, called gallic acid; but ſome late experiments render this opinion doubtful; and this principle, if it exiſts in oak bark, is in intimate combination with the extractive or colouring matter.

In the common proceſs of tanning, the ſkin, which is chiefly compoſed of gelatine, ſlowly combines in its organized form with the tannin and extractive matter of the infuſions of bark; the greater proportion of its increaſe of weight, however, is owing to tannin, and from this ſubſtance the leather derives its characteriſtic properties; but its colour, and the degree of its flexibility, appear to be influenced by the quantity of colouring matter that it contains. When ſkin, in large quantity, is ſuffered to exert its full action on a ſmall portion of infuſion of bark, containing tannin and extractive matter, the fluid is found colourleſs. It gives no precipitate to ſolution of gelatine, and produces very little effect on the ſalts of iron or of tin. The tanning principle of oak bark is more ſoluble in water than the extractive matter; and the relative proportion of tannin to extractive matter is much greater in ſtrong infuſions of oak bark than in weak ones; and when ſtrong infuſions are uſed for tanning, a larger proportion of tannin is combined with the matter of ſkin.

The ſtate of the ſkin with regard to its impregnation with tannin may be eaſily aſcertained by cutting it tranſverſely with a ſharp knife, as the tanned part will appear of a nutmeg colour, while the unimpregnated part retains its whiteneſs. Though the impregnation of the ſkins with tannin be an eſſential part of the proceſs, ſomething more is required to give the leather its proper degree of ſtrength and pliability. The infuſions of oak bark, eſpecially the weaker infuſions, contain, beſides tannin, more or leſs of extractive matter, which is abſorbed by the ſkins during the tanning proceſs. Hence is appears, that a ſolution of tannin alone would not convert the ſkins into leather; and that as concentrated infuſions of oak bark contain a leſs proportional quantity of extractive matter, they are not ſo well calculated for the purpoſes of tanning as the weaker infuſions. This is an important concluſion, as it ſhews that the vulgar opinion of tanners reſpecting the propriety of the old methods, and what they call *feeding* the leather, is founded on rational principles. In fact it appears, that, though, in the quick method, recommended by Seguin and Deſmond, the leather may be more expeditiouſly, and perhaps more completely impregnated with tannin, it is deficient in ſtrength and pliability, from the want of its due proportion of extractive matter. Tanning

Having thus explained the principles on which the material part of the tanning proceſs depends, we muſt briefly notice the *rationale* of the preliminary operations.

Chaptal has ſhewn, that when ſkin is immerſed in a tanning liquor, without having been previouſly freed from its cuticle or ſcarf-ſkin, the impregnation of tannin takes place only on the fleſh ſide. This ſhews the neceſſity, eſpecially in the thicker hides or butts, of removing the cuticle, before ſteeping the hides in the tanning liquor. The ſmall degree of putrefaction to which the butts are ſubjected, has this effect, and the ſteeping of the hides and ſkins in lime water contributes to the ſame end; for though lime does not ſeem to be capable of diſſolving the cuticle, it renders it friable, ſo that it is eaſily removed by the inſtruments employed for ſcraping off the hair. Not only the cuticle, but likewiſe the ſoft matter of the extremity of the hair is acted on by lime; and this effect muſt conſiderably tend to facilitate the proceſs of depilation. The ſame ſubſtance mixing with the fat on the fleſhy ſide of the ſkins, forms a ſoapy compound, which, with other extraneous matter, is removed by the ſubſequent waſhings.

It has been ſuppoſed that the acids in which the ſkins are ſteeped, previous to their immerſion in tanning liquors, have the effect of opening their pores, and thus rendering them more eaſily penetrable by the tanning principle and extractive matter. We believe that this opinion is erroneous, as we cannot ſee how acids, the obvious effect of which ſeems to be that of contracting animal matter, can enlarge the pores of the ſkins. It is probable that they produce ſome other advantageous effect not yet ſufficiently underſtood, in preparing the ſkins for being more perfectly acted on by the tanning liquors.

The principal effect of the grainer, or the pigeons dung employed in the thinner ſkins, ſeems to be that of promoting putrefaction, and rendering the ſkins leſs elaſtic, though the alkali evolved during the fermentation of the dung, may aſſiſt in removing the fat on the fleſh ſide of the ſkins.

Subſtitutes for oak bark. As from the preſent great demand, and conſequent ſcarcity of oak timber, oak bark has become a very expenſive article, it may be proper to enumerate a few of the principal vegetable ſubſtances, eſpecially thoſe indigenous to Great Britain, that may be ſubſtituted for it. Of theſe the bark of the Scotch fir appears to be moſt deſerving of attention, and was ſome years ago employed by a gentleman in Ireland with great ſucceſs. Several ſpecies of willow afford a good ſubſtitute for oak bark, particularly the Leiceſter willow, of which the entire bark produces a greater quantity of ſolid extract than the entire bark of oak. Next to theſe may be mentioned the bark of the common elm, the root of tormentil (*tormentilla vulgaris*, Lin.) which has been long employed in the north of Scotland as an article of domeſtic

meſtic tanning. To theſe may be added the herb avens (*geum urbanum*, Lin.), ſeveral ſpecies of cinquefoil, and of biſtort, common ladies mantle (*alchemilla vulgaris*), and the root of the common water-flag (*iris pſeudacorus*, Lin.). Of plants not indigenous to Britain, but generally cultivated here, we may particularly notice the *horſe-cheſnut*, the bark of which is a ſtrong aſtringent, and might be employed, we think, with great advantage in tanning. The moſt powerful tanning ſubſtance, however, with which we are acquainted, is the juice or extract of the *mimoſa catechu*, commonly called *Japan earth*, one pound of which will tan as much leather as ſeven or eight pounds of oak bark.

Our limits will not permit us to extend this article, by deſcribing the proceſſes for tanning employed in other countries. On the method purſued in Ruſſia, our readers may conſult Tooke's *View of the Ruſſian Empire;* and of the French method of tanning, an ample account has been given in a publication by De Lalande. Another on the ſame ſubject may ſoon be expected from Chaptal. The moſt complete work on Britiſh tanning, and on other proceſſes to which leather is ſubjected, with which we are acquainted, is a ſmall volume entitled *The Art of Tanning and Currying Leather*, publiſhed by the Dublin Society in 1780. Several uſeful papers on this ſubject may alſo be found in Nicholſon's *Philoſophical Journal*, and Tilloch's *Philoſophical Magazine.*

For an account of other proceſſes connected with the leather manufacture, ſee LEATHER and CURRYING.

TANTALIUM, a new metal which has been detected in two minerals. See MINERALOGY, p. 250.

TANTALUS, in fabulous hiſtory, king of Phrygia and Paphlagonia, was the ſon of Jupiter and the nymph Plota. He one day entertained the gods at his table; when, to prove their divinity, he ſerved up his ſon Pelops cut in pieces. All the deities, except Ceres, perceived his cruelty and impiety, and would not touch his proviſions. That goddeſs, whoſe thoughts were ſolely employed about her daughter Proſerpine, inadvertently ate a part of his left ſhoulder. Pelops, however, was reſtored to life; and an ivory ſhoulder given him in the room of that which had been eaten; while Tantalus was thrown into Tartarus, where he was puniſhed with perpetual hunger and thirſt. He was chained in a lake; the water of which reached up to his chin, but retired when he attempted to drink. The branch of a tree loaded with fruit hung down even to his lips, but on his attempting to pluck the fruit the branch ſprung upwards.

TANTALUS, a genus of birds belonging to the order of grallæ. See ORNITHOLOGY *Index.*

TANTALUS's Cup. See *SCIENCE, Amuſements of*, N° 33.

TANZY, or TANSY. See TANACETUM, BOTANY *Index.*

TAORMINA, a town in Sicily, which is ſituated on a high rock, and is 88 miles ſouth of Meſſina. Of its origin little is known. A colony from the iſle of Naxos ſettled at the foot of Etna, at no great diſtance from the ſhore, and at about a league or a league and a half from the preſent ſituation of Taormina. Dionyſius the Tyrant attacked this colony, and either took or ſet fire to their city. The inhabitants retired to the rocks of Mount Taurus; among which they found a tract of ground ſufficiently level and ſecure, and of ſufficient extent. Here therefore they built a city; which, after the mountain, they named *Tauromenium.* It was at length raiſed to a very flouriſhing ſtate by trade, and became celebrated as a ſeat of the arts, the remains of which ſhow that the fine arts muſt have been once ſucceſsfully cultivated at Tauromenium. Taormina || Taper.

Among other remains are ſtill to be ſeen a ſpacious theatre, a tomb, and a large natural grotto, which appears to have been anciently adorned within with artificial ornaments. After the inhabitants of Taormina embraced Chriſtianity, they ſtill continued to viſit this grotto with devout veneration. Inſtead of the Pagan divinities to whom it had before been ſacred, they ſubſtituted a ſaint, the venerable St Leonard. But St Leonard did not long draw crowds to this grotto; and the Chriſtians have either defaced its Pagan decorations, or ſuffered them to fall into decay by the injuries of time. It is now black and ſmoky; and it is with difficulty that any remains of the Greek paintings with which it was once ornamented can be diſtinguiſhed.

TAPE-WORM. See TÆNIA, HELMINTHOLOGY *Index.*

TAPER, TAPERING, is underſtood of a piece of timber, or the like, when thick at one end, and gradually diminiſhing to the other; as is the caſe in pyramids, cones, &c.

To meaſure TAPER-Timber, &c. See *SLIDING Rule.*

TAPER-Bored, is applied to a piece of ordnance when it is wider at the mouth than towards the breech.

TAPER, alſo denotes a kind of tall wax candle, placed in a candleſtick, and burnt at funeral proceſſions, and in other church ſolemnities.

Tapers are made of different ſizes; in ſome places, as Italy, &c. they are cylindrical; but in moſt other countries, as England, France, &c. they are conical or taper; whence poſſibly the name; unleſs we rather chooſe to derive taper, in the adjective ſenſe from the ſubſtantive taper, in the Saxon *tapen* or *tapon*, *cereus*, "wax-candle." Both kinds are pierced at bottom for a pin in the candleſtick to enter.—There are two ways of making tapers, the firſt with the ladle, the ſecond by hand; for which ſee CANDLE.

Paſchal TAPER, among the Romaniſts, is a large taper, wheron the deacon applies five bits of frankincenſe, in holes made for the purpoſe in form of a croſs; and which he lights with new fire in the ceremony of Eaſter Saturday.

The Pontifical makes Pope Zoſimus the author of this uſage; but Baronius will have it more ancient, and quotes a hymn of Prudentius to prove it. That pope he ſuppoſes to have only eſtabliſhed the uſe thereof in pariſh-churches, which, till then, had been reſtrained to greater churches.

F. Papebroch explains the original of the paſchal taper more diſtinctly, in his *Conatus Chronico-Hiſtoricus*, &c. It ſeems, though the council of Nice regulated the day whereon Eaſter was to be celebrated, it laid it on the patriarch of Alexandria to make a yearly canon thereof, and to ſend it to the pope. As all the other moveable feaſts were to be regulated by that of Eaſter, a catalogue of them was made every year; and this was written on a taper, *cereus*, which was bleſſed in the church with much ſolemnity.

Taper, Tapeſtry.

This taper, according to the abbot Chaſtelain, was not a wax-candle made to be burnt; it had no wick, nor was it any thing more than a kind of column of wax, made on purpoſe to write the liſt of moveable feaſts on; and which would ſuffice to hold that liſt for the ſpace of a year.

For among the ancients, when any thing was to be written to laſt for ever, they engraved it on marble or ſteel; when it was to laſt a long while, they wrote it on Egyptian paper; and when it was only to laſt a ſhort time, they contented themſelves to write it on wax. In proceſs of time they came to write the moveable feaſts on paper, but they ſtill faſtened it to the paſchal taper. Such is the original of the benediction of the paſchal taper.

TAPESTRY, a kind of cloth made of wool and ſilk, adorned with figures of different animals, &c. and formerly uſed for lining the walls of rooms, churches, &c.

The art of weaving tapeſtry is ſuppoſed to have been borrowed from the Saracens; accordingly the workmen employed in this manufacture in France were formerly called *Surazins* or *Sarazinois*. Guicciardini aſcribes the invention of tapeſtry hangings to the inhabitants of the Netherlands; but he has not mentioned at what time the diſcovery was made. This art was brought into England by William Sheldon, near the end of Henry VIII.'s reign. In 1619 a manufacture was eſtabliſhed at Mortlake in Surry by Sir Francis Crane, who received 2000l. from King James to encourage the deſign. The firſt manufacture of tapeſtry at Paris was ſet up under Henry IV. in 1606 or 1607, by ſeveral artiſts whom that monarch invited from Flanders. Under Louis XIV. the manufacture of the Gobelins was inſtituted, which has introduced very beautiful cloths, remarkable for ſtrength, for elegance of deſign, and a happy choice of colours. The fineſt paintings are copied, and eminent painters have been employed in making deſigns for the work.

Tapeſtry-work is diſtinguiſhed by the workmen into two kinds, viz. that of high and that of low warp; though the difference is rather in the manner of working than in the work itſelf; which is in effect the ſame in both: only the looms, and conſequently the warps, are differently ſituated; thoſe of the low warp being placed flat and parallel to the horizon, and thoſe of the high warp erected perpendicularly. The Engliſh anciently excelled all the world in the tapeſtry of the high warp; and they ſtill retain their former reputation, though with ſome little change: their low warps are ſtill admired; but as for the high ones, they are quite laid aſide by the French. The French, before the revolution, had three conſiderable tapeſtry manufactures beſides that of the Gobelins; the firſt at Aubuſſon in Auvergne, the ſecond at Felletin in the Upper Marche, and the third at Beauvais. They were all equally eſtabliſhed for the high and the low warp; but they had all laid aſide the high warp excepting the Gobelins. There were admirable low warps likewiſe in Flanders, generally exceeding thoſe of France; the chief and almoſt only Flemiſh manufactures were at Bruſſels, Antwerp, Oudenard, Liſle, Tournay, Bruges, and Valenciennes; but of the ſtate of theſe manufactures now we are ignorant.

The uſual widths of tapeſtry are from two ells to three ells Paris meaſure. Tapeſtr

The Manufacture of Tapeſtry of the High Warp.—The loom on which it is wrought is placed perpendicularly: it conſiſts of four principal pieces; two long planks or cheeks of wood, and two thick rollers or beams. The planks are ſet upright, and the beams acroſs them, one at the top and the other at the bottom, or about a foot diſtance from the ground. They have each their trunnions, by which they are ſuſpended on the planks, and are turned with bars. In each roller is a groove, from one end to the other, capable of containing a long round piece of wood, faſtened therein with hooks. The uſe of it is to tie the ends of the warp to. The warp, which is a kind of worſted, or twiſted woollen thread, is wound on the upper roller; and the work, as faſt as wove, is wound on the lower. Withinſide the planks, which are ſeven or eight feet high, fourteen or fifteen inches broad, and three or four thick, are holes pierced from top to bottom, in which are put thick pieces of iron, with hooks at one end ſerving to ſuſtain the coat-ſtave: theſe pieces of iron have alſo holes pierced, by putting a pin in which the ſtave is drawn nearer or ſet farther off; and thus the coats or threads are ſtretched or looſened at pleaſure. The coat-ſtave is about three inches diameter, and runs all the length of the loom; on this are fixed the coats or threads, which make the threads of the warp croſs each other. It has much the ſame effect here as the ſpring-ſtave and treddles have in the common looms. The coats are little threads faſtened to each thread of the warp with a kind of ſliding knot, which forms a ſort of maſh or ring. They ſerve to keep the warp open for the paſſage of broaches wound with ſilks, woollens, or other matters uſed in the piece of tapeſtry. In the laſt place, there are a number of little ſticks of different lengths, but all about an inch in diameter, which the workman keeps by him in baſkets, to ſerve to make the threads of the warp croſs each other, by paſſing them acroſs; and, that the threads thus croſſed may retain their proper ſituation, a packthread is run among the threads above the ſtick.

The loom being thus formed, and mounted with its warp, the firſt thing the workman does is to draw on the threads of this warp the principal lines and ſtrokes of the deſign to be repreſented on the piece of tapeſtry; which is done by applying cartoons made from the painting he intends to copy to the ſide that is to be the wrong ſide of the piece, and then, with a black lead pencil, following and tracing out the contours thereof on the thread of the right ſide; ſo that the ſtrokes appear equally both before and behind.

As for the original deſign the work is to be finiſhed by, it is hung up behind the workmen, and wound on a long ſtaff, from which a piece is unrolled from time to time as the work proceeds.

Beſides the loom, &c. here deſcribed, there are three other principal inſtruments required for working the ſilk or the wool of the woof within the threads of the warp; theſe are a broach, a reed, and an iron needle. The broach is made of a hard wood, ſeven or eight inches long, and two-thirds of an inch thick, ending in a point with a little handle. This ſerves as a ſhuttle; the ſilks, woollens, gold, or ſilver, to be uſed in the work.

Tapeſtry. work being wound on it. The reed or comb is alſo of wood, eight or nine inches long, and an inch thick on the back, whence it grows leſs and leſs to the extremity of the teeth, which are more or leſs apart, according to the greater or leſs degree of fineneſs of the intended work. Laſtly, the needle is made in form of the common needle, only bigger and longer. Its uſe is to preſs cloſe the wool and ſilks when there is any line or colour that does not fit well.

All things being prepared for the work, and the workman ready to begin, he places himſelf on the wrong ſide of the piece, with his back towards the deſign: ſo that he works as it were blindfold, ſeeing nothing of what he does, and being obliged to quit his poſt, and go to the other ſide of the loom whenever he would view and examine the piece, to correct it with his preſſing-needle. To put ſilk, &c. in the warp, he firſt turns and looks at the deſign; then, taking a broach full of the proper colour, he places it among the threads of the warp, which he brings croſs each other with his fingers, by means of the coats or threads faſtened to the ſtaff; this he repeats every time he is to change his colour. Having placed the ſilk or wool, he beats it with his reed or comb; and when he has thus wrought in ſeveral rows over each other, he goes to ſee the effects they have, in order to reform the contours with his needle, if there be occaſion. As the work advances, it is rolled upon the lower beam, and they unroll as much warp from the upper beam as ſuffices them to continue the piece: the like they do of the deſign behind them. When the pieces are wide, ſeveral workmen may be employed at once.

We have but two things to add: the firſt is, that the high warp tapeſtry goes on much more ſlowly than the low warp, and takes up almoſt twice the time and trouble. The ſecond is, that all the difference that the eye can perceive between the two kinds, conſiſts in this, that in the low warp there is a red fillet, about one-twelfth of an inch broad, running on each ſide from top to bottom, which is wanting in the high warp.

Manufacture of Tapeſtry of the Low Warp.—The loom or frame, whereon the low warp is wrought, is much like that of the weavers; the principal parts thereof are two ſtrong pieces of wood forming the ſides of the loom, and bearing a beam or roller at each end: they are ſuſtained at bottom with other ſtrong pieces of wood in manner of treſtles; and, to keep them the firmer, they are likewiſe faſtened to the floor with a kind of buttreſſes, which prevent any ſhaking, though there are ſometimes four or five workmen leaning on the fore-beam at once.

The rollers have each their trunnions, by which they are ſuſtained: they are turned by large iron pins three feet long. Along each beam runs a groove, wherein is placed the wich, a piece of wood of about two inches diameter, and almoſt of the length of the roller: this piece fills the groove entirely, and is faſtened therein, from ſpace to ſpace, by wooden pins. To the two wiches are faſtened the two extremities of the warp, which is wound on the farther roller, and the work, as it advances, on the nearer.

Acroſs the two ſides, almoſt in the middle of the loom, paſſes a wooden bar, which ſuſtains little pieces of wood, not unlike the beam of a balance: to theſe pieces are faſtened ſtrings, which bear certain ſpring ſtaves, where-

Tapeſtry || Tar.

with the workman, by means of two treddles under the loom whereon he ſets his feet, gives a motion to the coats, and makes the threads of the warp riſe and fall alternately. Each loom has more or fewer of theſe ſpring-ſtaves, and each ſtaff more or fewer coats, as the tapeſtry conſiſts of more or fewer threads.

The deſign or painting the tapeſtry-man is to follow is placed underneath the warp; where it is ſuſtained from ſpace to ſpace with ſtrings, by means of which the deſign is brought nearer the warp.

The loom being mounted, there are two inſtruments uſed in working it, viz. the reed and the flute. The flute does the office of the weaver's ſhuttle; it is made of an hard poliſhed wood, three or four lines thick at the ends, and ſomewhat more in the middle, and three or four inches long. On it are wound the ſilks or other matters to be uſed as the woof of the tapeſtry. The comb or reed is of wood or ivory; it has uſually teeth on both ſides; it is about an inch thick in the middle, but diminiſhes each way to the extremity of the teeth: it ſerves to beat the threads of the woof cloſe to each other, as faſt as the workman has paſſed and placed them with his flute amongſt the threads of the warp.

The workman is ſeated on a bench before the loom, with his breaſt againſt the beam, only a cuſhion or pillow between them; and, in this poſture, ſeparating, with his fingers, the threads of the warp, that he may ſee the deſign underneath, and taking a flute, mounted with a proper colour, he paſſes it among the threads, after having raiſed or lowered them, by means of the treddles moving the ſpring-ſtaves and coats.

Laſtly, to preſs and cloſe the threads of the ſilk or yarn, &c. thus placed, he ſtrikes each courſe (i. e. what the flute leaves in its paſſing and coming back again) with the reed.

TAPIOCA, a ſpecies of ſtarch, which the Brazileans make from the roots of the caſſada plant. See JATROPHA, BOTANY *Index*.

TAPIR, a quadruped of the order of belluæ, reſembling the hippopotamus. See MAMMALIA *Index*.

TAPPING, in general, the act of piercing a hole in a veſſel, and applying a tube or canula in the aperture, for the commodious drawing off the liquor contained therein.

TAPPING, in *Surgery*. See PARACENTESIS, SURGERY *Index*.

TAPROBANA, the ancient name of the iſland of Ceylon. See CEYLON, and GEOGRAPHY, N° 28.

TAR, a thick, black, unctuous ſubſtance, obtained chiefly from old pines and fir-trees by burning them with a cloſe ſmothering heat. It is prepared in great quantities in Norway, Sweden, Germany, Ruſſia, and North America, and in other countries where the pine and fir abound.

Becher, the celebrated chemiſt, firſt propoſed to make tar from pit-coal. Manufactures for this purpoſe have been eſtabliſhed many years ago in the biſhopric of Liege, and in ſeveral parts of England. In the year 1781, the earl of Dundonald obtained a patent for extracting tar from pit-coal by a new proceſs of diſtillation. Great hopes were entertained of the value of this diſcovery, but we have not heard that it has anſwered expectation.

Tar, which is well known for its economical uſes, is properly an empyreumatic oil of turpentine, and has been

Tar
||
Targum.

much used as a medicine both internally and externally. Tar-water, or water impregnated with the more soluble parts of tar, was formerly a very popular remedy.

TARANTO, the ancient TARENTUM, a sea-port town of Italy, in the kingdom of Naples, and in the Terra de Otranto. It is a strong and populous place, with an archbishop's see, and the title of a principality. It is seated on a peninsula, and is defended by a strong castle; but the harbour is choked up. E. Long. 17. 29. N. Lat. 40. 35.

TARANTULA, a species of aranea, so called from Taranto, the place where it is said to abound. See ARANEA, ENTOMOLOGY *Index*.

TARASCON, an ancient and populous town of France, in the department of the Mouths of the Rhone, and late province of Provence, with a well-built castle, seated on the river Rhone, opposite Beaucaire, with which it communicates by a bridge of boats. Its commerce consists in oil, brandy, starch, and stuffs that are much worn, one sort being of coarse silk, and the other of the same material and wool. It is 10 miles north of Arles, and 375 south by east of Paris. E. Long. 4. 45. N. Lat. 43. 46.

TARAZONA, a strong town of Spain, in the kingdom of Arragon, and on the frontiers of Old Castile, with a bishop's see. It is seated partly on a rock, and partly in a fertile plain, on the river Chiles. It was taken from the Moors in 1110. W. Long. 1. 26. N. Lat. 42. 10.

TARCHONANTHUS, FLEA-BANE, a genus of plants belonging to the class syngenesia; and in the natural system ranging under the 49th order, *Compositæ*. See BOTANY *Index*.

TARE, is an allowance for the outside package that contains such goods as cannot be unpacked without detriment; or for the papers, threads, bands, &c. that inclose or bind any goods imported loose; or though imported in casks; chests, &c. yet cannot be unpacked and weighed neat.

TARE, or VETCH. See VICIA, BOTANY *Index*.

TARGET, a kind of shield or weapon of defence made use of by the ancients.

TARGIONIA, a genus of plants belonging to the class of cryptogamia, and natural order of *Algæ*. See BOTANY *Index*.

TARGUM, a name given to the Chaldee paraphrases of the books of the Old Testament. They are called *paraphrases* or *expositions*, because they are rather comments and explications than literal translations of the text. They are written in the Chaldee tongue, which became familiar to the Jews after the time of their captivity in Babylon, and was more known to them than the Hebrew itself. So that when the Hebrew text was read in the synagogue, or in the temple, they generally added to it an explication in the Chaldee tongue for the service of the people, who had but a very imperfect knowledge of the Hebrew tongue. It is probable, that even from the time of Ezra this custom began, since this learned scribe, reading the law to the people in the temple, explained it, with the other priests that were with him, to make it understood by the people (Nehem. viii. 7—9.).

But though the custom of making these sorts of expositions in the Chaldee language be very ancient among the Hebrews, yet have they no written paraphrases or targums before the era of Onkelos and Jonathan, who lived about the time of our Saviour. Jonathan is placed about 30 years before Christ, under the reign of Herod the Great. Onkelos is something more modern. The Targum of Onkelos is the most of all esteemed, and copies are to be found in which it is inserted verse for verse with the Hebrew. It is so short and so simple, that it cannot be suspected of being corrupted. This paraphrast wrote only upon the books of Moses; and his style approaches nearly to the purity of the Chaldee, as it is found in Daniel and Ezra. This targum is quoted in the Misna, but was not known either to Eusebius, St Jerome, or Origen. Targum

The Targum of Jonathan son of Uziel is upon the greater and lesser prophets. He is much more diffuse than Onkelos, and especially upon the lesser prophets, where he takes great liberties, and runs on in allegories. His style is pure enough, and approaches pretty near to the Chaldee of Onkelos. It is thought that the Jewish doctors who lived above 700 years after him made some additions to him.

The Targum of Joseph the Blind is upon the Hagiographa. This author is much more modern, and less esteemed than those we have now mentioned. He has written upon the Psalms, Job, the Proverbs, the Canticles, Ecclesiastes, Ruth, and Esther. His style is a very corrupt Chaldee, with a great mixture of words from foreign languages.

The Targum of Jerusalem is only upon the Pentateuch; nor is that entire or perfect. There are whole verses wanting, others transposed, others mutilated; which has made many of opinion that this only is a fragment of some ancient paraphrase that is now lost. There is no targum upon Daniel, or upon the books of Ezra and Nehemiah.

These targums are of great use for the better understanding not only of the Old Testament, on which they are written, but also of the New. As to the Old Testament, they serve to vindicate the genuineness of the present Hebrew text, by proving it to be the same that was in use when these targums were made, contrary to the opinion of those who think the Jews corrupted it after our Saviour's time. They help to explain many words and phrases in the Hebrew original, and they hand down to us many of the ancient customs of the Jews. And some of them, with the phraseologies, idioms, and peculiar forms of speech, which we find in them, do in many instances help as much for the better illustration and better understanding of the New Testament as of the Old; the Jerusalem Chaldee dialect, in which they are written, being the vulgar language of the Jews in our Saviour's time. They also very much serve the Christian cause against the Jews, by interpreting many of the prophecies of the Messiah in the Old Testament in the same manner as the Christians do. Many instances are produced to this purpose by Dr Prideaux in his *Connect. of the Hist.* of the Old and New Testament, vol. iv. p. 777, &c.

These targums are published in the second edition of the great Hebrew Bible set forth at Basil by Buxtorf the father, anno 1610; for he has rectified the Chaldee text, and reformed the vowel pointings in it; the targums having at first been written without vowel points, which were afterwards added very erroneously by some Jews.

TARIF, a table containing the names of different ſorts of merchandiſe, with the duties to be paid as ſettled among trading nations.

TARPA, SPURIUS MECIUS, a Latin critic in the time of Julius Cæſar and Auguſtus. He had his tribunal in the temple of Apollo, where, with four aſſiſtants, he paſſed ſentence on the works of the poets. Cicero and Horace make honourable mention of this critic.

TARPAULIN, a piece of canvas, well tarred over, to keep off the rain from any place. The term is alſo often applied in a burleſque ſenſe to a perſon that has been all his life bred to the ſea.

TARPEIAN, in Roman antiquity, an appellation given to a ſteep rock in Rome; whence, by the law of the twelve tables, thoſe guilty of certain crimes were precipitated. It took its name from Tarpeia, a veſtal virgin, who was killed by the Sabines, as related under the article ROME, N° 24.

TARQUIN the ELDER, king of Rome, ſucceeded Ancus Martius 615 B. C. See ROME, N° 35—40.

TARQUIN the *Proud*, a tyrant and uſurper. See ROME, N° 49—51, &c.

TARRAGON, or DRAGON-WORT. See BOTANY *Index*.

TARROCK, a ſpecies of lorus. See ORNITHOLOGY *Index*.

TARSHISH, a town frequently mentioned by ancient authors, the ſituation of which it is difficult to aſcertain. See OPHIR.

TARTAN, in ſea language, a ſmall coaſting veſſel navigated in the Mediterranean, with only one maſt and a bowſprit, the principal ſail, which is very large, being extended by a lateen-yard. When tartans put up a ſquare ſail, it is called a *ſail of fortune*.

TARTAR, a hard ſolid ſubſtance which ſeparates from wine after complete fermentation, and adheres to the top and ſides of the taſks. It is an impure tartrate of potaſh with the acid in exceſs. See CHEMISTRY, N° 999.

TARTARIC ACID. See CHEMISTRY, p. 529.

TARTARY, a name given by geographers and hiſtorians to a conſiderable extent of territory in Aſia, lying between Ruſſia and China, and including a great variety of nations, now chiefly dependent on theſe two empires. The whole country is uſually divided into *Weſtern Tartary*, and *Eaſtern* or *Chineſe Tartary*, of which the former includes Weſtern Turkiſtan, Khariſm, and Great Bucharia; while the latter comprehends the country of the *Monguls* and the *Mandſhurs*, now both ſubject to Ruſſia, and Little Bucharia. The geography of ſeveral parts of this extenſive tract has already been conſidered under the articles BUCHARIA, CHINA, and RUSSIA, and we ſhall here confine ourſelves to that which is now commonly known by the name of *Independent Tartary*, by which we underſtand that extent of country now poſſeſſed by the *Kirghiſes*, and the Uſbeck Tartars, including the Khariſm, and Great and Little Bucharia.

Independent Tartary thus defined, extends from the Caſpian ſea on the weſt to the mountains of Belur on the eaſt, a ſpace of about 870 Britiſh miles, and from the mountains of Gaur in the ſouth, to the ſouthern boundaries of the Ruſſian empire on the north, including nearly 1500 Britiſh miles. About half of this extent is occupied by the Kirghiſes to the north, and the Uſbecks to the ſouth.

Tartary.

3 Kirghiſes.

The country of the Kirghiſes is ſeparated from Siberia by the great ſteppe or deſert of Iſſim, an extenſive plain interſected by a river of the ſame name, and abounding with lakes of ſalt and bitter waters. Even the ſoil of this ſteppe is in many places impregnated with ſalt and nitre, though in ſeveral ſpots the ſoil is by no means unfruitful. There are no towns, as the inhabitants dwell wholly in tents.

The Kirghiſes have been long divided into three principal hordes, called the *great*, *middle*, and *leſſer*. Of theſe, the two latter are now regarded as ſubjects of the Ruſſian empire, though they ſeem by no means to be dependent on that power. The great horde, defended by mountains on the ſouth and eaſt, are properly independent. This laſt horde is ſuppoſed to contain about 60,000 families, while the leſſer and middle hordes are ſaid to comprehend each about half that number. The whole population is computed at about 500,000.

The Kirghiſes have gradually moved from the eaſt towards the weſt. Their manners are deſcribed at conſiderable length by Pallas. Their tents are of a ſort of felt; their drink kumiſs, made of acidulated mares milk. The great horde is conſidered as the ſource of the other two. Being ſettled near the mountains of Alak, or *Ala Tau*, this horde has been called the Alatanian Kirghiſes. They lead a wandering life, from the borders of the Upper Sirr, near Taſhkund, to the ſteppe of Iſſim. Each horde has its particular khan; but the middle horde, when Pallas viſited this country, was contented with a prince, who ſeemed to acknowledge the khan of the leſſer horde; and in 1777, this khan was called Nur-Hali, an equitable prince. Their features are Tartaric, with flat noſe and ſmall eyes, but not oblique like thoſe of the Monguls and Chineſe. They have horſes, camels, cattle, ſheep, and goats. Some individuals of the middle horde, it is ſaid, had 10,000 horſes, 300 camels, 4000 cattle, 20,000 ſheep, and upwards of 2000 goats; while in the leſſer horde were proprietors of 5000 horſes, and a proportional number of the other animals. Their dromedaries furniſh a conſiderable quantity of woolly hair, ſold to the Ruſſians and Bucharians, being annually clipped like that of ſheep. Their chief food is mutton; and the lamb is ſo exquiſite, that it is ſent from Orenburg to St Peterſburg for the tables of the palace. The lamb ſkins are the moſt celebrated next to thoſe of Bucharia; but the wool of the ſheep is coarſe, and uſed only for domeſtic purpoſes, for felts and thick cloths. The ſteppes ſupply them with objects of the chaſe, wolves, foxes, marmots, antelopes, &c. In the ſouthern and eaſtern mountains are found wild ſheep, the ox of Tibet, which ſeems to delight in ſnowy alps; with chacals, tigers, and wild aſſes.

As the Kirghiſians regard each other as brethren, they are obliged to employ ſlaves who are captives taken in their incurſions. Their dreſs conſiſts of cloſe veſts, large trowſers, and pointed boots. The ladies adorn their heads with the necks of herons, diſpoſed like horns. They appear to be Mahometans, but have a more relaxed creed.

The Kirghiſians carry on ſome trade with Ruſſia. The chief traffic is at Orenburg, and wholly by exchange; but the middle horde proceed to Omſk. About 150,000 ſheep are annually brought to Orenburg, with horſes, cattle, lamb ſkins, camels wool, and ſometimes ſlaves.

Tartary. ſlaves. In return they take manufactured articles, chiefly clothes and furniture. From Bucharia, Khiva, and Taſhkund, they receive arms and coats-of-mail, which Ruſſia refuſes, in return for camels and cattle. They are extremely fond of the Kalmuk women, who long retain their charms; and often marry them if they will adopt the Mahometan religion. They have an annual feſtival in honour of the dead. About the beginning of the 17th century this people, who were formerly Shamanians, became children of circumciſion, by the exertions of the prieſts of Turkiſtan.

4 Uſbeks. The country of the Uſbek Tartars includes Khariſm and part of Great Bucharia. The former of theſe extends from the river Gihon to the Caſpian ſea, and is bounded on the north and eaſt by vaſt deſerts. Its length is about 400 Britiſh miles, and its breadth rather leſs than 350. The chief town is Khiva, beſides which there are five walled cities or towns, within half a day's journey of each other. The khan is abſolute, and independent of any but the high prieſt, or lama, by whom he is controlled. The Kievinſki Tartars differ little from the Kirghiſes, but ſurpaſs even them in treachery. Their manners are nearly the ſame, except that the Kirghiſes live in tents, while the others inhabit cities and villages. Their only trade is with Bokhara and Perſia; whither they carry cattle, furs, and hides, which they procure from the Kirghiſes and Turkoman Tartars. The place itſelf produces little more than cotton, lamb furs, of a bad quality, and ſome raw ſilk; part of which they manufacture. The town of Khiva ſtands on a riſing ground, with three gates, and a ſtrong thick wall of earth much higher than the houſes, with turrets at ſmall diſtances, and a broad deep ditch full of water. It occupies a large ſpace, and commands a pleaſant proſpect; but the houſes are built with mud, having flat roofs covered with earth. It is 17 days journey from the Caſpian ſea, and 33 from Orenburg, allowing 40 verſts to the day's journey.

5 Town of Khiva.

The people of Khiva bring to Orenburg large quantities of raw cotton; but the coaſts of the Caſpian are held by ſome remains of Turkomans in the north, and by Uſbeks in the ſouth. A conſiderable trade is carried on with Manguſhlak. As the merchants of Khiva brought gold and gems to Aſtrakan, probably from the two Bucharias, it was ſuggeſted to Peter the Great that theſe products were found in Khariſm, in conſequence of which he attempted a ſettlement. But the Ruſſians, to the number of 3000, were cut off by the Uſbeks.

6 Great Bucharia. Great Bucharia, by far the moſt important part of Independent Tartary, extends for about 700 Britiſh miles in length from north to ſouth, by a medial breadth of about 350, being bounded on the north by the mountains of Argun, and divided from Khariſm and Corazan by the river Amu, and extenſive deſerts, while on the ſouth and eaſt it has for its boundaries the mountains of Gaur and of Beber.

The chief city of Great Bucharia is SAMARCAND, on the ſouthern bank of the river Sogd. The other places of note are BOKHARA on the ſame river, Balk on the river Dehaſh, Zouf, and Kotlan.

The face of the country preſents a great variety, abounding with rivers, hills, and mountains, but being in general deficient in wood. Near the rivers the ſoil is very productive, the graſs ſometimes exceeding the height of a man; and in ſome parts much induſtry is ſhown in the cultivation of rice and other grain. Tartar

The rivers are, the Amu and Sirr. Beſides the ſea of Aral, already deſcribed under that head, there are ſeveral conſiderable lakes, particularly that of Palkati, Tengis, or Balcaſh, being about 140 miles long by 70 broad.

"In all the regions of the earth (ſays Sir William Ouſeley), there is not a more flouriſhing or a more delightful country than this, eſpecially the diſtrict of Bokhara. If a perſon ſtand on the Kohendis (or ancient caſtle) of Bokhara, and caſt his eyes around, he ſhall not ſee any thing but beautiful and luxuriant verdure on every ſide of the country; ſo that he would imagine the green of the earth and the azure of the heavens were united; and as there are green fields in every quarter, ſo there are villas interſperſed among the green fields. The Sogd, for eight days journey, is all delightful country, affording fine proſpects, and full of gardens and orchards, and villages, corn fields, and villas, running ſtreams, reſervoirs, and fountains, both on the right hand and on the left. You paſs from corn fields into rich meadows and paſture lands; and the ſtraits of Sogd are the fineſt in the world."

7 Religion of the Ta The religion of the Uſbeks and Bucharians is the Mahometan of the Sunni ſect, and the government of the khans is deſpotic. There are no accounts to be met with of the ſtate of the population, but it is believed that on any emergency they could muſter an army of 100,000. The revenue of theſe fertile provinces is not certainly known, though that of Coraſan is ſaid to amount to half a million ſterling annually, and it is probable that the revenue of Great Bucharia is at leaſt equal to that of Coraſan.

8 Trade. Beſides the caravans to Perſia, Hindoſtan, and China, ſome trade is carried on with the Ruſſians; the Bucharian merchants not only furniſhing their own products, but others from the eaſtern countries to which they trade.

9 Manners. The manners and cuſtoms of the Uſbeks are ſimilar to thoſe of the other Tartars; but they are ſuppoſed to be the moſt ſpirited and induſtrious of theſe barbarians. Though many reſide in tents in the ſummer, yet in winter they inhabit the towns and villages. They are accuſtomed to make ſudden inroads into the Perſian provinces. The native Bucharians are comparatively fair, and correſpond in form and features with thoſe of Little Bucharia. The Bucharians never bear arms. The Uſbeks, on the contrary, are no ſtrangers to the uſe of the muſket, and it is ſaid that even their women are not averſe to warfare. The language is Turkiſh, but that of the Bucharians has never been inveſtigated, though it be probably a dialect of the Perſian. Their literature would furniſh an ample theme, Samarcand having been a celebrated ſchool of oriental ſcience, cultivated even by monarchs, as Ulug Beg and others.

"Such are the generoſity and liberality of the inhabitants, that no one (ſays Sir William Ouſeley) turns aſide from the rites of hoſpitality; ſo that a perſon contemplating them in this light, would imagine *that all the families of the land were but one houſe.* When a traveller arrives there, every perſon endeavours to attract him to himſelf, that he may have opportunities of performing kind offices for the ſtranger; and the beſt proof of their hoſpitable and generous diſpoſition is that

every

every peaſant, though poſſeſſing but a bare ſufficiency, allots a portion of his cottage for the reception of a gueſt. On the arrival of a ſtranger they contend one with another for the pleaſure of taking him to their home, and entertaining him. Thus, in acts of hoſpitality, they exceed their incomes. I happened once to be in Sogd, and there I ſaw a certain palace, or great building, the doors of which were faſtened back with nails againſt the walls. I aſked the reaſon of this, and they informed me that it was a hundred years and more ſince thoſe doors had been ſhut, all that time they had continued open day and night; ſtrangers might arrive there at the moſt unſeaſonable hours, or in any numbers, for the maſter of the houſe had provided every thing neceſſary both for the men and for their beaſts; and he appeared with a delighted and joyful countenance when the gueſts tarried a while."

For a more particular account of the manners and cuſtoms of the Tartars, ſee the articles BUKHARIA and KALMUKS; Pallas's *Travels in the Southern Provinces of the Ruſſian Empire*, and Tooke's *View of the Ruſſian Empire*. An account of the Baſchkirs, alſo a tribe of wandering Tartars, and of the Tartars of the Krimea, has been given under RUSSIA.

We cannot here enter on the hiſtory of Tartary. The moſt intereſting parts of it will be found under the articles CHINA and MOGUL, and we may refer thoſe who wiſh for a more detailed account to the 4th volume of the *Modern Univerſal Hiſtory*, and to the *Aſiatic Reſearches*.

Krim TARTARY. See CRIMEA.

TARTRATES, in *Chemiſtry*, are ſaline bodies, compoſed of an alkaline, earthy, or metallic baſe, and tartaric acid.

TASSEL, a pendant ornament at the corners of a cuſhion, &c. In building, taſſels denote thoſe pieces of board that lie under the ends of the mantlet trees.

TASSO, TORQUATO, a celebrated Italian poet, was born at Sorrento in the kingdom of Naples, in 1544. He was the ſon of Bernardo Taſſo, and of Portia de Roſſi, a lady of an illuſtrious family of Naples.

At three years of age Taſſo was committed by his father to the care of Angeluzza, a man of great learning, who at this tender age, it is ſaid, began to teach him grammar; at four he was ſent to the Jeſuits college, and at ſeven was well acquainted with Latin and Greek. At the age of 12 he went from Rome to Mantua, where his father had entered into the ſervice of the duke Guglielmo Gonzaga; he had then completed his knowledge of the Latin and Greek languages; he was well aequainted with rhetoric and poetry, and maſter of Ariſtotle's Ethics. He was ſoon after ſent to the univerſity of Padua; and at 18, publiſhed his Rinaldo, a poem on the plan of Homer's Odyſſey. This extended his fame through all Italy; but his father went to Padua, to remonſtrate againſt his apparent purpoſe of giving himſelf up to philoſophy and poetry, and made uſe of many harſh expreſſions, which Taſſo heard with great patience. "Of what uſe is that philoſophy on which you value yourſelf ſo much?" "It has enabled me (replied Taſſo) to endure the harſhneſs of your reproofs."

He ſoon after went to Bologna, by the invitation of the city and college; but in a ſhort time he returned to Padua at the urgent deſire of Scipio Gonzaga, who had been elected prince of the academy eſtabliſhed in that city under the name of the *Ætherei*. In this retreat he formed the deſign of his *Jeruſalem Delivered*, invented the fable, diſpoſed the parts, and determined to dedicate it to the houſe of Eſte; and being preſſed to reſide at Ferrara, he gave his conſent. The duke of Ferrara gave him an apartment in his palace, where he lived in peace and affluence, and proſecuted his work, which he determined to dedicate to the duke, and which was publiſhed book by book, as he finiſhed them. Taſſo.

At the age of 30 he finiſhed his *Jeruſalem*, and the whole was reprinted and publiſhed together, the ſucceſs of which was aſtoniſhing. It was tranſlated into Latin, French, Spaniſh, and even the oriental languages, almoſt as ſoon as it appeared. Soon after the publication of his *Jeruſalem* he loſt his father, who had been appointed governor of Oſtia on the Po by the duke of Mantua; and a pretended friend to Taſſo, belonging to Ferrara, to whom he had incautiouſly committed ſome tranſactions of a very delicate nature concerning his patron the duke, had the perfidy to betray him. This coming to the ears of the duke, he ſhut up Taſſo in priſon, from which, however, he found means to eſcape, after a year's confinement, and retired to Turin, being then about 34 years of age, and was recommended to the duke of Savoy, who ſhowed him many marks of eſteem and regard. Fearing, however, that he might be delivered up to the duke of Mantua, he ſecretly retired to Rome, and went directly to his friend Mauritio Cataneo, by whom he was received with great kindneſs, and his preſence made the whole city rejoice. Here he endeavoured to make his peace with the duke, and was fortunate enough to ſucceed.

After this he lived at Mantua about a year, in great favour with the prince; but growing weary of a ſtate of dependence, he reſolved to go to Naples, and endeavour to recover his mother's jointure, which had been ſeized by her relations; but as this law ſuit had no appearance of being ſoon determined, he went from Naples to Rome, where he continued about a year, in high favour with Pope Sextus Quintus, and then went to Florence, at the earneſt deſire of Ferdinando, grand duke of Tuſcany, who had been cardinal at Rome when Taſſo firſt reſided there.

Having ſpent another year at Florence, he returned to Naples, where he corrected his Jeruſalem Delivered.

Cardinal Cynthio, who was a great patron of learning and genius, and knew Taſſo when he firſt reſided at Rome, prevailed with him once more to leave his retreat at Naples and live with him in that city, where he continued till he was 50, and then returned to Naples to proſecute his law ſuit, from which place, however, he was ſoon recalled; and being introduced to the pope, his holineſs ſaid, "that his merit would confer as much honour on the laurel he was about to receive, as the laurel had formerly conferred on others."

It happened that while they waited for fair weather, for the purpoſe of celebrating the ſolemnity of Taſſo's coronation with laurel, that great poet took his laſt illneſs, and died on the 15th day of his ſickneſs, aged 51. His poems have acquired him an immortal reputation, the chief of which are, 1. Jeruſalem Delivered. 2. Jeruſalem Conquered. 3. Rinaldo. 4. The Seven Days of the Creation. 5. The Tragedy of Torimond.

6.

Taſſo, Taſte.

6. Aminta, &c. All his works were printed together at Florence in 1724, in 6 vols. folio, with the pieces for and againſt his Jeruſalem Delivered.

TASTE, a certain ſenſation excited in the mind by certain bodies, which are called *ſapid*, applied to the tongue and palate, and moiſtened with ſaliva. This is the original and proper meaning of the word *taſte* (ſee METAPHYSICS, N° 46.); but as the qualities of bodies which produce theſe ſenſations are unknown, they have got the names of the ſenſations themſelves, by ſubſtituting the cauſe for the effect. Taſtes have been divided into ſimple and compound, and philoſophers have endeavoured to aſcertain the number of each ſpecies. Attempts have likewiſe been made to determine from their taſtes the effects of different ſubſtances on the human body, taken into the ſtomach as food or phyſic; but by ſtating the reſults of ſuch inquiries, we ſhould be more likely to miſlead than to communicate uſeful information.

TASTE is likewiſe uſed in a figurative ſenſe, to denote that faculty by which we perceive whatever is beautiful or ſublime in the works of nature or of art. This faculty reliſhes ſome things, is diſguſted with others, and to many is indifferent. It has alſo been called an internal *ſenſe*, and by one philoſopher, a *reflex ſenſe*, while others have conſidered it as the joint exertion of perception and judgment in ſome caſes, and as a play of the imagination in others.

To decide among theſe different opinions, it will be neceſſary to aſcertain, if we can, what are the objects of this faculty, *Scarlet*, *blue*, *green*, and *yellow*, are all beautiful colours, and a *cube* and a *ſphere* are beautiful figures; but it does not appear to us, that a man could be ſaid to have either a good or a bad taſte for reliſhing the perception of a *ſcarlet* more than that of a *yellow* colour, or a *ſpherical* more than a *cubical* figure.

With reſpect to the objects of the external ſenſe, we are ſo conſtituted by nature as to reliſh thoſe kinds of food which are moſt wholeſome, and ſuch a taſte is juſtly ſaid to be ſound and uncorrupted. It is in the higheſt perfection too at firſt, for it depends not on culture of any kind, and is incapable of improvement. The reverſe is the caſe with reſpect to internal taſte. Every voice, it is true, unites in applauding elegance, ſimplicity, ſpirit in writing, and in blaming affectation, or a falſe brilliancy; but when critics come to particulars, this ſeeming unanimity vaniſhes. Perhaps no man ever beheld the riſing or ſetting ſun without feeling emotions of pleaſure; yet it is certain that the emotions of the clown are not the ſame, at leaſt in degree, with thoſe of the philoſopher. Any beautiful object preſented to the eye, gives a pleaſing ſenſation to the mind; and it appears to us that the clown feels nothing more than a mere ſenſation from the view of the riſing ſun, ſimilar to what he would feel from a blazing heath. In poetry and painting the vulgar are always delighted with the melody of the verſe, and the brilliancy of the colours, and think of nothing elſe as beauties.

If this be ſo, the pleaſures which the vulgar derive from what are called objects of taſte, are mere gratifications of the ſenſes; but very different is the pleaſure which the man of cultivated taſte derives from the beauties of nature or of art. The mere ſenſation of the clown is followed by a train of ideas which hurries him beyond the object before him to its beneficent effects and its Almighty Creator. Taſte.

The nature of any perſon's taſte, therefore, is generally determined from the character of his imagination and the ſoundneſs of his judgment. The ſimple perception of the object we find is inſufficient to excite theſe emotions, unleſs it is accompanied with this operation of mind. Thus, when we feel the beauty or ſublimity of natural ſcenery, we are conſcious of a variety of images in our minds, very different from thoſe which the objects themſelves can preſent to the eye.

If the mind is in ſuch a ſtate as to prevent this freedom of imagination, the emotion is not perceived. In ſo far as the beauties of nature or art affect the external ſenſes, their effect is the ſame on every man who is in poſſeſſion of theſe ſenſes. But to a man in pain or in grief, the ſame ſcene will not produce any feeling of admiration, which at other times would have produced it in perfection.

There are many objects of taſte which produce not their full effect on the imagination, but through the medium of the judgment. The beauty of the Farneſe Hercules is one kind of beauty; that of the gladiators in the palace of Chighi, another; and that of the Apollo Belvidere a third. Each of theſe figures is acknowledged to be perfect in its kind; but according to Sir Joſhua Reynolds, the higheſt perfection of the human figure is not to be found but in that form which might be taken from them all, and which would partake of the activity of the gladiator, of the delicacy of the Apollo, and of the muſcular ſtrength of the Hercules. In this view the perfection of theſe ſtatues conſiſts in ſomething which being perceived by the eye, is referred by the underſtanding to what we know of the characters of Hercules, Apollo, and the gladiator, and which we ſuppoſe it was the intention of the ſtatuaries to expreſs. There are beſides, objects of which taſte is ſometimes ſaid to judge, though they have little or no effect whatever on the imagination. A book of abſtract ſcience, written in a prolix and intricate ſtile, may be ſaid to be in a bad taſte; and had Swift, in his clear and ſimple ſtile, written an *Eſſay on the Human Underſtanding*, his work, ſuppoſing him maſter of the ſubject, would undoubtedly have diſplayed more taſte than Locke's, in which the terms are ſometimes vague, and the period often encumbered. This is the caſe of Berkeley, who is admitted by all to have been a writer of good taſte, though neither the Principles of Human Knowledge, the Dialogues on Matter, nor the Minute Philoſopher, is capable of affording pleaſure, either to the ſenſes or the imagination. His beauty conſiſts merely in the perſpicuity of his ſtile, of which the underſtanding alone is the judge. The metaphyſical writings of Dr Reid poſſeſs in an eminent degree the ſame beauty; and no man of true taſte can read them without admiring the elegant ſimplicity of the compoſition as much as the ſtrength of the reaſoning, and feeling from the whole a pleaſure which the poetical ſtyle of Shafteſbury cannot communicate.

If this be a juſt account of the pleaſures of taſte, that faculty cannot be properly conſidered as a mere internal ſenſe, ſince to its enjoyments a well-ſtored fancy is neceſſary in ſome caſes, and the reaſoning power in all; and the poet and the painter who wiſhed to excel in their

their respective professions, must not content themselves, the one with filling the ear of the reader with melliflu-ous sounds, and the other with dazzling or deceiving the eye of the spectator by the brilliancy of his colours, but both must strive for fame by captivating the imagination; whilst the architect, who aspires to a similar celebrity, must make the purpose of his ornaments obvious to every person capable of judging. The land-scapes of Claude Lorrain, the music of Handel, and poetry of Milton, excite feeble emotions in our minds, when our attention is confined to the qualities they present to our senses, or when it is to such qualities of their composition that we turn our regard. It is then only we feel the sublimity or beauty of their productions, when our imaginations are kindled by their power, when we lose ourselves amid the number of images that pass before our minds, and when we waken at last from this play of fancy as from the charm of a romantic dream.

* *Lourse delivered at the Royal Academy, Dec. 4. 177*

It is well observed by Sir Joshua Reynolds *, that taste is sometimes praised in such terms by orators and poets, who call it *inspiration*, and *a gift from heaven*, that though a student by such praise may have his attention roused, and a desire excited of obtaining this gift, he is more likely to be deterred than encouraged in the pursuit of his object. "He examines his own mind, and perceives *there* nothing of that divine inspiration with which he is told so many others have been favoured. He never travelled to heaven to gather new ideas; and he finds himself possessed of no other qualifications than what mere common observation and a plain understanding are able to confer. Thus he becomes gloomy amidst the splendour of figurative declamation, and thinks it hopeless to pursue an object which he supposes out of the reach of human industry. But on this, as on many other occasions, we ought to distinguish how much is to be given to enthusiasm, and how much to common sense; taking care not to lose in terms of vague admiration that solidity and truth of principle upon which alone we can reason." Whoever possesses the ordinary powers of perception, sensibility of heart, good sense, and an imagination capable of being roused by the striking objects of nature and of art, may, without inspiration, become, by mere experience, a man of fine taste in the objects of which he aspires to be a critical judge.

This being the case, we may easily account for the variety of tastes which prevail among men, not only as individuals but as nations. We have already mentioned the difference in one instance between the European taste and the African respecting female beauty; and we may now affirm, as we hope to prove our affirmation, that the one taste is equally correct with the other. The charms of female beauty exist not in the mere external form and colour considered by themselves (for then the inanimate statue of the Venus de Medicis would give more delight to the European beholder than the finest woman that ever lived); but we associate external beauty with sweetness of disposition, and with all the train of endearments which take place in the union of the sexes; and it is this association which delights the man of taste, as giving refinement to an appetite which itself is gross and sensual. A similar association must be formed in the breast of the African who has any taste; and as he never knew feminine softness, or any of the endearing qualities of the sex, but as united with thick lips, a flat nose, a black skin, and woolly hair—a sable beauty of that description must excite in his breast the same emotions that are excited in the breast of an European by the fair woman with Grecian features.

Taste.

But is there not an ideal or perfect beauty of the human form? There certainly is, as of every other natural object; but it cannot be the same in Europe as in Africa, unless to a Being who is acquainted with all the peculiarities of form, national and individual, that are to be found among the inhabitants of the whole earth. It has been supposed, and we think completely proved, by one of the best writers that we have on the philosophy of taste *, that the sublimity or beauty of forms arises altogether from the associations we connect with them, or the qualities of which they are expressive to us. The qualities expressed by the male and female forms are very different; and we would by no means think the woman beautiful who should have the form of the Farnese Hercules, or admire the shapes of the hero who should be formed like the Venus de Medicis; because the proportions of such a woman would indicate strength and intrepidity, where we wish to find only gentleness and delicacy; and the delicate form of the hero would indicate softness and effeminacy, where the opposite qualities only can be esteemed. As we associate with the female form many desirable qualities, every woman is esteemed more or less beautiful as her figure and features indicate a greater or smaller number of these qualities; and the same is the case with respect to the qualities which adorn the male character, and the form and features by which they are expressed. Upon comparing a number of human beings with one another, we find, that with respect to every feature and limb, there is one central form to which nature always tends, though she be continually deviating from it on the right hand and on the left: (See NOSE). This form therefore is considered as the most perfect form of the species, and most expressive of the qualities for which that species is valued; but in Africa, the central form, with respect to the proportions of the human body and the features of the human face, is very different from what it is in Europe; and therefore the ideal or perfect beauty of the human form and features cannot be the same in both countries. No doubt, if a man could examine the limbs and features of every individual of the human race, he would discover one central form belonging to the whole, and be led to esteem it the standard of beauty; but as this is obviously impossible, the common idea or central form belonging to each great class of mankind must be esteemed the standard of beauty in that class, as indicating most completely the qualities for which individuals are esteemed. Thus there is a common form in childhood and a common form in age; each of which is the more perfect as it is the more remote from peculiarities: but though age and childhood have something in common, we should not deem the child beautiful who was formed exactly like the most handsome man, nor the man handsome who was formed exactly like the most beautiful child. This doctrine is well illustrated by Sir Joshua Reynolds, who has applied it to every object esteemed beautiful in nature; and proved, that the superiority of Claude Lorrain over the landscape-painters of the Dutch and

* *Mr Alison.*

Taſte. Flemiſh ſchools, ariſe chiefly from his having generalized his conceptions, and formed his pictures by compounding together the various draughts which he had previouſly made from various beautiful ſcenes and proſpects. "On the whole (ſays he), it ſeems to me that there is but one preſiding principle which regulates and gives ſtability to every art. The works, whether of poets, painters, moraliſts, or hiſtorians, which are built upon general nature, live for ever; while thoſe which depend for their exiſtence on particular cuſtoms and habits, a particular view of nature, or the fluctuation of faſhion, can only be coeval with that which firſt raiſed them from obſcurity. All the individual objects which are exhibited to our view by nature, upon cloſe examination, will be found to have their blemiſhes and defects. The moſt beautiful forms have ſomething about them like weakneſs, minuteneſs, or imperfection. But it is not every eye that perceives theſe blemiſhes: It muſt be an eye long uſed to the contemplation and compariſon of theſe forms; which alone can diſcern what any ſet of objects of the ſame kind has in common, and what each wants in particular."

From theſe reaſonings the ſame great artiſt concludes, that the man who is ambitious of the character of poſſeſſing a correct taſte, ought to acquire a "habit of comparing and digeſting his notions. He ought not to be wholly unacquainted with that part of philoſophy which gives him an inſight into human nature, and relates to the manners, characters, paſſions, and affections. He ought to know *ſomething* concerning *mind*, as well as a great deal concerning the *body*, and the various external works of nature and of art; for it is only the power of diſtinguiſhing right from wrong that is properly denominated *taſte*.

"Genius and taſte, in the common acceptation, appear to be very nearly related; the difference lies only in this, that genius has ſuperadded to it a habit or power of execution. Or we may ſay, that taſte, when this power is added, changes its name, and is called *genius*. They both, in the popular opinion, pretend to an entire exemption from the reſtraint of rules. It is ſuppoſed that their powers are intuitive; that under the name of *genius* great works are produced, and under the name of *taſte* an exact judgment is given, without our knowing why, and without being under the leaſt obligation to reaſon, precept, or experience.

"One can ſcarce ſtate theſe opinions without expoſing their abſurdity; yet they are conſtantly in the mouths of men, and particularly of illiterate and affected connoiſſeurs. The natural appetite, or taſte of the human mind, is for *truth;* whether that truth reſults from the real agreement or equality of original ideas among themſelves, from the agreement of the repreſentation of any object with the thing repreſented, or from the correſpondence of the ſeveral parts of any arrangement with each other. It is the very ſame taſte which reliſhes a demonſtration in geometry, that is pleaſed with the reſemblance of a picture to an original, and touched with the harmony of muſic.

"But beſides *real*, there is alſo *apparent* truth, or opinion, or prejudice. With regard to real truth, when it is known, the taſte which conforms to it is and muſt be uniform. With regard to the ſecond ſort of truth, which may be called *truth upon ſufferance*, or *truth by courteſy*, it is not fixed but variable. However, whilſt theſe opinions and prejudices on which it is founded continue, they operate as truth; and the art, whoſe office it is to pleaſe the mind as well as inſtruct it, muſt direct itſelf according to *opinion*, or it will not attain its end. In proportion as theſe prejudices are known to be generally diffuſed or long received, the taſte which conforms to them approaches nearer to certainty, and to a ſort of reſemblance to real ſcience, even where opinions are found to be no better than prejudices. And ſince they deſerve, on account of their duration and extent, to be conſidered as really true, they become capable of no ſmall degree of ſtability and determination by their permanent and uniform nature. Taſte.

"Of the judgment which we make on the works of art, and the preference that we give to one claſs of art over another, if a reaſon be demanded, the queſtion is perhaps evaded by anſwering, I judge from my taſte; but it does not follow that a better anſwer cannot be given, though for common gazers this may be ſufficient. Every man is not obliged to inveſtigate the cauſes of his approbation or diſlike. The arts would lie open for ever to caprice and caſualty, if thoſe who are to judge of their excellencies had no ſettled principles by which they are to regulate their deciſions, and the merit or defect of performances were to be determined by unguided fancy. And indeed we may venture to aſſert, that whatever ſpeculative knowledge is neceſſary to the artiſt, is equally and indiſpenſably neceſſary to the critic and the connoiſſeur.

"The firſt idea that occurs in the conſideration of what is fixed in art or in taſte, is that preſiding principle which we have already mentioned, the general idea of nature. The beginning, the middle, and the end of every thing that is valuable in taſte, is compriſed in the knowledge of what is truly nature; for whatever ideas are not conformable to thoſe of nature or univerſal opinion, muſt be conſidered as more or leſs capricious; the idea of nature comprehending not only the forms which nature produces, but alſo the nature and internal fabric and organization, as I may call it, of the human mind and imagination. General ideas, beauty, or nature, are but different ways of expreſſing the ſame thing, whether we apply theſe terms to ſtatues, poetry, or picture. Deformity is not nature, but an accidental deviation from her accuſtomed practice. This general idea therefore ought to be called *nature:* and nothing elſe, correctly ſpeaking, has a right to that name. Hence it plainly appears, that as a work is conducted under the influence of general ideas, or partial, it is principally to be conſidered as the effect of a good or a bad taſte."

Upon the whole, we may conclude that the real ſubſtance, as it may be called, of what goes under the name of *taſte*, is fixed and eſtabliſhed in the nature of things; that there are certain and regular cauſes by which the imagination and paſſions of men are affected; and that the knowledge of theſe cauſes is acquired by a laborious and diligent inveſtigation of nature, and by the ſame ſlow progreſs as wiſdom or knowledge of every kind, however inſtantaneous its operations may appear when thus acquired. A man of real taſte is always a man of judgment in other reſpects; and thoſe inventions which either diſdain or ſhrink from reaſon, are generally more like the dreams of a diſtempered brain than the exalted enthuſiaſm of a ſound and true genius. In the midſt of the higheſt flights of fancy or imagination, reaſon ought

to preſide from firſt to laſt; and he who ſhall decide on the beauties of any one of the fine arts by an imaginary innate ſenſe or feeling, will make as ridiculous an appearance as the connoiſſeur mentioned by Dr Moore, who praiſed as a work of the divine Raphael the wretched daubing by a Swiſs copyiſt. The reader who wiſhes for further inſtruction in the philoſophy of taſte, may conſult Gerard's Eſſay on Taſte, with the diſſertations of Voltaire, D'Alembert, and Monteſquieu; Dr Blair's Lectures on the Belles Lettres; Dr Reid's Eſſays on the Intellectual Powers of Man; Aliſon's Eſſays on the Nature and Principles of Taſte; and Sir Joſhua Reynold's Diſcourſes delivered in the Royal Academy.

TATE, NAHUM, an Engliſh poet, born in Ireland about the middle of the reign of Charles II. where he received his education. He was made poet-laureat to King William upon the death of Shadwell, and held that place until the reign of George I. whoſe firſt birthday ode he lived to write, and executed it with unuſual ſpirit. He died in the Mint in 1716. He was the author of nine dramatic performances, a great number of poems, and a verſion of the Pſalms in conjunction with Dr Brady.

TATIAN, a writer of the primitive church in the ſecond century. He was born in Aſſyria, and trained up in the heathen religion and learning. Coming over to Chriſtianity, he became the diſciple of Juſtin Martyr, whom he attended to Rome. While Juſtin lived, he continued ſteadily orthodox: but after Juſtin's death he made a ſchiſm, and became the author of a new ſect, condemning marriage, enjoining abſtinence from wine and animal food, and ſuffering only water to be uſed in the holy myſteries; whence his followers were called *Encratitæ* and *Hydroparaſtatæ*. None of his works are now extant, but his piece againſt the Gentiles; or, as it is uſually entitled, his *Oration to the Greeks*.

TATIUS, ACHILLES, a native of Alexandria, was the author of a book on the ſphere, which Father Petau tranſlated into Latin. There is alſo attributed to him a Greek romance on the loves of Leucippe and Clitophon, of which Salmaſius has given a beautiful edition in Greek and Latin with notes. Suidas ſays, that this Achilles Tatius was a Pagan, but that he afterwards embraced the Chriſtian religion, and became a biſhop. Photius mentions him in his Bibliotheca.

TATONNEUR. See LEMUR, MAMMALIA *Index*.

TATTOOING, or TATTOWING, an operation in uſe among the iſlanders in the South ſea for marking their bodies with figures of various kinds which they conſider as ornamental. It is performed by puncturing the ſkin, and rubbing a black colour into the wounds. The inſtrument uſed ſomewhat reſembles a comb, the teeth of which are repeatedly ſtruck into the ſkin by means of a ſmall mallet. It is very painful; but the children are forced by their relations to ſubmit to it.

TATTOU, a beat of a drum at night to adverti ſe the ſoldiers to retreat, or repair to their quarters in the garriſon, or to their tents in a camp.

TAVERNIER, JOHN BAPTIST, a French traveller, was born in 1605. In the courſe of 40 years he travelled ſix times to Turkey, Perſia, and the Eaſt Indies, and viſited all the countries in Europe, travelling moſtly on foot. His travels have been frequently reprinted in ſix volumes 12mo. He died on his ſeventh journey to the eaſt, at Moſcow, in 1686. Tavernier || Tawing.

TAVIRA, or TAVILA, a conſiderable town of Portugal, and capital of the province of Algarve, with a handſome caſtle, and one of the beſt harbours in the kingdom, defended by a fort. It is ſeated in a fertile country, at the mouth of the river Gilaon, between Cape Vincent and the ſtrait of Gibraltar, 100 miles weſt by north of Cadiz. W. Long. 7. 46. N. Lat. 37. 18.

TAVISTOCK, a town of Devonſhire in England, ſituated on the river Tavey or Tave. W. Long. 4. 12. N. Lat. 50. 37. It ſends two members to parliament, and gives the title of *marquis* to the noble family of Ruſſel duke of Bedford.

TAUNTON, a large, elegant, and well built town of Somerſetſhire, 146 miles from London. It conſiſts principally of four ſtreets paved and lighted; the market-place is ſpacious, and has a handſome market-houſe, with a town hall over it, which was finiſhed in 1773. It has an extenſive woollen manufactory; and in 1780 a ſilk manufactory was introduced. Its caſtle, the ruins of which remain, was in 1645 defended for the parliament by Colonel Blake againſt an army of 10,000 men under Lord Goring, but was diſmantled by Charles II. In 1685 the duke of Monmouth made this place his head-quarters. Its church, which is large and beautiful, is a fine ſpecimen of the florid Gothic ſtyle of architecture. The tower, which is lofty, is of excellent workmanſhip, crowned at the top with four ſtately pinnacles, 32 feet high. The whole perhaps is not equalled in the kingdom. Taunton is pleaſantly ſeated on the river Tone, which is navigable to Bridgewater; is reckoned the beſt town in the county; and ſends two members to parliament. W. Long. 3. 17. N. Lat. 50. 59.

TAURIS, or TEBRIS, a town of Perſia, and capital of Aderbeitzan. It was formerly the capital of Perſia, and is now the moſt conſiderable next to Iſpahan; for it contains 15,000 houſes, beſides many ſeparate ſhops, and about 200,000 inhabitants. It is about five miles in circumference, and carries on a prodigious trade in cotton, cloth, ſilks, gold and ſilver brocades, fine turbans, and ſhagreen leather. There are 300 caravanſeras, and 250 moſques. Some travellers ſuppoſe it to be the ancient Ecbatana; but of this there is no certainty. It is ſeated in a delightful plain, ſurrounded with mountains, from whence a ſtream iſſues, which runs through the city. E. Long. 47. 50. N. Lat. 38. 18.

TAURUS, a great chain of mountains in Aſia, which begin at the eaſtern part of Little Carimania, and extend very far into India. In different places they have different names.

TAURUS, in *Aſtronomy*, one of the 12 ſigns of the zodiac.

TAUTOLOGY, a needleſs repeating of the ſame thing in different words.

TAWING, the art of dreſſing ſkins in white, ſo as to be fit for divers manufactures, particularly gloves, &c.

All ſkins may be tawed; but thoſe chiefly uſed for this purpoſe are lamb, ſheep, kid, and goat ſkins.

The method of tawing is this: Having cleared the

Tawing. skins of wool or hair by means of lime, they are laid in a large vatt of wood or stone, set on the ground, full of water, in which quicklime has been slaked; wherein they are allowed to lie a month or six weeks, according as the weather is more or less hot, or as the skins are required to be more or less soft and pliant.

While they are in the vatt, the water and lime are changed twice, and the skins are taken out and put in again every day: and when they are taken out for the last time, they are laid all night to soak in a running water, to get out the greatest part of the lime; and in the morning are laid together by sixes one upon another, upon a wooden leg, and are scraped stoutly one after another, to get the flesh off from the fleshy side, with a cutting two-handled instrument called a *knife;* and then they cut off the legs (if they are not cut off before) and other superfluous parts about the extremes. Then they are laid in a vatt or pit with a little water, where they are fulled with wooden pestles for the space of a quarter of an hour; and then the vatt is filled up with water, and they are rinsed in it.

In the next place, they are thrown on a clean pavement to drain, and afterwards cast into a fresh pit of water, out of which they rinse them well, and are laid again on the wooden leg, six at a time, with the hair side outermost: after which they rub a kind of whetstone very briskly, to soften and fit them to receive four or five more preparations, given them on the leg both on the flesh side and the hair-side, with the knife, after the manner above mentioned.

After this they are put into a pit of water and wheaten bran, and stirred about in it with wooden poles, till the bran is perceived to stick to them, and then they are left: as they rise of themselves to the top of the water by a kind of fermentation, they are plunged down again to the bottom; and at the same time fire is set to the liquor, which burns as easily as if it were brandy, but goes out the moment the skins are all covered.

They repeat this operation as often as the skins rise above the water; and when they have done rising they take them out, lay them on the wooden leg, the fleshy side outwards, and pass the knife over them to scrape off the bran.

Having thus cleared them of the bran, they lay the skins in a large basket, and load them with huge stones to promote the draining: and when they have drained sufficiently, they give them their feeding; which is performed after the manner following:

For 100 of large sheep skins, and for smaller in proportion, they take eight pounds of alum and three of sea-salt, and melt the whole with water in a vessel over the fire, pouring the solution out, while yet lukewarm, into a kind of trough, in which is twenty pounds of the finest wheat-flour, with the yolks of eight dozen of eggs; of all which is formed a kind of paste, a little thicker than children's pap; which, when done, is put into another vessel, to be used in the following manner.

They pour a quantity of hot water into the trough in which the paste was prepared, mixing two spoonfuls of the paste with it; to do which they use a wooden spoon, which contains just as much as is required for a dozen of skins: and when the whole is well diluted, two dozen of the skins are plunged into it; but they take care that the water be not too hot, which would spoil the paste and burn the skins. Tawing. Taxation.

After they have lain some time in the trough they take them out, one after another, with the hand, and stretch them out; this they do twice: and after they have given them all their paste, they put them into tubs, and there full them afresh with wooden pestles.

They then put them into a vatt, where they are suffered to lie for five or six days, or more; then they take them out in fair weather, and hang them to dry on cords or racks: and the quicker they are dried the better; for if they be too long a drying, the salt and alum within them are apt to make them rise in a grain, which is an essential fault in this kind of dressing.

When the skins are dry, they are made up into bundles, and just dipt in fair water, and taken out and drained: they are then thrown into an empty tub; and after having lain some time are taken out and trampled under foot.

They then draw them over a flat iron instrument, the top of which is round like a battledore, and the bottom fixed into a wooden block, to stretch and open them; and having been opened, they are hung in the air upon cords to dry; and being dry, they are opened a second time, by passing them again over the same instrument.

In the last place, they are laid on a table, pulled out, and laid smooth, and are then fit for sale.

TAXATION. Besides those expences which are necessary to the existence, or conducive to the comfort and enjoyment of private individuals, there are others of which the benefit is directly applicable to the whole society. These benefits indeed are chiefly of a negative kind, but they are not therefore the less essential. They consist in the preservation of person and property from that violence both internal and external, to which the irregular passions of human nature continually expose them. The regular administration of justice, and defence against foreign enemies, are so essential to the well-being of a people, that they can with no propriety hesitate, when necessary, to part even with a large portion of their income in order to provide for the proper accomplishment of these objects. A certain pomp and magnificence too, in those who are to take the lead in these departments, have been deemed both ornamental to the society, and necessary for securing respect and obedience from the body of the people. If, besides these grand and indispensable advantages of foreign and internal security, public funds can be applied to any other purposes, evidently tending to promote the national well-being, yet beyond the reach of private exertions,—to canals, high roads, or public institutions of any description,—there can be no doubt surely as to the propriety of such an application.

It is evident, therefore, that the money which is necessary for the above purposes, forms a perfectly necessary and proper part of national expenditure. The government of the country, indeed may, as elsewhere observed (Political Economy), economically speaking, be considered as part of its fixed capital, essential to the advantageous employment of the rest. Without the security which the labourer thence derives, of reaping the fruits of his industry, he would have little motive to action; every thing would be the prey of the strongest, and

and all impulſe to activity ceaſing, univerſal poverty would enſue. At the ſame time we may obſerve with regard to this as to other fixed capitals, that the expence is expedient only ſo far as it is neceſſary, and that if the ſame functions can be performed at a ſmaller coſt, a decided gain ariſes to the public. It becomes therefore an important object to inquire in what manner the offices of government may be adequately performed, with the leaſt burden on the people.

We have formerly, under the head of POLITICAL ECONOMY, ſlightly illuſtrated ſome leading principles reſpecting public revenue. But as the ſubject is important, we ſhall conſider it here in ſomewhat greater detail.

Taxes may be arranged in the following manner. 1. *Aſſeſſed taxes*, or thoſe which the ſubject is required to pay directly into the hands of the ſovereign or commonwealth. Under this title are comprehended all the taxes which bear the above name; all income or capitation taxes, and every ſpecies of land taxes. Theſe taxes are almoſt always intended to fall upon income. 2. Taxes upon commodities, which are paid, in the firſt inſtance, not by the conſumer, but by the producer, or importer. Theſe taxes fall upon conſumption; the man who does not uſe the articles, pays no tax. They operate thus partly as ſources of revenue, and partly as ſumptuary laws. 3. *Stamp duties*, or duties upon thoſe deeds which regulate the transference of property. Theſe duties fall chiefly upon capital.

1. *Aſſeſſed Taxes.*—Aſſeſſed taxes, according to the above definition, ſeem to be the moſt ſimple and direct mode of raiſing a revenue. The money comes at once from the pockets of the people into thoſe of the ſovereign. No tax is ſo certain of yielding a revenue. The money is demanded, and muſt be paid. Where properly arranged alſo, they may probably be made to fall more equally than any other, upon the different claſſes, according to their ability. In abſolute governments, therefore, and in governments little ſkilled in the ſcience of finance, theſe taxes are commonly preferred, as thoſe which can be levied with the leaſt trouble. They have likewiſe this merit that they coſt little in the collection, and conſequently nearly their whole amount is brought into the treaſury.

Aſſeſſed taxes, however, are liable to many objections. None are ſo heavily felt. In other caſes the tax is concealed under the price of the commodity with which it confounds itſelf; but here the money is paid directly without any thing in return. It muſt generally too be paid in a conſiderable ſum at once, a circumſtance which muſt often be productive of ſerious inconvenience, while the ſame ſum, broken down into ſmall portions, might have been paid without difficulty. For theſe reaſons, much greater diſcontent is excited by theſe taxes than by taxes upon commodities. A double revenue perhaps, may, in the latter way, be raiſed with leſs murmuring. In popular governments, therefore, and in thoſe where finance has been reduced to a ſyſtem, the object has generally been to avoid direct aſſeſſment as much as poſſible. In this country, the greater part, by far, of the revenue had been raiſed by taxes upon commodities, till, within theſe laſt twenty years, the preſſure of public wants made it neceſſary to have recourſe to every mode of raiſing money which promiſed to be effectual, and thus the aſſeſſed taxes have been raiſed to a very great amount. The moſt important of theſe taxes may be included under *land tax*, *capitation taxes*, *houſe tax*, and *income tax*. Taxation.

Land Tax.—There is no claſs of men who may with more propriety be burthened with an extraordinary impoſition, than the proprietors of land. They enjoy commonly a liberal income, without care or trouble of their own. Their property, being of permanent value, is much preferable to any ſource of income which expires with its poſſeſſor. From being local and immoveable, it is peculiarly dependent on the protecting influence of government, and may therefore be reaſonably called upon to contribute ſomething more than the common ſhare to its ſupport. In almoſt all countries, therefore, the landholders, beſides being liable to the ſame burdens with the reſt of the ſociety, are ſubject to a peculiar tax, called *land tax*.

In India and other great oriental empires, the principal revenue of the ſovereign is derived from land. It ariſes, however, not properly in the way of tax, but of rent. The ſovereign, in thoſe abſolute governments, is judged to be the ſole proprietor of all the land in his dominions, which are let out by him or his deputy, to the farmers. This is alſo the principal ſource of the revenue which we derive from our Eaſt Indian poſſeſſions. It is otherwiſe, however, in all the European countries. There, almoſt all the land is private property, and the contribution which government draws from it is therefore a tax.

The adherents of the economical ſyſtem have propoſed to ſubſtitute a land tax in the room of every other. They maintain that all taxes muſt finally fall upon the produce of land, ſince it alone affords that ſurplus revenue, out of which public contributions can be drawn. Were this doctrine true, much trouble and expence would doubtleſs be ſaved, exchanging the preſent complicated and laborious ſyſtem of taxation, for one ſo ſimple and eaſy. But we have already endeavoured to ſhow, under the head of POLITICAL ECONOMY, that the principles of this ſect have no ſolid foundation; that manufactures and commerce are ſources of wealth, as well as agriculture, though in a ſomewhat inferior degree. It will follow, therefore, that they are equally liable to be affected by taxation. It is in vain to urge that the merchant muſt have his profit, and the labourer his hire, and that otherwiſe they will not employ their capital and labour. Were a tax to be impoſed upon any one branch of induſtry, leaving the reſt untouched, there is no doubt, that wages and profit in that branch muſt riſe, till the merchant or labourer is placed on a level with the reſt of the community, otherwiſe he will transfer his capital and induſtry to ſome other branch. But where the impoſition falls indiſcriminately upon the different employments of labour and ſtock, there is no ſuch refuge; the labourer and merchant muſt ſuffer a diminution of income; nor is there any proceſs by which he can throw this diminution upon the landlord.

Other perſons of a much leſs informed character, are often heard urging, that we have only to lay the impoſition upon the landlords; and that they will not be long of indemniſying themſelves by raiſing the rent of their lands. Such arguments will make little impreſſion upon thoſe who have at all attended to the true principles of political economy. The value of lands, as of every other article, is determined by the demand and the

Taxation.

the ſupply. A tax upon the rent of land would have no tendency, either to increaſe the one, or to diminiſh the other, conſequently no tendency to raiſe the value of land. Indeed, were we to ſuppoſe, according to this hypotheſis, that proprietors have an unlimited power of raiſing their lands, whenever they are ſo inclined, it is quite contrary to common ſenſe to ſuppoſe that they ſhould not exert that power, without waiting for the ſtimulus of a tax.

For theſe reaſons, land cannot, with any propriety, be made the ſole ſubject of taxation; but it is very fair, as above obſerved, that it ſhould pay ſomewhat more than other ſources of revenue. A difficulty, however, ariſes from the variations to which its value is ſubject, ſometimes on the decreaſing, but more commonly on the increaſing ſide. The rate which, at one time, is equitable, becomes quite otherwiſe at another. An attempt, on the part of government, to keep up a continual ſurvey of all the lands in the kingdom, would be attended with very heavy expence, and would, after all, be probably fruitleſs. Beſides, ſuch a meaſure would operate as a diſcouragement to the improvement of land, when ſo large a ſhare would go out of the hands of the improver. Theſe objections have weighed ſo ſtrongly with the legiſlature of this country, that they have not raiſed this tax, ſince its firſt impoſition in the reign of King William. It was then meant to be at the rate of four ſhillings in the pound, though in fact, it was by no means ſo much. It was alſo very unequally diſtributed, even at the beginning; a ſerious evil, which, however, it might have required very great trouble to avoid. Since that time, a great and general riſe has taken place in the value of land, which has made this tax much higher ſtill, than when it was originally impoſed. It has alſo rendered it, however, ſtill more unequal. Although almoſt all the land in Great Britain has improved; yet this improvement has taken place in very different proportions, according as each diſtrict differed in natural advantages, and in the induſtry of the inhabitants. The land tax accordingly is, at the preſent moment, moſt exceedingly unequal; but as it fortunately happens, that there is ſcarcely a diſtrict in Great Britain which has not improved more or leſs, the general moderation of the tax has rendered its inequality leſs grievous.

A method has been propoſed of obviating this diſadvantage, by keeping a regiſter, in which the landlord and tenant ſhall be jointly obliged to enter the rent which the land bears, a new entry being made at every variation. A valuation may be made of the lands which the proprietor keeps in his own poſſeſſion. Something of this kind, it is ſaid, actually takes place in the Venetian territory. The diſcouragement to improvement indeed ſtill remains, but even this might be obviated by an equitable, and even liberal allowance being made, for any ſums which the landlord may ſatisfactorily prove to have been expended in this way. The chief objection to the plan ſeems to be the danger of colluſion between the farmer and landlord, who would have a mutual intereſt in repreſenting the rent as leſs than it really was. The agreement indeed might, by law, be made obligatory on the farmer only to the extent of the ſum regiſtered; but it may be doubtful, whether even this regulation would always be an adequate ſecurity againſt fraud. The valuations would neceſſarily depend a good deal upon the diſcretion of the revenue officer; which, in an arbitrary government at leaſt, might become a ſerious objection. The additional expence of ſuch a plan would be conſiderable; but, provided it could be made to anſwer the purpoſe, this ought not to deter from its adoption.

Tax

Frederick of Pruſſia impoſed a higher tax upon lands held by a noble, than upon thoſe held by a baſe tenure. He conceived that the privileges and flattering advantages of nobility were ſuch as to compenſate for this additional charge. We are rather diſpoſed to conſider this proceeding as ſevere. A nobleman, with the ſame income, is poorer than a commoner, becauſe he has a greater rank to ſupport; and in the preſent ſtate of Europe, a great proportion of the nobility are extremely poor. This extreme, however, is much better than that of France before the revolution, of the Auſtrian ſtates, and of moſt of the old governments of Europe. There the nobility, poſſeſſing the chief influence in the adminiſtration, had obtained for themſelves liberal exemptions, and thrown the principal weight of this, as of other taxes, upon the inferior orders. In Sardinia, and in ſome provinces of France, lands held by a noble tenure paid nothing whatever.

Some taxes upon land are proportioned, not to its rent, but to its produce. This is the caſe in the Aſiatic countries. In China, a tenth, and in India, a fifth of the whole produce of the land, are claimed by government. In England and Ireland, the church is ſupported by a tax of this kind, which is called *tithe*.

Theſe taxes are liable to two very great objections. They are, in the firſt place, unequal. It is rent only that can be the proper ſubject of taxation; that part of the produce which is neceſſary to pay the expence of cultivation, ought to remain untouched. But this expence is far greater in poor than in rich lands. In the former, perhaps, the produce may be little more than ſufficient to pay the expences incurred; while in rich lands, not only the neceſſity of labour is leſs, but the produce greater. If, by well employed capital, and coſtly cultivation, the farmer ſucceeds in extracting tolerable crops from an ungrateful ſoil, it is both cruel and unjuſt that he ſhould be obliged to pay as much as if he had no ſuch obſtacle to ſtruggle with.

But if this tax be objectionable on the ground of equity, it is ſtill more ſo, on that of expediency. The firſt excitement to labour and improvements of every kind, muſt undoubtedly be the proſpect of enjoying their fruits. Where the rate of taxation is fixed, this proſpect remains unimpaired; for whatever addition the proprietor or farmer can, by ſuch means, make to the produce of his land, is all his own. But the caſe is very different, when it muſt be ſo deeply ſhared in by perſons who have done nothing to forward this increaſe of produce. A ſovereign prince indeed may derive, from ſuch an arrangement, ſome motive to encourage agriculture, and improve the means of communication, ſo as to raiſe the value of its produce. But this advantage, which will ſcarcely ever counterbalance the attendant evils, diſappears altogether, when this impoſition is to be paid for the ſupport of an eccleſiaſtical body. Theſe, being only life-renters, and ſeldom poſſeſſed of much capital, cannot be expected to co-operate

in

in any meaſure for the improvement of the lands. The jarrings too, which are likely to take place between the paſtor and his flock, form a moral argument againſt this mode of ſupport.

It muſt not be concealed, however, that a permanent commutation of tithes would be a meaſure little favourable to the intereſts of the clergy. It ſeems both juſt to themſelves, and advantageous to the public, that when the country is in a ſtate of improvement, this body ſhould not be left behind; it ſhould be able to keep pace with the other members of the ſociety. This it can never do, if it has merely a certain fixed ſum allotted for its maintenance, without the poſſibility of augmentation. This evil has, in fact, been ſeriouſly felt in the church of Scotland, the income of whoſe members, notwithſtanding all that has been done for their relief, is ſtill very inferior to what it was thirty or forty years ago. A ſource of income, which riſes or falls with the value of land, ſeems the moſt effectual mode of maintaining this proportion between the income of the clergy, and of the reſt of the ſociety; we need not, therefore, wonder, that the clergy ſhould be ſo tenacious of it.

To reconcile theſe contrarieties, would certainly be attended with difficulty; yet it does not ſeem to be abſolutely impoſſible. The firſt object would be, to tranſfer the tax from the produce to the rent. This might be done by forming a correct eſtimate, on an average of a few years, of the value of the tithe; and then aſſigning a claim to ſuch a proportion of the rent, as would be equal to that value. This would remove all diſcouragements to the exertion of the cultivator. Thoſe which preſs againſt the exertions of the landlord would indeed remain in full force, though without any increaſe. In moſt caſes, theſe exertions would be of very ſmall importance, when compared with thoſe of the former. But, beſides, a ſcheme might probably be contrived ſimilar to that above ſuggeſted, by which the landlord might receive an adequate allowance for any improvements he might make.

The ground-rent of houſes forms part of the rent of land. In remote country ſituations, it is often no more than the ſame land would yield, if employed for the purpoſes of agriculture. But in the vicinity, and ſtill more in the heart of a great town, competition, and the value attached by convenience or faſhion to ſome particular ſituations, raiſe this rent to a very extravagant height.

Ground-rent ſeems to be a ſtill more proper ſubject of taxation than that of common land. It ariſes commonly from circumſtances entirely independent of any care or attention on the part of the proprietor. Yet ground rents have never been conſidered as a ſeparate ſubject of taxation. This has probably been from the difficulty of diſtinguiſhing them from the building rent. In every tax upon houſes, however, part muſt fall upon the ground rent, provided that be able to bear it. By diminiſhing the demand for houſes, it will diminiſh alſo the demand for ground to build them on.

Capitation or *Poll Taxes*,—afford one of the eaſieſt and moſt obvious modes of taxation. To lay an aſſeſſment upon every individual without exception, ſeems the moſt effectual mode of preventing all trouble, and leaving no room for evaſion. In moſt of the abſolute governments, where the ſovereign does not claim the ſole property of the lands, as in Turkey and Ruſſia, poll taxes are impoſed in lieu of land tax. Taxation.

The rudeſt form of this impoſition is, when it is laid equally upon every individual. An equality of this kind is the moſt grievous inequality. To make the pooreſt ſubject pay as much as the richeſt, is palpably unjuſt. The only caſe, where ſuch a tax can be proper, is where it falls upon ſlaves. In this caſe, it is paid, not by the ſlave, but by the maſter. The number of ſlaves forms the moſt accurate teſt of the value of his property; and accordingly, in Ruſſia, an eſtate is deſcribed, not by the number of acres, but by the number of ſlaves which it contains. This tax has alſo the good property of encouraging manumiſſion. In all other caſes, ſuch a tax can only be rendered tolerable by its extreme moderation.

Nations were not long of perceiving the prepoſterous nature of this arrangemennt, and of ſeeking to ſubſtitute ſome more equitable one in its place. Fortune was evidently the moſt correct ſtandard to proceed upon; but a cloſe inquiſition into private concerns was conceived to be burdenſome and oppreſſive. If each individual were to report his own fortune, could the report be truſted to? If, on the other hand, the aſſeſſment were to be regulated by the officers of government, according to what they ſuppoſed to be his wealth, a door was opened to vexatious and arbitrary proceedings. In order to avoid theſe oppoſite dangers, it has been common to regulate the contribution according to the rank of the contributor, which it is ſuppoſed will bear at leaſt a certain proportion to his fortune. This was the caſe with the different poll taxes impoſed in this country during the reign of King William. It was the caſe alſo in France with regard to that part of the *taille* which fell upon the nobility. It is extremely unequal; for many men of rank have no fortune correſponding; and where it ſo happens, their rank impoveriſhes them, by the expence which is requiſite for its ſupport. Yet, as rank affords a certain approximation to fortune, it is certainly better to fix it according to that ſtandard, than to leave it to the arbitrary appointment of the officers of government. Inequality is a leſs evil than uncertainty.

In that part of the *taille* which fell upon the inferior orders, the latter mode was adopted. This tax was the ſubject perhaps of more grievous diſcontent, than any other which yielded an equal revenue. It cannot be ſuppoſed that the intendant ſhould not be often ſwayed by motives of favouritiſm, private intereſt, or private reſentment; and the very uncertainty to which the people were expoſed, formed a ſevere hardſhip. They were tempted to conceal their wealth, and even to employ inadequate inſtruments of trade or agriculture, in order to deceive the watchful eye of the intendant.

Houſe Tax.—In order to avoid the defects incident to the above modes of aſſeſſment, rent of houſes has been fixed upon as affording the beſt criterion of the amount of a man's income. It certainly affords a tolerable criterion of his expenditure; and though this may often differ conſiderably from his means, yet as it is rather the object of government to diſcourage profuſe expenditure, there may be no harm in ſuch an inequality.

The moſt equitable mode of taxing houſes, would evidently be in the proportion of their rent. In this country, accordingly, part of the land tax is made to fall upon the rent of houſes. This branch of the land

tax

Taxation.

tax is ſubject to the ſame inequalities, both original and acquired, as the other branches. The aſſeſſment, not upon each houſe, but upon each diſtrict, continues invariably the ſame. In general, it is ſtill higher than upon land. The value of houſes, however, has not riſen ſo invariably as that of land; hence, in ſome diſtricts where the population has decreaſed, the tax falls with conſiderable weight. Since that time another tax has been impoſed upon houſes which is in proportion to the rent, and varies with it. The heavieſt tax upon houſes, however, is now that which is regulated by the number of *windows*.

At the time of the original impoſition of the houſe tax, it ſeems to have been conſidered difficult or impoſſible to aſcertain and follow the fluctuations of the rent. Some obvious and undeniable circumſtance, connected with the very form and conſtruction of the houſe, was therefore ſelected. The moſt ancient is the number of hearths. Hearth money is a very ancient duty, and ſeems to have exiſted even before the Conqueſt. Under Charles II. a tax of two ſhillings on all hearths was granted to the crown for ever. This tax was grievous to the people, on account of the domiciliary viſits to which it neceſſarily ſubjects them. It had beſides the worſt kind of inequality, preſſing harder on the poor than the rich. A man of 20l. a-year may have two hearths; a man of 200l. not above four or five. A man of 1000l. will ſcarcely have ten. Hearth money, therefore, was aboliſhed at the Revolution. In its ſtead was afterwards ſubſtituted the window tax, which could be aſcertained without entering the houſe of the contributor. It was ſoon found, however, to be liable to the ſame inequality as hearth money. In conſideration of this, the rate was greatly increaſed with the increaſe of the number of windows, and houſes having leſs than ſix were entirely exempted. If, however, as would rather appear, the rent can be aſcertained in a ſatisfactory manner, it would ſeem better to lay the whole of the houſe tax upon it directly, rather than by any circuitous and doubtful mode.

There are two parts of houſe rent; the ground rent, or that which is given for the uſe of the ground on which the houſe ſtands; and the building rent, which is paid to the builder, as a remuneration for his trouble and expence. The ground rent, as above obſerved, muſt pay a ſhare of the tax; but the building rent cannot be affected by it. The builder muſt have his profit, otherwiſe he would turn his capital and induſtry into another direction. This rule, however, is ſomewhat modified by the very durable nature of the ſubject. When the tax is firſt impoſed, it is very probable that the ſupply of houſes may continue for ſome time nearly adequate to the demand; in which caſe the proprietor muſt lower his price in order to get his houſes let. As the old houſes decay, however, new ones are wanted, which will not be built without an adequate remuneration; and thus the general law will again operate.

Income Tax.—The object of all the different aſſeſſed taxes is to make the ſubject contribute an equitable proportion of his income to the expences of the ſtate. But thoſe which we have above enumerated, though they may procure an approximation to this point, can never attain it with perfect preciſion. If therefore an income tax, eſtabliſhed on juſt principles, could be collected without any farther grievances, than the always unavoidable payment of the contribution, it would certainly be the moſt equitable aſſeſſment of any, and might with propriety ſuperſede all other taxes of this deſcription. Serious, however, are the difficulties which attend it. The correctneſs of the eſtimate muſt always depend, in a great meaſure, on the honour of the contributors; but all men are not honeſt; and the cheating of the king, is, according to the popular code, ſo venial an offence, that accurate returns cannot, in all caſes, be expected. If, on the other hand, the collectors, as in the French *taille*, take upon themſelves to farm this eſtimate, a door is opened to arbitrary and oppreſſive exactions. The impoſſibility alſo of eſcaping the tax by any ſpecies of privation makes its weight more ſenſibly felt, than in thoſe which are in any degree voluntary. For all theſe reaſons, an income tax has hitherto been among the laſt reſources to which a nation has had recourſe in its extremeſt neceſſity. Tax.

Moſt of the capitation taxes, as formerly obſerved, partook more or leſs of the nature of the income tax. The ſubſidies, ſo frequent in our early finance, were, like the *taille*, compoſed, partly according to rank, and partly according to fortune. Among the nobility, alienation of eſtates was yet rare, and the diſproportion between rank and wealth, much greater than in ſubſequent times. The eſtimate of income ſeems to have been made by the collectors. Such impoſitions, however, were ill brooked by a free and turbulent people; the ſubſidies became more and more unproductive; and at laſt were entirely given up. The firſt was impoſed under Richard II. in 1370; the laſt under Charles II. in 1673.

In ſome ſmall republican ſtates, a tax of this kind is levied, the amount of which is entirely regulated by the good faith of the contributor. At Hamburgh every citizen is ſaid to have placed in the public coffers a ſum, which is declared upon oath to be one fourth per cent. of his whole property, which, reckoning intereſt at five per cent. would be one twentieth of his income. It was not ſuppoſed that this mode of collection gave occaſion to any fraud. The good faith of the people and their confidence in their government, ſupplied the place of compulſory laws. The ſecrecy was conſidered neceſſary by a mercantile ſtate; but in ſome of the ſmall Swiſs republics, every citizen declared publicly upon oath the amount of his income, and was aſſeſſed accordingly. Such unſuſpected good faith could only exiſt in theſe ſmall ſtates, where patriotiſm was ardent, and the confidence of the people in their government entire.

Since the diſcontinuance of ſubſidies, nothing of this kind had been attempted in Britain, till the year 179 , when the accumulating weight of public debt ſuggeſted to Mr Pitt the neceſſity of raiſing a large portion of the ſupplies within the year. For this purpoſe, there appeared a neceſſity for having recourſe to an income tax; and ſo ſtrong a ſenſe was entertained by the nation of the preſſing nature of the exigency, that it was ſubmitted to with leſs reluctance than might have been expected.

An attempt was at firſt made to connect this impoſition with the former aſſeſſed taxes. Theſe were to be tripled; but if any perſon was able to prove, that this charge amounted to more than a tenth of his income, he was relieved from all which exceeded that proportion. At the ſame time, a voluntary ſubſcription was opened;

opened; but the produce, though honourable to national patriotism, afforded but a ſlender ſupply to public wants. Theſe irregular and uncertain approximations towards an income tax were ſoon given up, and their place ſupplied by the tax itſelf, in its own ſhape.

To obviate the inconveniences of diſcloſure or arbitrary aſſeſſment, meaſures have been adopted, as effectual probably as any that could be deviſed. The commiſſioners of income tax are choſen by the freeholders of the county, or by the electors in a borough, in the ſame manner as a member of parliament, excepting that a ſmaller qualification is requiſite. To the office of theſe commiſſioners, public opinion attaches a certain dignity, which makes it be performed gratuitouſly, and by the moſt diſtinguiſhed perſons in the diſtrict. Theſe are, by oath, bound to ſecrecy. The ſtatements are given, in the firſt inſtance, by the contributor; but if the commiſſioners are not ſatisfied with his return, they can require from him ſatisfactory explanations. According to the ſources of income, the perſon is aſſeſſed at the amount of one year, or at an average of three years. The reſult of theſe regulations ſeems to have been ſuch as to obviate, almoſt entirely, the chief inconveniences attached to this mode of taxation. The ſimple payment of the income tax indeed, is moſt grievouſly complained of; but the acceſſories of diſcloſure, or arbitrary aſſeſſment, which were conſidered as preſenting unſurmountable obſtacles to this meaſure, ſcarcely ſeem to be complained of at all.

The moſt important conſideration in ſuch a tax relates to the proportion in which it ſhould be paid by the different members of the community. That the loweſt orders, who ſubſiſt by the labour of their hands, ought to be exempted, ſeems univerſally agreed. This would produce the ſame effect as a tax upon the neceſſaries of life, the effects of which we ſhall diſcuſs hereafter. But independent of this claſs, an equal impoſition upon the higher and middling claſſes of the community would be extreme inequality. The larger the income, the leſs of it muſt be ſpent upon neceſſaries or common conveniences, and the more upon objects of mere ſhow and oſtentation. Theſe laſt can certainly admit more eaſily of retrenchment; and as the opulent have a greater ſtake in the country, it ſeems reaſonable that they ſhould contribute ſomewhat more in a ſeaſon of public exigency. A gradation continually augmenting, ſuch as takes place in moſt of the other aſſeſſed taxes, ſeems to be ſtrongly called for in this. The full proportion of ten per cent. was, from the firſt, impoſed upon incomes of 200l. a-year, and though this was infinitely too low, yet at a ſubſequent period (in 1806) it was brought down to 150l. This ſum, according to the preſent rate of expence, is the very loweſt at which any family in the middling rank can poſſibly be ſupported. The whole of this claſs, therefore, a claſs which has ſo many claims to the favour of the legiſlature, is aſſeſſed to the very ſame amount as the higheſt claſſes. The firſt conveniences of life are taxed at the ſame rate as its moſt ſuperfluous luxuries. Certainly 1000l. a-year ought to be the firſt income liable to the very heavy charge of 10 per cent.; and the deficiency hence ariſing might be very fairly ſupplied by an increaſe, gradually augmenting, upon incomes above that amount. Fifteen per cent. perhaps, ought to be the utmoſt that it ever roſe to; but this charge might doubtleſs be more eaſily ſupported by an income of 10,000l. a-year, than half of it by one of 200l. or 300l.

Modifications ought alſo to take place, according to the ſource from which the income is derived. That which ariſes from capital is undoubtedly of greater value than mere profeſſional income. It does not expire with its poſſeſſor; it relieves him from the care and anxiety of laying up a proviſion for his family, and allows him to ſpend his whole income, when, to another perſon, it would be the moſt culpable imprudence. Of all ſpecies of capital, land ſeems to be the moſt valuable and durable. It ſtands alſo moſt in need of the protection of the ſtate. It generally, too, comes to its poſſeſſor by inheritance, and is not the fruit of his own induſtry. With regard to money, although its value is ſtill much ſuperior to ſalaries or profeſſional profits, yet it ſeems rather to be the policy of government to favour its accumulation, which a very great addition of charge might diſcourage. Money beſides is a more moveable ſpecies of property than land, or even than profeſſional income. If heavily taxed, the proprietor might withdraw into another country, and his capital, with the induſtry which it ſupported, be thus loſt to the community.

The preſent tax makes no diſtinction between income which dies with its poſſeſſor, and income ariſing from land or capital. Yet ſuch a diſtinction, if it appeared eligible, might eaſily be made under the preſent ſyſtem of collection, which demands a ſtatement, not only of the amount of income, but of the ſource from which it ariſes. The propriety, however, of ſuch a charge demands ſome conſideration. Land, it is true, is well able to bear a conſiderable ſhare of the public burthens. But land, in this country, and in almoſt every other, is the ſubject of a peculiar tax, over and above what is paid by income ariſing from other ſources. If therefore it were alſo to pay a greater proportion of the income tax, the preſſure might become unjuſtly ſevere. The land tax in this country amounts to about two millions. Were we to ſuppoſe the ſhare of the income paid by land to amount to 5,000,000l. (a large allowance), land would then pay fourteen per cent. which ſeems as much as can reaſonably be exacted. No ſuch burden, at leaſt in any ſenſible degree, falls upon ſtock; but for the reaſons above ſtated, the propriety of taxing it heavily ſeems ſomewhat equivocal.

According to the original bill, as propoſed by Mr Pitt, very liberal exemptions were granted on account of children. To encourage marriage and the rearing of families, has been generally conſidered by legiſlators as an important object. From ſome recent ſpeculations, however it has appeared doubtful whether it be deſirable to remove the obſtacles to marriage which ariſe from the difficulty of ſubſiſtence. Whether from theſe views, or for the mere wiſh of rendering the tax more productive, this exemption has been gradually circumſcribed. The laſt regulation made reſpecting it ſeems to be of a very capricious nature. An allowance of four per cent. is given, but only for the number of children exceeding two. This allowance beſides is given, not out of the income tax itſelf, but out of the aſſeſſed taxes. It is difficult to conceive any motive for this laſt regulation; and, eſpecially in the caſe of the middling claſſes, it may ſometimes render the exemption nugatory.

Other Aſſeſſed Taxes.—A conſiderable revenue is raiſed in

Taxation.

in this country by taxes on men ſervants, pleaſure horſes, carriages, dogs, &c. Theſe are all luxuries, the uſe of which is confined to the moſt opulent claſſes; they form, therefore, extremely proper ſubjects of taxation. The income tax indeed, modified as above ſtated, might perhaps come inſtead of all ſuch taxes; but while that tax favours the higher above the middling claſſes, theſe in queſtion tend to remedy that inequality. One aſſeſſment, however, is of a different nature; that upon labouring horſes. It is not likely, and certainly could never be intended, that this tax ſhould reſtrain the uſe of theſe indiſpenſable inſtruments of agriculture. Neither can the duty fall upon the farmer, who, in all caſes, muſt have his profits. To ſecure this, he muſt pay the leſs rent, in proportion as he pays the more tax; and this duty will finally operate as a land tax. It does not ſeem, however, to have any advantages above a direct aſſeſſment of the ſame nature. It will bear hard upon the farmer who is in the middle of his leaſe at the time of its being impoſed. If at all heavy, it may have ſome tendency to limit the uſe of ſuch horſes, and to encourage inferior ſubſtitutes. The tax was firſt laid at 2s. and was juſtified only by its extreme lightneſs. It was then gradually raiſed to 14s.; but a propoſal to raiſe it ſtill higher was thrown out by parliament, and has never been again revived.

2. *Taxes upon Commodities.*—The experience of the diſcontent excited by direct aſſeſſments, and of the difficulty of proportioning them equally, led to the impoſition of taxes on conſumable commodities. Theſe being laid in the firſt inſtance on the commodity at the time of its production or importation, are finally paid by the conſumer in the increaſed price of his goods. No taxes are ſo little felt, or excite ſo little diſcontent. The duty, mingling with the price of the goods, is confounded with it; and, unleſs when the tax is firſt impoſed, and a ſudden riſe in conſequence takes place, the great maſs of the people are even ignorant, how much of what they pay goes to government, and how much conſtitutes the mere price of the goods. The payment is alſo made in the moſt convenient manner, and may be divided into the ſmalleſt portions. The power of not paying by ceaſing to conſume the article taxed, goes a great way in ſuppreſſing murmurs. Thus, indeed, thoſe whoſe expence does not keep pace with their fortunes, pay an unequal ſhare of the common contribution. But as the law is generally diſpoſed to recommend economy, it will not perhaps conſider this as a ſerious objection.

For theſe reaſons, the modern ſyſtem of finance, particularly in this country where it is ſo much an object to avoid diſcontent, has ſhewn a decided favour to this mode of raiſing a revenue. And perhaps, upon the whole, they are the beſt of any; yet the evils with which they are attended are by no means inconſiderable.

1. Theſe taxes take more out of the pocket of the people, in proportion to what they put in that of the public, than any other. This ariſes from the extenſive and minute ſuperintendence which is neceſſary for their proper collection. For this purpoſe, a number of officers muſt be kept, whoſe ſalaries form a ſerious deduction from the produce. In Smith's time, this expence amounted to above $5\frac{1}{2}$ per cent. on the duties of exciſe, and above 10 per cent. on thoſe of cuſtoms. The great augmentation of revenue which has taken place ſince that time, has been produced more by an increaſe of duty on articles formerly taxed, than by the introduction of new ſubjects of taxation. The expence of collection, however, bears ſtill a larger proportion to the amount collected, than either in the ſtamps or aſſeſſed taxes.

Taxati

There is another way, in which the burden of theſe taxes is rendered heavier on the public. The merchant or producer advances the tax, often a conſiderable time before he can diſpoſe of the article. He muſt therefore have not only indemnification to the amount of the duty, but alſo profit on the advance which he has made. It is univerſally obſerved, that when a new tax is impoſed, the article riſes more than in proportion to it. The public commonly murmur, and complain that the merchant has merely made the tax a pretence for this diſproportionate increaſe in the price of his article. The truth is, however, that the merchant has a reaſonable claim to receive the ſame profit on that part of his capital, which he has employed in advancing the tax, as upon that which he employed in the original purchaſe of the commodity.

2. Though the collection of theſe taxes is leſs grievous to the great maſs of the people, yet it falls heavier on certain claſſes. Theſe are the dealers in exciſeable commodities. As evaſion is much eaſier here than in aſſeſſed taxes, a more grinding ſyſtem of ſuperintendance becomes requiſite. The tax-gatherer muſt have continual acceſs to every part, not only of the workſhop, but even of the private houſe, of the dealer in them. No time, no place, can be exempt from his viſits. The power with which he is inveſted may alſo, if he be ſo diſpoſed, give occaſion to inſolence at leaſt, if not to oppreſſion. Now, as the dealers in theſe commodities form a part, and even a pretty numerous part of the ſociety, any hardſhip falling upon them muſt be a conſiderable evil. It is felt, beſides, though not directly, by the reſt of the ſociety. It has already been obſerved, under the head of POLITICAL ECONOMY, that every diſagreeable circumſtance attendant on any profeſſion, neceſſarily raiſes the rate of wages and profit in that profeſſion. It cannot be ſuppoſed, that the dealers in theſe commodities will ſubmit to the hardſhips we have noticed, without claiming ſome indemnification in the price of their goods. Thus the firſt inconvenience will be augmented, and ſtill more will be taken from the people, without any addition to the revenue of the public.

3. Theſe taxes give birth to the trade of ſmuggling, a trade at once injurious to the public, and ruinous to the individual. Unfortunately the lax ſtate of public morals, in regard to this point, offers a ſtrong temptation to graſp at the extraordinary profits which ſmuggling affords; and from the ſame cauſe, the produce of ſuch traffic, when ſucceſsful, is always ſure of a ready ſale. This trade, however, in the end, generally ruins not only the fortune, but alſo the morals of him by whom it is purſued. It trains to the practice of falſehood, perjury, and other vices, without which it cannot be carried on with any chance of ſucceſs.

4. Such taxes always alter more or leſs, the natural, and conſequently the moſt advantageous direction of national induſtry. The tax upon wine muſt diminiſh the conſumption of that article, and conſequently the induſtry

Taxation. duſtry employed in producing it. Wine indeed is not a commodity of Britiſh production; but it muſt be purchaſed with Britiſh commodities, and if the merchant cannot import it, neither can he afford a market for theſe Britiſh articles which were to be given in exchange for it. Dr Smith ſeems to imagine, that theſe taxes produce an abſolute defalcation in the amount of national produce; a ſuppoſition in which we are inclined to differ from him. Although there is a diminution in the demand for this particular article; yet as the ſum levied is not withdrawn from the national expenditure, but is merely transferred from one claſs of perſons to another, it muſt ſtill ſupport a demand, if not for the ſame, at leaſt for ſome other ſpecies of commodities. Thus the public will ſuffer chiefly from the inconveniences attendant on the change. Other reſtraints, however, for which there is no ſuch compenſation, are neceſſarily attendant on the collection of ſuch duties. In order to render this efficacious, regulations muſt often be made, as to the manner in which the trade is to be carried on; and it is always to be apprehended, that governments will be more attentive to the ſecurity of the revenue, than to the eaſe of the public. In arbitrary and unenlightened governments, this propenſity becomes often ſo powerful, as to throw the moſt formidable obſtacles in the way of that free circulation of commodities on which the proſperity of trade, and of all induſtry, eſſentially depends.

The commodities on which theſe duties are impoſed, may be either the neceſſaries or the luxuries of life. Between theſe two diviſions the line is not eaſily drawn. Neceſſaries, ſtrictly ſpeaking, are confined to thoſe things, without which life cannot be ſupported or health preſerved. Yet, though the philoſopher may reaſon thus, the ſovereign cannot confine his people within ſuch ſtrict limits. In regard to food indeed, which is entirely a domeſtic arrangement, this definition may hold; but in clothing and lodging, the arrangements of which are in the eye of the public, long cuſtom may impoſe obligations of decency and propriety, which fall little ſhort of abſolute neceſſity. Every thing, in this reſpect, muſt be conſidered as neceſſary, which a common labouring perſon of the loweſt claſs cannot want, without incurring the reproach, or exciting the commiſeration, of others in the ſame ſtation.

Taxes upon the neceſſaries of life have the ſame effect with taxes upon the wages of labour. Dr Smith, and moſt other writers, ſeem to conceive that the immediate effect of ſuch taxes is to raiſe the wages of labour. But we do not ſee that ſuch can be the caſe. Nothing can raiſe the wages of labour, except an augmentation of the funds deſtined for its ſupport. But theſe funds, far from being raiſed by ſuch taxes, are ſomewhat diminiſhed. The employers of the poor, being themſelves affected by them, will be leſs able to pay wages than before. It is quite a fallacy to urge, that the labourer, if he does not get ſufficient wages, will refuſe to work. This might be, if the tax affected only a certain claſs of labourers, and left the reſt free. The labourer, if he could not, over and above the tax, obtain the regular ſtandard rate, would withdraw to other employments. The conſequence would be, a riſe of the wages of the taxed labour, with a ſlight fall in thoſe of every other, proportioned to the additional number who would thus be thrown upon it. But where the tax falls equally upon labour of every deſcription, as taxes upon the neceſſaries of life muſt do, there is no new quarter to which the labourer can turn; there is nothing either to raiſe or to lower wages; the ſupply of and demand for labour continue the ſame. The effect of the tax is merely to diminiſh the ſubſiſtence of the labourer in proportion to its amount. Taxation.

This, however, is merely the firſt effect; for the diminiſhed ſubſiſtence will ſoon begin to act upon the population, which furniſhes the ſupply of labour. Were wages at the time ſo low as to furniſh merely the neceſſaries of life according to the firſt definition, that is, ſuch neceſſaries as it could not ſubſiſt without, the inevitable conſequence ſeems to be, that part of the labouring poor muſt periſh for want. Such a calamitous effect ſeems actually to reſult, in the crowded population of ſome eaſtern empires, when a deficient crop produces a ſcarcity of ſubſiſtence. Happily, however, the labouring poor are ſeldom ſo wholly without reſource. In general the wages are ſufficient to allow them a portion of the other deſcription of neceſſaries, and even of luxuries, by retrenching which, they can, in the event of ſuch a tax, preſerve themſelves from abſolute ſtarvation. In the end, however, the diſcouragement to marriage, and difficulty of rearing children, will reduce the population. This reduction, diminiſhing the ſupply of labour, will increaſe wages, till they cover the amount of the tax. The ſame ſum, divided among a ſmaller number, will make more to each.

High wages operate as a complete tax upon every ſpecies of manufactured produce. The manufacturer muſt charge upon the price of his goods the whole ſum which he has paid to his workmen with a profit. In the market of the world, therefore, he muſt, *cæteris paribus*, be underſold by the manufacturer who reſides in a country where labour is cheaper. When theſe high prices, however, are the reſult of national proſperity, when they improve the ſubſiſtence of the labourer, and lay a foundation for increaſed population, this diſadvantage will weigh very light in the balance. But where they are the reſult of diminiſhed population, and attended with no improvement in the condition of the labouring poor, they form one of the greateſt evils with which a nation can be afflicted.

For theſe reaſons, taxes upon the neceſſaries of life, though certainly productive, have always been found to be oppreſſive and ruinous to the proſperity of a ſtate. Luxuries, therefore, form the proper objects of taxation. As every one, if unable to purchaſe his uſual quantity, can either diminiſh it or abſtain altogether, the riſe of the article has no tendency to induce ſuch a degree of want, as to check population, and thus cauſe a riſe to the wages of labour. This power of abſtinence may indeed lead to a certain inequality; but as this inequality is altogether voluntary, it can neither excite murmuring, nor be conſidered as a ſerious hardſhip. The greateſt irregularity is in the caſe of abſentees, by whom ſuch taxes are evaded altogether.

It is not, however, we muſt obſerve, from the mere luxuries of ſhew and oſtentation that any important or permanent revenue is to be drawn. Theſe are confined chiefly to perſons of large fortune, who are few in number, and are always ſubject to the influence of faſhion, ſo that little dependence can be placed on their regular conſumption. The luxuries from which alone a great

Taxation.

revenue can be drawn are thoſe which, among the higher and middling claſſes, have come to be conſidered almoſt as neceſſaries, and which are extenſively uſed by ſuch as are in eaſy circumſtances, even among the lower orders. The only drink neceſſary for ſupporting the human conſtitution in perfect health, ſeems to be pure water. Men, however, have an univerſal propenſity for ſomething more, both to gratify their taſte, and to exhilarate their ſpirits. Fermented and ſpirituous liquors, tea, coffee, &c. are had recourſe to with this view, and are habitually uſed in various forms and degrees, by almoſt every inhabitant of this country. Such articles form therefore the grand baſis of this ſyſtem of taxation.

Of all ſuperfluities, tea ſeems to be one of the greateſt. It affords neither nouriſhment nor ſtrength, and is generally conſidered by phyſicians as injurious to the human conſtitution. Being imported beſides from a remote country, the intercourſe with which was, by the mercantile ſyſtem, ſtigmatized as injurious, it was conſidered as every way a fair ſubject of taxation. Very high duties were accordingly accumulated upon it, which, in 1783, amounted to nearly 30 per cent. on the value, beſides an exciſe of 1s. on every pound. It was found that ſo high a duty opened a wide door to the ſmuggling of a commodity of ſo ſmall bulk, and which was then imported in large quantities by all the neighbouring countries. It was calculated, that though duty was paid on five or ſix millions of pounds, the conſumption of Great Britain amounted to more than double that quantity. A plan was therefore brought forward by Mr Pitt to ſubſtitute in its room an additional tax on windows. Smuggling was no doubt checked, and the people were, on the whole, gainers; yet the new tax, being aſſeſſed, was more heavily felt by the public than its predeceſſor, which was only a duty on conſumption. Since that time, the exigency of the times has made it again neceſſary to have recourſe to this article; and the tax upon tea has been raiſed even higher than it was previous to the commutation tax. The diminution, however, of the Indian trade carried on by the other powers, joined to the ſtricter precautions againſt ſmuggling, has prevented its renewal to nearly the ſame extent as formerly. Tobacco is a ſtill more complete ſuperfluity than tea, yet its uſe is very extenſive. It has therefore been juſtly conſidered as one of the propereſt of all ſubjects of taxation, and duties have been laid upon it, amounting to five or ſix times the original value of the article.

Wine is the wholeſomeſt of all fermented liquors, and is even pretty extenſively uſed as a medicine. Theſe circumſtances might ſeem to entitle it to ſome favour, which, however, it has not experienced. Being entirely a foreign commodity, and being particularly cultivated by a nation long the object of our commercial jealouſy, it has incurred the decided hoſtility of the mercantile ſyſtem. Duties have been impoſed, conſiderably exceeding the original value. A preference has alſo been ſhewn to the wines of Portugal and Spain, (though inferior in quality), which has rendered them the common drink of this country.

Spirits are an article extenſively conſumed in this country, and on which a high duty may, with the greateſt propriety, be impoſed, for the purpoſes not only of revenue, but of moral regulation. They afford no nouriſhment, and are in the higheſt degree liable to abuſe. They are affected by the general tax on malt; Tax but pay, beſides, a conſiderable one when manufactured. In order to obviate the ſmuggling which was carried to a great extent in the making of ſpirits, it has been found adviſable to lay the duty on the ſtill, in proportion to its contents. It is paid by the month; and the diſtiller, when he chooſes at any time to intermit his operations for that period, may, by giving due notice to the officers of revenue, avoid being charged. When this plan was firſt adopted, the duty was comparatively very low. But Mr Pitt ſoon found himſelf completely deceived as to the productiveneſs of this rate of duty. It was raiſed therefore ſucceſſively to 162l. its preſent rate. This ſyſtem lays the diſtiller under a temptation to work very rapidly, which is ſuppoſed to be injurious to the quality of the ſpirits. It obliges them alſo to work without intermiſſion, which they did at firſt without even the exception of Sunday, till that practice was prohibited by the legiſlature. It may be proper to notice, that this mode of impoſition is confined to Scotland, and that in England it is laid upon the wort or waſh.

Fermented liquors from malt are much more uſeful. They are the moſt nutritive perhaps of any ſpecies of drink, and are on that account well ſuited to thoſe who are engaged in hard labour. Neither do they offer the ſame temptations to exceſs; yet their extenſive uſe, and the neceſſity of raiſing a revenue, have led the legiſlature to conſider them as a ſtaple ſubject of taxation, and they are now charged with a duty of nearly 100 per cent. Dr Smith adviſes the transference of the whole tax on beer to the malt tax. The latter appears to be leſs liable to ſmuggling, and it obviates the preſent exemption enjoyed by private brewers, which is evidently unreaſonable and unequal. The only objection ſeems to be, that, being impoſed at an earlier period of the manufacture, it obliges the manufacturer to lie longer out of his advance, and conſequently to demand a greater profit; though this might perhaps be obviated by allowing him a longer credit. The additional taxes, however, impoſed upon this article, have been all laid upon beer or porter. In general, it would appear that conſiderable unneceſſary trouble is occaſioned by taxing ſucceſſively different ſtages of a manufacture. By laying the whole either upon malt, or upon beer, a conſiderable expence of collection might be ſaved, without any diminution of the produce.

There are many ſpecies of food which cannot, ſtrictly ſpeaking, be conſidered as neceſſaries of life, ſince their place can be ſupplied by ſome leſs expenſive ſubſtitute. Butcher meat can be ſupplied by eggs, butter, and other products of milk; wheaten bread by other bread of inferior grains, It may be obſerved, however, that the impoſition of a tax on the ſuperior article would produce an increaſed demand for the inferior; and conſequently raiſe its price. Accordingly, both butcher meat and wheaten bread are univerſally numbered among the neceſſaries of life; nor do we recollect, in the Britiſh ſyſtem of taxation, an inſtance of ſolid food liable to duty. This is not the caſe in other countries, particularly in Holland. Heavy taxes are there impoſed upon both articles. All butcher meat pays a duty of more than 7 per cent. of its value. All cattle, beſides, pay about 5s. per annum. The tax upon ground corn is alſo very heavy and undiſtinguiſhing. Wheat

pays

Tax on. pays 104 florins (nearly 9l.) per laſt. Nor are the inferior grains entirely exempted. Rye pays 42 florins (about 3l. 10s.); barley, beans, and oats, about 2l. Smith is not diſpoſed to cenſure theſe heavy impoſitions, as they may have been rendered neceſſary by the long wars in which this people were engaged for the ſupport of their independence; and when proper ſubjects of taxation are exhauſted, recourſe muſt be had to improper ones. Upon examining the liſt, however, of Dutch taxes, we do not find that the taxes upon articles of luxury are ſo very high, as to have reduced the legiſlators of that country to ſuch an extremity. The exciſe upon the *aam* of wine, equal to 40 Engliſh gallons, is only 14 florins, or about 1l. 5s. Tobacco, ſo fair an article of taxation, and ſo much uſed in Holland, is taxed only by a ſlight licence, eſtimated at little more than a halfpenny a pound. Beer and ſpirits are taxed ſtill more moderately than wine. Beſides, even ſuppoſing all the articles of luxury to be exhauſted, we ſhould conceive it more adviſable to have recourſe to aſſeſſments upon income to the neceſſary extent, than to duties upon articles of neceſſity. Accordingly, in this country, a larger revenue in proportion to the population, is now raiſed than ever was raiſed in Holland, without having recourſe to theſe ruinous reſources.

Clothes and furniture are, to a certain extent, as much neceſſaries of life as food. The quantity of them, however, which comes under this deſcription, is much leſs; by far the greater part of the expence which is laid out in this way being for the purpoſe of convenience at moſt, if not of mere ſhew and oſtentation. There ſeems therefore no reaſon for ſparing any, beyond thoſe plaineſt articles which decency demands from the loweſt of the people. This claſs of commodities, however, has met with peculiar indulgence, in conſequence of the favour entertained by the mercantile ſyſtem for manufactures of every kind. Woollens and hardwares, the two ſtaples of England, have been completely exempted. The ſame favour has been ſhewn to linen, the ſtaple of the ſiſter kingdoms. Yet, provided a correſponding drawback were allowed on exportation, there does not appear any good reaſon why the finer ſorts of all theſe fabrics ſhould not be made a ſubject of revenue. Printed linens and cottons, which have recently been ſo abundantly produced both in England and Scotland, have been made to pay a conſiderable tax.

But though the legiſlature of this country has been thus laudably attentive to avoid touching on the firſt neceſſaries of life, there are ſtill ſeveral particulars in which it has failed. One of the moſt important of theſe is coal, an article of the firſt utility, the univerſal fuel of this country, and the material of many of its moſt important manufactures. It is the leſs able to bear any duty, becauſe from its local and bulky nature, the expence of tranſport is often very heavy. London is ſupplied with coal from Newcaſtle, which is 300 miles diſtant. If a bounty could in any caſe be adviſable, it would be in ſuch a caſe. The legiſlature, however, has judged otherwiſe, and has impoſed upon every ton of ſea-borne coal, a duty of 3s. 6d. Coals carried by land or inland navigation are duty free. Through the exertion of Lord Melville, Scotland, to the north of St Abb's Head, has been freed from this duty; a circumſtance which has materially contributed to her rapid proſperity.

Salt, though it may not be requiſite for the ſupport of life, has yet, by immemorial uſage among civilized nations, been conſtituted a neceſſary of life. Notwithſtanding this, the ſmall quantity uſed by each individual, and the minute portions in which it is purchaſed, make a tax upon it be levied with leſs murmuring than moſt other taxes. Governments, taking advantage of this circumſtance, have almoſt univerſally made it a ſource of revenue. Taxation.

In this country the tax on this article preſſes with the greater ſeverity, as ſalt is eſſential to the fiſhery, one of the moſt important ſources of national wealth. It is true, the duty is drawn back, when ſalt is ſo employed: but the facility of ſmuggling by means of this drawback, produces the neceſſity of ſtrict regulations, which cramp extremely this branch of induſtry, eſpecially when carried on in that ſmall ſcale which is peculiarly ſuited to it.

Leather, ſoap, and candles, are alſo neceſſaries of life taxed in this country. But though theſe articles are to a certain extent neceſſary, by far the greateſt conſumption of them is for purpoſes of luxury. Although therefore theſe taxes do preſs upon the poor, their weight is not very ſevere. It might ſeem eaſy enough, at leaſt in the firſt and laſt of them, to exempt thoſe coarſer forms of the commodity, which are uſed by the lower claſſes, and thus the deficiency of revenue might be compenſated by an increaſe on the more expenſive forms.

Taxes may be impoſed either upon exportation or importation. The duties of cuſtoms were at firſt levied on both indiſcriminately; but as the mercantile ſyſtem gained ground, and an anxious deſire prevailed to encourage exportation and check importation, in the hope of increaſing the ſpecie in the country, all the new duties were laid upon the latter, while the former was more and more exempted. Although this ſyſtem may not have taken its riſe from the moſt enlightened views, yet no reaſonable exception can be taken to it. The taxes impoſed by any government ought to fall upon the conſumption of its own people, not upon that of others; and as this is a maxim of juſtice, ſo it is equally recommended by policy. Were a government to tax its own exported commodities, theſe commodities would alſo have to pay the taxes of the country into which they were imported. Loaded with this double burden, they could not advantageouſly come into competition with ſimilar articles, either the produce of that country, or imported from another which followed a more liberal policy. It is only therefore upon goods imported or produced for home conſumption, that theſe taxes can with propriety fall. From ſimilar views, the materials of manufacture have been generally exempted from duty. We have already obſerved, that, provided theſe manufactures be objects of luxury, there is no good reaſon why they ſhould not pay a tax. But there is an evident advantage in levying the duty *after*, rather than *before*, the manufacturing proceſs. In the latter caſe, the merchant being obliged to advance it ſo early, muſt have a profit on his advance, proportioned to the length of time which elapſes till the commodity is fit for ſale; and this profit muſt be paid by the conſumer in the price of the goods.

Should we ſuppoſe indeed a nation to poſſeſs a monopoly of any particular commodity, ſuch a nation might impoſe

Taxation. impoſe a tax on its export, without danger of its merchants being ſupplanted in the foreign market. Still this could not but be conſidered as a ſomewhat illiberal ſyſtem; and it would alſo bear hard upon the producer, who would ſtill probably have a double ſyſtem of duties to pay, ſince it cannot be ſuppoſed that the foreign country ſhould regard theſe monopolized commodities with peculiar favour.

With the view of following up the principles of the mercantile ſyſtem, importation duties have often been laid upon goods, ſo heavy as to amount to a prohibition. Such duties are not intended to produce any revenue, but to favour ſome home manufacture, or to injure that of ſome foreign nation, which is an object of commercial jealouſy. In the ſame manner, bounties are given to forward the growth of ſome branch of induſtry, which is the object of peculiar favour. In both caſes, the revenue is ſacrificed, without any real advantage accruing to the public. The induſtry and capital of the nation are thus turned from their natural direction into one which is leſs advantageous, and the public is injured inſtead of being benefited.

It is an undoubted principle, that whether the tax be paid at the time of importation, or at manufacture, it ought to be paid only once. Some governments, profoundly ignorant of the true principles of political economy, have repeated the impoſition at every ſucceſſive ſale of the property. This is obviouſly unequal. The value of property, and the frequency of its transference, are two things altogether diſtinct. One ſpecies of goods may thus come to pay ten or twelve times as much as another of the ſame value. But great as is its inequality, its impolicy is ſtill more glaring. It forms the moſt powerful check to that free interchange of commodities which is the very ſoul of all induſtry. It tends to confine the conſumption of every article to the place of its production, and thus to exclude all thoſe benefits which ariſe from the extenſion of the market. Of this ruinous nature is the Spaniſh *alcavala*, which conſiſts in an impoſition, originally of 10, but now only of 6 per cent. on every ſale without exception, whatever be the nature of the property, or however frequently repeated. The mere undiſtinguiſhing nature of ſuch a tax muſt be a great evil; but it is rendered far more pernicious by the obſtruction which it thus throws in the way of every ſpecies of commercial intercourſe.

It may be eſtabliſhed as a principle in regard to theſe taxes, that they ought to be as uniform as poſſible, and not to vary in different parts of the country. Such variations neceſſarily lead to reſtraints on the free circulation of commodities. Each province becomes as an independent kingdom, the frontier of which is guarded by cuſtomhouſes and by chains of officers, through which whoever paſſes muſt ſubmit not only to the payment of duties, but to the inconvenience and delay of having his goods ſearched. Such was the caſe both in France and in Spain, where each province having formerly been ſeparate and independent, retained ſtill its diſtinct ſyſtem of taxation. The tranſporting of goods from one province to another was like exporting them to a foreign country; the ſame barriers of cuſtomhouſes, duties, and revenue officers, obſtructed their paſſage. One of the circumſtances which has moſt contributed to the proſperity of Great Britain is the uniformity of taxation throughout, and conſequently the entire freedom of commerce from one part of the iſland to the other. This was the principal advantage which Scotland derived from the union; and it has been ſuch as fully to compenſate for the increaſed burdens to which that meaſure ſubjected her. Taxat

Duties upon conſumption, inſtead of being levied upon the trader, may be levied upon the perſon conſuming, who may be made to pay a certain ſum as a *licence* to uſe the commodity. Such a mode of levy has ſome of the advantages of aſſeſſed taxes, in regard to the facility and cheapneſs of collection. It is ſtill alſo in ſome degree ſpontaneous; but it muſt obviouſly be, in moſt caſes, very unequal. Of two perſons, who ſhould pay the ſame ſum for a licence to uſe wine, one might conſume twenty times the quantity of the other. A licence has beſides the diſadvantage of being paid all at once, and of being more ſenſibly felt than taxes which confound themſelves with the price of the commodity. In general, therefore, it is a much leſs eligible form. There are a few inſtances, however, of very coſtly and durable goods, ſuch as coaches, plate, &c. where it is found to be the moſt convenient. Wine and other liquors, when conſumed in taverns, may, it is ſuppoſed, be fairly required to pay more than when conſumed in private houſes. An attempt, however, to proportion this addition to the quantity conſumed, would be attended with unſurmountable difficulties. A licence is therefore required to be taken out by innkeepers who deal in theſe articles. This tax falls with equal weight upon the great and ſmall dealers; but it may be rather conſidered as deſirable to check the multiplication of the laſt.

3. *Stamp Duties.*—Under the title of ſtamp duties, we would include all thoſe which fall upon the deeds which regulate the transference of property.

The firſt of theſe duties, of which we find any mention, are thoſe upon teſtamentary donations. A law of Auguſtus impoſed the *viceſima hereditatum*, or twentieth penny, upon all inheritances. It was in Holland, however, which was preſſed by the ſevereſt neceſſity of raiſing a revenue, and not very diſcriminating in the mode of doing it, that the ſyſtem of *ſtamp* duties firſt originated, and was carried to a formidable extent. Such were the difficulties of that ſtate, that they are ſaid to have publicly propoſed a reward to any one who ſhould ſuggeſt a new ſource of revenue. This plan was propoſed and approved. From Holland it was, in 1671, imported into this country, and has ſince become one of the great ſources of public income. In other countries, deeds regarding the transference of property are required to be entered in a public regiſter, and the tax laid on the regiſtration. A conſiderable revenue was thus raiſed in France. Auction duties upon the ſale of property, both moveable and immoveable, though ſomewhat different in point of form, coincide exactly with theſe taxes in their eſſence and tendency.

Taxes of this nature are attended with conſiderable conveniencies to the contributors. From the nature of the tranſaction, there muſt always be money in hand with which the tax can be paid; and the time of payment is thus the moſt convenient of any. In many caſes, the ſum to be paid at a time is ſmall. It is only part of the ſociety which is liable to them to any great extent, and theſe only occaſionally; they are not felt as intrenching on daily and habitual comforts; nor do they

Taxation. they excite that general murmur, which is alone formidable to government. It is not to be wondered at, therefore, if the latter ſhould avail themſelves of this paſſive diſpoſition in the people for the extenſion of this ſource of ſupply. The truth is, however, that in all eſſential reſpects, theſe taxes are among the moſt improper of any.

1. They are unequal, inaſmuch as the value of any property is altogether unconnected with the frequency of its transference. This inequality would ſubſiſt, even though the ſtamp duty were always in exact proportion to the value of the property. But this is, in general, far from being ſtrictly the caſe. It may be noticed, however, that in the recent additions made to the ſtamp duties in this country, the principle of equality has been more attended to.

2. The greater part of ſuch taxes fall not upon the income, but upon the capital of the country; not upon that fund which may be properly and ſafely expended, but upon that, the expenditure of which muſt be ultimately ruinous. This circumſtance is peculiar to theſe duties; for though others, when very ſevere, may oblige the contributor to encroach on his capital, they alone fall directly and immediately upon that fund. An objection of this nature would alone be ſufficient to diſſuade their adoption.

3. Such taxes, when they fall upon moveable goods, have a direct tendency to check commerce, and through it every kind of induſtry. They are then a complete *alcavala*, differing from that ruinous impoſt only by being more moderate.

Thus we find, that the facility of collection, and the avoiding of diſcontent, which have tempted modern governments to extend ſo much this ſource of revenue, are altogether fallacious advantages, and bear no proportion to the ill conſequences with which ſuch taxes are neceſſarily attended. It would therefore be much better that the duties upon the transference of moveable goods ſhould be laid upon their original production. They would thus pay only once, and no impediment would be thrown in the way of their free circulation. Duties upon the ſale of land and other immoveable goods, ought to be converted into aſſeſſed taxes, payable on their yearly uſe. In the preſent circumſtances of this country indeed, it is perhaps too much to expect that taxes, which are paid without much murmuring, ſhould be taken off; but the conſiderations now ſtated ought certainly to deter from any farther addition to them.

Legacies from any diſtant relation are a ſort of accidental and unexpected advantage, and it is therefore to be ſuppoſed, that the perſon receiving will have ſecured a regular ſource of ſubſiſtence independent of them. He will not therefore, it is likely, be diſpoſed to complain very grievouſly, if this extrinſic ſource of wealth be ſomewhat diminiſhed by a duty to government. In this country, accordingly, ſuch legacies are chargeable with a duty of 10 per cent. This tax ſeems one of the moſt unexceptionable of the kind, and only liable to the objection of falling upon capital. It is otherwiſe with money left by a father or other very near relation. The death of ſuch perſons commonly diminiſhes, inſtead of increaſing, the wealth of the family; and the ſum left forms often the ſole dependance of a great part of it. Accordingly, in Great Britain, the duty on legacies to the neareſt relations is very ſlight, and gradually increaſes as the conſanguinity becomes more remote. Taxation ‖ Tay.

Receipt ſtamps, though they are formally paid by the ſeller, fall really upon the purchaſer. The merchant, who muſt have his profit, will calculate the expence which he is likely to be at in ſtamps, and will lay a correſponding augmentation on the price of his goods. Such taxes, unleſs very heavy, will fall upon income only, not upon capital.

Bills of exchange, and policies of inſurance, being neceſſary inſtruments of trade, ſeem as improper ſubjects of taxation as can well be. The only thing tolerable in theſe taxes, as impoſed in this country, is their moderation.

Auction duties ſeem liable to every objection which can be ſtated againſt taxes of this deſcription. They are the more ſevere, as they muſt fall often upon unfortunate perſons who are reduced to the neceſſity of diſpoſing, in this manner, of their property.

Stamps upon law proceedings tend to increaſe the expence of obtaining juſtice, which is already complained of in general as too heavy. They may indeed be ſuppoſed to be of ſome uſe in checking a litigious ſpirit; but this ſeems already to be done pretty effectually by the other expences attendant on judicial proceedings.

Taxes upon indentures, or upon the entrance to any profeſſion, produce a monopoly to the perſons exerciſing that profeſſion. They thus tend at once to raiſe the price of their labour and of its fruits, and to diminiſh the neceſſity of qualifying themſelves for its performance. The chief weight of theſe taxes falls upon the perſons exerciſing the profeſſion of the law. The public are apt to regard ſuch perſons with a degree of hoſtility, which has probably induced government to believe it might tax them without danger of exciting any general murmur. The truth is, however, that theſe taxes fall not on the practitioners themſelves, but on thoſe who complain of them, on the perſons engaged in litigation; ſo that their effect is preciſely the ſame with that of taxes on law proceedings. It differs from them only as a licence differs from a duty upon commodities, and is leſs eligible, as falling more unequally. The perſons who pay the ſame ſum at entrance, carry on their profeſſion with very different degrees of ſucceſs.

Some impoſitions, which aſſume the form of ſtamp duties, are in reality taxes upon commodities. Such are the game duty, the duty on cards, hats, plate, &c. But moſt of theſe ſeem to be unexceptionable ſubjects.

TAXUS, the YEW-TREE, a genus of plants belonging to the claſs dicœcia, and in the natural ſyſtem ranging under the 51ſt order, *Coniferæ*. See BOTANY *Index*.

TAY, in Latin *Tavus*, or *Taus*, the largeſt river in Scotland, riſes in Braidalbane, on the frontiers of Lorn; and having in the paſſage of a few miles augmented its ſtream by the acceſſion of ſeveral ſmall rills, ſpreads itſelf into the lake called *Loch Dochart;* out of which having run but a little ſpace, it expands itſelf again. Leaving this ſecond lake, it rolls ſome miles with a conſiderable body of water, and then diffuſes itſelf in the ſpacious Loch Tay; which, rekoning from the ſources of the river, is 24 miles in length, though, ſtrictly ſpeaking,

Tay, Taylor.

ſpeaking, the lake is but 13: almoſt as ſoon as it iſſues from hence, it receives the river Lyon, coming out of Loch Lyon, and running through Glen Lyon; which, having travelled in a manner parallel to it, from its ſource, for a ſpace of 25 miles, at length joins the Tay as it enters Athol, which it next traverſes, and, directing its courſe in a manner due eaſt, receives almoſt all the waters of that country. Bending then to the ſouth, at the diſtance of ſix miles, it reaches Dunkeld; which, in the language of our anceſtors, ſignifies "the hill of hazels," was the very centre of the old Caledonia, and is at preſent eſteemed the heart of the Highlands. The river is very broad here, inſomuch that there is a ferry-boat over it at each end of the town. Declining ſtill to the ſouth-eaſt, with a winding courſe, for above 12 miles, the Tay receives a large ſupply of waters from the county of Angus; and then running ſouth-weſt for eight miles more, is joined in that ſpace by ſeveral rivers, the moſt conſiderable of which is the Almond. Turning then to the ſouth-eaſt, at the diſtance of about three miles, this copious river comes with a ſwelling ſtream to Perth.

The Tay, continuing ſtill a ſouth-eaſt courſe, receives, a few miles below Perth, the river Erne; which, iſſuing from a loch of the ſame name, traverſes the county of Strathern, and paſſes by Abernethy, once the capital of the Pictiſh kingdom. Swelled by the waters of this laſt river, the Tay, running next directly eaſt, enlarges itſelf till it becomes about three miles broad; but contracts again before the town of Dundee; ſoon after which it opens into the German ocean. At the entrance of the frith, there are ſands both on the north and on the ſouth ſide; the former ſtyled *Goa*, the latter *Aberlay* and *Drumlan;* and before theſe, in the very mouth of the frith, thoſe which are called the *Croſs Sands*. At Buttonneſs, which is the northern promontory, there are two light-houſes. The ſpace between the north and the ſouth ſands may be near a mile, with about three fathoms water; but being within the frith, it grows deeper, and in the road of Dundee is full ſix fathoms. The frith of Tay is not indeed ſo large or ſo commodious as that of Forth, but from Buttonneſs to Perth it is not leſs than 40 miles; and the whole may be, without any great impropriety, ſtyled a harbour, which has Fife on one ſide, and the ſhires of Perth and Angus on the other, both very fertile and pleaſant countries.

TAYLOR, Dr Jeremy, biſhop of Down and Connor in Ireland, was the ſon of a barber at Cambridge, where he was educated. Upon entering into orders, he became divinity lecturer of St Paul's in London; and was, by the intereſt of Archbiſhop Laud, elected fellow of All Souls college, Cambridge, in 1636. Two years after he became one of the chaplains of the archbiſhop, who beſtowed on him the rectory of Uppingham in Rutlandſhire. In 1642, he was chaplain to the king; and a frequent preacher before him and the court at Oxford. He afterward attended in the king's army in the condition of a chaplain. Upon the declining of his majeſty's cauſe, he retired into Wales, where he was permitted to officiate as miniſter, and to keep a ſchool, in order to maintain himſelf and his children. In this retirement he wrote ſeveral of his works. Having ſpent ſeveral years there, his family was viſited with ſickneſs; and he loſt three ſons of great hopes within the ſpace of two or three months. This affliction touched him ſo ſenſibly, that it made him deſirous to leave the country; and, going to London, he for a time officiated in a private congregation of loyaliſts to his great hazard. At length meeting with Edward lord Conway, that nobleman carried him over with him into Ireland, and ſettled him at Portmore, where he wrote his *Ductor Dubitantium*. Upon the Reſtoration he returned to England. Soon after, he was advanced to the biſhopric of Down and Connor in Ireland; and had the adminiſtration of the ſee of Dromore granted to him. He was likewiſe made privy-counſellor and vice-chancellor of the univerſity of Dublin; which place he held till his death. He died of a fever at Liſnegarvy in 1667, and was interred in a chapel which he himſelf had built on the ruins of the old cathedral of Dromore.

Taylor, *Dr Brook*, was born at Edmonton, Auguſt 18th 1685. He was the ſon of John Taylor, Eſq. of Biſrons-houſe in Kent, by Olivia, daughter of Sir Nicholas Tempeſt, of Durham, Baronet. His grandfather, Nathaniel Taylor, was one of thoſe puritans whom "Cromwell thought fit to elect by a letter, dated June 14th 1653, to repreſent the county of Bedford in parliament." The character of his father partook in no ſmall degree of the auſterity that had been tranſmitted to him in the line of his anceſtors, and by the ſpirit of the times in which they lived; and to this cauſe may be aſcribed the diſaffection which ſometimes ſubſiſted between the father and even ſuch a ſon as is the ſubject of this article. The old gentleman's moroſe temper, however, yielded to the powers of muſic; and the moſt eminent profeſſors of the art in that period were hoſpitably welcomed in his houſe. His ſon Brook was induced, by his natural genius, and by the diſpoſition of his father, which he wiſhed by all the means in his power to conciliate, to direct his particular attention to muſic; and he became in very early life a diſtinguiſhed proficient in it.—"In a large family piece, he is repreſented at the age of 13 ſitting in the centre of his brothers and ſiſters; the two elder of whom, Olivia and Mary, crown him with laurel, bearing the inſignia of harmony."

To muſic he added another accompliſhment, in which he equally excelled. "His drawings and paintings, of which ſome are ſtill preſerved, require not thoſe allowances for error or imperfection with which we ſcan the performances of even the ſuperior *dilettanti;*—they will bear the teſt of ſcrutiny and criticiſm from artiſts themſelves, and thoſe of the firſt genius and profeſſional abilities." Though he was eminent in the culture and practice both of muſic and drawing in his early youth, his whole attention was not occupied by theſe faſcinating arts. His claſſical education was conducted at home under a private tutor; and his proficiency in the ordinary branches of the languages and the mathematics was ſo great, that he was deemed qualified for the univerſity at the early age of 15.

In 1701 he was entered a fellow commoner of St John's College, Cambridge. At that period mathematics engaged more particularly the attention of the univerſity; and the examples of eminence in the learned world, derived from that branch of ſcience, attracted the notice and roufed the emulation of every youth poſſeſſed of talents and of application. We may preſume, that Brook Taylor, from the very hour of his admiſſion

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Taylor. at college, adopted the course of study which a Machin, a Keil, and, above all, a Newton, had opened to the mind of man, as leading to discoveries of the celestial system.—That he applied early to these studies, and without remission, is to be inferred from the early notice and kind attention with which he was honoured by those eminent persons, and from the extraordinary progress which he made in their favourite science."

In 1708 he wrote his treatise On the Centre of Oscillation, which was not published in the Philosophical Transactions till some years afterwards. In 1709, he took his degree of Bachelor of Laws. In 1712, he was chosen a Fellow of the Royal Society. During the interval between these two periods, he corresponded with Professor Keil on several of the most abstruse subjects of mathematical disquisition. Sir William Young informs us, that he has in his possession a letter, dated in 1712, addressed to Mr Machin, which contains at length a solution of Kepler's problem, and marking the use to be derived from that solution. In this year he presented to the Royal Society three different papers: one On the Ascent of Water between two Glass Planes; a second, On the Centre of Oscillation; and a third, on the Motion of a stretched String. It appears from his correspondence with Keil, that in 1713 he presented a paper on his favourite subject of Music; but this is not preserved in the Transactions.

His distinguished proficiency in those branches of science, which engaged the particular attention of the Royal Society at this period, and which embroiled them in contests with foreign academies, recommended him to the notice of its most illustrious members; and in 1714 he was elected to the office of secretary. In this year he took at Cambridge his degree of Doctor of Laws: and at this time he transmitted, in a letter to Sir Hans Sloane, An Account of some curious Experiments relative to Magnetism; which, however, was not delivered to the Society till many years afterward, when it was printed in the Transactions. His application to those studies to which his genius inclined was indefatigable; for we find that in 1715 he published in Latin his *Methodus Incrementorum;* also a curious essay preserved in the Philosophical Transactions, entitled An Account of an Experiment for the Discovery of the Laws of Magnetic Attraction; likewise a treatise well known to mathematicians, and highly valued by the best judges, on the Principles of Linear Perspective. In the same year (such were his admirable talents, and so capable were they of being directed to various subjects), he conducted a controversial correspondence with the Count Raymond de Montmort, on the Tenets of Malebranche; which occasioned his being particularly noticed in the eulogium pronounced by the French academy on the decease of that eminent metaphysician.

The new philosophy of Newton (as it was then called) engaged the attention of mathematicians and philosophers both at home and abroad. At Paris it was in high estimation; and the men of science in that city were desirous of obtaining a personal acquaintance with the learned secretary of the Royal Society, whose reputation was so generally acknowledged, and who had particularly distinguished himself in the Leibnitzian or German controversy, as we may denominate it, of that period. In consequence of many urgent invitations, he determined to visit his friends at Paris in the year 1716. Taylor. He was received with every possible token of affection and respect; and had an opportunity of displaying many traits of character, which mark the general scholar and accomplished gentleman, as well as the profound mathematician. His company was courted by all "who had temper to enjoy, or talents to improve, the charms of social intercourse." Besides the mathematicians, to whom he had always free access, he was here introduced to Lord Bolingbroke, the Count de Caylus, and Bishop Bossuet.

Early in 1717 he returned to London, and composed three treatises, which were presented to the Royal Society, and published in the 30th volume of the Transactions. About this time his intense application had impaired his health to a considerable degree; and he was under the necessity of repairing, for relaxation and relief, to Aix-la-Chapelle. Having likewise a desire of directing his attention to subjects of moral and religious speculation, he resigned his office of secretary to the Royal Society in 1718.

After his return to England in 1719, he applied to subjects of a very different kind from those that had employed the thoughts and labours of his more early life. Among his papers of this date, Sir William Young has found detached parts of A Treatise on the Jewish Sacrifices, and a dissertation of considerable length On the Lawfulness of eating Blood. He did not, however, wholly neglect his former subjects of study, but employed his leisure hours in combining science and art; with this view he revised and improved his treatise on Linear Perspective. Drawing continued to be his favourite amusement to his latest hour; and it is not improbable, that his valuable life was shortened by the sedentary habits which this amusement, succeeding his severer studies, occasioned. "He drew figures with extraordinary precision and beauty of pencil. Landscape was yet his favourite branch of design. His original landscapes are mostly painted in water colours, but with all the richness and strength of oils. They have a force of colour, a freedom of touch, a varied disposition of planes of distance, and a learned use of aerial as well as linear perspective, which all professional men who have seen these paintings have admired."

The work of Dr Brook Taylor in linear perspective was censured by Bernoulli, in a treatise published in the Acts of Leipsic, as "abstruse to all, and as unintelligible to artists for whom it was more especially written." It must be acknowledged that this excellent work, for so it deserves to be called, was not level to the apprehensions of practitioners in the art of drawing and design; but it was much esteemed by mathematicians. Three editions of it have been published; and as it is now scarce, a republication of it in its most improved and perfect state would be very acceptable. Mr Kirby, however, has made it more plain and popular, in his treatise entitled "Brook Taylor's Perspective made easy;" and this book, detailing and illustrating the principles of the original work, has been the *vade mecum* of artists. Dr Brook Taylor was incensed by the invidious attacks of Bernoulli; and he published An Apology against J. Bernoulli's Objections, which may be seen in the 30th volume of the Philosophical Transactions. Bernoulli, with his usual envy of British mathematicians, had disputed our author's right to his own

Taylor. work. We have no reaſon to doubt Dr Taylor's claims to the undecided diſcovery of the method which he deſcribes, though he is not an original inventor. This method was long before publiſhed by Guido Ubaldi, in his Perſpective, printed at Peſaro in 1600; where it is delivered very clearly, and confirmed by moſt elegant demonſtrations; and where it is actually applied to the art of delineating the ſcenes of a theatre.

Toward the end of the year 1720, Dr Brook Taylor accepted the invitation of Lord Bolingbroke to ſpend ſome time at La Source, a country-ſeat near Orleans, which he held in right of his wife, the widow of the Marquis de Villette, nephew of Madame de Maintenon. In the next year he returned to England, and publiſhed the laſt paper which appears with his name in the Philoſophical Tranſactions, entitled, An Experiment made to aſcertain the Proportion of Expanſion of Liquor in the Thermometer, with regard to the degree of Heat.

In 1721, Dr Brook Taylor married Miſs Bridges of Wallington in the county of Surry, a young lady of good family, but of ſmall fortune; and this marriage occaſioned a rupture with his father, whoſe conſent he had never obtained. The death of this lady in 1725, and that of an infant ſon, whom the parents regarded as the preſage and pledge of reconciliation with the father, and who actually proved ſuch, deeply affected the ſenſibility of Dr Taylor. However, during the two ſucceeding years he reſided with his father at Bifrons, where "the muſical parties, ſo agreeable to his taſte and early proficiency, and the affectionate attentions of a numerous family welcoming an amiable brother, ſo long eſtranged by paternal reſentment, not only ſoothed his ſorrows, but ultimately engaged him to a ſcene of country retirement, and domeſticated and fixed his habits of life. He could no more recur to the deſultory reſources and cold ſolace of ſociety, which caſual viſits, ſlight acquaintance, and diſtant friendſhips, afford the man—who hath *none to make and cheer a conſtant home.*"

In 1725 he formed a new connection; and with the full approbation of his father and family, married Sabetta, daughter of John Sawbridge, Eſq. of Olantigh, in Kent. In 1729, on the death of his father, he ſucceeded to the family eſtate of Bifrons. In the following year he loſt his wife in childbed. The daughter whoſe birth occaſioned this melancholy event ſurvived, and became the mother of Sir William Young, to whom we owe theſe memoirs of his grandfather.

In the interval that elapſed between the years 1721 and 1730, no production by Brook Taylor appears in the Philoſophical Tranſactions; nor did he publiſh in the courſe of that time any work. His biographer has found no traces of his learned labour, excepting a Treatiſe of Logarithms, which was committed to his friend Lord Paiſley (afterward Abercorn), in order to be prepared for the preſs; but which probably never was printed. His health was now much impaired; relaxation became neceſſary, and he was diverted by new connections from the habit of ſevere ſtudy, which had diſtinguiſhed the early period of his life, and which had contributed to contract the duration of it. Happy in the ſocial circle of domeſtic enjoyment, and devoting his attention to buſineſs or amuſement as they occurred, his application and his literary emulation ſeem to have declined. He did not long ſurvive the loſs of his ſecond wife; and his remaining days were days of increaſing imbecility and ſorrow. Taylor Tea.

"The eſſay entitled *Contemplatio Philoſophica*, publiſhed by Sir William Young, 1793, appears to have been written about this time, and probably with a view to abſtract his mind from painful recollections and regret. It was the effort of a ſtrong mind, and is a moſt remarkable example of the cloſe logic of the mathematician applied to metaphyſics. But the blow was too deep at heart for ſtudy to afford more than temporary relief. The very reſource was hurtful, and intenſe ſtudy but accelerated the decline of his health. His friends offered every comfort; in particular Lord Bolingbroke preſſed his conſolation, and ſought to call his mind from regret of domeſtic endearments to ſocial friendſhip at Dawley.

The attention and kindneſs of his friends, however, could not ward off the approaches of diſſolution. "Having ſurvived his ſecond wife little more than a year, Dr Brook Taylor died of a decline in the 46th year of his age, December the 29th 1731, and was buried in the church-yard of St Ann's, Soho. I am ſpared (ſays his deſcendant) the neceſſity of cloſing this biographical ſketch with a prolix detail of his character: in the beſt acceptation of duties relative to each ſituation of life in which he was engaged, his own writings, and the writings of thoſe who beſt knew him, prove him to have been the finiſhed Chriſtian, gentleman, and ſcholar."

TAYLOR-Bird. See MOTACILLA, ORNITHOLOGY *Index.*

TEA, the dried leaves of the tea plant.—A commodity with which we are ſo well acquainted, which affords a beverage ſo generally uſed and ſo generally agreeable, and which forms ſo conſiderable an article of commerce, muſt excite curioſity to know ſomething of its hiſtory, and of the nature of the plant from which it is obtained.

The tea plant is a native of Japan, China, and Tonquin, and has not, as far as we can learn, been found growing ſpontaneouſly in any other parts of the world. Linnæus arranged it under the claſs of *polyandria*, and order of *monogynia*, and Thunberg, one of the moſt diſtinguiſhed pupils of that illuſtrious botaniſt, who reſided 16 months in Batavia and Japan, has claſſed it in the ſame manner as his maſter. Several of the Britiſh botaniſts, on the other hand, refer it to the order of *trigynia*; deriving their authority from a plant in the duke of Northumberland's garden at Sion-houſe, which had three ſtyles.

Linnæus ſays that there are two ſpecies of the tea plant; the *bohea*, the corolla of which has ſix petals; and the *viridis* or green tea, which has nine petals. Thunberg makes only one ſpecies, the bohea, conſiſting of two varieties; the one with broad and the other with narrow leaves.

The tea plant, which is an evergreen, grows to the height of five or ſix feet; Le Compte ſays ten or twelve. The leaves, which are the only valuable part of it, are about an inch and a half long, narrow, indented, and tapering to a point, like thoſe of the ſweet briar, and of a dark green colour. The root is like that of the peach tree, and its flowers reſemble thoſe of the white wild roſe. The ſtem ſpreads into many irregular branches.

branches. The wood is hard, of a whitiſh green colour, and the bark is of a greeniſh colour, with a bitter, nauſeous, and aſtringent taſte. The fruit is ſmall, and contains ſeveral round blackiſh ſeeds, about the bigneſs of a bean or large pea.

This plant delights in valleys, is frequent on the ſloping ſides of mountains and the banks of rivers, where it enjoys a ſouthern expoſure. It flouriſhes in the northern latitudes of Pekin as well as round Canton, but attains the greateſt perfection in the mild temperate regions of Nankin. It is ſaid only to be found between the 30th and 45th degree of north latitude. In Japan it is planted round the borders of fields, without regard to the ſoil; but as it is an important article of commerce with the Chineſe, whoſe fields are covered with it, it is by them cultivated with care. The Abbé Rochen ſays, it grows equally well in a poor as in a rich ſoil; but that there are certain places where it is of a better quality. The tea which grows in rocky ground is ſuperior to that which grows in a light ſoil; and the worſt kind is that which is produced in a clay ſoil. It is propagated by ſeeds; from ſix to twelve are put into a hole about five inches deep, at certain diſtances from each other. The reaſon why ſo many ſeeds are ſown in the ſame hole is ſaid to be, that only a fifth part vegetate. Being thus ſown, they grow without any other care. Some, however, manure the land, and remove the weeds; for the Chineſe are as fond of good tea, and take as much pains to procure it of an excellent quality, as the Europeans do to procure excellent wine.

The leaves are not fit for being plucked till the ſhrub be of three years growth. In ſeven years it riſes to a man's height; but as it then bears but few leaves, it is cut down to the ſtem, and this produces a new crop of freſh ſhoots the following ſummer. We are informed by Kœmpfer, that there are three ſeaſons in which the leaves are collected in the iſles of Japan, from which the tea derives different degrees of perfection.

The firſt gathering commences at the end of February or beginning of March. The leaves are then ſmall, tender, and unfolded, and not above three or four days old: theſe are called *ficki-tſiaa*, or "tea in powder," becauſe it is pulveriſed; it is alſo called *imperial tea*, being generally reſerved for the court and people of rank; and ſometimes alſo it is named *bloom tea*. It is ſold in China for 20d. or 2s. per pound. The labourers employed in collecting it do not pull the leaves by handfuls, but pick them one by one, and take every precaution that they may not break them. However long and tedious this labour may appear, they gather from 4 to 10 or 15 pounds a-day.

The ſecond crop is gathered about the end of March or beginning of April. At this ſeaſon part of their leaves have attained their full growth, and the reſt are not above half their ſize. This difference does not, however, prevent them from being all gathered indiſcriminately. They are afterwards picked and aſſorted into different parcels, according to their age and ſize. The youngeſt, which are carefully ſeparated from the reſt, are often ſold for leaves of the firſt crop, or for imperial tea. Tea gathered at this ſeaſon is called *too-tſiaa*, or "Chineſe tea," becauſe the people of Japan infuſe it, and drink it after the Chineſe manner.

The third crop is gathered in the end of May or in the month of June. The leaves are then very numerous and thick, and have acquired their full growth. This kind of tea, which is called *ben-tſiaa*, is the coarſeſt of all, and is reſerved for the common people. Some of the Japaneſe collect their tea only at two ſeaſons of the year, which correſpond to the ſecond and third already mentioned; others confine themſelves to one general gathering of their crop, towards the month of June: however, they always form afterwards different aſſortments of their leaves. Tea.

The fineſt and moſt celebrated tea of Japan is that which grows near Ud-ſi, a ſmall village ſituated cloſe to the ſea, and not far diſtant from Meaco. In the diſtrict of this village is a delightful mountain, having the ſame name, the climate of which is ſaid to be extremely favourable to the culture of tea; it is therefore incloſed by a hedge, and ſurrounded with wide ditches, which prevent all acceſs to it. The tea ſhrubs that grow on this mountain are planted in regular order, and are divided by different avenues and alleys.

The care of this place is entruſted to people who are ordered to guard the leaves from duſt, and to defend them from the inclemency of the weather. The labourers who are appointed to collect the tea abſtain from every kind of groſs food for ſome weeks before they begin, that their breath and perſpiration may not in the leaſt injure the leaves. They gather them with the moſt ſcrupulous nicety, and never touch them but with very fine gloves. When this choice tea has undergone the proceſs neceſſary for its preparation, it is eſcorted by the ſuperintendant of the mountain and a ſtrong guard to the emperor's court, and reſerved for the uſe of the imperial family.

As the tea ſhrub grows often on the rugged banks of ſteep mountains, acceſs to which is dangerous, and ſometimes impracticable, the Chineſe, in order to come at the leaves, are ſaid to uſe a ſingular ſtratagem: Theſe ſteep places are generally frequented by great numbers of monkeys, which being irritated and provoked, to revenge themſelves tear off the branches, and ſhower them down upon thoſe who have inſulted them. The Chineſe immediately collect theſe branches, and ſtrip them of their leaves.

When the tea leaves have been collected, they are expoſed to the ſteam of boiling water; after which they are put upon plates of copper, and held over the fire until they become dry and ſhrivelled, and appear ſuch as we have them in Europe. According to the teſtimony of Kœmpfer, tea is prepared in the ſame manner in the iſles of Japan. "There are to be ſeen there (ſays this traveller) public buildings erected for the purpoſe of preparing the freſh gathered tea. Every private perſon who has not ſuitable conveniences, or who is unacquainted with the operation, may carry his leaves thither as they dry. Theſe buildings contain a great number of ſmall ſtoves raiſed about three feet high, each of which has a broad plate of iron fixed over its mouth. The workmen are ſeated round a large table covered with mats, and are employed in rolling the tea leaves which are ſpread out upon them. When the iron plates are heated to a certain degree by the fire, they cover them with a few pounds of freſh gathered leaves, which being green and full of ſap, crackle as ſoon as they touch the plate. It is then the buſineſs of the workman to ſtir them with his naked hands as quickly as poſſible, until they become ſo warm that he cannot

Tea. eaſily endure the heat. He then takes off the leaves with a kind of ſhovel, and lays them upon mats. The people who are employed in mixing them, take a ſmall quantity at a time, roll them in their hands always in the ſame direction; while others keep continually ſtirring them, in order that they may cool ſooner, and preſerve their ſhrivelled figure the longer. This proceſs is repeated two or three times, and even oftener, before the tea is depoſited in the warehouſes. Theſe precautions are neceſſary to extract all the moiſture from the leaves."

The people of Japan and China generally keep their tea a year before uſing it, becauſe, when quite freſh and newly gathered, it poſſeſſes a narcotic quality which hurts the brain. Imperial tea is generally preſerved in porcelain vaſes, or in leaden or tin caniſters covered with fine mats made of bamboo. Common tea is kept in narrow-mouthed earthen pots; and coarſe tea, the flavour of which is not ſo eaſily injured, is packed up in baſkets of ſtraw.

An infuſion of tea is the common drink of the Chineſe; and indeed when we conſider one circumſtance in their ſituation, we muſt acknowledge that Providence has diſplayed much goodneſs in ſcattering this plant with ſo much profuſion in the empire of China. The water is ſaid to be unwholeſome and nauſeous, and would therefore perhaps, without ſome corrective, be unfit for the purpoſes of life. The Chineſe pour boiling water over their tea, and leave it to infuſe, as we do in Europe; but they drink it without any mixture, and even without ſugar. The people of Japan reduce theirs to a fine powder, which they dilute with warm water until it has acquired the conſiſtence of thin ſoup. Their manner of ſerving tea is as follows: They place before the company the tea equipage, and the box in which this powder is contained; they fill the cups with warm water, and taking from the box as much powder as the point of a knife can contain, throw it into each of the cups, and ſtir it with a tooth-pick until the liquor begins to foam; it is then preſented to the company, who ſip it while it is warm. According to F. du Halde, this method is not peculiar to the Japaneſe; it is alſo uſed in ſome of the provinces of China.

The firſt European writer who mentions tea is Giovanni Botero, an eminent Italian author, who publiſhed a treatiſe about the year 1590, Of the Cauſes of the Magnificence and Greatneſs of Cities. He does not indeed mention its name, but deſcribes it in ſuch a manner that it is impoſſible to miſtake it. "The Chineſe (ſays he) have an herb out of which they preſs a delicate juice, which ſerves them for drink inſtead of wine: it alſo preſerves their health, and frees them from all thoſe evils which the immoderate uſe of wine produces among us *."

* *Anderſon's Commerce*, vol. ii. p. 138.

Tea was introduced into Europe in the year 1610 by the Dutch Eaſt India Company. It is generally ſaid, that it was firſt imported from Holland into England, in 1666, by the lords Arlington and Oſſory, who brought it into faſhion among people of quality. But it was uſed in coffee-houſes before this period, as appears from an act of parliament made in 1660, in which a duty of 8d. was laid on every gallon of the infuſion ſold in theſe places. In 1666 it was ſold in London for 60s. per pound, though it did not coſt more than 2s. 6d. or 3s. 6d. at Batavia. It continued at this price till 1707. In 1715 green tea began to be uſed; and as great quantities were then imported, the price was leſſened, and the practice of drinking tea deſcended to the lower ranks †. In 1720 the French began to ſend it to us by a clandeſtine commerce. Since that period the demand has been increaſing yearly, and it has become almoſt a neceſſary of life in ſeveral parts of Europe, and among the loweſt as well as the higheſt ranks.

Tea.

† *Hanway's Journal.*

The following table will give an idea of the quantity of tea imported annually into Great Britain and Ireland ſince 1717:

From 1717 to 1726	-	700,000 lbs.
1732 to 1742	-	1,200,000
1755 near	-	4,000,000
1766 -	-	6,000,000
1785 about	-	12,000,000
1794 from	16 to	20,000,000

Beſides theſe immenſe quantities imported into Britain and Ireland, much has been brought to Europe by other nations. In 1766 the whole tea imported into Europe from China amounted to 17 millions of pounds; in 1785 it was computed to be about 19 millions of pounds ‡. *

‡ *Ra* vol. i *Robe* *Indi*

Several reſearches have been made in Europe to determine whether the tea plant grows ſpontaneouſly; but theſe reſearches have been hitherto in vain. When Captain Cook viſited Teneriffe in his laſt voyage, Mr Anderſon his ſurgeon was informed by a gentleman of acknowledged veracity, that a ſhrub is common near Santa Cruz which agrees exactly with the deſcription given of the tea-plant by Linnæus. It is conſidered as a weed, and large quantities are rooted out of the vineyards every year: But the Spaniards who inhabit the iſland ſometimes make uſe of it, and aſcribe to it all the qualities of the tea imported from China.

Many attempts have been made to introduce this valuable plant into Europe; but from want of proper precautions moſt of theſe attempts have miſcarried. The ſeeds, being of an oily nature, are apt to grow rancid during a long voyage, unleſs proper care is taken to preſerve them. There are two methods of preſerving theſe ſeeds: The firſt is, to incloſe them in wax after they have been dried in the ſun; the ſecond is, to leave them in their huſks, and ſhut them up cloſely in a box made of tin: but neither of theſe methods has been attended with general ſucceſs, whatever care has been taken to obtain freſh ſeeds, or to preſerve them. The beſt method would be, to ſow freſh ſeeds in fine light earth immediately on leaving Canton, and to cover them with wire to ſecure them from rats and other animals that might attack them. The boxes ought not to be too much expoſed to the air, nor to that kind of dew which riſes from the ſea. The earth in the boxes muſt neither be hard nor dry, and ſhould from time to time be gently watered with freſh or rain water; and when the ſhoots begin to appear, they ought to be kept in a ſlight moiſture, and ſheltered from the ſun. The tea-plants to be found in England have been procured by theſe means only; and though ſeveral of the young riſing ſhoots periſhed, the laſt method propoſed is probably that which may be followed with greateſt ſucceſs.

The fineſt tea-plant known in England was raiſed in Kew

Kew gardens; it was carried thither by Sir J. Ellis, who brought it from ſeed: but the firſt that ever flouriſhed in Europe was one belonging to the duke of Northumberland at Sion, from a drawing of which our engraving is taken. The plants which are cultivated in the gardens near London thrive well in the green-houſe during winter, and ſome ſtand that ſeaſon in the open air. Linnæus, who obtained this ſhrub in its growing ſtate, contrived to preſerve it in the open air in the northern latitude of Sweden. France has alſo procured ſome plants. There can be no doubt but they would ſucceed in many countries of Europe, if proper care were paid to their cultivation till they became inured to the climate. It will be a great advantage if we can rear that plant, which can never ſuffer ſo much from change of ſoil as from growing muſty during the long voyage from China. Beſides, the demand for tea is now become ſo great, that the Chineſe find it neceſſary, or at leaſt profitable, to adulterate it. Bad tea is now become an univerſal complaint. The abbé Groſier tells us, that there is a kind of moſs which grows in the neighbourhood of the little city of Mang-ing-hien, which is ſold as a delicate ſpecies of tea. If this delicious commodity is adulterated in China, can we flatter ourſelves that none comes to us but what is pure and unmixed? How would our fine ladies like to be told, that inſtead of tea they drink nothing but the infuſion of moſs from the rocks of Mang-ing-hien (F)?

Of the chemical qualities and effects of tea on the conſtitution, many various and oppoſite opinions have been formed. About a century ago, Bontikoe, a Dutch phyſician, beſtowed extravagant encomiums on the benefits of tea. With him it was good for every thing; and any quantity might be drunk, even to the amount of 200 diſhes in a day. Whether Bontikoe in this caſe acted as a phyſician, or, being a Dutchman, was eager to encourage the ſale of an important article of his country's commerce, is not eaſy to ſay. On the other hand, the pernicious effects of tea upon the nervous ſyſtem have been often repeated, and very oppoſite effects have been aſcribed to it. Some affirm that green tea is mildly aſtringent; others ſay it is relaxing: Some ſay it is narcotic, and procures ſleep; while others contend, that taken before bed-time it aſſuredly prevents it.

Tea. Dr Lettſom, who has written the Natural Hiſtory of the Tea Tree, made ſeveral experiments to determine its chemical qualities. He found an infuſion of it preſerved beef freſh; it is therefore antiſeptic; and from its ſtriking a purple colour with the ſalt (ſulphate) of iron, he juſtly concludes that it is aſtringent; and he thinks alſo, that the eſſential qualities of tea reſide in its fragrant and volatile parts.

We have heard much of the bad effects of tea, but we have neither felt nor obſerved them. If it were ſo pernicious as it has been repreſented by ſome, its effects muſt certainly be evident in China, where it is drunk by all ranks; yet ſo far from being thought hurtful in that country, it is in high eſtimation. The preſent emperor has compoſed a kind of eloge on the virtues of tea. We are told by thoſe who have written the hiſtory of China, that inflammatory diſeaſes are leſs frequent there than in many other countries, which is aſcribed ſolely to the liberal uſe of tea. It muſt be obſerved by all, that tea is an antidote againſt intemperance, and that he who reliſhes the one ſeldom runs into the other. Raynal ſays, that tea has contributed more to the ſobriety of this nation than the ſevereſt laws, the moſt eloquent harangues of Chriſtian orators, or the beſt treatiſes of morality. We have no doubt but it may be hurtful to ſome conſtitutions in particular circumſtances; but we ſuſpect that the nervous diſorders ſo often attributed to tea, are rather owing to hereditary diſeaſes, to want of exerciſe, and to irregularity in food or ſleep, than to tea.

"Weak tea drunk too hot (ſays Dr Leake) will enervate, and if very ſtrong, may prove equally pernicious by affecting the head or ſtomach. But when it is drunk in moderation, and not too warm, with a large addition of milk, I believe it will ſeldom prove hurtful, but, on the contrary, ſalutary. After ſtudy or fatigue it is a moſt refreſhing and grateful repaſt; it quenches thirſt, and cheers the ſpirits, without heating the blood; and the pleaſing ſociety, in which we ſo often partake of it is no inconſiderable addition to its value; for whatever affords rational pleaſure to the mind, will always contribute to bodily health.

In this country teas are generally divided into three kinds of green, and five of bohea: The former are, 1. Imperial or bloom tea, with a large looſe leaf, light green

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(F) There is very good reaſon to believe, that the adulteration of tea is not confined to China. It is practiſed, and often with too much ſucceſs, among ourſelves. Mr Twining, a conſiderable tea dealer in London, publiſhed a pamphlet ſome years ago, in which he has expoſed this infamous traffic. The information (he ſays) was obtained from a gentleman who had made very accurate inquiries into this ſubject.

The ſmouch for mixing with black teas is made of the leaves of the aſh. When gathered, they are firſt dried in the ſun, then baked: they are next put upon a floor, and trod upon until the leaves are ſmall, then ſifted and ſteeped in copperas with ſheep's dung; after which, being dried on a floor, they are fit for uſe. There is alſo another mode: When the leaves are gathered, they are boiled in a copper with copperas and ſheep's dung; when the liquor is ſtrained off, they are baked and trod upon, until the leaves are ſmall, after which they are fit for uſe. The quantity manufactured at a ſmall village, and within eight or ten miles thereof, cannot be aſcertained, but is ſuppoſed to be about 20 tons in a year. One man acknowledges to have made 600 weight in every week for ſix months together. The fine is ſold at 4l. 4s. per cwt. equal to 9d per lb. The coarſe is ſold at 2l. 2s. per cwt. equal to $4\frac{1}{4}$ per lb. Elder buds are manufactured in ſome places to repreſent fine teas.

For the honour of human nature, we hope ſuch a traffic as this is not very common; but if it be, thoſe concerned in it deſerve exemplary puniſhment. The only way (Mr Twining ſays) to eſcape this adulterated tea, is never to purchaſe from thoſe who offer their teas to ſale at lower prices than genuine teas can be afforded; but to purchaſe them only from perſons of character.

Tea, Teachers.

green colour, and a faint delicate ſmell. 2. Hyſon, ſo called from the name of the merchant who firſt imported it; the leaves of which are cloſely curled and ſmall, of a green colour, verging to a blue: And, 3. Singlo tea, from the name of the place where it is cultivated. The boheas are, 1. Souchong, which imparts a yellow green colour by infuſion. 2. Cambo, ſo called from the place where it is made; a fragrant tea, with a violet ſmell; its infuſion pale. 3. Congo, which has a learger leaf than the following, and its infuſion ſomewhat deeper, reſembling common bohea in the colour of the leaf. 4. Pekoe tea; this is known by the appearance of ſmall white flowers mixed with it. 5. Common bohea, whoſe leaves are of one colour. There are other varieties, particularly a kind of green tea, done up in roundiſh balls, called *gunpowder-tea*.

Tea-Tree of New Zealand, is a ſpecies of myrtle, of which an infuſion was drunk by Captain Cook's people in their voyages round the world. Its leaves were finely aromatic, aſtringent, and had a particular pleaſant flavour at the firſt infuſion; but this went off at the next filling up of the tea-pot, and a great degree of bitterneſs was then extracted; for which reaſon it was never ſuffered to be twice infuſed. In a fine ſoil in thick foreſts this tree grows to a conſiderable ſize; ſometimes 30 or 40 feet in height, and one foot in diameter. On a hilly and dry expoſure it degenerates into a ſhrub of five or ſix inches; but its uſual ſize is abought eight or ten feet high, and three inches in diameter. In that caſe its ſtem is irregular and unequal, dividing very ſoon into branches, which ariſe at acute angles, and only bear leaves and flowers at top. The flowers are white, and very ornamental to the whole plant.

Mr White, in his Journal of a Voyage to New South Wales, mentions a ſhrub which he calls a *tea-tree* merely from its being uſed by the convicts as a ſuccedaneum for tea; for he had not ſeen the flower, nor did he know to what genus it belonged. It is a creeping kind of a vine, running to a great extent along the ground; the ſtalk ſlender; the leaf not ſo large as the common bay leaf; the taſte ſweet, exactly like the liquorice root of the ſhops.

TEACHERS, perſons employed in conducting the education of the young.

We will venture to ſay, that there is no claſs of men to whom a nation is ſo much indebted as to thoſe employed in inſtructing the young: For if it be education that forms the only diſtinction between the civilized and the ſavage, much certainly is due to thoſe who devote themſelves to the office of inſtruction. It muſt be the duty therefore of every ſtate to take care that proper encouragement be given to thoſe who undertake this office. There ought to be ſuch a ſalary as would render it an object of ambition to men of abilities and learning, or at leaſt as would keep the teacher reſpectable. In Scotland, the office of a ſchoolmaſter was formerly much more lucrative than at preſent, and moſt of that claſs had received liberal education; and this is the reaſon why the common people in Scotland have been famous even to a proverb, for their learning. But at preſent the ſalary of a country ſchoolmaſter, independent of fees for ſcholars, is not greater than a ploughman can earn, being ſeldom more than 81. 6s. 8d. the conſequence of which is that this, which is in fact an honourable, becauſe an uſeful profeſſion, is now ſinking into contempt. It is no longer an object to a man of learning; and we muſt ſoon be ſatisfied with ſchoolmaſters that can read, write, and caſt accounts, a little better than the loweſt of the people, or who from ſome natural deformity are unable to exerciſe a trade. And what in this caſe muſt become of the minds of the common people? They muſt be totally uncultivated.

Teach. || Te Deu.

We have obſerved a great difference between the cultivation of the common people in one part of Scotland compared with another; and we have found, that whereever a ſchoolmaſter is looked upon as a mean profeſſion there is ſcarcely a duly qualified perſon to be found to undertake the office; and in thoſe places the common people are lamentably ignorant. In other places again, where the ſchoolmaſter is conſidered as one of the principal perſons in the pariſh, there men of a liberal education, young divines, and preachers, do not think themſelves diſgraced by exerciſing this profeſſion; and there the common people ſhow a degree of acuteneſs, knowledge, and obſervation, and poſſeſs ſuch poliſhed manners, as raiſe them very high above thoſe of their own rank in other parts of the country.

Many and keen have been the debates about a reform of government of late years; but little attention has been paid to the formation of the minds of the common people, who conſtitute the greater part of the nation; of courſe they are ready to join the ſtandard of every ſeditious demagogue who ſounds the alarm of oppreſſion; and ſhould they at length be rouſed, their cruelty and barbarity, like the common people of France, would be exactly in proportion to their ignorance and want of principle.

We are willing to hope, then, that the government and the moneyed men of the nation, who alone have property to loſe and money to beſtow, will at length find it to be their intereſt to patronize ſchoolmaſters.

TEAL. See ANAS, ORNITHOLOGY *Index*

TEARS, a lymph or aqueous humour, which is limpid, and a little ſaltiſh: it is ſeparated from the arterial blood by the lachrymal glands and ſmall glandulous grains on the inſide of the eyelids.

TEASELS, a plant cultivated in the weſt of England for the uſe of clothiers. See DIPSACUS, BOTANY *Index*.

TEBETH, the tenth month of the Jewiſh eccleſiaſtical year, and fourth of the civil. It anſwers to our month of December.

TECLENBURG, a town of Germany, in the circle of Weſtphalia, capital of a county of the ſame name, with a caſtle built on a hill. It was bought by the king of Pruſſia in 1707. E. Long. 8. 2. N. Lat. 52. 20.

TECHNICAL, expreſſes ſomewhat relating to arts or ſciences: in this ſenſe we ſay technical terms. It is alſo particularly applied to a kind of verſes wherein are contained the rules or precepts of any art, thus digeſted to help the memory to retain them; an example whereof may be ſeen in the article MEMORY.

TECTONA, TEAK-WOOD, a genus of plants belonging to the claſs pentandria. See BOTANY, p. 139.

TE DEUM, the name of a celebrated hymn, uſed in the Chriſtian church, and ſo called becauſe it begins with theſe words, *Te Deum laudamus*, We praiſe thee, O God. It is ſung in the Romiſh church with great

pomp

pomp and solemnity upon the gaining of a victory, or other happy event; and is believed to be the composition of St Ambrose bishop of *Milan*.

TEES, a river which rises on the confines of Cumberland, and running eastward, divides the county of Durham from Yorkshire, and falls into the German sea below Stockton.

TEETH, the bones placed in the jaws for chewing food, that it may be the more easily digested in the stomach. The anatomical structure of the teeth has already been ascribed under Anatomy. The diseases to which they are liable, as well as the most successful remedies for removing them, are fully detailed under Medicine and Surgery.

Much attention has been paid to the beauty and preservation of the teeth among most nations. The Romans rubbed and washed them with great care; and when they lost them, supplied their place with artificial teeth made of ivory; and sometimes, when loose, bound them with gold. Ligatures of wire have been found to hurt the natural teeth with which the artificial are connected: whereas silken twist cannot affect them to any considerable degree for several years.

Guilleman gives us the composition of a paste for making artificial teeth, which shall never grow yellow: the composition is white wax granulated, and melted with a little gum elemi, adding powder of white mastich, coral, and pearl.

When several teeth are out in the same place, it is best to make a set, or the number wanted, out of one piece, all adhering together, which may be fastened to the two next of the sound or natural teeth. And even a whole set of artificial teeth may be made for one or both jaws, so well fitted to admit of the necessary motions, and so conveniently retained in the proper situation by means of springs, that they will answer every purpose of natural teeth, and may be taken out, cleaned, and replaced, by the patient himself with great ease.

The common trick of mountebanks and other such practitioners, is to use various washes for teeth, the sudden effects of which, in cleaning and whitening the teeth, surprise and please people; but the effects are very pernicious. All the strong acid spirits will do this. As good a mixture as any thing can be, on this occasion, is the following: take plantane-water an ounce, honey of roses two drams, muriatic acid ten drops; mix the whole together, and rub the teeth with a piece of linen rag dipped in this every day till they are whitened. The mouth ought to be well washed with cold water after the use of this or any other acid liquor; and indeed the best of all teeth washes is cold water, with or without a little salt; the constant use of this will keep them clean and white, and prevent them from aching.

After all the numerous cures which have been proposed for preventing the toothach, we will venture to recommend the keeping the teeth clean as the most efficacious, and avoiding every kind of hot food, especially hot liquids, as tea, &c. They who are constantly using powders generally destroy their teeth altogether, as the valetudinarian does his health.

TEETHING in children. See Medicine.

TEFF, a kind of grain, sown all over Abyssinia, from which is made the bread commonly used throughout the country. We have no description of this plant but from Mr Bruce, who says that it is herbaceous; and that from a number of weak leaves surrounding the root proceeds a stalk of about 28 inches in length, not perfectly straight, smooth, but jointed or knotted at particular distances. This stalk is not much thicker than that of a carnation or julyflower. About eight inches from the top, a head is formed of a number of small branches, upon which it carries the fruit and flowers; the latter of which is small, of a crimson colour, and scarcely perceptible by the naked eye but from the opposition of that colour. The pistil is divided into two, seemingly attached to the germ of the fruit, and has at each end small capillaments forming a brush. The stamina are three in number; two on the lower side of the pistil, and one on the upper. These are each of them crowned with two oval stigmata, at first green, but after crimson. The fruit is formed in a capsula, consisting of two conical hollow leaves, which, when closed, seems to compose a small conical pod, pointed at the top. The fruit or seed is oblong, and is not so large as the head of the smallest pin; yet it is very prolific, and produces these seeds in such quantity as to yield a very abundant crop in the quantity of meal. Teff.

Our author, from the similarity of the names, conjectures it to be the *tipha* mentioned, but not described, by Pliny; but this conjecture, which he acknowledges to be unsupported, is of very little importance.

There are three kinds of meal made from teff, of which the best (he says) is as white as flour, exceedingly light, and easily digested; the second is of a browner colour; and the last, which is the food of soldiers and servants, is nearly black. This variety he imagines to arise entirely from the difference of soils in which the seeds are sown, and the different degrees of moisture to which the plant is exposed when growing. The manner of making the meal or flour into bread is by taking a broad earthen jar, and having made a lump of it with water, they put it into an earthen jar at some distance from the fire, where it remains till it begins to ferment or turn sour; they then bake it into cakes of a circular form, and about two feet in diameter: it is of a spungy soft quality, and not a disagreeable sourish taste. Two of these cakes a-day, and a coarse cotton cloth once a-year, are the wages of a common servant.

At their banquets of raw meat, the flesh being cut in small bits, is wrapt up in pieces of this bread, with a proportion of fossil salt and Cayenne pepper. Before the company sits down to eat, a number of these cakes of different qualities are placed one upon the other, in the same manner as our plates, and the principal people sitting first down, eat the white teff; the second or coarser sort serves the second rate people that succeed them, and the third is for the servants. Every man, when he is done, dries or wipes his fingers upon the bread which he is to leave for his successor, for they have no towels; and this is one of the most beastly customs among them.

Of this teff bread the natives makes a liquor, by a process which our author describes in the following words: The bread, when well toasted, is broken into small pieces, which are put into a large jar, and have warm water poured upon them. It is then set by the fire, and frequently stirred for several days, the mouth of the jar being close covered. After being allowed to settle three or four days, it acquires a sourish taste, and is what they call *bouza*, or the common beer of the country. The bouza in Atbara is made in the same manner, only instead

Teff || Tegerhy.

ſtead of teff, cakes of barley meal are employed. Both are very bad liquors, but the worſt is that made of barley.

TEFFLIS, or TIFFLIS, a town of Aſia, in Georgia, one of the ſeven nations between the Black ſea and the Caſpian. It is the capital of that country, the place of reſidence of its ſovereign, and is called by the inhabitants *Thilis-Cabar*, "warm town," from the warm baths in its neighbourhood. Though its circumference does not exceed two Engliſh miles, it contains 20,000 inhabitants, of which more than half are Armenians; the remainder are principally Georgians, with ſome Tartars. According to Major Rennel, it has 20 Armenian and 15 Greek churches, and three metſheds. But Mr Coxe, on the authority of Profeſſor Guldenſtaedt, ſtates the places of worſhip to be one Roman Catholic, 13 Greek, and ſeven Armenian churches. There are ſome magnificent caravanſeras, bazars, and palaces in the city, but no moſques; for the Georgians, though living under a Mohammedan government, have always riſen up in arms as often as any attempts have been made to erect ſuch places of Mohammedan worſhip. Many of the Romiſh miſſionaries live here in diſguiſe under the denomination of phyſicians, ſurgeons, and chemiſts; and the great cures which they perform procure them much eſteem, though they are ſometimes expoſed to the inſults of the people when they attempt to make any proſelytes to their church. All the houſes are of ſtone, with flat roofs, which ſerve, according to the cuſtoms of the Eaſt, as walks for the women. They are neatly built; the rooms are wainſcotted, and the floors ſpread with carpets. The ſtreets ſeldom exceed ſeven feet in breadth; and ſome are ſo narrow as ſcarcely to allow room for a man on horſeback: they are conſequently very filthy.

Tefflis is a place of conſiderable trade, eſpecially in furs, which are conveyed hence to Conſtantinople by the way of Erzerum. As for the ſilks of this country, they are bought up on the ſpot by the Armenians, and conveyed to Smyrna and other ports of the Mediterranean; but the greateſt part is firſt ſent to Erzerum to be manufactured, the Georgians being very ignorant and unſkilful in that reſpect. From hence, likewiſe, great quantities of a root called *boya* is ſent to Erzerum and Indoſtan for the uſe of the linen dyers. Here is likewiſe a foundery, at which are caſt a few cannon, mortars, and balls, all of which are very inferior to thoſe of the Turks. The gunpowder made here is very good. The Armenians have likewiſe eſtabliſhed in this town all the manufactures carried on by their countrymen in Perſia: the moſt flouriſhing is that of printed linens. Tefflis is ſeated on the river Kur, at the foot of a mountain; and on the ſouth ſide of it ſtands a large caſtle or fortreſs, built by the Turks in 1576, when they made themſelves maſters of the city and country, under the command of the famous Muſtapha Pacha. It is 125 miles weſt of Terki. E. Long. 63. 3. N. Lat. 41. 59.

TEGERHY, a principal town in Fezzan, in Africa, about 80 miles ſouth-weſt of the capital. It collects from its lands little other produce than dates and Indian corn. In this, as in every town in Fezzan, a market for butcher-meat, corn, fruit, and vegetables, is regularly held. Mutton and goats fleſh are ſold by the quarter without weighing; the uſual price is from 32 to 40 grains of gold-duſt, or four or five ſhillings Engliſh money. The fleſh of the camel, which is much more highly valued, is commonly ſold at a dearer rate, and is divided into ſmaller lots. Agriculture and paſturage ſeem to be the principal occupations.

Tege || Teleg

TEGUMENT, any thing that ſurrounds or covers another.

TEIND, in *Scots Law*. See LAW, N° clxx.

Commiſſion of TEINDS. See COMMISSION.

TEINTS, and SEMITEINTS, in *Painting*, denote the ſeveral colours uſed in a picture, conſidered as more or leſs high, bright, deep, thin, or weakened and diminiſhed, &c. to give the proper relievo, ſoftneſs, or diſtance &c. of the ſeveral objects.

TELEGRAPH (derived from τηλε and γραφω), is the name very properly given to an inſtrument, by means of which information may be almoſt inſtantaneouſly conveyed to a conſiderable diſtance.

The telegraph, though it has been generally known and uſed by the moderns only for a few years, is by no means a modern invention. There is reaſon to believe that amongſt the Greeks there was ſome ſort of telegraph in uſe. The burning of Troy was certainly known in Greece very ſoon after it happened, and before any perſon had returned from thence. Now that was altogether ſo tedious a piece of buſineſs, that conjecture never could have ſupplied the place of information. A Greek play begins with a ſcene, in which a watchman deſcends from the top of a tower in Greece, and gives the information that Troy was taken. "I have been looking out theſe ten years (ſays he) to ſee when that would happen, and this night it is done." Of the antiquity of a mode of conveying intelligence quickly to a great diſtance, this is certainly a proof.

The Chineſe, when they ſend couriers on the great canal, or when any great man travels there, make ſignals by fire from one day's journey to another, to have every thing prepared; and moſt of the barbarous nations uſed formerly to give the alarm of war by fires lighted on the hills or riſing grounds.

Polybius calls the different inſtruments uſed by the ancients for communicating information πυρσοι, *pyrſiæ*, becauſe the ſignals were always made by means of fire. At firſt they communicated information of events merely by torches; but this method was of little uſe, becauſe it was neceſſary before-hand to fix the meaning of every particular ſignal. Now as events are exceedingly various, it was impoſſible to expreſs the greater number of them by any premeditated contrivance. It was eaſy, for inſtance, to expreſs by ſignals that a fleet had arrived at ſuch a place, becauſe this had been foreſeen, and ſignals accordingly had been agreed upon to denote it; but an unexpected revolt, a murder, and ſuch accidents, as happen but too often, and require an immediate remedy, could not be communicated by ſuch ſignals; becauſe to foreſee them was impoſſible.

Æneas, a contemporary of Ariſtotle, who wrote a treatiſe on the duties of a general, endeavoured to correct thoſe imperfections, but by no means ſucceeded. "Thoſe (ſays he) who would give ſignals to one another upon affairs of importance, muſt firſt prepare two veſſels of earth, exactly equal in breadth and depth; and they need be but four feet and a half deep, and a foot and a half wide. They then muſt take pieces of cork, proportioned to the mouth of theſe veſſels, but not quite ſo wide, that they may be let down with eaſe to the bottom of theſe veſſels. They next fix in the middle of this

Polyb. book chap.

Fig. 1.

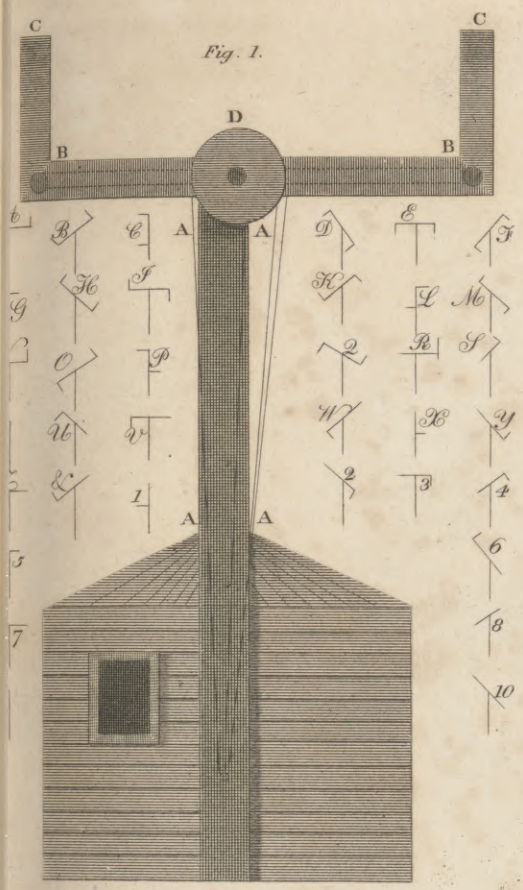
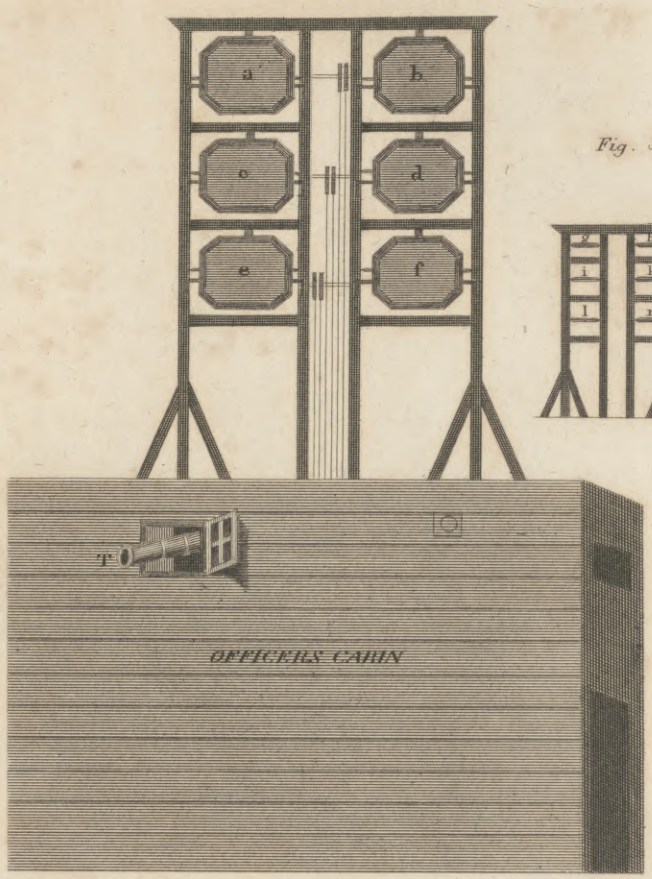


Fig. 2.



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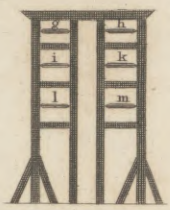
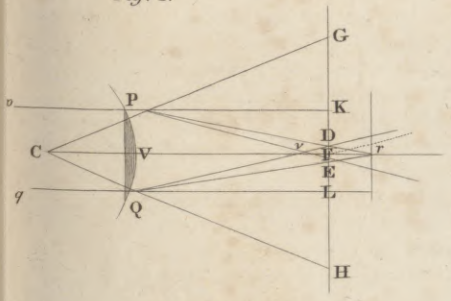


TELESCOPE.

Fig. 1.



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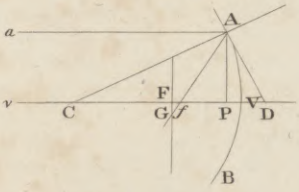


Fig. 2.

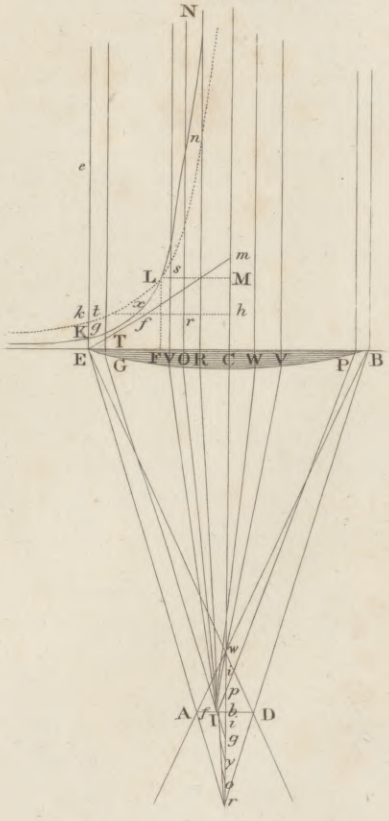


Fig. 4.

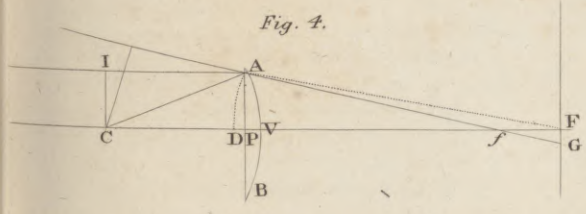
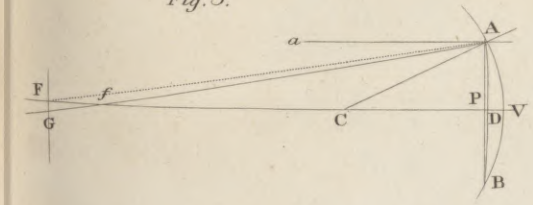


Fig. 5.



E. Mitchell Sculp.

Tele aph. this cork a ſtick, which muſt be of equal ſize in both theſe veſſels. This ſtick muſt be divided exactly and diſtinctly, by ſpaces of three inches each, in order that ſuch events as generally happen in war may be written on them. For example, on one of theſe ſpaces the following words may be written: 'A BODY OF HORSE ARE MARCHED INTO THE COUNTRY.' On another, 'A BODY OF INFANTRY, heavily armed, are arrived hither.' On a third, 'INFANTRY LIGHTLY ARMED. On a fourth, 'HORSE AND FOOT.' On another, 'SHIPS;' then 'PROVISIONS;' and ſo on till all the events which may probably happen in the war that is carrying on are marked in theſe intervals.

This being done, each of the two veſſels muſt have a little tube or cock of equal bigneſs, to let out the water in equal proportion. Then the two veſſels muſt be filled with water; the pieces of cork, with their ſticks thruſt through them, muſt be laid upon them, and the cocks muſt be opened. Now, it is plain, that as theſe veſſels are equal, the corks will ſink, and the ſticks deſcend lower in the veſſels, in proportion as they empty themſelves. But to be more certain of this exactneſs, it will be proper to make the experiment firſt, and to examine whether all things correſpond and agree together, by an uniform execution on both ſides. When they are well aſſured of this, the two veſſels muſt be carried to the two places where the ſignals are to be made and obſerved: water is poured in, and the corks and ſticks are put in the veſſels. When any of the events which are written on the ſticks ſhall happen, a torch or other light is raiſed, which muſt be held aloft till ſuch time as another is raiſed by the party to whom it is directed. (This firſt ſignal is only to give notice that both parties are ready and attentive). Then the torch or other light muſt be taken away, and the cocks ſet open. When the interval, that is that part of the ſtick where the event of which notice is to be given or written, ſhall be fallen to a level with the veſſels, then the man who gives the ſignal lifts up his torch; and on the other ſide, the correſpondent ſignal-maker immediately turns the cock of his veſſel, and looks at what is writ on that part of the ſtick which touches the mouth of the veſſel: on which occaſion, if every thing has been executed exactlly and equally on both ſides, both will read the ſame thing."

This method was defective, becauſe it could not convey any other intelligence except what was written on the ſticks, and even that not particularly enough. With regard to all unforeſeen events, it was quite uſeleſs.

Pol us, bid A new method was invented by Cleoxenus (others ſay by Democlitus), and very much improved by Polybius, as he himſelf informs us. He deſcribes this method as follows: Take the letters of the (Greek) alphabet, and divide them into five parts, each of which will conſiſt of five letters, except the laſt diviſion, which will have only four. Let theſe be fixed on a board in five columns. The man who is to give the ſignals is then to begin by holding up two torches, which he is to keep aloft till the other party has alſo ſhown two. This is only to ſhow that both ſides are ready. Theſe firſt torches are then withdrawn. Both parties are provided with boards, on which the letters are diſpoſed as formerly deſcribed. The perſon who then gives the ſignal is to hold up torches on the left to point out to the other party from what column he ſhall take the letters as they are pointed out to him. If it is to be from the firſt column, he holds up one torch; if from the ſecond, two; and ſo on for the others. He is then to hold up torches on the right, to denote the particular letter of the column that is to be taken. All this muſt have been agreed on before-hand. The man who gives the ſignals muſt have an inſtrument (διοπτρων), conſiſting of two tubes, and ſo placed as that, by looking through one of them, he can ſee only the right ſide, and through the other only the left, of him who is to anſwer. The board muſt be ſet up near this inſtrument; and the ſtation on the right and left muſt be ſurrounded with a wall (παρεμπεφραχθαι) ten feet broad, and about the height of a man, that the torches raiſed above it may give a clear and ſtrong light, and that when taken down they may be completely concealed. Let us now ſuppoſe that this information is to be communicated.—*A number of the auxiliaries, about a hundred, have gone over to the enemy.* In the firſt place, words muſt be choſen that will convey the information in the feweſt letters poſſible; as, *A hundred Cretans have deſerted*, Κρητες εκατον απ' ημων ηυλωμοληκαν. Having written down this ſentence, it is conveyed in this manner. The firſt letter is a K, which is in the ſecond column; two torches are therefore to be raiſed on the left hand to inform the perſon who receives the ſignals to look into that particular column. Then five torches are to be held up on the right, to mark the letter *k*, which is the laſt in the column. Then four torches are to be held up on the left to point out the ρ (*r*), which is in the fourth column, and two on the right to ſhow that it is the ſecond letter of that column. The other letters are pointed out in the ſame manner. —Such was the *pyrſia* or telegraph recommended by Polybius. Telegraph.

But neither this nor any other method mentioned by the ancients ſeems ever to have been brought into general uſe; nor does it appear that the moderns had thought of ſuch a machine as a *telegraph* till the year 1663, when the Marquis of Worceſter, in his CENTURY OF INVENTIONS, affirmed that he had diſcovered "a method by which, at a window, as far as eye can diſcover black from white, a man may hold diſcourſe with his correſpondent, without noiſe made or notice taken; being according to occaſion given, or means afforded, *ex re nata*, and no need of proviſion before hand; though much better if foreſeen, and courſe taken by mutual conſent of parties." This could be done only by means of a telegraph, which in the next ſentence is declared to have been rendered ſo perfect, that by means of it the correſpondence could be carried on "by night as well as by day, though as dark as pitch is black."

About 40 years afterwards M. Amontons propoſed a new telegraph. His method was this: Let there be people placed in ſeveral ſtations, at ſuch a diſtance from one another, that by the help of a teleſcope a man in one ſtation may ſee a ſignal made in the next before him; he muſt immediately make the ſame ſignal, that it may be ſeen by perſons in the ſtation next after him, who are to communicate it to thoſe in the following ſtation, and ſo on. Theſe ſignals may be as letters of the alphabet, or as a cipher, underſtood only by the two perſons who are in the diſtant places, and not by thoſe who make the ſignals. The perſon in the ſecond ſtation making the ſignal to the perſon in the third the very moment he ſees it in the firſt, the news may be carried to the greateſt

Telegraph.

diſtance in as little time as is neceſſary to make the ſignals in the firſt ſtation. The diſtance of the ſeveral ſtations, which muſt be as few as poſſible, is meaſured by the reach of a teleſcope. Amontons tried this method in a ſmall tract of land before ſeveral perſons of the higheſt rank at the court of France.

It was not, however, till the French revolution that the telegraph was applied to uſeful purpoſes. Whether M. Chappe, who is ſaid to have invented the telegraph firſt uſed by the French about the end of 1793, knew any thing of Amontons's invention or not, it is impoſſible to ſay; but his telegraph was conſtructed on principles nearly ſimiliar. The manner of uſing this telegraph was as follows: At the firſt ſtation, which was on the roof of the palace of the Louvre at Paris, M. Chappe, the inventor, received in writing, from the committee of public welfare, the words to be ſent to Liſle, near which the French army at that time was. An upright poſt was erected on the Louvre, at the top of which were two tranſverſe arms, moveable in all directions by a ſingle piece of mechaniſm, and with inconceivable rapidity. He invented a number of poſitions for theſe arms, which ſtood as ſigns for the letters of the alphabet; and theſe, for the greater celerity and ſimplicity, he reduced in number as much as poſſible. The grammarian will eaſily conceive that ſixteen ſigns may amply ſupply all the letters of the alphabet, ſince ſome letters may be omitted not only without detriment but with advantage. Theſe ſigns, as they were arbitrary, could be changed every week; ſo that the ſign of B for one day might be the ſign of M the next; and it was only neceſſary that the perſons at the extremity ſhould know the key. The intermediate operators were only inſtructed generally in theſe ſixteen ſignals; which were ſo diſtinct, ſo marked, ſo different the one from the other, that they were eaſily remembered. The conſtruction of the machine was ſuch, that each ſignal was uniformly given in preciſely the ſame manner at all times: It did not depend on the operator's manual ſkill; and the poſition of the arm could never, for any one ſignal, be a degree higher or a degree lower, its movement being regulated mechanically.

M. Chappe having received at the Louvre the ſentence to be conveyed, gave a known ſignal to the ſecond ſtation, which was Mont Martre, to prepare. At each ſtation there was a watch tower, where teleſcopes were fixed, and the perſon on watch gave the ſignal of preparation which he had received, and this communicated ſucceſſively through all the line, which brought them all into a ſtate of readineſs. The perſon at Mont Martre then received, letter by letter, the ſentence from the Louvre, which he repeated with his own machine; and this was again repeated from the next height, with inconceivable rapidity, to the final ſtation at Liſle.

Engliſh Review, June 1796.

The firſt deſcription of the telegraph was brought from Paris to Frankfort on the Maine by a former member of the parliament of Bourdeaux, who had ſeen that which was erected on the mountain of Belville. As given by Dr Hutton from ſome of the Engliſh papers, it is as follows. AA is a beam or maſt of wood placed upright on a riſing ground (fig. 1.), which is about 15 or 16 feet high. BB is a beam or balance moving upon the centre AA. This balance-beam may be placed vertically or horizontally, or any how inclined, by means of ſtrong cords, which are fixed to the wheel D, on the edge of which is a double groove to receive the two cords. This balance is about 11 or 12 feet long, and nine inches broad, having at the ends two pieces of wood CC, which likewiſe turn upon angles by means of four other cords that paſs through the axis of the main balance, otherwiſe the balance would derange the cords; the pieces C are each about three feet long, and may be placed either to the right or left, ſtraight or ſquare, with the balance-beam. By means of theſe three the combination or movement is very extenſive, remarkably ſimple, and eaſily performed. Below is a ſmall wooden gouge or hut, in which a perſon is employed to obſerve the movements of the machine. In the mountain neareſt to this another perſon is to repeat theſe movements, and a third to write them down. The time taken up for each movement is 20 ſeconds; of which the motion alone is four ſeconds, the other 16 the machine is ſtationary. Two working models of this inſtrument were executed at Frankfort, and ſent by Mr W. Playfair to the duke of York; and hence the plan and alphabet of the machine came to England.

Plate DXXVIII. fig. 1.

Various experiments were in conſequence tried upon telegraphs in this country; and one was ſoon after ſet up by government in a chain of ſtations from the admiralty-office to the ſea coaſt. It conſiſts of ſix octagon boards, each of which is poiſed upon an axis in a frame, in ſuch a manner that it can be either placed vertically, ſo as to appear with its full ſize to the obſerver at the neareſt ſtation, as in fig. 2. or it becomes inviſible to him by being placed horizontally, as in fig. 3. ſo that the narrow edge alone is expoſed, which narrow edge is from a diſtance inviſible. Fig. 2. is a repreſentation of this telegraph, with the parts all ſhut, and the machine ready to work. T, in the officer's cabin, is the teleſcope pointed to the next ſtation. Fig. 3. is a repreſentation of the machine not at work, and with the ports all open. The opening of the firſt port (fig. 2.) expreſſes *a*, the ſecond *b*, the third *c*, the fourth *d*, the fifth *e*, the ſixth *f*, &c.

Six boards make 36 changes, by the moſt plain and ſimple mode of working; and they will make many more if more were neceſſary: but as the real ſuperiority of the telegraph over all other modes of making ſignals conſiſts in its making letters, we do not think that more changes than the letters of the alphabet, and the ten arithmetical ciphers, are neceſſary; but, on the contrary, that thoſe who work the telegraphs ſhould avoid communicating by words or ſigns agreed upon to expreſs ſentences; for that is the ſure method never to become expert at ſending unexpected intelligence accurately.

This telegraph is without doubt made up of the beſt number of combinations poſſible; five boards would be inſufficient, and ſeven would be uſeleſs. It has been objected to it, however, that its form is too clumſy to admit of its being raiſed to any conſiderable height above the building on which it ſtands; and that it cannot be made to change its direction, and conſequently cannot be ſeen but from one particular point.

Several other telegraphs have been propoſed to remedy theſe defects, and perhaps others to which the inſtrument is ſtill liable. The dial-plate of a clock would make an excellent telegraph, as it might exhibit 144 ſigns ſo as to be viſible at a great diſtance. A telegraph on this principle, with only ſix diviſions inſtead of twelve,

Tel. twelve, would be ſimple and cheap, and might be raiſed 20 or 30 feet high above the building, without any difficulty: it might be ſupported on one poſt, and therefore turn round, and the contraſt of colours would always be the ſame.

Supplement for 94. A very ingenious improvement of the telegraph has been propoſed in the Gentleman's Magazine. It conſiſts of a ſemicircle, to be properly elevated, and fixed perpendicularly on a ſtrong ſtand. The radius 12 feet; the ſemicircle conſequently ſomewhat more than 36. This to be divided into 24 parts. Each of theſe will therefore compriſe a ſpace of 18 inches, and an arch of 7° 30′ on the circumference. Theſe 24 diviſions to be occupied by as many circular apertures of ſix inches diameter; which will leave a clear ſpace of ſix inches on each ſide between the apertures. Theſe apertures, beginning from the left, to denote the letters of the alphabet, omitting K, J conſonant, V, X, and Q, as uſeleſs for this purpoſe. There are then 21 letters. The four other ſpaces are reſerved for ſignals. The inſtrument to have an index moveable by a windlaſs on the centre of the ſemicircle, and having two tops, according as it is to be uſed in the day or night; one, a circular top of lacquered iron or copper, of equal diameter with the apertures (and which conſequently will eclipſe any of them againſt which it reſts); the other, a ſpear or arrow-ſhaped top, black and highly poliſhed, which, in ſtanding before any of the apertures in the day-time, will be diſtinctly viſible. In the night, the apertures to be reduced by a diaphragm fitting cloſe to each, ſo as to leave an aperture of not more than two inches diameter. The diaphragm to be of well-poliſhed tin; the inner rim lacquered black half an inch. All the apertures to be illuminated, when the inſtrument is uſed in the night-time, by ſmall lamps; to which, if neceſſary, according to circumſtances, convex lenſes may be added, fitted into each diaphragm, by which the light may be powerfully concentrated and increaſed. Over each aperture one of the five priſmatic colours leaſt likely to be miſtaken (the remaining two being leſs diſtinguiſhable, and not wanted, are beſt omitted) to be painted; and, in their natural order, on a width of eighteen inches and a depth of four, red, orange, yellow, green, blue; or, ſtill to heighten the contraſt, and render immediately ſucceſſive apertures more diſtinguiſhable, red, green, orange, blue, yellow. The whole inner circle beneath and between the apertures to be painted black.

When the inſtrument is to be uſed, the index to be ſet to the ſignal apertures on the right. All the apertures to be covered or dark when it begins to be uſed, except that which is to give the ſignal. A ſignal gun to be fired to appriſe the obſerver. If the index is ſet to the firſt aperture, it will denote that words are to be expreſſed; if to the ſecond, that figures; if to the third, that the figures ceaſe; and that the intelligence is carried on in words. When figures are to be expreſſed, the alternate apertures from the left are taken in their order, to denote from 1 to 10 incluſively; the ſecond from the right denotes 100; the fifth 1000. This order, and theſe intervals, are taken to prevent any confuſion in ſo peculiarly important an article of the intelligence to be conveyed. Telegraph.

Perhaps, however, none of the telegraphs hitherto offered to the public exceeds the following, either in ſimplicity, cheapneſs, or facility in working, and it might perhaps, with a few trifling additions, be made exceedingly diſtinct. It is thus deſcribed in the Repertory of Arts and Manufactures: For a nocturnal telegraph, let there be four large patent reflectors, lying on the ſame plane, parallel to the horizon, placed on the top of an obſervatory. Let each of theſe reflectors be capable, by means of two winches, either of elevation or depreſſion to a certain degree. By elevating or depreſſing one or two of the reflectors, eighteen very diſtinct arrangements may be produced, as the following ſcheme will explain (A). Vol. I. p. 382.

A	B	C	E	F	G
o ooo	o o oo	o oo o	o ooo	 ooo o	 o oo o

I	K	L	M	N	O
 oo o o	 ooo o	oo oo	o o o o	o o oo	 oo oo

P	R	S	T	U	Y
 o o o o	 oo o o	oo o o	o oo o	 o o oo	o oo o

For the ſake of example, the above arrangements are made to anſwer to the moſt neceſſary letters of the alphabet; but alterations may be made at will, and a greater number of changes produced, without any addition to the reflectors. In the firſt obſervatory there need only be a ſet of *ſingle* reflectors; but in the others each reflector ſhould be double, ſo as to face both the preceding and ſubſequent obſervatory; and each obſervatory ſhould be furniſhed with two teleſcopes. The proper diameter of the reflectors, and their diſtance from each other, will be aſcertained by experience.

To convert this machine into a diurnal telegraph, nothing more is neceſſary than to inſert, in the place of the reflectors, gilt balls, or any other conſpicuous bodies.

Were telegraphs brought to ſo great a degree of perfection, that they could convey information ſpeedily and diſtinctly; were they ſo much ſimplified, that they could be conſtructed and maintained at little expence—the advantages which would reſult from their uſe are almoſt inconceivable. Not to ſpeak of the ſpeed with which information could be communicated and orders given in time of war, by means of which misfortunes might be prevented or inſtantly repaired, difficulties removed, and diſputes precluded, and by means of which the whole kingdom could be prepared in an inſtant to oppoſe an

(A) Each reflector, after every arrangement, muſt be reſtored to its place.

Telegraph, Telemachus.

invading enemy; it might be uſed by commercial men to convey a commiſſion cheaper and ſpeedier than an expreſs can travel. The capitals of diſtant nations might be united by chains of poſts, and the ſettling of thoſe diſputes which at preſent take up months or years might then be accompliſhed in as many hours. An eſtabliſhment of telegraphs might then be made like that of the poſt; and inſtead of being an expence, it would produce a revenue. Until telegraphs are employed to convey information that occurs very frequently, the perſons who are ſtationed to work them will never become expert, and conſequently will neither be expeditious nor accurate, though, with practice, there is no doubt but they will attain both in a degree of perfection of which we can as yet have but little conception.

Various other improvements of the telegraph might have been mentioned, but our limits do not permit us to dwell longer on the ſubject.

TELEMACHUS, the ſon of Ulyſſes and Penelope, was ſtill in the cradle when his father went with the reſt of the Greeks to the Trojan war. At the end of this celebrated war, Telemachus, anxious to ſee his father, went to ſeek him; and as the place of his reſidence, and the cauſe of his long abſence, were then unknown, he viſited the court of Menelaus and Neſtor to obtain information. He afterwards returned to Ithaca, where the ſuitors of his mother Penelope had conſpired to murder him, but he avoided their ſnares; and by means of Minerva he diſcovered his father, who had arrived in the iſland two days before him, and was then in the houſe of Eumæus. With this faithful ſervant and Ulyſſes Telemachus concerted how to deliver his mother from the importunities of her ſuitors, and it was effected with great ſucceſs. After the death of his father, Telemachus went to the iſland of Ææa, where he married Circe, or, according to others, Caſſiphone the daughter of Circe, by whom he had a ſon called *Latinus*. He ſome time after had the misfortune to kill his mother-in-law Circe, and fled to Italy, where he founded Cluſium. Telemachus was accompanied in his viſit to Neſtor and Menelaus by the goddeſs of wiſdom under the form of Mentor, It is ſaid that, when a child, Telemachus fell into the ſea, and that a dolphin brought him ſafe to ſhore, after he had remained ſome time under water. From this circumſtance Ulyſſes had the figure of a dolphin engraved on the ſeal which he wore on his ring.

From theſe ſtories, collected from Homer and the other poets of antiquity, the celebrated Fenelon, archbiſhop of Cambray, took the idea of his well-known *Adventures of Telemachus*; which, though not compoſed in verſe, is juſtly intitled to be eſteemed a poem.

Lectures on Rhetoric and the Belles Lettres.

"The plan of the work (ſays Dr Blair) is in general well contrived; and is deficient neither in epic grandeur nor unity of object. The author has entered with much felicity into the ſpirit and ideas of the ancient poets, particularly into the ancient mythology, which retains more dignity, and makes a better figure in his hands than in thoſe of any other modern poet. His deſcriptions are rich and beautiful; eſpecially of the ſofter and calmer ſcenes, for which the genius of Fenelon was beſt ſuited; ſuch as the incidents of paſtoral life, the pleaſures of virtue, or a country flouriſhing in peace. There is an inimitable ſweetneſs and tenderneſs in ſeveral of the pictures of this kind which he has given;" and his meaſured proſe, which is remarkably harmonious, gives the ſtyle nearly as much elevation as the French language is capable of ſupporting even in regular verſe.

Telem chu ll Telet

According to the ſame eminent critic, "the beſt executed part of the work is the firſt ſix books, in which Telemachus recounts his adventures to Calypſo. The narration throughout them is lively and intereſting. Afterwards, eſpecially in the laſt 12 books, it becomes more tedious and languid; and in the warlike adventures which are attempted, there is a great defect of vigour. The chief objection againſt this work being claſſed with epic poems, ariſes from the minute details of virtuous policy, into which the author in ſome places enters; and from the diſcourſes and inſtructions of Mentor, which recur upon us too often, and too much in the ſtrain of common-place morality. Though theſe were well ſuited to the main deſign of the author, which was to form the mind of a young prince, yet they ſeem not congruous to the nature of epic poetry; the object of which is to improve us by means of actions, characters, and ſentiments, rather than by delivering profeſſed and formal inſtruction."

TELEPHIUM, True Orpine, a genus of plants belonging to the claſs pentandria; and in the natural ſyſtem ranging under the 54th order, *Miſcellaneæ*. See Botany *Index*.

TELESCOPE, an optical inſtrument for viewing diſtant objects; ſo named by compounding the Greek words τηλη, *far off*, and σκοπεω, *I look at* or *contemplate*. This name is commonly appropriated to the larger ſizes of the inſtrument, while the ſmaller are called perspective-glasses, spy-glasses, opera-glasses. A particular kind, which is thought to be much brighter than the reſt, is called a night-glass.

To what has been ſaid already with reſpect to the inventor of this moſt noble and uſeful inſtrument in the article Optics, we may add the two following claims.

Mr Leonhard Digges, a gentleman of the 17th century of great and various knowledge, poſitively aſſerts in his *Stratioticos*, and in another work, that his father, a military gentleman, had an inſtrument which he uſed in the field, by which he could bring diſtant objects near, and could know a man at the diſtance of three miles. He ſays, that when his father was at home he had often looked through it, and could diſtinguiſh the waving of the trees on the oppoſite ſide of the Severn. Mr Digges reſided in the neighbourhood of Briſtol.

Francis Fontana, in his *Celeſtial Obſervations*, publiſhed at Naples in 1646, ſays, that he was aſſured by a Mr Hardy, advocate of the parliament of Paris, a perſon of great learning and undoubted integrity, that on the death of his father, there was found among his things an old tube, by which diſtant objects were diſtinctly ſeen; and that it was of a date long prior to the teleſcope lately invented, and had been kept by him as a ſecret.

It is not at all improbable, that curious people, handling ſpectacle glaſſes, of which there were by this time great varieties, both convex and concave, and amuſing themſelves with their magnifying power and the ſingular effects which they produced in the appearances of things, might ſometimes chance ſo to place them as to produce diſtinct and enlarged viſion. We know perfectly, from the table and ſcheme which Sirturus has given us of the tools or diſhes in which the ſpectacle-

makers

Teleſcope. makers faſhioned their glaſſes, that they had convex lenſes formed to ſpheres of 24 inches diameter, and of 11 inferior ſizes. He has given us a ſcheme of a ſet which he got leave to meaſure, belonging to a ſpectacle-maker of the name of *Rogette* at Corunna in Spain; and he ſays that this man had tools of the ſame ſizes for concave glaſſes. It alſo appears, that it was a general practice (of which we do not know the preciſe purpoſe) to uſe a convex and concave glaſs together. If any perſon ſhould chance to put together a 24-inch convex and a 12-inch concave (wrought on both ſides) at the diſtance of ſix inches, he would have diſtinct viſion, and the object would appear of double ſize. Concaves of ſix inches were not uncommon, and one ſuch combined with the convex of 24, at the diſtance of nine inches, would have diſtinct viſion, and objects would be quadrupled in diameter. When ſuch a thing occurred, it was natural to keep it as a curioſity, although the *rationale* of its operation was not in the leaſt underſtood. We doubt not but that this happened much oftener than in theſe two inſtances. The chief wonder is, that it was not frequent, and taken notice of by ſome writer. It is pretty plain that Galileo's firſt teleſcope was of this kind, made up of ſuch ſpectacle-glaſſes as he could procure; for it magnified only three times in diameter; a thing eaſily procured by ſuch glaſſes as he could find with every ſpectacle-maker. And he could not but obſerve, in his trials of their glaſſes, that the deeper concaves and flatter convexes he employed, he produced the greater amplification; and then he would find himſelf obliged to provide a tool not uſed by the ſpectacle-makers, viz. either a much flatter tool for a convex ſurface, or a much ſmaller ſphere for a concave; and, notwithſtanding his telling us that it was by reflecting on the nature of refraction, and without any inſtruction, we are perſuaded that he proceeded in this very way. His next teleſcope magnified but five times. Now the ſlighteſt acquaintance with the obvious laws of refraction would have directed him at once to a very ſmall and deep concave, which would been much eaſier made, and have magnified more. But he groped his way with ſuch ſpectacle-glaſſes as he could get, till he at laſt made tools for very flat object-glaſſes and very deep eye-glaſſes, and produced a teleſcope which magnified about 25 times. Sirturus ſaw it, and took the meaſures of it. He afterwards ſaw a ſcheme of it which Galileo had ſent to a German prince at Inſpruck, who had it drawn (that is, the circles for the tools) on a table in his gallery. The object-glaſs was a plano-convex, a portion of a ſphere, of 24 inches diameter; the eye-glaſs was a double concave of two inches diameter; the focal diſtances were therefore 24 inches and one inch nearly. This muſt have been a very lucky operation, for Sirturus ſays it was the beſt teleſcope he had ſeen: and we know that it requires the very beſt work to produce this magnifying power with ſuch ſmall ſpheres. Teleſcopes continued to be made in this way for many years; and Galileo, though keenly engaged in the obſervation of Jupiter's ſatellites, being candidate for the prize held out by the Dutch for the diſcovery of the longitude, and therefore much intereſted in the advantage which a convex eye-glaſs would have given him, never made them of any other form. Kepler publiſhed his Dioptrics in 1611; in which he tells us, all that he or others had diſcovered of the law of refraction, viz. that in very ſmall obliquities of incidence, the angle of refraction was nearly one-third of the angle of incidence. This was indeed enough to have pointed out, with ſufficient exactneſs, the conſtruction of every optical inſtrument that we are even now poſſeſſed of; for this proportionality of the angles of incidence and refraction is aſſumed in the conſtruction of the optical figure for all of them; and the deviation from it is ſtill conſidered as the *refinement* of the art, and was not brought to any rule till 50 years after by Huyghens, and called by him ABERRATION. Yet even the ſagacious Kepler ſeems not to have ſeen the advantage of any other conſtruction of the teleſcope; he juſt ſeems to acknowledge the poſſibility of it: and we are ſurpriſed to ſee writers giving him as the author of the aſtronomical teleſcope, or even as hinting at its conſtruction. It is true, in the laſt propoſition he ſhows how a teleſcope may be made *apparently* with a convex eye-glaſs: but this is only a frivolous fancy; for the eye-glaſs is directed to be made convex externally, and a very deep concave on the inſide; ſo that it is, in fact, a meniſcus with the concavity prevalent. In the 86th propoſition, he indeed ſhows that it is poſſible ſo to place a convex glaſs behind another convex glaſs, that an eye ſhall ſee objects diſtinct, magnified, and inverted; and he ſpeaks very ſagaciouſly on the ſubject. After having ſaid that an eye placed behind the point of union of the firſt glaſs will ſee an object inverted, he ſhows that a ſmall part only will be ſeen; and then he ſhows that a convex glaſs, duly proportioned and properly placed, will ſhow more of it. But in ſhowing this, he ſpeaks in a way which ſhows evidently that he had formed no diſtinct notions of the manner in which this effect would be produced, only ſaying vaguely that the convergency of the ſecond glaſs would counteract the divergency beyond the focus of the firſt. Had he conceived the matter with any tolerable diſtinctneſs, after ſeeing the great advantage of taking in a field greater in almoſt any proportion, he would have eagerly catched at the thought, and enlarged on the immenſe improvement. Had he but drawn one figure of the progreſs of the rays through two convex glaſſes, the whole would have been open to his view.

This ſtep, ſo eaſy and ſo important, was reſerved for Father Scheiner, as has been already obſerved in the article OPTICS; and the conſtruction of this author, together with that of Janſen, are the models on which all refracting teleſcopes are now conſtructed; and in all that relates to their magnifying power, brightneſs, and field of viſion, they may be conſtructed on Kepler's principle, that the angles of refraction are in a certain given proportion to the angles of incidence.

But after Huyghens had applied his elegant geometry to the diſcovery of Snellius, viz. the proportionality, not of the angles, but of the ſines, and had aſcertained the aberrations from the foci of infinitely ſlender pencils, the reaſons were clearly pointed out why there were ſuch narrow limits affixed by nature to the performance of optical inſtruments, in conſequence of the indiſtinctneſs of viſion which reſulted from conſtructions where the magnifying power, the quantity of light, or the field of viſion, were extended beyond certain moderate bounds. The theory of aberrations, which that moſt excellent geometer eſtabliſhed, has enabled us to diminiſh this indiſtinctneſs ariſing from any of theſe cauſes; and this

diminution

Teleſcope. diminution is the ſole aim of all the different conſtructions which have been contrived ſince the days of Galileo and Scheiner.

THE deſcription which has been already given of the various conſtructions of teleſcopes in the article OPTICS, is ſufficient for inſtructing the reader in the general principles of their conſtruction, and with moderate attention will ſhow the manner in which the rays of light proceed, in order to enſure the different circumſtances of amplification, brightneſs, and extent of field, and even diſtinctneſs of viſion, in as far as depends on the proper intervals between the glaſſes. But it is inſufficient for giving us a knowledge of the improvements which are aimed at in the different departures from the original conſtructions of Galileo and Scheiner, the advantage of the double eye-glaſs of Huyghens, and the quintuple eye-glaſs of Dollond: ſtill more is it inſufficient for ſhowing us why the higheſt degrees of amplification and moſt extenſive field cannot be obtained by the mere proportion of the focal diſtances of the glaſſes, as Kepler had taught. In ſhort, without the Huyghenian doctrine of aberrations, neither can the curious reader learn the limits of their performance, nor the artiſt learn why one teleſcope is better than another, or in what manner to proceed to make a teleſcope differing in any particular from thoſe which he ſervilely copies.

Although all the improvements in the conſtruction of teleſcopes ſince the publication of Huyghens's Dioptrics have been the productions of this iſland, and although Dr Smith of Cambridge has given the moſt elegant and perſpicuous account of this ſcience that has yet appeared, we do not recollect a performance in the Engliſh language (except the Optics of Emerſon) which will carry the reader beyond the mere ſchoolboy elements of the ſcience, or enable a perſon of mathematical ſkill to underſtand or improve the conſtruction of optical inſtruments. The laſt work on this ſubject of any extent (Dr Prieſtley's Hiſtory of Viſion) is merely a parlour book for the amuſement of half-taught dilettanti, but is totally deficient in the mathematical part, although it is here that the ſcience of optics has her chief claim to pre-eminence, and to the name of a DISCIPLINA ACCURATA. But this would have been *ultra crepidam;* and the author would in all probability have made as poor a figure here as he has done in his attempts to degrade his ſpecies in his Commentaries on the *Vibratiunculæ* of Hartley; motions which neither the author nor his amplificator were able to underſtand or explain. We truſt that our readers, jealous as we are of every thing that ſinks us in the ſcale of nature's works, will pardon this tranſient ejaculation of ſpleen, when our thoughts are called to a ſyſtem which, of *abſolute and unavoidable neceſſity*, makes the DIVINE MIND nothing but a quivering of *that matter* of which it is the AUTHOR and unerring DIRECTOR. *Sed miſſum faciamus.*

We think therefore that we ſhall do the public ſome ſervice, by giving ſuch an account of this *higher branch* of optical ſcience as will at leaſt tend to the complete underſtanding of this noble inſtrument, by which our conceptions of the extent of almighty power, and wiſdom, and beneficence, are ſo wonderfully enlarged. In the proſecution of this we hope that many general rules will emerge, by which artiſts who are not mathematicians may be enabled to conſtruct optical inſtruments with intelligence, and avoid the many blunders and defects which reſult from mere ſervile imitation. Teleſ.

The general aim in the conſtruction of a teleſcope is, to form, by means of mirrors or lenſes, an image of the diſtant object, as large, as bright, and as extenſive as is poſſible, conſiſtently with diſtinctneſs; and then to view the image with a magnifying glaſs in any convenient manner. This gives us an arrangement of our ſubject. We ſhall firſt ſhow the principles of conſtruction of the object-glaſs or mirror, ſo as that it ſhall form an image of the diſtant object with theſe qualities; and then ſhow how to conſtruct the magnifying glaſs or eye-piece, ſo as to preſerve them unimpaired.

This indiſtinctneſs which we wiſh to avoid ariſes from two cauſes; the ſpherical figures of the refracting and reflecting ſurfaces, and the different refrangibility of the differently coloured rays of light. The firſt may be called the SPHERICAL and the ſecond the CHROMATIC indiſtinctneſs; and the deviations from the foci, determined by an elementary theorem, given under OPTICS, may be called the SPHERICAL and the CHROMATIC aberrations.

The limits of a work like this will not permit us to give any more of the doctrine of aberrations than is abſolutely neceſſary for the conſtruction of achromatic teleſcopes; and we muſt refer the reader for a general view of the whole to Euler's *Dioptrics*, and other works of that kind. Dr Smith has given as much as was neceſſary for the compariſon of the merits of different glaſſes of ſimilar conſtruction, and this in a very plain and elegant manner.

We ſhall begin with the aberration of colour, becauſe it is the moſt ſimple.

Let white or compounded light fall perpendicularly on the flat ſide PQ (fig. 1.) of a plano convex lens PVQ, whoſe axis is CV and vertex V. The white ray *p* P falling on the extremity of the lens is diſperſed by refraction at the point P of the ſpherical ſurface, and the red ray goes to the point *r* of the axis, and the violet ray to the point *v*. In like manner the white ray *q* Q is diſperſed by refraction at Q, the red ray going to *r*, and the violet to *v*. The red ray P *r* croſſes the violet ray Q *v* in a point D, and Q *r* croſſes P *v* in a point E; and the whole light refracted and diſperſed by the circumference whoſe diameter is PQ, paſſes through the circular area, whoſe diameter is DE. Suppoſing that the lens is of ſuch a form that it would collect red rays, refracted by its whole ſurface in the point *r*, and violet in the point *v*; then it is evident that the whole light which occupies the ſurface of the lens will paſs through this little circle, whoſe diameter is DE. Therefore white light iſſuing from a point ſo diſtant that the rays may be conſidered as parallel, will not be collected in another point or focus, but will be diſperſed over the ſurface of that little circle: which is therefore called the *circle of chromatic diſperſion;* and the radiant point will be repreſented by this circle. The neighbouring points are in like manner repreſented by circles; and theſe circles encroaching on and mixing with each other, muſt occaſion hazineſs or confuſion, and render the picture indiſtinct. This indiſtinctneſs will be greater in the proportion of the number of circles which are in this manner mixed together. This will be in the proportion of the room that is for them; that is, in proportion to the area of the circle, or in the duplicate proportion P DX fig.

tion

tion of its diameter. Our firſt buſineſs therefore is, to obtain meaſures of this diameter, and to mark the connection between it and the aperture and focal diſtance of the lens.

Let i be to r as the ſine of incidence in glaſs to the ſine of refraction of the red rays; and let i be to v as the ſine of incidence to the ſine of refraction of the violet rays. Then we ſay, that when the aperture PQ is moderate, $v-r : v+r-2i = DE : PQ$, very nearly. For let DE, which is evidently perpendicular to Vr, meet the parallel incident rays in K and L and the radii of the ſpherical ſurface in G and H. It is plain that GPK is equal to the angle of incidence on the poſterior or ſpherical ſurface of the lens; and GPr and GPv are the angles of the refraction of the red and the violet rays; and that GK, GD, and GE, are very nearly as the ſines of thoſe angles, becauſe the angles are ſuppoſed to be ſmall. We may therefore inſtitute this proportion $DE : KD = v-r : r-i$; then, by doubling the conſequents $DE : 2KD = v-r : 2r-2i$. Alſo $DE : 2KD + DE = v-r : 2r-2i+v-r$, $= v-r : r+v-2i$. But $2KD + DE$ is equal to KL or PQ. Therefore we have $DE : PQ = v-r : r+v-2i$. Q. E. D.

Cor. 1. Sir Iſaac Newton, by moſt accurate obſervation, found, that in common glaſs the ſines of refraction of the red and violet rays were 77 and 78 where the ſine of incidence was 50. Hence it follows, that $v-r$ is to $v+r-2i$ as 1 to 55; and that the diameter of the ſmalleſt circle of diſperſion is $\frac{1}{55}$th part of that of the lens.

2. In like manner may be determined the circle of diſperſion that will comprehend the rays of any particular colour or ſet of colours. Thus all the orange and yellow will paſs through a circle whoſe diameter is $\frac{1}{200}$th of that of the lens.

3. In different ſurfaces, or plano-convex lenſes, the angles of aberration rPv are as the breadth PQ directly, and as the focal diſtance VF inverſely; becauſe any angle DPE is as its ſubtenſe DE directly and radius DP inverſely. N. B. We call VF the focal diſtance, becauſe at this diſtance, or at the point F, the light is moſt of all conſtipated. If we examine the focal diſtance by holding the lens to the ſun, we judge it to be where the light is drawn into the ſmalleſt ſpot.

When we reflect that a lens of $5\frac{1}{2}$ inches in diameter has a circle of diſperſion $\frac{1}{10}$th of an inch in diameter, we are ſurpriſed that it produces any picture of an object that can be diſtinguiſhed. We ſhould not expect greater diſtinctneſs from ſuch a lens than would be produced in a camera obſcura without a lens, by ſimply admitting the light through a hole of $\frac{1}{10}$th of an inch in diameter. This, we know, would be very hazy and confuſed. But when we remark the ſuperior vivacity of the yellow and orange light in compariſon with the reſt, we may believe that the effect produced by the confuſion of the other colours will be much leſs ſenſible. But a ſtronger reaſon is, that the light is much denſer in the middle of the circle of diſperſion, and is exceedingly faint towards the margin. This, however, muſt not be taken for granted; and we muſt know diſtinctly the manner in which the light of different colours is diſtributed over the circle of chromatic diſperſion, before we pretend to pronounce on the immenſe difference between the indiſtinctneſs ariſing from colour and that ariſing from the ſpherical figure. We think this the more neceſſary, becauſe the illuſtrious diſcoverer of the chromatic aberration has made a great miſtake in the compariſon, becauſe he did not conſider the diſtribution of the light in the circle of ſpherical diſperſion. It is therefore proper to inveſtigate the chromatic diſtribution of the light with the ſame care that we beſtowed on the ſpherical diſperſion in Optics, and we ſhall then ſee that the ſuperiority of the reflecting teleſcope is incomparably leſs than Newton imagined it to be. Teleſcope.

Therefore let EB (fig. 2.) repreſent a plano-convex lens, of which C is the centre and Cr the axis. Let us ſuppoſe it to have no ſpherical aberration, but to collect rays occupying its whole ſurface to ſingle points in the axis. Let a beam of white or compounded light fall perpendicularly on its plane ſurface. The rays will be ſo refracted by its curved ſurface, that the extreme red rays will be collected at r, the extreme violent rays at w, and thoſe of intermediate refrangibility at intermediate points, o, y, g, b, p, v, of the line rw, which is nearly $\frac{1}{23}$th of rC. The extreme red and violet rays will croſs each other at A and D; and AD will be a ſection or diameter of the circle of chromatic diſperſion, and will be about $\frac{1}{55}$th of EB. We may ſuppoſe wr to be biſected in b, becauſe wb is to br very nearly in the ratio of equality (for $rb : r\,C = bA : cE, = bA : cB, = wb : w\,C$). The line rw will be a kind of priſmatic ſpectrum, red from r to o, orange-coloured from o to y, yellow from y to g, green from g to b, blue from b to p, purple from p to v, and violet from v to w. Fig. 2.

The light in its compound ſtate muſt be ſuppoſed uniformly denſe as it falls upon the lens; and the ſame muſt be ſaid of the rays of any particular colour. Newton ſuppoſes alſo, that when a white ray, ſuch as eE, is diſperſed into its component coloured rays by refraction at E, it is uniformly ſpread over the angle DEA. This ſuppoſition is indeed gratuitous; but we have no argument to the contrary, and may therefore conſider it as juſt. The conſequence is, that each point w, v, p, b, &c. of the ſpectrum is not only equally luminous, but alſo illuminates uniformly its correſponding portion of AD: that is to ſay, the coating (ſo to term it) of any particular colour, ſuch as purple, from the point p, is uniformly denſe in every part of AD on which it falls. In like manner, the colouring of yellow, intercepted by a part of AD in its paſſage to the point y, is uniformly denſe in all its parts. But the denſity of the different colours in AD is extremely different: for ſince the radiation in w is equally denſe with that in p, the denſity of the violet colouring, which radiates from w, and is ſpread over the whole of AD, muſt be much leſs than the denſity of the purple colouring, which radiates from p, and occupies only a part of AD round the circle b. Theſe denſities muſt be very nearly in the inverſe proportion of wb^2 to pb^2.

Hence we ſee, that the central point b will be very intenſely illuminated by the blue radiating from pb and the green intercepted from bg. It will be more faintly illuminated by the purple radiating from vp, and the yellow intercepted from gy; and ſtill more faintly by the violet from wv, and the orange and red intercepted from yr. The whole colouring will be a white, tending a little to yellowneſs. The accurate proportion of

theſe

Telescope. these colourings may be computed from our knowledge of the position of the points *o*, *y*, *g*, &c. But this is of little moment. It is of more consequence to be able to determine the proportion of the total intensity of the light in *b* to its intensity in any other point I.

For this purpose draw *r* IR, I *w* W, meeting the lens in R and W. The point I receives none of the light which passes through the space RW: for it is evident that *b* I : CR = *b* A : CE, = 1 : 55, and that CR = CW; and therefore, since all the light incident on EB passes through AB, all the light incident on RW passes through I *i* (*b i* being made = *b* I). Draw *o* IO, *y* IY, *g* IG, I *p* P, I *v* V. It is plain, that I receives red light from RO, orange from OY, yellow from YG, green from GE, a little blue from BP, purple from PV, and violet from VW. It therefore wants some of the green and of the blue.

That we may judge of the intensity of these colours at I, suppose the lens covered with paper pierced with a small hole at G. The green light only will pass through I; the other colours will pass between I and *b*, or between I and A, according as they are more or less refrangible than the particular green at I. This particular colour converges to *g*, and therefore will illuminate a small spot round I, where it will be as much denser than it is at G as this spot is smaller than the hole at G. The natural density at G, therefore, will be to the increased density at I, as $g\,I^2$ to $g\,G^2$, or as $g\,b^2$ to $g\,C^2$, or as $b\,I^2$ to CG^2. In like manner, the natural density of the purple coming to I through an equal hole at P will be to the increased density at I as $b\,I^2$ to CP^2. And thus it appears, that the intensity of the differently coloured illuminations of *any* point of the circle of dispersion, is inversely proportional to the square of the distance from the centre of the lens to the point of its surface through which the colouring light comes to this point of the circle of dispersion. This circumstance will give us a very easy, and, we think, an elegant solution of the question.

Bisect CE in F, and draw FL perpendicular to CE, making it equal to CF. Through the point L describe the hyperbola KLN of the second order, that is, having the ordinates EK, FL, RN, &c. inversely proportional to the squares of the abscissæ CE, CF, CR, &c.; so that $FL : RN = \frac{1}{CF^2} : \frac{1}{CR^2}$, or $= CR^2 : CF^2$, &c. It is evident that these ordinates are proportional to the densities of the severally coloured lights which go from them to any points whatever of the circle of dispersion.

Now the total density of the light at I depends both on the density of each particular colour and on the number of colours which fall on it. The ordinates of this hyperbola determine the first; and the space ER measures the number of colours which fall on I, because it receives light from the whole of ER, and of its equal BW. Therefore, if ordinates be drawn from any point of ER, their sum will be as the whole light which goes to I; that is, the total density of the light at I will be proportional to the area NREK. Now it is known that CE × EK is equal to the infinitely extended area lying beyond EK; and CR × RN is equal to the infinitely extended area lying beyond RN. Therefore the area NREK is equal to CR × RN — CE × EK. But RN and EK are respectively equal to $\frac{CF^3}{CR^2}$ and $\frac{CF^3}{CE^2}$. Therefore the density at I is proportional to $CF^3 \times \left(\frac{CR}{CR^2} - \frac{CE}{CE^2}\right)$, $= CF^3 \times \left(\frac{1}{CR} - \frac{1}{CE}\right)$, $= CF^3 \times \frac{CE - CR}{CE \times CR}$, $= CF^3 \times \frac{ER}{CE \times CR}$, $= \frac{CF^3}{CE} \times \frac{ER}{CR}$. But because CF is $\frac{1}{2}$ of CE, $\frac{CF^3}{CE}$ is $= \frac{CF^3}{2\,CF}$, $= \frac{CF^2}{2}$, a constant quantity. Therefore the density of the light at I is proportional to $\frac{ER}{CR}$, or to $\frac{AI}{b\,I}$, because the points R and I are similarly situated in EC and A *b*.

Farther, if the semiaperture CE of the lens be called 1, $\frac{CF^2}{2}$ is $= \frac{1}{8}$, and the density at I is $= \frac{AI}{8\,b\,I}$.

Here it is proper to observe, that since the point R has the same situation in the diameter EB that the point I has in the diameter AD of the circle of dispersion, the circle described on EB may be conceived as the magnified representation of the circle of dispersion. The point F, for instance, represents the point *f* in the circle of dispersion, which bisects the radius *b* A; and *f* receives no light from any part of the lens which is nearer the centre than F, being illuminated only by the light which comes through EF and its opposite BF′. The same may be said of every other point.

In like manner, the density of the light in *f*, the middle between *b* and A, is measured by $\frac{EF}{CF}$, which is $= \frac{EF}{EF}$, or 1. This makes the density at this point a proper standard of comparison. The density there is to the density at I as 1 to $\frac{AI}{b\,I}$, or as *b* I to AI; and this is the simplest mode of comparison. The density half way from the centre of the circle of dispersion is to the density at any point I as *b* I to IA.

Lastly, through L describe the common rectangular hyperbola *k* L *n*, meeting the ordinates of the former in *k*, L, and *n*: and draw *k h* parallel to EC, cutting the ordinates in *g*, *f*, *r*, &c. Then CR : CE = E *k* : R *n*, and CR : CE — CR = E *k* : R *n* — E *k*, or CR : RE = E *k* : *r n*, and *b* 1 : IA = E *k* : *r n*. And thus we have a very simple expression of the density in any point of the circle of dispersion. Let the point be anywhere, as at I. Divide the lens in R as AD is divided in I, and then *r n* is as the density in I.

These two measures were given by Newton; the first in his *Treatise de Mundi Systemate*, and the last in his *Optics*, but both without demonstration.

If the hyperbola *k* L *n* be made to revolve round the axis CQ, it will generate a solid spindle, which will measure the whole quantity of light which passes through different portions of the circle of dispersion. Thus the solid produced by the revolution of L *k f* will measure all the light which occupies the outer part of the circle of dispersion lying without the middle of the radius. This space is $\frac{3}{4}$ths of the whole circle; but the quantity of light is but $\frac{1}{4}$th of the whole.

Teleſcope. A ſtill more ſimple expreſſion of the whole quantity of light paſſing through different portions of the circle of chromatic diſperſion may now be obtained as follows:

It has been demonſtrated, that the denſity of the light at I is as $\frac{AI}{bI}$, or as $\frac{ER}{CR}$. Suppoſe the figure to turn round the axis. I or R deſcribe circumferences of circles; and the whole light paſſing through this circumference is as the circumference, or as the radius, and as the denſity jointly. It is therefore as $\frac{ER}{CR} \times CR$, that is, as ER. Draw any ſtraight line E*m*, cutting RN in *s*, and any other ordinate FL in *x* R *s*. The whole light which illuminates the circumference deſcribed by I is to the whole light which illuminates the centre *b* as ER to EC, or as R*s* to C*m*. In like manner, the whole light which illuminates the circumference deſcribed by the point *f* in the circle of diſperſion is to the whole light which illuminates the centre *b*, as F*x* to C*m*. The lines C*m*, RS, F*x*, are therefore proportional to the whole light which illuminates the correſponding circumferences in the circle of diſperſion. Therefore the whole light which falls on the circle whoſe radius is *b*I, will be repreſented by the trapezium in CRS; and the whole light which falls on the ring deſcribed by IA, will be repreſented by the triangle E*s*R; and ſo of any other portions.

By conſidering the figure, we ſee that the diſtribution of the light is exceedingly unequal. Round the margin it has no ſenſible denſity; while its denſity in the very centre is incomparably greater than in any other point, being expreſſed by the aſymptote of a hyperbola. Alſo the circle deſcribed with the radius $\frac{Ab}{2}$ contains $\frac{1}{4}$ths of the whole light. No wonder then that the confuſion cauſed by the mixture of theſe circles of diſperſion is leſs than one ſhould expect; beſides, it is evident that the moſt lively or impreſſive colours occupy the middle of the ſpectrum, and are there much denſer than the reſt. The margin is covered with an illumination of deep red and violet, neither of which colours are brilliant. The margin will be of a dark claret colour. The centre revives all the colours, but in a proportion of intenſity greatly different from that in the common priſmatic ſpectrum, becauſe the radiant points L, *p*, *b*, *g*, &c. by which it is illuminated, are at ſuch different diſtances from it. It will be white; but we apprehend not a pure white, being greatly overcharged with the middle colours.

Theſe conſiderations ſhow that the coloured fringes, which are obſerved to border very luminous objects ſeen on a dark ground through optical inſtruments, do not proceed from the object-glaſs of a teleſcope or microſcope, but from an improper conſtruction of the eye-glaſſes. The chromatic diſperſion would produce fringes of a different colour, when they produce any at all, and the colours would be differently diſpoſed. But this diſperſion by the object-glaſs can hardly produce any fringes: its effect is a general and almoſt uniform mixture of circles all over the field, which produces an uniform hazineſs, as if the object were viewed at an improper diſtance, or out of its focus, as we vulgarly expreſs it.

We may at preſent form a good gueſs at the limit which this cauſe puts to the performance of a teleſcope. A point of a very diſtant object is repreſented, in the picture formed by the object-glaſs, by a little circle, whoſe diameter is at leaſt $\frac{1}{100}$th of the aperture of the object-glaſs, making a very full allowance for the ſuperior brilliancy and denſity of the central light. We look at this picture with a magnifying eye-glaſs. This magnifies the picture of the point. If it amplify it to ſuch a degree as to make it an object individually diſtinguiſhable, the confuſion is then ſenſible. Now this can be computed. An object ſubtending one minute of a degree is diſtinguiſhed by the dulleſt eye, even although it be a dark object on a bright ground. Let us therefore ſuppoſe a teleſcope, the object-glaſs of which is of ſix feet focal diſtance, and one inch aperture. The diameter of the circle of chromatic diſperſion will be $\frac{1}{100}$th of an inch, which ſubtends at the centre of the object-glaſs an angle of about $9\frac{1}{2}$ ſeconds. This, when magnified ſix times by an eye-glaſs, would become a diſtinguiſhable object; and a teleſcope of this length would be indiſtinct if it magnified more than ſix times, if a point were thus ſpread out into a ſpot of uniform intenſity. But the ſpot is much leſs intenſe about its margin. It is found experimentally that a pieee of engraving, having fine croſs hatches, is not ſenſibly indiſtinct till brought ſo far from the limits of perfectly diſtinct viſion, that this indiſtinctneſs amounts to 6′ or 5′ in breadth.—Therefore ſuch a teleſcope will be ſenſibly diſtinct when it magnifies 36 times; and this is very agreeable to experience.

Teleſcope.

We come, in the ſecond place, to the more arduous taſk of aſcertaining the error ariſing from the ſpherical figure of the ſurfaces employed in optical inſtruments. —Suffice it to ſay, before we begin, that although geometers have exhibited other forms of lenſes which are totally exempt from this error, they cannot be executed by the artiſt; and we are therefore reſtricted to the employment of ſpherical ſurfaces.

Of all the determinations which have been given of ſpherical aberration, that by Dr Smith, in his Optics, which is an improvement of the fundamental theorem of that moſt elegant geometer Huyghens, is the moſt perſpicuous and palpable. Some others are more conciſe, and much better fitted for after uſe, and will therefore be employed by us in the proſecution of this article. But they do not keep in view the optical facts, giving the mind a picture of the progreſs of the rays, which it can contemplate and diſcover amidſt many modifying circumſtances. By ingenious ſubſtitutions of analytical ſymbols, the inveſtigation is rendered expeditious, conciſe, and certain; but theſe are not immediate ſymbols of things, but of operations of the mind; objects ſufficiently ſubtile of themſelves, and having no need of ſubſtitutions to make us loſe ſight of the real ſubject; and thus our occupation degenerates into a proceſs almoſt without ideas. We ſhall therefore ſet out with Dr Smith's fundamental Theorem.

1. *In Reflections.*

Let AVB (fig. 3.) be a concave ſpherical mirror, of which C is the centre, V the vertex, CV the axis, and F the focus of an infinitely ſlender pencil of parallel rays paſſing Fig. 3.

Telescope. passing through the centre. Let the ray aA, parallel to the axis, be reflected in AG, crossing the central ray CV in f. Let AP be the sine of the semi-aperture AV, AD its tangent, and CD its secant.

The aberration Ff from the principal focus of central rays is equal to $\frac{1}{2}$ of the excess VD of the secant above the radius, or very near equal to $\frac{1}{2}$ of VP, the versed sine of the semi-aperture.

For because AD is perpendicular to CA, the points C, A, D, are in a circle, of which CD is the diameter; and because Af is equal to Cf, by reason of the equality of the angles fAC, fCA, and CA a, f is the centre of the circle through C, A, D, and fD is $= \frac{1}{2}$ CD. But FC is $= \frac{1}{2}$ CV. Therefore Ff is $\frac{1}{2}$ of VD.

But because DV : VP = DC : VC, and DC is very little greater than VC when the aperture AB is moderate, DV is very little greater than VP, and Ff is very nearly equal to $\frac{1}{2}$ of VP.

Cor. 1. The longitudinal aberration is $= \frac{AV^2}{4CV}$, for PV is very nearly $= \frac{AV^2}{2CV}$.

Cor. 2. The lateral aberration FG is $= \frac{AV^3}{2CV^2}$. For FG : Ff = AP : Pf, = AV : $\frac{1}{4}$ CV nearly, and therefore FG $= \frac{AV^3}{4CV} \times \frac{2}{CV} = \frac{AV^3}{2CV^2}$.

2. *In Refractions.*

Fig. 4. or 5. Let AVB (fig. 4. or 5.) be a spherical surface separating two refracting substances, C the centre, V the vertex, AV the semi-aperture, AP its sine, PV its versed sine, and F the focus of parallel rays infinitely near to the axis. Let the extreme ray aA, parallel to the axis, be refracted into AG, crossing CF in f, which is therefore the focus of extreme parallel rays.

The rectangle of the sine of incidence, by the difference of the sines of incidence and refraction, is to the square of the sine of refraction, as the versed sine of the semi-aperture is to the longitudinal aberration of the extreme rays.

Call the sine of incidence i, the sine of refraction r, and their difference d.

Join CA, and about the centre f describe the arch AD.

The angle ACV is equal to the angle of incidence, and CAf is the angle of refraction. Then, since the sine of incidence is to the sine of refraction as VF to CF, or as Af to Cf, that is, as Df to Cf, we have

CF : FV = Cf : fD
by conversion CF : CV = Cf : CD
altern. conver. CF—Cf : CV—CD = CF : CV
or - Ff : VD = CF : CV, $= r : d$.

Now PV $= \frac{AP^2}{CP+CV}$, $= \frac{AP^2}{2CV}$ nearly, and PD $= \frac{AP^2}{fP+fV}$ $= \frac{AP^2}{2fV}$ nearly, $= \frac{AP^2}{2FV}$ nearly. Therefore PV : PD = FV : CV, and DV : PV = CF : FV nearly.

We had above Ff : VD = $r : d$;
and now - VD : PV = CF : FV, $= r : i$;
therefore - Ff : PV = $r^2 : di$,

and Ff $= \frac{r^2}{di} \times$ PV. Q. E. D.

The aberration will be different according as the refraction is made towards or from the perpendicular; that is, according as r is less or greater than i. They are in the ratio of $\frac{r^2}{di}$ to $\frac{i^2}{dr}$, or of r^3 to i^3. The aberration therefore is always much diminished when the refraction is made from a rare into a dense medium. The proportion of the sines for air and glass is nearly that of 3 to 2. When the light is refracted into the glass, the aberration is nearly $\frac{4}{9}$ of PV; and when the light passes out of glass into air, it is about $\frac{9}{4}$ of PV.

Cor. 1. Ff $= \frac{r^2}{di} \times \frac{AP^2}{2CV}$ nearly, and it is also $= \frac{r^2}{d^2} \times \frac{AP^2}{2FV}$, because PV $= \frac{AP^2}{2CV}$ nearly, and $i : d$ = FV : CV.

Cor. 2. Because fP : PA = Ff : FG
or FV : AV = Ff : FG nearly,
we have FG, the lateral aberration, $=$ Ff $\times \frac{AV}{FV}$, $= \frac{r^2}{d^2} \times \frac{AV^3}{2FV^2}$, $= \frac{r^2}{i^2} \times \frac{AV^3}{2CV^2}$.

Cor. 3. Because the angle FAf is proportional to $\frac{FG}{FV}$ very nearly, we have the angular aberration FAf $= \frac{r^2}{d^2} \times \frac{AV^3}{2FV^3} = \frac{r^2}{i^2} \times \frac{AV^3}{2CV^3}$.

In general, the longitudinal aberrations from the focus of central parallel rays are as the squares of the apertures directly, and as the focal distances inversely; and the lateral aberrations are as the cubes of the apertures directly, and the squares of the focal distances inversely; and the angular aberrations are as the cubes of the aperture directly, and the cubes of the focal distances inversely.

The reader must have observed, that to simplify the investigation, some small errors are admitted. PV and PD are not in the exact proportion that we assumed them, nor is Df equal to FV. But in the small apertures which suffice for optical instruments, these errors may be disregarded.

This spherical aberration produces an indistinctness of vision, in the same manner as the chromatic aberration does, viz. by spreading out every mathematical point of the object into a little spot in its picture; which spots, by mixing with each other, confuse the whole. We must now determine the diameter of the circle of diffusion, as we did in the case of chromatic dispersion.

Let a ray $\beta\alpha$ (fig. 6.) be refracted on the other side of the axis, into αHφ, cutting AfG in H, and draw the perpendicular EH. Call AV a, αV α, Vf (or VF, or Vφ, which in this comparison may be taken as equal) $= f$, Ff $= b$, and fE $= \varphi x$.

AV^2 : αV^2 = Ff : Fφ (already demonstrated) and Fφ $= \frac{\alpha^2}{a^2} b$, and Ff—Fφ, (or $f\varphi$) $= b - \frac{\alpha^2}{a^2} b$, $= \frac{a^2b - \alpha^2 b}{a^2}$, $= \frac{b}{a^2} \times a^2 - \alpha^2$, $= \frac{b}{a^2} \times \overline{a+\alpha} \times \overline{a-\alpha}$. Also P$f$: PA $= fE$

Telescope. $= f\mathrm{E} : \mathrm{EH}$, or $f : a = x : \frac{ax}{f}$, $= \mathrm{EH}$. And $\mathrm{P}\pi : \mathrm{P}\varphi = \mathrm{EH} : \mathrm{E}\varphi$, or $\alpha : f = \frac{ax}{f} : \frac{ax}{\alpha}$, $= \mathrm{E}\varphi$. Therefore $f\varphi = \frac{ax}{\alpha} + x$, $= \frac{\overline{a+\alpha}x}{\alpha}$, $= \frac{x}{a} \times \overline{a+\alpha}$. Therefore $\frac{x}{a} \times \overline{a+\alpha} = \frac{b}{a^2} \times \overline{a+\alpha} \times \overline{a-\alpha}$, and $\frac{x}{a} = \frac{b}{a^2} \times \overline{a-\alpha}$, and $x = \frac{b}{a^2} \times \alpha\,(a-\alpha)$. Therefore x is greatest when $\alpha \times \overline{a-\alpha}$ is greatest; that is, when $\alpha = \frac{1}{2}a$. Therefore EH is greatest when $\mathrm{P}\pi$ is equal to the half of AP. When this is the case, we have at the same time $\frac{b}{a^2} \times \alpha\,(a-\alpha) = \frac{b}{a^2} \times \frac{1}{4}a^2$, and $x = \frac{1}{4}b$, or $\mathrm{EH} = \frac{1}{4}\mathrm{FG}$. That is, the diameter of the circle of aberration through which the whole of the refracted light must pass, is $\frac{1}{4}$ of the diameter of the circle of aberration at the focus of parallel central rays. In the chromatic aberration it was $\frac{1}{2}$; so that in this respect the spherical aberration does not create so great confusion as the chromatic.

We are now able to compare them, since we have now the measure of both the circles of aberration.

It has not been found possible to give more than four inches of aperture to an object glass of 100 feet focal distance, so as to preserve sufficient distinctness. If we compute the diameter of the circle EH corresponding to this aperture, we shall find it not much to exceed $\frac{1}{120{,}000}$ of an inch. If we restrict the circle of chromatic dispersion to $\frac{1}{250}$ of the aperture, which is hardly the fifth part of the whole dispersion in it, it is $\frac{1}{62\frac{1}{2}}$ of an inch, and is about 1900 times greater than the other.

The circle of spherical aberration of a plano-convex lens, with the plane side next the distant object, is equal to the circle of chromatic dispersion when the semi-aperture is about 15^0: For we saw formerly that EH is $\frac{1}{4}$ of FG, and that FG is $= \frac{r^2}{i^2} \frac{\mathrm{AP}^3}{2\mathrm{AC}^2}$, and therefore $\mathrm{EG} = \frac{r^2}{i^2} \times \frac{\mathrm{AP}^3}{8\mathrm{AC}^2}$. This being made $= \frac{\mathrm{AP}}{55}$, gives us $\mathrm{AP} = \sqrt{\frac{8i^2\mathrm{AC}^2}{55r^2}}$, which is nearly $\frac{\mathrm{AC}}{4}$, and corresponds to an aperture of 30^0 diameter, if r be to i as 3 to 2.

Sir Isaac Newton was therefore well entitled to say, that it was quite needless to attempt figures which should have less aberration than spherical ones, while the confusion produced by the chromatic dispersion remained uncorrected. Since the indistinctness is as the squares of the diameters of the circles of aberration, the disproportion is quite beyond our imagination, even when Newton has made such a liberal allowance to the chromatic dispersion. But it must be acknowledged, that he has not attended to the distribution of the light in the circle of spherical aberration, and has hastily supposed it to be like the distribution of the coloured light, indefinitely rare in the margin, and denser in the centre.

We are indebted to Father Boscovich for the elegant determination of this distribution, which we have given in the article Optics. From this it appears, that the light in the margin of the circle of spherical aberration, instead of being incomparably rarer than in the spaces between it and the centre, is incomparably denser. The indistinctness therefore produced by the intersection of these luminous circumferences is vastly great, and increases the whole indistinctness exceedingly. By a gross calculation which we made, it appears to be increased at least 500 times. The proportional indistinctness therefore, instead of being 1900^2 to 1, is only $\frac{1900^2}{500}$, or nearly 7220 to 1; a proportion still sufficiently great to warrant Newton's preference of the reflecting telescope of his invention. And we may now observe, that the reflecting telescope has even a great advantage over a refracting one of the same focal distance, with respect to its spherical aberration: For we have seen (*Cor.* 2.) that the lateral aberration is $\frac{r^3}{i^2} \frac{\mathrm{AV}^3}{2\mathrm{CV}^2}$. This for a plano-convex glass is nearly $\frac{9}{4} \frac{\mathrm{AV}^3}{2\mathrm{CV}^2}$. And the diameter of the circle of aberration is one-fourth of this, or $\frac{9}{16} \times \frac{\mathrm{AV}^3}{2\mathrm{CV}^2}$. In like manner, the lateral aberration of a concave mirror is $\frac{\mathrm{AV}^3}{2\mathrm{CV}^2}$; and the diameter of the circle of dispersion is $\frac{\mathrm{AV}^3}{8\mathrm{CV}^2}$; and therefore if the surfaces were portions of the same sphere, the diameter of the circle of aberration of refracted rays would be to that of the circle of aberration of reflected rays as $\frac{9}{16}$ to $\frac{1}{4}$, or as 9 to 4. But when the refracting and reflecting surfaces, in the position here considered, have the same focal distance, the radius of the refracting surface is four times that of the reflecting surface. The proportion of the diameters of the circles of spherical aberration is that of 9×4^2 to 4, or of 144 to 4, or 36 to 1. The distinctness therefore of the reflector is 36×36, or 1296 times greater than that of a plano-convex lens (placed with the plane side next the distant object) of the same breadth and focal distance, and will therefore admit of a much greater magnifying power. This comparison is indeed made in circumstances most favourable to the reflector, because this is the very worst position of a plano-convex lens. But we have not as yet learned the aberration in any other position. In another position the refraction and consequent aberration of both surfaces are complicated.

Before we proceed to the consideration of this very difficult subject, we may deduce from what has been already demonstrated several general rules and maxims in the construction of telescopes, which will explain (to such readers as do not wish to enter more deeply into the subject), and justify the proportion which long practice of the best artists has sanctioned.

Indistinctness proceeds from the commixture of the circles of aberration on the retina of the eye: For any one *sensible* point of the retina, being the centre of a circle of aberration, will at once be affected by the admixture of the rays of as many different pencils of light as there are sensible points in the area of that circle, and will convey to the mind a mixed sensation of as many

Teleſcope. viſible points of the object. This number will be as the area of the circle of aberrations, whatever be the ſize of a ſenſible point of the retina. Now in viſion with teleſcopes, the diameter of the circle of aberration on the retina is as the *apparent* magnitude of the diameter of the correſponding circle in the focus of the eye-glaſs; that is, as the angle ſubtended by this diameter at the centre of the eye-glaſs; that is, as the diameter itſelf directly, and as the focal diſtance of the eye-glaſs inverſely. And the area of that circle on the retina is as the area of the circle on the focus of the eye-glaſs directly, and as the ſquare of the focal diſtance of the eye-glaſs inverſely. And this is the meaſure of the apparent indiſtinctneſs.

Cor. In all ſorts of teleſcopes, and alſo in compound microſcopes, an object is ſeen equally diſtinct when the focal diſtances of the eye-glaſſes are proportional to the diameters of the circles of aberration in the focus of the object-glaſs.

Here we do not conſider the trifling alteration which well conſtructed eye-glaſſes may add to the indiſtinctneſs of the firſt image.

In refracting teleſcopes, the apparent indiſtinctneſs is as the area of the object-glaſs directly, and as the ſquare of the focal diſtance of the eye-glaſs inverſely. For it has been ſhown, that the area of the circle of diſperſion is as the area of the object-glaſs, and that the ſpherical aberration is inſignificant when compared with this.

Therefore, to make reflecting teleſcopes equally diſtinct, the diameter of the object-glaſs muſt be proportional to the focal diſtance of the eye-glaſs.

But in reflecting teleſcopes, the indiſtinctneſs is as the ſixth power of the aperture of the object-glaſs directly, and as the fourth power of the focal diſtance of the object-glaſs and ſquare of the focal diſtance of the eye-glaſs inverſely. This is evident from the dimenſions of the circle of aberration, which was found proportional to $\frac{AV^3}{CV^2}$.

Therefore, to have them equally diſtinct, the cubes of the apertures muſt be proportional to the ſquares of the focal diſtance multiplied by the focal diſtance of the eye-glaſs.

By theſe rules, and a ſtandard teleſcope of approved goodneſs, an artiſt can always proportion the parts of any inſtrument he wiſhes to conſtruct. Mr Huyghens made one, of which the object-glaſs had 30 feet focal diſtance and three inches diameter. The eye-glaſs had 3.3 inches focal diſtance. And its performance was found ſuperior to any which he had ſeen; nor did this appear owing to any chance goodneſs of the object-glaſs, becauſe he found others equally good which were conſtructed on ſimilar proportions. This has therefore been adopted as a ſtandard.

It does not at firſt appear how there can be any difficulty in this matter, becauſe we can always diminiſh the aperture of the object-glaſs or ſpeculum till the circle of aberration is as ſmall as we pleaſe. But by diminiſhing this aperture, we diminiſh the light in the duplicate ratio of the aperture. Whatever be the aperture, the brightneſs is diminiſhed by the magnifying power, which ſpreads the light over a greater ſurface in the bottom of the eye. The apparent brightneſs muſt be as the ſquare of the aperture of the teleſcope directly, and the ſquare of the amplification of the diameter of an object inverſely. Teleſcope. Objects therefore will be ſeen equally bright if the apertures of the teleſcopes be as the focal diſtances of the object-glaſſes directly, and the focal diſtances of the ſingle eye-glaſs (or eye-glaſs equivalent to the eye-piece) inverſely. Therefore, to have teleſcopes equally diſtinct and equally bright, we muſt combine theſe proportions with the former. It is needleſs to go farther into this ſubject, becauſe the conſtruction of refracting teleſcopes has been ſo materially changed by the correction of the chromatic aberration, that there can hardly be given any proportion between the object-glaſs and eye-glaſſes. Every thing now depends on the degree in which we can correct the aberrations of the object-glaſs. We have been able ſo far to diminiſh the chromatic aberration, that we can give very great apertures without its becoming ſenſible. But this is attended with ſo great an increaſe of the aberration of figure, that this laſt becomes a ſenſible quality. A lens which has 30° for its ſemi-aperture, has a circle of aberration equal to its chromatic aberration. Fortunately we can derive from the very method of contrary refractions, which we employ for removing the chromatic aberration, a correction of the other. We are indebted for this contrivance alſo to the illuſtrious Newton.

We call this Newton's contrivance, becauſe he was the firſt who propoſed a conſtruction of an object-glaſs in which the aberration was corrected by the contrary aberrations of glaſs and water.

Huyghens had indeed ſuppoſed, that our all-wiſe Creator had employed in the eyes of animals many refractions in place of one, in order to make the viſion more diſtinct; and the invidious detractors from Newton's fame have catched at this vague conjecture as an indication of his knowledge of the poſſibility of deſtroying the aberration of figure by contrary refractions. But this is very ill-founded. Huyghens has acquired ſufficient reputation by his theory of aberrations. The ſcope of his writing in the paſſage alluded to, is to ſhow that, by dividing any intended refraction into parts, and producing a certain convergence to or divergence from the axis of an optical inſtrument by means of two or three lenſes inſtead of one, we diminiſh the aberrations four or nine times. This conjecture about the eye was therefore in the natural train of his thoughts. But he did not think of deſtroying the aberration altogether by oppoſite refractions. Newton, in 1669, ſays that opticians need not trouble themſelves about giving figures to their glaſſes other than ſpherical. If this figure were all the obſtacle to the improvement of teleſcopes, he could ſhow them a conſtruction of an object-glaſs having ſpherical ſurfaces where the aberration is deſtroyed; and accordingly gives the conſtruction of one compoſed of glaſs and water, in which this is done completely by means of contrary refractions.

The general principle is this: When the radiant point R (fig. 7.), or focus of incident rays, and its conjugate focus F of refracted central rays, are on oppoſite ſides of the refracting ſurface or lens V, the conjugate focus *f* of marginal rays is nearer to R than F is. But when the focus of incident rays R′ lies on the ſame ſide with its conjugate focus F′ for central rays, R′*f*′ is greater than R′ F′. Fig. 7.

Now fig. 8. repreſents the contrivance for deſtroying the colour produced at F, the principal focus of the convex Fig. 8.

Telescope. convex lens V, of crown glass, by means of the contrary refraction of the concave lens *v* of flint glass. The incident parallel rays are made to converge to F by the first lens. This convergence is diminished, but not entirely destroyed, by the concave lens *v*, and the focus is formed in F. F and F′ therefore are conjugate foci of the concave lens. If F be the focus of V for central rays, the marginal rays will be collected at some point *f* nearer to the lens. If F be now considered as the focus of light incident on the centre of *v*, and F′ be the conjugate focus, the marginal ray *p* F would be refracted to some point *f′* lying beyond F′. Therefore the marginal ray *pf* may be refracted to F, if the aberration of the concave be properly adjusted to that of the convex.

This brings us to the most difficult part of our subject, the compounded aberrations of different surfaces. Our limits will not give us room for treating this in the same elementary and perspicuous manner that we employed for a single surface. We must try to do it in a compendious way, which will admit at once the different surfaces and the different refractive powers of different substances. This must naturally render the process more complicated; but we hope to treat the subject in a way easily comprehended by any person moderately acquainted with common algebra; and we trust that our attempt will be favourably received by an indulgent public, as it is (as far as we know) the only dissertation in our language on the construction of achromatic instruments. We cannot but express our surprise at this indifference about an invention which has done so much honour to our country, and which now constitutes a very lucrative branch of its manufacture. Our artists infinitely surpass all the performances of foreigners in this branch, and supply the markets of Europe without any competition; yet it is from the writings on the continent that they derive their scientific instruction, and particularly from the dissertations of Clairaut, who has wonderfully simplified the analysis of optical propositions. We shall freely borrow from him, and from the writings of Abbé Boscovich, who has considerably improved the first views of Clairaut. We recommend the originals to the curious reader. Clairaut's dissertations are to be found in the Memoirs of the Academy of Paris, 1756, &c.; those of Boscovich in the Memoirs of the Academy of Bologna, and in his five volumes of *Opuscula*, published at Bassano in 1785. To these may be added D'Alembert and Euler. The only thing in our language is the translation of a very imperfect work by Schærfer.

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9. *Lemma* 1. In the right-angled triangle MXS (fig. 9.), of which one side MX is very small in comparison of either of the others; the excess of the hypothenuse MS, above the side XS, is very nearly equal to $\frac{MX^2}{2MS}$ or to $\frac{MX^2}{2XS}$. For if about the centre S, with the radius SM, we describe the semicircle AMO, we have $AX \times XO = MX^2$. Now AX = MS—SX, and XO, is nearly equal to 2MS or 2XS; on the other hand, MS is nearly equal to $XS + \frac{MX^2}{2XS}$; and in like manner MG is nearly equal to $\frac{MX}{2XG} + XG$, and MH is nearly equal to $\frac{MX^2}{2XH} + XH$.

Prop. I. Let the ray *m* M, incident on the spherical surface AM, converge to G; that is, let G be the focus of incident rays. It is required to find the focus F of refracted rays?

Let *m* express the ratio of the sine of incidence and refraction; that is, let *m* be to 1 as the sine of incidence to the sine of refraction in the substance of the sphere.

Then - MG : GS = sin. MSH : sin. SMG,
and - *m* : 1 = sin. SMG : sin. SMH;
therefore $m \times MG : GS = \text{sin. MSH} : \text{sin. SMH}$.
Now S, MSH : S, SMH = MH : HS. Therefore, finally,
m MG : GS = MH : HS.

Now let MS, the radius of the refracting surface, be called *a*. Let AG, the distance of the focus of incident rays from the surface, be called *r*. And let AH, the focal distance of refracted rays, be called *x*. Lastly, let the sine MX of the semi-aperture be called *e*. Observe, too, that *a*, *r*, *x*, are to be considered as positive quantities, when AS, AG, AH, lie from the surface in the direction in which the light is supposed to move. If therefore the refracting surface be concave, that is, having the centre on that side from which the light comes; or if the incident rays are divergent, or the refracted rays are divergent; then *a*, *r*, *x*, are negative quantities.

It is plain that HS = *x*—*a*; GS = *r*—*a*; also AX $= \frac{e^2}{2a}$ nearly. HX = $a - \frac{e^2}{2a}$. GX = $r - \frac{e^2}{2a}$. Now add to HX and to GX their differences from MH and MG, which (by the Lemma) are $\frac{e^2}{2x}$ and $\frac{e^2}{2r}$. We get MH $= x - \frac{e^2}{2a} + \frac{e^2}{2x}$, and MG = $r - \frac{e^2}{2a} + \frac{e^2}{2r}$. In order to shorten our notation, make $k = \frac{1}{a} - \frac{1}{r}$. This will make MG = $r - \frac{ke^2}{2}$.

Now substitute these values in the final analogy at the top of this column, viz. MH : HS = *m*.MG : GS; it becomes $x - \frac{e^2}{2a} + \frac{e^2}{2x} : x - a = mr - \frac{mke^2}{2} : r - a$ (or *a r k*), because $k = \frac{r-a}{ar}$, and $ark = r - a$. Now multiply the extreme and mean terms of this analogy. It is evident that it must give us an equation which will give us a value of *x* or AH, the quantity sought.

But this equation is quadratic. We may avoid the solution by an approximation which is sufficiently accurate, by substituting for *x* in the fraction $\frac{e^2}{2x}$ (which is very small in all cases of optical instruments), an approximate very easily obtained, and very near the truth. This is the focal distance of an infinitely slender pencil of rays converging to G. This we know by the common optical theorem to be $\frac{amr}{m-1r \pm a}$. Let this be

called

Telescope.

called φ; if we substitute k in place of $\frac{1}{a}-\frac{1}{r}$, this value of φ becomes $=\frac{a\,m}{m-a\,k}$.

This gives us, by the by, an easily remembered expression (and beautifully simple) of the refracted focus of an infinitely slender pencil, corresponding to any distance r of the radiant point. For since $\varphi=\frac{a\,m}{m-a\,k}$, $\frac{1}{\varphi}$ must be $=\frac{m-a\,k}{a\,m}$, $=\frac{m}{a\,m}-\frac{a\,k}{a\,m}=\frac{1}{a}-\frac{k}{m}$. We may even express it more simply, by expanding k, and it becomes $\frac{1}{\varphi}=\frac{1}{a}-\frac{1}{m\,a}-\frac{1}{m\,r}$.

Now put this value of $\frac{1}{\varphi}$ in place of the $\frac{1}{x}$ in the analogy employed above. The first term of the analogy becomes $x-\frac{e^2}{2\,a}+\frac{e^2}{2\,a}-\frac{k\,e^2}{2\,m}$, or $x-\frac{k\,e^2}{2\,m}$. The analogy now becomes $x-\frac{k\,e^2}{2\,m}:x\,a=m\,r-\frac{m\,k\,e^2}{2}:a\,r\,k$. Hence we obtain the linear equation $m\,r\,x-\frac{m\,k\,e^2\,x}{2}-m\,r\,a+\frac{m\,k\,a\,e^2}{2}=a\,r\,k\,x-\frac{a\,r\,k\,e^2}{2\,m}$; from which we finally deduce

$$x=\frac{m\,r\,a-\frac{1}{2}\,m\,a\,k\,e^2-\frac{a\,r\,k^2\,e^2}{2\,m}}{m\,r-a\,r\,k-\frac{1}{2}\,m\,k\,e}.$$

We may simplify this greatly by attending to the elementary theorem in fluxions, that the fraction $\frac{x+\dot{x}}{y+\dot{y}}$ differs from the fraction $\frac{x}{y}$ by the quantity $\frac{y\dot{x}-x\dot{y}}{y^2}$; this being the fluxion of $\frac{x}{y}$. Therefore $\frac{x+\dot{x}}{y+\dot{y}}=\frac{x}{y}+\frac{y\,\dot{x}-x\,\dot{y}}{y^2}$. Now the preceding formula is nearly in this situation. It may be written thus;

$$\frac{m\,r\,a\quad\left(-\frac{1}{2}\,m\,a\,k\,e^2-\frac{a\,r\,k^2\,e^2}{2\,m}\right)}{m\,r-a\,r\,k\qquad -m\,k\,e^2},$$

when the last terms of the numerator and denominator are very small in comparison with the first, and may be considered as the $\dot{x}$ and $\dot{y}$ while $m\,r\,a$ is the x, and $m\,r-a\,r\,k$ is the y. Treating it in this way, it may be stated thus:

$$x=\frac{m\,r\,a}{m\,r-a\,r\,k}+\frac{(m\,r\,a)\,\frac{1}{2}\,m\,k\,e^2-(m\,r-a\,r\,k)\left(\frac{1}{2}\,m\,k\,a\,e^2+\frac{a\,r\,k^2\,e^2}{2\,m}\right)}{r^2\,(m-a\,k)^2}$$

$$\text{or } x=\frac{m\,r\,a}{r(m-ak)}+\frac{(m\,r\,a)\,m\,k-(m\,r-a\,r\,k)\left(m\,k\,a+\frac{a\,r\,k^2}{m}\right)}{r^2\,(m-a\,k)^2}\times\frac{1}{2}\,e^2.$$

The first term $\frac{m\,r\,a}{r(m-ak)}$, or $\frac{m\,a}{m-ak}$, is evidently $=\varphi$, the focal distance of an infinitely slender pencil. Therefore the aberration is expressed by the second term, which we must endeavour to simplify. Telesc

If we now perform the multiplication indicated by $-(m\,r-a\,r\,k)\times\left(m\,k\,a-\frac{a\,r\,k^2}{m}\right)$, it is plain that $-m\,r\times m\,k\,a$ destroys the first term $m\,r\,a\times m\,k$ of the numerator of our small fraction, and there remains of this numerator $\left(m\,a^2\,r\,k^2-a\,r^2\,k^2+\frac{a^2\,r^2\,k}{m}\right)\frac{1}{2}\,e^2$, which is equal to $m^2\,a^2\left(\frac{r\,k^2}{m}-\frac{r^2\,k^2}{m^2\,a}+\frac{r^3\,k^3}{m^3}\right)\frac{1}{2}\,e^2$.

The denominator was $r^2\,(m-a\,k)^2$, and the fraction now becomes $\frac{m^2\,a^2}{(m-a\,k)^2}\left(\frac{k^2}{m\,r}-\frac{k^2}{m^2\,a}+\frac{k^3}{m^3}\right)\frac{1}{2}\,e^2$, which is evidently $=\varphi^2\left(\frac{k^2}{m\,r}-\frac{k^2}{m^2\,a}+\frac{k^3}{m^3}\right)\frac{e^2}{2}$. Now recollect that $k=\frac{1}{a}-\frac{1}{r}$. Therefore $\frac{k^3}{m^2}=\frac{k^2}{m^2}\left(\frac{1}{a}-\frac{1}{r}\right)=\frac{k^2}{m^2\,a}-\frac{k^2}{m^2\,r}$. Therefore, instead of $-\frac{k^2}{m^2\,a}$, write $\frac{-k^2}{m^2}-\frac{k^2}{m\,r}$, and we get the fraction $\varphi^2\left(\frac{k^3}{m^3}-\frac{k^3}{m^2}-\frac{k^2}{m^2\,r}+\frac{k^2}{m\,r}\right)\frac{e^2}{2}=\varphi^2\left(\frac{k^3}{m}-\frac{m\,k^3}{m^3}-\frac{m\,k^2}{m^3\,r}+\frac{m^2\,k^2}{m^3\,r}\right)\frac{e^2}{2}$, which is equal to $\varphi^2\frac{1-m}{m^3}\left(k^3-\frac{m\,k^2}{r}\right)\frac{e^2}{2}$, and finally to $-\varphi^2\frac{m-1}{m^3}\left(k^3-\frac{m\,k^2}{r}\right)\frac{e^2}{2}$.

Therefore the focal distance of refracted rays is $x=\varphi-\varphi^2\frac{m-1}{m^3}\left(k^3-\frac{m\,k^2}{r}\right)\frac{e^2}{2}$.

This consists of two parts. The first φ is the focal distance of an infinitely slender pencil of central rays, and the other $-\varphi^2\frac{m-1}{m^3}\left(k^3-\frac{m\,k^2}{r}\right)\frac{e^2}{2}$ is the aberration arising from the spherical figure of the refracting surface.

Our formula has thus at last put on a very simple form, and is vastly preferable to Dr Smith's for practice.

This aberration is evidently proportional to the square of the semi-aperture, and to the square of the distance φ: but in order to obtain this simplicity, several quantities were neglected. The assumption of the equality of AX to $\frac{e^2}{2\,a}$ is the first source of error. A much more accurate value of it would have been $\frac{2\,a\,e^2}{4\,a^2+e^2}$, for it is really $=\frac{e^2}{2\,a-\mathrm{AX}}$. If for AX we substitute its approximated value $\frac{e^2}{2a}$, we should have $\mathrm{AX}=\frac{e^2}{2\,a-\frac{e^2}{2\,a}}$, $=\frac{2\,a\,e^2}{4a^2-e^2}$. To have used this value would not have much complicated the calculus; but it did not occur to us till we had finished the investigation, and it would have required the whole to be changed. The operation in page 246. col. 1. par. 3. is another source of error. But these errors are very inconsiderable when the aperture

Telescope. ture is moderate. They increaſe for the moſt part with an increaſe of aperture, but not in the proportion of any regular function of it; ſo that we cannot improve the formula by any manageable proceſs, and muſt be contented with it. The errors are preciſely the ſame with thoſe of Dr Smith's theorem, and indeed with thoſe of any that we have ſeen, which are not vaſtly more complicated.

As this is to be frequently combined with ſubſequent operations, we ſhorten the expreſſion by putting θ for $\frac{m-1}{m^3}\left(k^3-\frac{m\,k^2}{r}\right)\frac{e^2}{2}$. Then $\varphi^3\theta$ will expreſs the aberration of the firſt refraction from the focal diſtance of an infinitely ſlender pencil; and now the focal diſtance of refracted rays is $f=\varphi-\varphi^2\theta$.

If the incident rays are parallel, r becomes infinite, and $\theta=\frac{m-1}{m^3}k^3\frac{e^2}{2}$. But in this caſe k becomes $=\frac{1}{a}$, and $\frac{1}{\varphi}=\frac{m-1}{ma}$, and $\varphi=\frac{m\,a}{m-1}$, and $\varphi^2\theta$ becomes $\frac{m^2\,a^2}{(m-1)^2}\times\frac{m-1}{m^3}\times\frac{1}{a^3}\times\frac{e^2}{2},=\frac{e^2}{(2m-1)ma}$. This is the aberration of extreme parallel rays.

We muſt now add the refraction of another ſurface.

Lemma 2. If the focal diſtance AG be changed by a ſmall quantity Gg, the focal diſtance AH will alſo be changed by a ſmall quantity Hh, and we ſhall have

$$m\cdot AG^2 : AH^2 = G\,g : H\,h.$$

Draw Mg, Mh, and the perpendiculars Gi, Hk. Then, becauſe the ſines of the angles of incidence are in a conſtant ratio to the ſines of the angles of refraction, and the increments of theſe ſmall angles are proportional to the increments of the ſines, theſe increments of the angles are in the ſame conſtant ratio. Therefore,

We have the angle CMg to HMh as m to 1.

Now $\quad G\,g : G\,i = AG : AM,$

and $\quad G\,i : h\,k = m\cdot AG : HA,$

and $\quad h\,k : H\,h = MA : AH :$

therefore $\quad G\,g : H\,h = m\cdot AG^2 : AH^2.$

The eaſieſt and moſt perſpicuous method for obtaining the aberration of rays twice refracted, will be to conſider the firſt refraction as not having any aberration, and determine the aberration of the ſecond refraction. Then conceive the focus of the firſt refraction as ſhifted by the aberration. This will produce a change in the focal diſtance of the ſecond refraction, which may be determined by this Lemma.

Fig. 10. Prop. II. Let AM, BN (fig. 10.) be two ſpherical ſurfaces, including a refracting ſubſtance, and having their centres C and c in the line AG. Let the ray aA paſs through the centres, which it will do without refraction. Let another ray mM, tending to G, be refracted by the firſt ſurface into MH, cutting the ſecond ſurface in N, where it is farther refracted into NI. It is required to determine the focal diſtance BI?

It is plain that the ſine of incidence on the ſecond ſurface is to the ſine of refraction into the ſurrounding air as 1 to m. Alſo BI may be determined in relation to BH, by means of BH, Nx, Be, and $\frac{1}{m}$, in the ſame way that AH was determined in relation to AG, by means of AG, MX, AC, and m.

Let the radius of the ſecond ſurface be b, and let e ſtill expreſs the ſemi-aperture, (becauſe it hardly differs from Nx). Alſo let α be the thickneſs of the lens. Then obſerve, that the focal diſtance of the rays refracted by the firſt ſurface, (neglecting the thickneſs of the lens and the aberration of the firſt ſurface), is the diſtance of the radiant point for the ſecond refraction, or is the focal diſtance of rays incident on the ſecond ſurface. In place of r therefore we muſt take φ; and as we made $k=\frac{1}{a}-\frac{1}{r}$, in order to abbreviate the calculus, let us now make $l=\frac{1}{b}-\frac{1}{\varphi}$; and make $\frac{1}{f}=\frac{1}{b}-ml$, as we made $\frac{1}{\varphi}=\frac{1}{a}-\frac{k}{m}$. Laſtly, in place of $\theta=\frac{m-1}{m^3}\left(k^3-\frac{m\,k^2}{r}\right)\frac{e^2}{2}$, make $\theta'=\left(\frac{1}{m}-1\right)m^3\left(l^3-\frac{l^2}{m\varphi}\right)\frac{e^2}{2},=-\frac{m-1}{m}\left(m^3\,l^3-\frac{m^2\,l^2}{\varphi}\right)\frac{e^2}{2}$.

Thus we have got an expreſſion ſimilar to the other; and the focal diſtance BI, after two refractions, becomes $BI=f-f^2\theta'$.

But this is on the ſuppoſition that BH is equal to φ, whereas it is really $\varphi-\varphi^2\theta-\alpha$. This muſt occaſion a change in the value juſt now obtained of BI. The ſource of the change is twofold. 1ſt, Becauſe in the value $\frac{1}{b}-\frac{1}{\varphi}$, we muſt put $\frac{1}{b}-\frac{1}{\varphi-\varphi^2\theta-\alpha}$, and becauſe we muſt do the ſame in the fraction $\frac{m^2\,l^2}{\varphi}$. In the ſecond place, when the value of BH is diminiſhed by the quantity $\varphi^2\theta+\alpha$, BI will ſuffer a change in the proportion determined by the 2d Lemma. The firſt difference may ſafely be neglected, becauſe the value of θ is very ſmall, by reaſon of the coefficient $\frac{e^2}{2}$ being very ſmall, and alſo becauſe the variation bears a very ſmall ratio to the quantity itſelf, when the true value of φ differs but little from that of the quantity for which it is employed. The chief change in BI is that which is determined by the Lemma. Therefore take from BI the variation of BH, multiplied by $\frac{m\,BI^2}{BH^2}$, which is very nearly $=\frac{m f^2}{\varphi^2}$. The product of this multiplication is $m f^2\theta+\frac{m f^2\alpha}{\varphi^2}$. This being taken from f, leaves us for the value of BI $f-\frac{f^2 m\alpha}{\varphi^2}-f^2(m\theta+\theta')$.

In this value f is the focal diſtance of an infinitely ſlender pencil of rays twice refracted by a lens having no thickneſs, $\alpha-\frac{m f^2}{\varphi}$ is the ſhortening occaſioned by the thickneſs, and $f^2(m\theta+\theta')$ is the effect of the two aberrations ariſing from the aperture.

It will be convenient, for ſeveral collateral purpoſes, to exterminate from theſe formulæ the quantities k, l and φ. For this purpoſe make $\frac{1}{n}=\frac{1}{a}-\frac{1}{b}$. We have already $k=\frac{1}{a}-\frac{1}{r}$; and $\frac{1}{\varphi}=\frac{1}{a}-\frac{1}{ma}+\frac{1}{mr}$; and $l=\frac{1}{b}-\frac{1}{\varphi},=\frac{1}{b}-\frac{1}{a}+\frac{1}{ma}-\frac{1}{mr}$. Now for $\frac{1}{b}-\frac{1}{a}$ write $-\frac{1}{n}$, and

Teleſcope. and we get $l = \frac{1}{ma} - \frac{1}{mr} - \frac{1}{n}$. Therefore $\frac{1}{f} = \frac{1}{b} - ml$ (by conſtruction, page 347. Prop. II.) becomes $= \frac{1}{b} - \frac{1}{a} + \frac{1}{r} + \frac{m}{n}, = \frac{m}{n} + \frac{1}{r} - \frac{1}{n}, - \frac{m-1}{n} + \frac{1}{r}$.

This laſt value of $\frac{1}{f}$ (the reciprocal of the focus of a ſlender pencil twice refracted), viz. $\frac{m-1}{n} + \frac{1}{r}$, is the ſimpleſt that can be imagined, and makes n as a ſubſtitute for $\frac{1}{a} - \frac{1}{b}$; a moſt uſeful ſymbol, as we ſhall frequently find in the ſequel. It alſo gives a very ſimple expreſſion of the focal diſtance of parallel rays, which we may call the principal focal diſtance of the lens, and diſtinguiſh it in future by the ſymbol p; for the expreſſion $\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r}$ becomes $\frac{1}{p} = \frac{m-1}{n}$ when the incident light is parallel. And this gives us another very ſimple and uſeful meaſure of f; for $\frac{1}{f}$ becomes $= \frac{1}{p} + \frac{1}{r}$. Theſe equations $\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r}$, $\frac{1}{p} = \frac{m-1}{n}$, and $\frac{1}{f} = \frac{1}{p} + \frac{1}{r}$, deſerve therefore to be made very familiar to the mind.

We may alſo take notice of another property of n. It is half the radius of an iſoſceles lens, which is equivalent to the lens whoſe radii are a and b: for ſuppoſe the lens to be iſoſceles, that is $a = b$; then $n = \frac{1}{a} - \frac{1}{a}$. Now the ſecond a is negative if the firſt be poſitive, or poſitive if the firſt be negative. Therefore $\frac{1}{a} - \frac{1}{b} = \frac{1+b}{a^2} = \frac{a+a}{a^2} = \frac{2}{a}$, and $\frac{1}{u} = \frac{2}{a}$, and $n = \frac{a}{2}$. Now the focal diſtance of this lens is $\frac{m-1}{n}$, and ſo is that of the other, and they are equivalent.

But, to proceed with our inveſtigation, recollect that we had $\theta = \frac{m-1}{m^3}\left(k^3 - \frac{m k^2}{r}\right)\frac{e^2}{2}$. Therefore $m\theta = \frac{m-1}{m}\left(\frac{k^3}{m} - \frac{k^2}{r}\right)\frac{e^2}{2}$. And θ' was $= \frac{m-1}{m}\left(-m^3 l^3 + \frac{m l^2}{\varphi}\right)\frac{e^2}{2}$. Therefore $m\theta + \theta$, the aberration (neglecting the thickneſs of the lens) is $f^2 \frac{m-1}{m}\left(\frac{k^3}{m} - \frac{k^2}{r} - m^3 l^3 + \frac{m l^2}{\varphi}\right)\frac{e^2}{2}$.

If we now write for k, l, and φ, their values as determined above, performing all the neceſſary multiplications, and arrange the terms in ſuch a manner as to collect in one ſum the coefficients of a, n, and r, we ſhall find 4 terms for the value of $m\theta$, and 10 for the value of θ'. The 4 are deſtroyed by as many with contrary ſigns in the value of θ', and there remain 6 terms to expreſs the value of $m\theta + \theta'$, which we ſhall expreſs by one ſymbol 9; and the equation ſtands thus:

$$q = \frac{m-1}{m}\left(\frac{m^5}{n^3} - \frac{2m^2+m}{an^2} + \frac{m+2}{a^2 n} + \frac{3m^2+m}{rn^3} - \frac{4m+4}{arn} + \frac{3m+2}{r^2 n}\right)\frac{e^2}{2}.$$

Teleſco

The focal diſtance therefore of rays twice refracted, reckoned from the laſt ſurface, or BI, corrected for aberration, and for the thickneſs of the lens, is $f - f\frac{m\alpha}{\varphi^2} - f^2 q$, conſiſting of three parts, viz. f, the focal diſtance of central rays; $f^2 \frac{m\alpha}{\varphi^2}$, the correction for the thickneſs of the lens; and $f^2 q$, the aberration.

The formula at the top of this column appears very complex, but is of very eaſy management, requiring only the preparation of the ſimple numbers which form the numerators of the fractions included in the parentheſis. When the incident rays are parallel, the terms vaniſh which have r in the denominator, ſo that only the three firſt terms are uſed.

We might here point out the caſes which reduce the aberration expreſſed in the formula laſt referred to, to nothing; but as they can ſcarcely occur in the object-glaſs of a teleſcope, we omit it for the preſent, and proceed to the combination of two or more lenſes.

Lemma 3. If AG be changed by a ſmall quantity Gg, BI ſuffers a change Ii, and $Gg : Ii = AG^2 : BI^2$. For it is well known that the ſmall angles GMg and INi are equal; and therefore their ſubtenſes Gk, In are proportional to MG, NI, or to AG, AI nearly, when the aperture is moderate. Therefore we have (nearly)

$$\begin{aligned} Gk : In &: AG : BI \\ In : Ii &= AM : BI \\ Gg : Gk &= AG : AM \\ \text{Therefore } Gg : Ii &= AG^2 : BI^2 \end{aligned}$$

Prop. III. To determine the focal diſtance of rays refracted by two lenſes placed near to each other on a common axis.

Let AM, BN (fig. 11.) be the ſurfaces of the firſt lens, and CO, DP be the ſurfaces of the ſecond, and let β be the thickneſs of the ſecond lens, and δ the interval between them. Let the radius of the anterior ſurface of the ſecond lens be a', and the radius of its poſterior ſurface be b'. Let m' be to 1 as the ſine of incidence to the ſine of refraction in the ſubſtance of the ſecond lens. Laſtly, let p' be the principal focal diſtance of the ſecond lens. Let the extreme or marginal ray meet the axis in L after paſſing through both lenſes, ſo that DL is the ultimate focal diſtance, reckoned from the laſt ſurface. Fig. 11

It is plain that DL may be determined by means of a', b', m', p', and CI, in the ſame manner that BI was determined by means of a, b, m, p, and AG.

The value of BI is $f - m\alpha\frac{f^2}{\varphi^2} - f^2 q$. Take from this the interval δ, and we have $CI = f - m\alpha\frac{f^2}{\varphi^2} - \delta - f^2 q$. Let the ſmall part $-m\alpha\frac{f^2}{\varphi^2} - \delta - f^2 q$ be neglected for the preſent, and let CI be ſuppoſed $= f$. As we formed φ, f, and q, by means of a, b, m, n, and

r,

Teleſcope. r, let us now form φ', f', and q', for the ſecond lens, by means of a', b', m', n', $\left(=\frac{1}{a'}-\frac{1}{b'}\right)$, and r'. φ' will be the focal diſtance of a ſlender pencil refracted by the firſt ſurface, f will be the focal diſtance of this pencil after two refractions, and q' will be the coefficient of the aberration, neglecting the thickneſs and interval of the lenſes.

Proceeding in this way, DL will be $=f'-m\beta\frac{f^2}{\varphi}-f'^2 q$. But becauſe CI is really leſs than f, by the quantity $m\alpha\frac{f^2}{\varphi'^2}+\delta+f^2 q'$, we muſt (by Lemma 3.) ſubtract the product of this quantity, multiplied by $\frac{DL}{BI^2}$, (which is nearly $\frac{f'^2}{f^2}$), from $f'-m\beta\frac{f'^2}{\varphi'^2}f'^2 q'$.

By this proceſs we ſhall have

$$DL=f'-f'^2\left(\frac{m\alpha}{\varphi^2}+\frac{\delta}{f^2}+\frac{m'\beta}{\varphi'^2}\right)-f^2(q+q').$$

The firſt term f' of this value of DI is the focal diſtance of a ſlender pencil of central rays refracted by both lenſes, neglecting their thickneſs and diſtance; the ſecond term, $-f^2\left(\frac{m\alpha}{\varphi^2}+\frac{\delta}{f^2}+\frac{m'\beta}{\varphi'^2}\right)$ is the correction neceſſary for theſe circumſtances; and the third term, $-f'^2(q+q')$, is the correction for the aperture $2e$. And it is evident that q' is a formula preciſely ſimilar to q, containing the ſame number of terms, and differing only by the m', a', n', and r', employed in place of m, a, n, and r.

It is alſo evident, that if there be a third lens, we ſhall obtain its focal diſtance by a proceſs preciſely ſimilar to that by which we obtained DL; and ſo on for any number of lenſes.

Thus have we obtained formulæ by which the foci of rays are determined in the moſt general terms; and in ſuch a manner as ſhall point out the connection of the curvatures, thickneſſes and diſtances of the lenſes, with their ſpherical aberrations, and with the final aberration of the compound lens, and give the aberrations in ſeparate ſymbols, ſo that we can treat them by themſelves, and ſubject them to any conditions which may enable us to correct one of them by another.

We alſo ſee in general, that the corrections for the thickneſs and diſtance of the lenſes are exhibited in terms which involve only the focal diſtances of central rays, and have very little influence on the aberrations, and ſtill leſs on the ratio of the aberrations of the different lenſes. This is a moſt convenient circumſtance; for we may neglect them while we are determining q and q', and in determining the ratio of the focal diſtances of the ſeveral lenſes, on which the correction of the chromatic aberration chiefly depends. Therefore, in the conſtruction of a compound lens for uniting the different colours, we may neglect this correction for the thickneſs and diſtance till the end of the proceſs. When we apply it, we ſhall find that it chiefly affects the final focal diſtance, making it ſomewhat longer, but has hardly any influence either on the chromatic or ſpherical aberration. We do not heſitate to ſay, that the final formulæ here given are abundantly accurate, while they are vaſtly more manageable than thoſe employed by Euler or D'Alembert. We have calculated trigonometrically the progreſs of the rays through one of the glaſſes, which will be given as an example, giving it a very extravagant aperture, that the errors of the formulæ might be very remarkable. We found the real aberration exceed the aberration aſſigned by the formula by no more than $\frac{1}{53}$th part, a difference which is quite inſignificant. The proceſs here given derives its ſimplicity from the frequent occurrence of harmonic proportions in all optical theorems. This enabled Mr Clairaut to employ the reciprocals of the radii and diſtances with ſo much ſimplicity and generality. Teleſcope.

We conſider it as another advantage of Mr Clairaut's method, that it gives, by the way, formulæ for the more ordinary queſtions in optics, which are of wonderful ſimplicity, and moſt eaſily remembered. The chief problems in the elementary conſtruction of optical inſtruments relate to the focal diſtances of central rays. This determines the focal diſtances and arrangement of the glaſſes. All the reſt may be called the refinement of optics; teaching us how to avoid or correct the indiſtinctneſs, the colours and the diſtortions, which are produced in the images formed by theſe ſimple conſtructions. We ſhall mention a few of theſe formulæ which occur in our proceſs, and tend greatly to abbreviate it when managed by an experienced analyſt.

Let m be to 1 as the ſine of incidence to the ſine of refraction; let a and b be the radii of the anterior and poſterior ſurfaces of a lens; let r be the diſtance of the radiant point, or the focus of incident central rays, and f the diſtance of the conjugate focus; and let p be the principal focal diſtance of the lens, or the focal diſtance of parallel rays. Make $\frac{1}{n}$ equal to $\frac{1}{a}-\frac{1}{b}$; let the ſame letters a', b', r', &c. expreſs the ſame things for a ſecond lens; and a'', b'', r'', &c. expreſs them for a third; and ſo on. Then we have $\frac{1}{f}=\frac{m-1}{n}+\frac{1}{r}$; $\frac{1}{f'}=\frac{m'-1}{n'}+\frac{1}{r'}$; $\frac{1}{f''}=\frac{m''-1}{n''}+\frac{1}{r''}$, &c.

Therefore when the incident light is parallel, and r infinite, we have $\frac{1}{p}=\frac{m-1}{n}$; $\frac{1}{p'}=\frac{m'-1}{n'}$; $\frac{1}{p''}=\frac{m''-1}{n''}$, &c.

And when ſeveral lenſes are contiguous, ſo that their intervals may be neglected, and therefore $\frac{1}{f}$, belonging to the firſt lens, becomes $\frac{1}{r'}$, belonging to the ſecond, we have

1. $\frac{1}{r'}=\frac{1}{f}=\frac{m-1}{n}+\frac{1}{r}$, $=\frac{1}{p}+\frac{1}{r}$.
2. $\frac{1}{r''}=\frac{1}{f'}$, $=\frac{m'-1}{n'}+\frac{m-1}{n}+\frac{1}{r}$, $=\frac{1}{p'}+\frac{1}{p}+\frac{1}{r}$.
3. $\frac{1}{f''}=\frac{m''-1}{n''}+\frac{m'-1}{n}+\frac{m-1}{n}+\frac{1}{r}$, $=\frac{1}{p''}+\frac{1}{p'}+\frac{1}{p}+\frac{1}{r}$.

Nothing can be more eaſily remembered than theſe formulæ, how numerous ſo ever the glaſſes may be.

Having thus obtained the neceſſary analyſis and formula,

Telescope. mula, it now remains to apply them to the construction of achromatic lenses; in which it fortunately happens, that the employment of several surfaces, in order to produce the union of the differently refrangible rays, enables us at the same time to employ them for correcting each other's spherical aberration.

In the article OPTICS we gave a general notion of the principle on which we may proceed in our endeavours to unite the differently refrangible rays. A white or compounded ray is separated by refraction into its component coloured rays, and they are diffused over a small angular space. Thus it appears, that the glass used by Sir Isaac Newton in his experiments diffused a white ray, which was incident on its posterior surface in an angle of 30°, in such a manner that the extreme red ray emerged into air, making an angle of 50° 21$\frac{1}{3}$′ with the perpendicular; the extreme violet ray emerged in an angle of 51° 15$\frac{3}{5}$′; and the ray which was in the confines of green and blue, emerged in an angle of 50° 48$\frac{1}{3}$′. If the sine of the angle 30° of incidence be called 0.5, which it really is, the sine of the emergence of the red ray will be 0.77; that of the violet ray will be 0.78; and that of the intermediate ray will be 0.77$\frac{1}{2}$, an exact mean between the two extremes. This ray may therefore be called the mean refrangible ray, and the ratio of 77$\frac{1}{2}$ to 50, or of 1.55 to 1, will very properly express the mean refraction of this glass; and we have for this glass $m=1.55$. The sine of refraction, being measured on a scale, of which the sine of incidence occupies 100 parts, will be 154 for the red ray, 155 for the mean ray, and 156 for the violet ray. This number, or its ratio to unity, is commonly taken to represent the refractive power of the glass. There is some impropriety in this, unless we consider ratios as measured by their logarithms: for if m be 1, the substance does not refract at all. The refractive power can be properly measured only by the refraction which it produces; that is, by the change which it makes in the direction of the light, or the angle contained between the incident and refracted rays. If two substances produce such deviations always in one proportion, we should then say that their refractive powers are in that proportion. This is not true in any substances; but the sines of the angles, contained between the refracted ray and the perpendicular, are always in one proportion when the angle of incidence in both substances is the same. This being a cognisable function of the real refraction, has therefore been assumed as the only convenient measure of the refractive powers. Although it is not strictly just, it answers extremely well in the most usual cases in optical instruments: the refractions are moderate; and the sines are very nearly as the angles contained between the rays and the perpendicular; and the real angles of refraction, or deflections of the rays, are almost exactly proportional to $m-1$. The most natural and obvious measure of the refractive powers would therefore be $m-1$. But this would embarrass some very frequent calculations; and we therefore find it best, on the whole, to take m itself for the measure of the refractive power.

The separation of the red, violet, and intervening rays, has been called *dispersion*; and although this arises merely from a difference of the refractive power in respect of the different rays, it is convenient to distinguish this particular modification of the refractive power by a name, and we call it the DISPERSIVE POWER of the Telesco refracting substance.

It is susceptible of degrees; for a piece of flint-glass will refract the light, so that when the sine of refraction of the red ray is 77, the sine of the refraction of the violet ray is nearly 78$\frac{1}{2}$; or if the sine of refraction of the red ray, measured on a particular scale, is 1.54, the sine of refraction of the violet ray is 1.57. The dispersion of this substance, being measured by the difference of the extreme sines of refraction, is greater than the dispersion of the other glass, in the proportion of 3 to 2.

But this alone is not a sufficient measure of the absolute dispersive power of a substance. Although the ratio of 1.54 to 1.56 remains constant, whatever the real magnitude of the refractions of common glass may be, and though we therefore say that its dispersive power is constant, we know, that by increasing the incidence and the refraction, the absolute dispersion is also increased. Another substance shows the same properties, and in a particular case may produce the same dispersion; yet it has not for this sole reason the same dispersive power. If indeed the incidence and the refraction of the mean ray be also the same, the dispersive power cannot be said to differ; but if the incidence and the refraction of the mean ray be less, the dispersive power must be considered as greater, though the actual dispersion be the same; because if we increase the incidence till it becomes equal to that in the common glass, the dispersion will now be increased. The proper way of conceiving the dispersion therefore is, to consider it as a portion of the whole refraction; and if we find a substance making the same dispersion with half the general refraction, we must say that the dispersive quality is double; because by making the refraction equal, the dispersion will really be double.

If therefore we take m as a symbol of the separation of the extreme rays from the middle ray, $\frac{m}{m-1}$ is the natural measure of the dispersive power. We shall express this in the Leibnitzian notation, thus $\frac{dm}{m-1}$, that we may avoid the indistinctness which the Newtonian notation would occasion when m is changed for m' or m''.

It is not unusual for optical writers to take the whole separation of the red and violet rays for the measure of the dispersive power, and to compare this with the refracting power with respect to one of the extreme rays. But it is surely better to consider the mean refraction as the measure of the refracting power: and the deviation of either of the extremes from this mean is a proper enough measure of the dispersion, being always half of it. It is attended with this convenience, that being introduced into our computations as a quantity infinitely small, and treated as such for the ease of computation, while it is really a quantity of sensible magnitude; the errors arising from this supposition are diminished greatly, by taking one half of the deviation, and comparing it with the mean refraction. This method has, however, this inconvenience, that it does not exhibit at once the refractive power in all substances respecting any particular colour of light; for it is not the ray of any particular colour that suffers the mean refraction. In common glass it is the ray which is in the confines of the yellow and blue; in flint-glass it is nearly the mid-

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Telescope. dle blue ray; and in other ſubſtances it is a different ray. Theſe circumſtances appear plainly in the different proportions of the colours of the priſmatic ſpectrum exhibited by different ſubſtances. This will be conſidered afterwards, being a great bar to the perfection of achromatic inſtruments.

The way in which an achromatic lens is conſtructed is, to make uſe of a contrary refraction of a ſecond lens to deſtroy the diſperſion or ſpherical aberration of the firſt.

The firſt purpoſe will be anſwered if $\frac{d\,m}{n}$ be equal to $-\frac{d\,m'}{n'}$. For, in order that the different coloured rays may be collected into one point by two lenſes, it is only neceſſary that $\frac{1}{f}$, the reciprocal of the focal diſtance of rays refracted by both, may be the ſame for the extreme and mean rays, that is, that $\frac{m+d\,m-1}{n}+\frac{m'+d\,m'-1}{n'}+\frac{1}{r}$ be of the ſame value with $\frac{m-1}{n}+\frac{m'-1}{n'}+\frac{1}{r}$, which muſt happen if $\frac{d\,m}{n}+\frac{d\,m'}{n'}$ be $=0$, or $\frac{d\,m}{n}=-\frac{d\,m'}{n}$. This may be ſeen in another way, more comprehenſible by ſuch as are not verſant in theſe diſcuſſions. In order that the extreme colours which are ſeparated by the firſt lens may be rendered parallel by the ſecond; we have ſhown already that n and n' are proportional to the radii of the equivalent iſoſceles lenſes, being the halves of theſe radii. They are therefore (in theſe ſmall refractions) inverſely proportional to the angles formed by the ſurfaces at the edges of the lenſes. n' may therefore be taken for the angle of the firſt lens, and n for that of the ſecond. Now the ſmall refraction by a priſm, whoſe angle (alſo ſmall) is n', is $\overline{m-1}\times n$. The diſperſive power being now ſubſtituted for the refractive power, we have for this refraction of the priſm $d\,m\times n'$. This muſt be deſtroyed by the oppoſite refraction of the other priſm $d\,m'\times n$. Therefore $d\,m\times n'=d\,m'\times n$, or $\frac{d\,m}{n}=-\frac{d\,m'}{n'}$. In like manner, this effect will be produced by three lenſes if $\frac{d\,m}{n}+\frac{d\,m'}{n'}+\frac{d\,m''}{n''}$ be $=0$, &c.

Laſtly, the errors ariſing from the ſpherical figure, which we expreſſed by $-R^2\,(q+q')$ will be corrected if $q+q'$ be $=0$. We are therefore to diſcover the adjuſtments of the quantities employed in the preceding formulæ, which will inſure theſe conditions. It will render the proceſs more perſpicuous if we collect into one view the ſignifications of our various ſymbols, and the principal equations which we are to employ.

1. The ratios to unity of the ſines of mean incidence in the different media are - m, m', m''

2. The ratio of the differences of the ſines of the extremes - - - $\frac{d\,m}{d\,m'}=u$.

3. The ratio $\frac{m-1}{m'-1}$ - - - $=c$.

4. The radii of the ſurfaces $a, b\,;\ a', b'\,;\ a'', b''$.

5. The principal focal diſtances, or the focal diſtances of parallel central rays, - p, p', p''.

6. The focal diſtance of the compound lens P.

7. The diſtance of the radiant point, or of the focus of incident rays on each lens r, r', r''.

8. The focal diſtance of the rays refracted by each lens - - - f, f', f''.

9. The focal diſtance of rays refracted by the compound lens - - - F.

10. The half breadth of the lens - - e.

Alſo the following ſubſidiary values:

1. $\frac{1}{n}=\frac{1}{a}-\frac{1}{b}$; $\frac{1}{n'}=\frac{1}{a'}-\frac{1}{b'}$; $\frac{1}{n''}=\frac{1}{a''}-\frac{1}{b''}$.

2. $q=\frac{m-1}{m}\left(\frac{m^3}{n^3}-\frac{2\,m^2+m}{a\,n^2}+\frac{m+2}{a^2 n}+\frac{3\,m^2+m}{r\,n^2}-\frac{4(m+1)}{a\,r\,n}+\frac{3\,m+2}{r^2 n}\right)\frac{e^2}{2}$. And q' and q'' muſt be formed in the ſame manner from m', a', n', r'; and from m'', a'', n'', r'', as q is formed from m, a, n, r.

3. Alſo, becauſe in the caſe of an object-glaſs, r is infinitely great, the laſt term $\frac{1}{r}$ in all the values of $\frac{1}{f}, \frac{1}{f'}, \frac{1}{f''}$, $\frac{1}{r}, \frac{1}{r'}, \frac{1}{r''}$, will vaniſh, and we ſhall alſo have F=P.

Therefore in a double object-glaſs $\frac{1}{P}=\frac{m'-1}{n'}+\frac{m-1}{n}=\frac{1}{p}+\frac{1}{p'}$.

And in a triple object-glaſs $\frac{1}{P}=\frac{m''-1}{n''}+\frac{m'-1}{n'}+\frac{m-1}{n}$, $=\frac{1}{p''}+\frac{1}{p'}+\frac{1}{p}$.

Alſo, in a double object-glaſs, the correction of ſpherical aberration requires $q+q'=v$.

And a triple object-glaſs requires $q+q'+q''=v$. For the whole error is multiplied by F^4, and by $\frac{1}{2}e^2$; and therefore the equation which corrects this error may be divided by $F^4\,\frac{1}{2}e^2$.

This equation in the fourteenth line from the top of the column, giving the value of q, q', q'', may be much ſimplified as follows: In the firſt place, they may be divided by m, m', or m'', by applying them properly to the terms within the parentheſis, and expunging them from the denominator of the general factors $\frac{m-1}{m}, \frac{m'-1}{m'}, \frac{m''-1}{m''}$. This does not alter the values of q, q', and q''. In the ſecond place the whole equations may be afterwards divided by $m'-1$. This will give the values of $\frac{q}{m'-1}, \frac{q'}{m'-1}$, and $\frac{q''}{m'-1}$, which will ſtill be equal to nothing if $q+q'+q''$ be equal to nothing.

This diviſion reduces the general factor $\frac{m'-1}{m'}$ of q' to $\frac{1}{m'}$. And in the equation for q we obtain, in place of the general factor $\frac{m-1}{m}$, the factor $\frac{m-1}{m'-1}$, or c. This will alſo be the factor of the value of q'' when the third lens is of the ſame ſubſtance with the firſt, as is general-

Telescope. ly the case. And, in the third place, since the rays incident on the first lens are parallel, all the terms vanish from the value of q in which $\frac{1}{r}$ is found, and there remain only the three first, viz. $\frac{m^3}{n^3} - \frac{2m^2+m}{an^2} + \frac{m+2}{a^2n}$.

Performing these operations, we have

$$\frac{q}{m'-1} = c\left(\frac{m^2}{n^3} - \frac{2m+1}{an^2} + \frac{m+2}{ma^2n}\right)\frac{e^2}{2}$$

$$\frac{q'}{m'-1} = \left(\frac{m'^2}{n^3} - \frac{2'm+1}{a'n'^2} + \frac{m'+2}{m'a'^2n'} + \frac{3m'+1}{r'n'^2} - \frac{4(m'+1)}{m'a'r'n'} + \frac{3'm+2}{m'r'^2n'}\right)\frac{e^2}{2}$$

$$\frac{q''}{m'-1} = c\left(\frac{m^2}{n''^3} - \frac{2m+1}{a''n''^2} + \frac{m+2}{m''a''^2n''} + \frac{3m+1}{r''n''^2} + \frac{4(m+1)}{m''a''r''n''} + \frac{3m+2}{m''r''^2n''}\right)\frac{e^2}{2}.$$

Let us now apply this investigation to the construction of an object-glass; and we shall begin with a double lens.

Construction of a Double Achromatic Object-glass.

Here we have to determine four radii a, b, a', and b'. Make $n=1$. This greatly simplifies the calculus, by exterminating it from all the denominators. This gives for the equation $\frac{dm}{n} + \frac{dm'}{n'} = 0$, the equation $dm + \frac{dm'}{n'} = 0$, or $dm = -\frac{dm'}{n'}$, and $\frac{1}{n'} = -\frac{dm}{dm'}$, $= -u$. Also we have r', the focal distance of the light incident on the second lens, the same with the principal focal distance p of the first lens, (neglecting the interval, if any). Now $\frac{1}{p} = \frac{m-1}{n}$, which in the present case is $= m-1$. Also $\frac{1}{p'}$ is $= -u(m'-1)$, and $\frac{1}{P} = m-1-u(m'-1) = u'$.

Make these substitutions in the values of $\frac{q}{m-1}$ and $\frac{q'}{m'-1}$, and we obtain the following equation:

$$c\,m^2 - \frac{c(2m+1)}{a} + \frac{c(m+2)}{m\,a^2} - u^3 m'^2 - \frac{u^2(2m'+1)}{a'} - \frac{u(m'+2)}{m'a'^2} + u^2(3m'+1)(m-1) + \frac{4u(m'+1)(m-1)}{m'a'} - \frac{u(3m'+2)(m-1)^2}{m'} = 0.$$

Arrange these terms in order, according as they are factors of $\frac{1}{a^2}$, $\frac{1}{a}$, $\frac{1}{a'^2}$, $\frac{1}{a'}$, or independent quantities. It puts on this form:

$$\frac{c(m+2)}{m} \times \frac{1}{a^2} - c'(2m+1) \times \frac{1}{a} - \frac{u(m'+2)}{m'} \times \frac{1}{a'^2} - \left(u^2(2m'+1) - \frac{4u(m'+1)(m-1)}{m'}\right) \times \frac{1}{a'} + c\,m^2 + u^2(3m'+1)(m-1) - u^3 m'^2 - \frac{u(3m'+2)(m-1)^2}{m'} = 0.$$

Let A be the coefficient of $\frac{1}{a^2}$, B that of $\frac{1}{a}$, C that Telesco of $\frac{1}{a'^2}$, D that of $\frac{1}{a'}$, and E the sum of the independent quantity; that is, let A be $= \frac{c(m+2)}{m}$, $B = c(2m+1)$, $C = \frac{u(m'+2)}{m'}$, $D = u^2(2m'+2) - \frac{4u(m'+1)(m-1)}{m'}$ and $E = c\,m^2 + u^2(3m'+1)(m-1) - u^3 m'^2 - \frac{u(3m'+2)(m-1)^2}{m'}$.

Our final equation becomes

$$\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0.$$

The coefficients of this equation and the independent quantity are all known, from our knowledge of m, $m'\,dm$, dm'; and we are to find the values of a and a', and from them and $n=1$ to find the values of b and b'.

But it is evidently an indeterminate equation, because there are two unknown quantities; so that there may be an infinity of solutions. It must be rendered determinate by means of some other conditions to which it may be subjected. These conditions must depend on some other circumstances which may direct our choice.

One circumstance occurs to us which we think of very great consequence. In the passage of light from one substance to another, there is always a considerable portion reflected from the posterior surface of the first and from the anterior surface of the last; and this reflection is more copious in proportion to the refraction. This loss of light will therefore be diminished by making the internal surfaces of the lenses to coincide; that is, by making $b=a'$. This will be attended with another advantage. If we put between the glasses a substance of nearly the same refracting power, we shall not only completely prevent this loss of light, but we shall greatly diminish the errors which arise from an imperfect polish of the surfaces. We have tried this, and find the effect very surprising. The lens being polished immediately after the figure has been given it, and while it was almost impervious to light by reason of its roughness, which was still sensible to the naked eye, performed as well as when finished in the finest manner.

N. B. This condition, by taking away one refraction, obliges us to increase those which remain, and therefore increases the spherical aberrations. And since our formulæ do not fully remove those (by reason of the small quantities neglected in the process), it is uncertain whether this condition be the most eligible. We have, however, no direct argument to the contrary.

Let us see what determination this gives us.

In this case $\frac{1}{a'} = \frac{1}{b}$, $= \frac{1}{a} - 1$. For because $\frac{1}{n} = \frac{1}{a} - \frac{1}{b}$ and $n=1$, we have $1 + \frac{1}{b} = \frac{1}{a}$, and $\frac{1}{b} = \frac{1}{a} - 1$. Therefore $\frac{1}{a'^2} = \frac{1}{a^2} - \frac{2}{a} + 1$. Therefore, in our final equation, put $\frac{1}{a^2} - \frac{2}{a} + 1$ in place of $\frac{1}{a'^2}$, and $\frac{1}{a} - 1$ in

place

Telescope.

place of $\frac{1}{a'}$, and it becomes $\frac{A-C}{a^2} - \frac{B+D-2C}{a}$ $+E+D-C=0$.

Thus have we arrived at a common affected quadratic equation, where $\frac{1}{a}$ is the unknown quantity. It has the common form $px^2+qx+r=0$, where p is $=A-C$, q is equal to $2C-B-D$, r is equal to $E+D-C$, and x is equal to $\frac{1}{a}$.

Divide the equation by p, and we have $x^2+\frac{q}{p}x+\frac{r}{p}$ $=0$. Make $s=\frac{q}{p}$ and $t=\frac{r}{p}$, and we have x^2+sx $+t=0$. This gives us finally $\frac{1}{a}$, or $x=-\frac{1}{2}s\pm$ $\sqrt{\frac{1}{4}s^2-t}$.

This value of $\frac{1}{a}$ is taken from a ſcale of which the unit is half the radius of the iſoſceles lens which is equivalent to the firſt lens, or has the ſame focal diſtance with it. We muſt then find (on the ſame ſcale) the value of b, viz. $\frac{1}{a}-1$, which is alſo the value of a'. Having obtained a', we muſt find b' by means of the equation $\frac{1}{n'}=\frac{1}{a'}-\frac{1}{b'}$, and therefore $\frac{1}{b}=\frac{1}{a'}-\frac{1}{n'}$, But $\frac{1}{n'}=u$. Therefore $\frac{1}{b'}=\frac{1}{a'}+u$, $=\frac{1}{a}+u-1$.

Thus is our object-glaſs conſtructed; and we muſt determine its focal diſtance, or its reciprocal $\frac{1}{P}$. This is $=m-1-u\ (m'-1)$.

All theſe radii and diſtances are meaſured on a ſcale of which n is the unit. But it is more convenient to meaſure every thing by the focal diſtance of the compound object-glaſs. This gives us the proportion which all the diſtances bear to it. Therefore, calling P unity, in order to obtain $\frac{1}{a}$ on this ſcale, we have only to ſtate the analogy $m-1-u\ (m'-1) : 1=\frac{1}{a} : \frac{1}{A}$, and A is the radius of our firſt ſurface meaſured on a ſcale of which P is the unit.

If, in the formula which expreſſes the final equation for $\frac{1}{a}$, the value of t ſhould be poſitive, and greater than $\frac{1}{4}s^2$, the equation has imaginary roots; and it is not poſſible with the glaſſes employed, and the conditions aſſumed, to correct both the chromatic and ſpherical aberrations.

If t is negative and equal to $\frac{1}{4}s^2$, the radical part of the value is $=0$, and $\frac{1}{a}=-\frac{1}{2}s$. But if it be negative or poſitive, but leſs than $\frac{1}{4}s^2$, the equation has two real roots, which will give two conſtructions. That is to be preferred which gives the ſmalleſt curvature of the ſurfaces; becauſe, ſince in our formulæ which determine the ſpherical aberration ſome quantities are neglected, theſe quantities are always greater when a large arch (that is, an arch of many degrees) is employed. No radius ſhould be admitted which is much leſs than $\frac{1}{7}$ of the focal diſtance.

All this proceſs will be made plain and eaſy by an example.

Very careful experiments have ſhown, that in common crown-glaſs the ſine of incidence is to the ſine of refraction as 1.526 is to 1, and that in the generality of flint-glaſs it is as 1.604 to 1. Alſo that $\frac{dm}{dm'}=0.6054$ $=u$. Therefore $m-1=0.526$; $m'-1=0.604$; $c=\frac{m-1}{m'-1}=0.87086$. By theſe numbers we can compute the coefficients of our final equation. We ſhall find them as follows:

$A=2.012$
$B=3.529$
$C=1.360$
$D=-0.526$
$E=1.8659$

The general equation (p. 252. col. 2. lin. 8.), when ſubjected to the aſſumed coincidence of the internal ſurfaces, is $\frac{A-C}{a^2}-\frac{B+D-2C}{a}+E+D-C=0$. $A-C$ is $=0.652$; $B+D-2C$ is $=0.283$; and $E+D-C$ is $=-0.020$; and the equation with numerical coefficients is $\frac{0.652}{a^2}-\frac{0.283}{a}-0.020=0$, which correſponds to the equation $px^2+qx+r=0$. We muſt now make $s=\frac{q}{p}$, $=\frac{0.283}{0.652}$, $=0.434$, and $t=\frac{r}{p}$, $=\frac{0.02}{0.652}$, $=0.0307$. This gives us the final quadratic equation $\frac{1}{a^2}-\frac{0.434}{a}$ $-0.0307=0$. To ſolve this, we have $-\frac{1}{2}s=0.217$, and $\frac{1}{4}s^2=0.0471$. From this take t, which is $=-0.0307$ (that is, to 0.0471 add 0.0307), and we obtain 0.0778, the ſquare root of which is $=0.2789$. Therefore, finally, $\frac{1}{a}=0.2170\pm0.2789$, which is either 0.4959 or -0.0619. It is plain that the firſt muſt be preferred, becauſe the ſecond gives a negative radius, or makes the firſt ſurface of the crown-glaſs concave. Now as the convergence of the rays is to be produced by the crown-glaſs, the other ſurface muſt become very convex, and occaſion great errors in the computed aberration. We therefore retain 0.4959 for the value of $\frac{1}{a}$, and a is $=\frac{1}{0.4959}$, $=2.0166$.

To obtain b, uſe the equation $\frac{1}{b}=\frac{1}{a}-1$, which gives $\frac{1}{b}=-0.5041$, and therefore a convex ſurface. b is therefore $=\frac{1}{0.5041}=1.9837$.

a' is the ſame with b, and $\frac{1}{a'}=-0.5041$.

To obtain b', uſe the equation $\frac{1}{b'}=\frac{1}{a'}+u$. Now $u=$ 0.6054, and $\frac{1}{a'}=-0.5041$. The ſum of theſe is 0.1013;

Teleſcope. 0.1013; and ſince it is poſitive, the ſurface is concave.

$b' = \frac{1}{.1013} = 9.872.$

Laſtly, $\frac{1}{P} = m - 1 - u\ (m' - 1) = 0.1603$, and $P = \frac{1}{0.1603}, = 0.2383.$

Now to obtain all the meaſures in terms of the focal diſtance P, we have only to divide the meaſures already found by 6.2383, and the quotients are the meaſures wanted.

Therefore $a = \frac{2.0166}{6.2383} = 0.32325$

$b = \frac{1.9837}{6.2383} = -0.31798$

$a' = \text{ - - } = -0.31798$

$b' = \frac{9.872}{6.2383} = 1.5825$

$P = \text{ - } 1.$

If it be intended that the focal diſtance of the object-glaſs ſhall be any number n of inches or feet, we have only to multiply each of the above radii by n, and we have their lengths in inches or feet.

Thus we have completed the inveſtigation of the conſtruction of a double object-glaſs. Although this was intricate, the final reſult is abundantly ſimple for practice, eſpecially with the aſſiſtance of logarithms. The only troubleſome thing is the preparation of the numerical coefficients A, B, C, D, E of the final equation. Strict attention muſt alſo be paid to the poſitive and negative ſigns of the quantities employed.

We might propoſe other conditions. Thus it is natural to prefer for the firſt or crown-glaſs lens ſuch a form as ſhall give it the ſmalleſt poſſible aberration. This will require a ſmall aberration of the flint-glaſs to correct it. But a little reflection will convince us that this form will not be good. The focal diſtance of the crown-glaſs muſt not exceed one-third of that of the compound glaſs; theſe two being nearly in the proportion of $d\,m' - d\,m$ to $d\,m'$. Therefore if this form be adopted, and a be made about $\frac{1}{3}$th of b, it will not exceed $\frac{1}{5}$th of P. Therefore, although we may produce a moſt accurate union of the central and marginal rays by oppoſite aberrations, there will be a conſiderable aberration of ſome rays which are between the centre and the margin.

It is abſolutely impoſſible to collect into one point the whole rays (though the very remoteſt rays are united with the central rays), except in a very particular caſe, which cannot obtain in an object-glaſs; and the ſmall quantities which are neglected in the formula which we have given for the ſpherical aberration, produce errors which do not follow any proportion of the aperture which can be expreſſed by an equation of a manageable form. When the aperture is very large, it is better not to correct the aberration for the whole aperture, but for about $\frac{5}{6}$ths of it. When the rays correſponding to this diſtance are made to coincide with the central rays by means of appoſite aberrations, the rays which are beyond this diſtance will be united with ſome of thoſe which are nearer to the centre, and the whole diffuſion will be conſiderably diminiſhed. Dr Smith has illuſtrated this in a very perſpicuous manner in his theory of his Teleſc. Catoptric Microſcope.

But although we cannot adopt this form of an object-glaſs, there may be other conſiderations which may lead us to prefer ſome particular form of the crown-glaſs, or of the flint-glaſs. We ſhall therefore adapt our general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0$ to this condition.

Therefore let h expreſs this ſelected ratio of the two radii of the crown-glaſs, making $\frac{a}{b} = h$ (remembering always that a is poſitive and b negative in the caſe of a double convex, and h is a negative number).

With this condition we have $\frac{1}{b} = \frac{h}{a}$. But when we make n the unit of our formula of aberration, $\frac{1}{b} = \frac{1}{a} - 1$.

Therefore $1 = \frac{1}{a} - \frac{h}{a}$, and $\frac{1}{a} = \frac{1}{1-h}$. Now ſubſtitute this for $\frac{1}{a}$ in the general equation, and change all the ſigns (which ſtill preſerves it $= 0$), and we obtain

$$\frac{C}{a'^2} + \frac{D}{a'} - E - \frac{A}{(1-h)^2} + \frac{B}{1-h} = 0.$$

By this equation we are to find $\frac{1}{a}$, or the radius of the anterior ſurface of the flint-glaſs. The equation is of this form $p\,x^2 + q\,x + r = 0$, and we muſt again make $s = \frac{q}{p}$ and $t = \frac{r}{p}$. Therefore $s = \frac{D}{C}$, and $t = \frac{1}{C} \times \left(\frac{B}{1-h} - \frac{A}{(1-h)^2} - E\right)$. Then, finally,

$$\frac{1}{a'} = -\tfrac{1}{2}\,s \pm \sqrt{\tfrac{1}{4}\,s^2 - t}.$$

It may be worth while to take a particular caſe of this condition. Suppoſe the crown-glaſs to be of equal convexities on both ſides. This has ſome advantages: We can tell with preciſion whether the curvatures are preciſely equal, by meaſuring the focal diſtance of rays reflected back from its poſterior ſurface. Theſe diſtances will be preciſely equal. Now it is of the utmoſt importance in the conſtruction of an object-glaſs which is to correct the ſpherical aberration, that the forms be preciſely ſuch as are required by our formulæ.

In this caſe of a lens equally convex on both ſides $\frac{1}{a}$ is $= -\frac{1}{b}, = \frac{1}{2}$. Subſtitute this value for $\frac{1}{a}$ in the general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0$, and then $\frac{A}{a^2} = \frac{A}{4}$; $\frac{B}{a}$ becomes $\frac{B}{2}$. Now change all the ſigns, and we have $\frac{C}{a'^2} + \frac{D}{a'} - E - \frac{A}{4} + \frac{B}{2} = 0$, by which we are to find a'. This in numbers is $\frac{1.360}{a'^2} - \frac{0.526}{a'}$

Telescope. $\frac{0.526}{a'} - 0.6044 = 0$. Then $s = \frac{-0.526}{1.360}$, $= 0.3867$, and $t = \frac{-0.6044}{1.360}$, $= -0.4444$. Then $-\frac{1}{2}s = 0.1933$; $\frac{1}{4}s^2 = 0.0374$; and $\sqrt{\frac{1}{4}S^2 - t} = \pm 0.6941$; so that $\frac{1}{a'} = 0.1933 \pm 0.6941$. This gives two real roots, viz. 0.8874, and -0.5008. If we take the firſt, we ſhall have a convex anterior ſurface for the flint-glaſs, and conſequently a very deep concave for the poſterior ſurface. We therefore take the ſecond or negative root -0.5008.

We find $\frac{1}{b'}$, as before, by the equation $\frac{1}{b'} = \frac{1}{a'} + u$, $= 0.1046$, which will give a large value of b'.

We had $\frac{1}{a} = \frac{1}{2}$

and $\frac{1}{b} = -\frac{1}{2}$

and $\frac{1}{P}$ is the ſame as in the former caſe, viz. 0.1603.

Having all theſe reciprocals, we may find a, b, a', b', and P; and then dividing them by P, we obtain finally

$a = 0.3206$
$b = -0.3206$
$a' = -0.3201$
$b' = 1.533$
$P = 1.$

By comparing this object-glaſs with the former, we may remark, that diminiſhing a a little increaſes b, and in this reſpect improves the lens. It indeed has diminiſhed b', but this being already conſiderable, no inconvenience attends this diminution. But we learn, at the ſame time, that the advantage *muſt* be very ſmall; for we cannot diminiſh a much more, without making it as ſmall as the ſmalleſt radius of the object-glaſs. This proportion is therefore very near the maximum, or beſt poſſible; and we know that in ſuch caſes, even conſiderable changes in the radii will make but ſmall changes in the reſult: for theſe reaſons we are diſpoſed to give a ſtrong preference to the firſt conſtruction, on account of the other advantages which we ſhowed to attend it.

As another example, we may take a caſe which is very nearly the general practice of the London artiſts. The radius of curvature for the anterior ſurface of the convex crown-glaſs is $\frac{5}{6}$ths of the radius of the poſterior ſurface, ſo that $h = \frac{5}{6}$. This being introduced into the determinate equation, gives

$a = 0.2938$ $\quad a' = -0.3443$
$b = -0.3526$ $\quad b = 1.1474$

As another condition, we may ſuppoſe that the ſecond or flint-glaſs is of a determined form.

This caſe is ſolved much in the ſame manner as the former. Taking h to repreſent the ratio of a' and b', we have $\frac{1}{a'} = \frac{1}{1-h}$. This value being ſubſtituted in the general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a} + E = 0$, gives us $\frac{A}{a^2} - \frac{B}{a} + E - \frac{C}{(1-h)^2} - \frac{D}{1-h} = 0$. This gives for the final equation $x^2 + sx + t = 0$, $s = \frac{B}{A}$, and $t = \frac{1}{A} \times \left(E - \frac{C}{(1-h)^2} - \frac{D}{1-h}\right)$ and $\frac{1}{a} = -\frac{1}{2}\frac{1}{4}s \pm \sqrt{\frac{1}{4}s^2 - t}$. Telescope.

We might here take the particular caſe of the flint-glaſs being equally concave on both ſides. Then becauſe $\frac{1}{n'} = -u$, and in the caſe of equal concavities $\frac{2}{a'} = \frac{1}{n'}$, $= -u$, it is ſufficient to put $-\frac{1}{2}u$ for $\frac{1}{a'}$. This being done, the equation becomes $\frac{A}{a} - \frac{B}{a}\frac{Cu^2}{4} + \frac{Du}{2} + E = 0$. This gives $s = \frac{B}{A}$, and $t = \frac{1}{A} \times \left(\frac{4Du - 2Cu^2}{8} + E\right)$.

We imagine that theſe caſes are ſufficient for ſhowing the management of the general equation; and the example of the numerical ſolution of the firſt caſe affords inſtances of the only niceties which occur in the proceſs, viz. the proper employment of the poſitive and negative quantities.

We have oftener than once obſerved, that the formula is not perfectly accurate, and that in very large apertures errors will remain. It is proper therefore, when we have obtained the form of a compound object-glaſs, to calculate trigonometrically the progreſs of the light through it; and if we find a conſiderable aberration, either chromatic or ſpherical, remaining, we muſt make ſuch changes in the curvatures as will correct them. We have done this for the firſt example; and we find, that if the focal diſtance of the compound object glaſs be 100 inches, there remains of the ſpherical aberration nearly $\frac{1}{60}$th of an inch, and the aberration of colour is over corrected above $\frac{1}{9}$th of an inch. The firſt aberration has been diminiſhed about 6 times, and the other about 30 times. Both of the remaining errors will be diminiſhed by increaſing the radius of the inner ſurfaces. This will diminiſh the aberration of the crown-glaſs, and will diminiſh the diſperſion of the flint more than that of the crown. But indeed the remaining error is hardly worth our notice.

It is evident to any perſon converſant with optical diſcuſſions, that we ſhall improve the correction of the ſpherical aberration by diminiſhing the refractions. If we employ two lenſes for producing the convergency of the rays to a real focus, we ſhall reduce the aberration to $\frac{1}{4}$th. Therefore a better achromatic glaſs will be formed of three lenſes, two of which are convex and of crown-glaſs. The refraction being thus divided between them, the aberrations are leſſened. There is no occaſion to employ two concave lenſes of flint-glaſs; there is even an advantage in uſing one. The aberration being conſiderable, leſs of it will ſerve for correcting the aberration of the crown-glaſs, and therefore ſuch a form may be ſelected as has little aberration. Some light is indeed loſt by theſe two additional ſurfaces; but this is much more than compenſated by the greater apertures which we can venture to give when the curvature of the ſurface is ſo much diminiſhed. We proceed therefore to

The Conſtruction of a Triple Achromatic Object-glaſs.

It is plain that there are more conditions to be aſ-

ſumed

Telescope. sumed before we can render this a determinate problem, and that the investigation must be more intricate. At the same time, it must give us a much greater variety of constructions, in consequence of our having more conditions necessary for giving the equation this determinate form. Our limits will not allow us to give a full account of all that may be done in this method. We shall therefore content ourselves with giving one case, which will sufficiently point out the method of proceeding. We shall then give the results in some other eligible cases, as rules to artists by which they may construct such glasses.

Let the first and second glasses be of equal curvatures on both sides; the first being a double convex of crown-glass, and the second a double concave of flint-glass.

Still making n the unit of our calculus, we have in the first place $a=-b, =-a', =b'$. Therefore $\frac{1}{a'}-\frac{1}{b'}=-\left(\frac{1}{a}-\frac{1}{b}\right)$, or $\frac{1}{n'}=-\frac{1}{n}=-1$. Therefore the equation $\frac{m}{n}+\frac{d\,m'}{n'}+\frac{d\,m''}{n''}=0$ becomes $u-1+\frac{u}{u''}=0$, or $\frac{1}{n}=\frac{1}{u}-1$. Let us call this value u'.

We have $\frac{1}{p}=m-1$; $\frac{1}{p'}=-(m'-1)$; $\frac{1}{p''}=u'(m-1)$; $\frac{1}{P}=\frac{1}{p}+\frac{1}{p'}+\frac{1}{p''}$, $=m-m'+u'(m-1)$. And if we make $m'-m=C$, we shall have $\frac{1}{P}=-C+u'(m=1)$. Also $\frac{1}{p'}=m-1$; $\frac{1}{p''}=m-1-(m'-1), =m-m', =-C'$.

The equality of the two curvatures of each lens gives $\frac{1}{a}=\frac{1}{2n}$. Therefore $\frac{1}{a}=-\frac{1}{b}, =-\frac{1}{a'}, =\frac{1}{b'}=\frac{1}{2}$; and $\frac{1}{b''}=\frac{1}{a''}-\frac{1}{n''}, =\frac{1}{a''}-u$.

Substituting these values in the equation (p. 252. col. 2. par. 1.), we obtain the three formulæ.

1. $c\,m^2-\frac{1}{2}c(2m+1)+\frac{c(m+2)}{4m}$

2. $-m'^2+\frac{1}{2}(2m'+1)-\frac{m'+2}{4m'}+(3m'+1)(m-1)-\frac{2(m'+1)(m-1)}{m'}-\frac{(3m'+2)(m-1)^2}{m'}$

3. $c\,u'\,3m^2-\frac{c\,u'^2(2m+1)}{a''}+\frac{c\,u'(m+2)}{m\,a''^2}-c\,c'\,u'^2(3m+1)+\frac{4\,c\,c'\,u'(m+1)}{m\,a''}+\frac{c\,c'^2\,u'(3m+2)}{m}=0$.

Now arrange these quantities according as they are coefficients of $\frac{1}{a''^2}$ and of $\frac{1}{a''}$, or independent quantities.

Let the coefficient of $\frac{1}{a''^2}$ be A, that of $\frac{1}{a''}$ be B, and the independent quantity be C, we have

$A=\frac{c\,u'(m+2)}{m}$; $B=c\,u'^2(2m+1)-\frac{4\,c\,c'\,u'(m+1)}{m}$,

and $C=c\,m^2+\frac{c(m+2)}{4m}+\frac{1}{2}(2m'+1)+(3m'+1)(m-1)+c\,u'^3\,m^3+\frac{c\,c'^2\,u'(3m+2)}{m}-\frac{1}{2}c(2m+1)$ Telesc

$-m'^2-\frac{m'+2}{4m}-\frac{2(m'+1)(m-1)}{m'}-\frac{(3m'+2)(m-1)^2}{m'}$

$-c\,c'\,u'^2(3m+1)$.

Our equation now becomes $\frac{A}{a''^2}-\frac{B}{a''}+C=0$.

This reduced to numbers, by computing the values of the coefficients, is $\frac{1.312}{a''^2}-\frac{1.207}{a''}-0.3257=0$.

This, divided by 1.312, gives $s=-0.92$; and $t=-0.2482$; $-\frac{1}{2}s=0.46$; $\frac{1}{4}s^2=0.2116$; and $\sqrt{\frac{1}{4}s^2-t}=\pm 0.6781$.

And, finally, $\frac{1}{a''}=0.46\pm 0.6781$.

This has two roots, viz. 0.2181 and -1.1381. The last would give a small radius, and is therefore rejected.

Now, proceeding with this value of $\frac{1}{a''}$ and the $\frac{1}{n''}$, we get the other radius b'', and then, by means of u', we get the other radius which is common to the four surfaces. Then, by $\frac{1}{P}=\frac{1}{p''}-c'$, we get the value of P.

The radii being all on the scale of which u is the unit, they must be divided by P to obtain their value on the scale which has P for its unit. This will give us

$a=-b, =-a', =b'$,	$=0.530$
$a''=$	1.215
$b''=$	-0.3046
$P=$	$1.$

This is not a very good form, because the last surface has too great curvature.

We thought it worth while to compute the curvatures for a case where the internal surfaces of the lenses coincide, in order to obtain the advantages mentioned on a former occasion. The form is as follows:

The middle lens is a double concave of flint-glass; the last lens is of crown-glass, and has equal curvatures on both sides. The following table contains the dimensions of the glasses for a variety of focal distances. The first column contains the focal distances in inches; the second contains the radii of the first surface in inches; the third contains the radii of the posterior surface of the first lens and anterior surface of the second; and the fourth column has the radii of the three remaining surfaces.

P	a	b, a'	b', a'', b''
12	9.25	6.17	12.75
24	18.33	12.25	25.5
36	27.33	18.25	38.17
48	36.42	24.33	50.92
60	45.42	30.33	63.58
72	54.5	36.42	76.33
84	63.5	42.5	89.
96	72.6	48.5	101.75
108	81.7	54.58	114.42
120	90.7	60.58	127.17

We have had an opportunity of trying glasses of this construction, and found them equal to any of the same length, although executed by an artist by no means excellent in his profession as a glass-grinder. This very circumstance

Telescope. circumstance gave us the opportunity of seeing the good effects of interposing a transparent substance between the glasses. We put some clear turpentine varnish between them, which completely prevented all reflection from the internal surfaces. Accordingly these telescopes were surprisingly bright; and although the roughness left by the first grinding was very perceptible by the naked eye before the glasses were put together, yet when joined in this manner it entirely disappeared, even when the glasses were viewed with a deep magnifier.

The aperture of an object-glass of this construction of 30 inches focal distance was $3\frac{1}{3}$th inches, which is considerably more than any of Mr Dollond's that we have seen.

If we should think it of advantage to make all the three lenses isosceles, that is, equally curved on both surfaces, the general equation will give the following radii:

$$\begin{array}{lll} a = +0.639 & a' = -0.5285 & a'' = +0.6413 \\ b = -0.639 & b' = +0.5285 & b'' = -0.6413 \end{array}$$

This seems a good form, having large radii.

Should we choose to have the two crown-glass lenses isosceles and equal, we must make

$$\begin{array}{lll} a = +0.6412 & a' = -0.5227 & a'' = +0.6412 \\ b = -0.6412 & b' = +0.5367 & b'' = -0.6412 \end{array}$$

This form hardly differs from the last.

Our readers will recollect that all these forms proceed on certain measures of the refractive and dispersive powers of the substances employed, which are expressed by m, m', dm, and dm': and we may be assured that the formulæ are sufficiently exact, by the comparison (which we have made in one of the cases) of the result of the formula and the trigonometrical calculation of the progress of the rays. The error was but $\frac{1}{450}$th of the whole, ten times less than another error, which unavoidably remains, and will be considered presently. These measures of refraction and dispersion were carefully taken; but there is great diversity, particularly in the flint-glass. We are well informed that the manufacture of this article has considerably changed of late years, and that it is in general less refractive and less dispersive than formerly. This must evidently make a change in the forms of achromatic glasses. The proportion of the focal distance of the crown-glasses to that of the flint must be increased, and this will occasion a change in the curvatures, which shall correct the spherical aberration. We examined with great care a parcel of flint-glass which an artist of this city got lately for the purpose of making achromatic object-glasses, and also some very white crown-glass made in Leith; and we obtained the following measures:

$$m = 1.529 \qquad m' = 1.578 \qquad \frac{dm}{dm'} = \frac{142}{219} = 0.64841.$$

We computed some forms for triple object-glasses made of these glasses, which we shall subjoin as a specimen of the variations which this change of data will occasion.

If all the three lenses are made isosceles, we have

$$\begin{array}{lll} a = +0.796 & a' = -0.474 & a'' = +0.502 \\ b = -0.796 & b' = +0.474 & b'' = -0.502 \end{array}$$

Or

$$\begin{array}{lll} a = 0.504 & a' = -0.475 & a'' = +0.793 \\ b = -0.504 & b' = 0.475 & b'' = -0.793 \end{array}$$

If the middle lens be isosceles, the two crown-glass lenses may be made of the same form and focal distance, and placed the same way. This will give us Telescope.

$$\begin{array}{lll} a = +0.705 & a' = -0.475 & a'' = +0.705 \\ b = -0.547 & b' = +0.475 & b'' = -0.547 \end{array}$$

N. B. This construction allows a much better form, if the measures of refraction and dispersion are the same that we used formerly. For we shall have

$$\begin{array}{lll} a = +0.628 & a' = -0.579 & a'' = +0.628 \\ b = -0.749 & b' = +0.579 & b'' = -0.749 \end{array}$$

And this is pretty near the practice of the London opticians.

We may here observe, upon the whole, that an amateur has little chance of succeeding in these attempts. The diversity of glasses, and the uncertainty of the workman's producing the very curvatures which he intends, is so great, that the object-glass turns out different from our expectation. The artist who makes great numbers acquires a pretty certain guess at the remaining error; and having many lenses, intended to be of one form, but unavoidably differing a little from it, he tries several of them with the other two, and finding one better than the rest, he makes use of it to complete the set.

The great difficulty in the construction is to find the exact proportion of the dispersive powers of the crown and flint-glass. The crown is pretty constant; but there are hardly two pots of flint-glass which have the same dispersive power. Even if constant, it is difficult to measure it accurately; and an error in this greatly affects the instrument, because the focal distances of the lenses must be nearly as their dispersive powers. The method of examining this circumstance, which we found most accurate, was as follows:

The sun's light, or that of a brilliant lamp, passed through a small hole in a board, and fell on another board pierced also with a small hole. Behind this was placed a fine prism A (fig. 14.), which formed a spectrum ROV on a screen pierced with a small hole. Behind this was placed a prism B of the substance under examination. The ray which was refracted by it fell on the wall at D, and the distance of its illumination from that point to C, on which an unrefracted ray would have fallen, was carefully measured. This showed the refraction of that colour. Then, in order that we might be certain that we always compared the refraction of the same precise colour by the different prisms placed at B, we marked the precise position of the prism A when the ray of a particular colour fell on the prism B. This was done by an index AG attached to A, and turning with it, when we caused the different colours of the spectrum formed by A to fall on B. Having examined one prism B with respect to all the colours in the spectrum formed by A, we put another B in its place. Then bringing A to all its former positions successively, by means of a graduated arch HGK, we were certain that when the index was at the same division of the arch it was the very ray which had been made to pass through the first prism B in a former experiment. We did not solicitously endeavour to find the very extreme red and violet rays; because, although we did not learn the whole dispersions of the two prisms, we learned their proportions, which is the circumstance wanted in the construction of achromatic glasses. It is in vain to attempt this by measuring the spectrums themselves; for we cannot be certain of Fig. 14.

Telescope. ſelecting the very ſame colours for the compariſon, becauſe they ſucceed in an inſenſible gradation.

The intelligent reader will readily obſerve, that we have hitherto proceeded on the ſuppoſition, that when, by means of contrary refractions, we have united the extreme red and violet rays, we have alſo united all the others. But this is quite gratuitous. Sir Iſaac Newton would, however, have made the ſame ſuppoſition; for he imagined that the different colours divided the ſpectrum formed by all ſubſtances in the proportions of a muſical canon. This is a miſtake. When a ſpectrum is formed by a priſm of crown glaſs, and another of preciſely the ſame length is formed by the ſide of it by a priſm of flint-glaſs, the confine between the green and blue will be found preciſely in the middle of the firſt ſpectrum, but in the ſecond it will be conſiderably nearer to the red extremity. In ſhort, different ſubſtances do not diſperſe the colours in the ſame proportion.

The effect of this irrationality (ſo to call it) of diſperſion, will appear plainly, we hope, in the following manner: Let A (fig. 12.) repreſent a ſpot of white ſolar light falling perpendicularly on a wall. Suppoſe a priſm of common glaſs placed behind the hole through which the light is admitted, with its refracting angle facing the left hand. It will refract the beam of light to the right, and will at the ſame time diſperſe this heterogeneous light into its component rays, carrying the extreme red ray from A to R, the extreme orange from A to O, the extreme yellow from A to Y, &c. and will form the uſual priſmatic ſpectrum ROYGBPVC. If the whole length RC be divided into 1000 parts, we ſhall have (when the whole refraction AR is ſmall) RO very nearly 125, RY=200, RG=333, RB=500, RP=667, RV=778, and RC=1000; this being the proportion obſerved in the differences of the ſines of refraction by Sir Iſaac Newton. Fig. 12.

Perhaps a refracting medium may be found ſuch, that a priſm made of it would refract the white light from A′, in the upper line of this figure, in ſuch a manner that a ſpectrum R′O′Y′G′B′P′V′C′ ſhall be formed at the ſame diſtance from A′, and of the ſame length, but divided in a different proportion. We do not know that ſuch a medium has been found; but we know that a priſm of flint-glaſs has its refractive and diſperſive powers ſo conſtituted, that if A′H be taken about one-third of AR, a ſpot of white light, formed by rays falling perpendicularly at H′, will be ſo refracted and diſperſed that the extreme red ray will be carried from H′ to R′, and the extreme violet from H′ to C′, and the intermediate colours to intermediate points, forming a ſpectrum reſembling the other, but having the colours more conſtipated towards R′, and more dilated towards C; ſo that the ray which the common glaſs carried to the middle point B of the ſpectrum RC is now in a point B′ of the ſpectrum R′C′, conſiderably nearer to R′.

Dr Blair has found, on the other hand, that certain fluids, particularly ſuch as contain the muriatic acid, when formed into a priſm, will refract the light from H″ (in the lower line) ſo as to form a ſpectrum R″C″ equal to RC, and as far removed from A″ as RC is from A, but having the colours more dilated toward R″, and more conſtipated toward C, than is obſerved in RC; ſo that the ray which was carried by the priſm of common glaſs to the middle point B is carried to a point B″, conſiderably nearer to C″. Telescope.

Let us now ſuppoſe that, inſtead of a white ſpot at A, we have a priſmatic ſpectrum AB (fig. 13.), and that the priſm of common glaſs is applied as before, immediately behind the priſm which forms the ſpectrum AB. We know that this will be refracted ſidewiſe, and will make a ſpectrum ROYGBPC, inclined to the plane of refraction in an angle of 45°; ſo that drawing the perpendicular RC′, we have RC′=C′C. Fig. 13.

We alſo know that the priſm of flint-glaſs would refract the ſpectrum formed by the firſt priſm on EHF, in ſuch a manner that the red ray will go to R, the violet to C, and the intermediate rays to points *o*, *y*, *g*, *b*, *p*, *v*, ſo ſituated that O′*o* is = R′O′ of the other figure; Y*y* is = R′Y′ of that figure, G*g* = R′G′, &c. Theſe points muſt therefore lie in a curve R *o y g b p v* C, which is convex toward the axis R′C′.

In like manner we may be aſſured that Dr Blair's fluid will form a ſpectrum R *o′ y′ g′ b′ p′ v′* C, concave toward R′C.

Let it be obſerved by the way, that this is a very good method for diſcovering whether a medium diſperſes the light in the ſame proportion with the priſm which is employed for forming the firſt ſpectrum AB or EF. It diſperſes in the ſame or in a different proportion, according as the oblique ſpectrum is ſtraight or crooked; and the exact proportion correſponding to each colour is had by meaſuring the ordinates of the curves R *b* C or R *b′* C.

Having formed the oblique ſpectrum RBC by a priſm of common glaſs, we know that an equal priſm of the ſame glaſs, placed in a contrary poſition, will bring back all the rays from the ſpectrum RBC to the ſpectrum AB, laying each colour on its former place.

In like manner, having formed the oblique ſpectrum R *b* C by a priſm of flint-glaſs, we know that another priſm of flint-glaſs, placed in the oppoſite direction, will bring all the rays back to the ſpectrum EHF.

But having formed the oblique ſpectrum RBC by a priſm of common glaſs, if we place the flint-glaſs priſm in the contrary poſition, it will bring the colour R back to E, and the colour C to F; but it will not bring the colour B to H, but to a point *h*, ſuch that B *h* is equal to *b* H, and *b* B to *h* H. In like manner, the other colours will not be brought back to the ſtraight line EHF, but to a curve E *h* F, forming a crooked ſpectrum.

In like manner, the fluids diſcovered by Dr Blair, when employed to bring back the oblique ſpectrum RBC formed by common glaſs, will bring its extremities back to E and F, and form the crooked ſpectrum E *h′* F lying beyond EHF.

This experiment evidently gives us another method for examining the proportionality of the diſperſion of different ſubſtances.

Having, by common glaſs, brought back the oblique ſpectrum formed by common glaſs to its natural place AB, ſuppoſe the original ſpectrum at AB to contract gradually (as Newton has made it to do by means of a lens), it is plain that the oblique ſpectrum will alſo contract, and ſo will the ſecond ſpectrum at AB; and it will at laſt coaleſce into a white ſpot. The effect will be equivalent to a gradual compreſſion of the whole

figure,

Teleſcope. figure, by which the parallel lines AR and BC gradually approach, and at laſt unite.

In like manner, when the oblique ſpectrum formed by flint-glaſs is brought back to EHF by a flint-glaſs priſm, and the figure compreſſed in the ſame gradual manner, all the colours will coaleſce into a white ſpot.

But when flint-glaſs is employed to bring back the oblique ſpectrum formed by common glaſs, it forms the crooked ſpectrum E *h* F. Now let the figure be compreſſed. The curve E *h* F will be doubled down on the line H *h*, and there will be formed a compound ſpectrum H *h*, quite unlike the common ſpectrum, being purple or claret-coloured at H by the mixture of the extreme red and violet, and green edged with blue at *h* by the mixture of the green and blue. The fluid priſms would in like manner form a ſpectrum of the ſame kind on the other ſide of H.

This is preciſely what is obſerved in achromatic object-glaſſes made of crown-glaſs and flint: for the refraction from A to R correſponds to the refraction of the convex crown-glaſs; and the contrary refraction from R to E correſponds to the contrary refraction of the concave flint-glaſs, which ſtill leaves a part of the firſt refraction, producing a convergence to the axis of the teleſcope. It is found to give a purple or wine-coloured focus, and within this a green one, and between theſe an imperfect white. Dr Blair found, that when the eye-glaſs was drawn out beyond its proper diſtance, a ſtar was ſurrounded by a green fringe, by the green end of the ſpectrum, which croſſed each other within the focus; and when the eye-glaſs was too near the object-glaſs, the ſtar had a wine-coloured fringe. The green rays were ultimately moſt refracted. *N. B.* We ſhould expect the fringe to be of a blue colour rather than a green. But this is eaſily explained: The extreme violet rays are very faint, ſo as hardly to be ſenſible; therefore when a compound glaſs is made as achromatic as poſſible to our ſenſes, in all probability (nay certainly) theſe almoſt inſenſible violet rays are left out, and perhaps the extreme colours which are united are the red and the middle violet rays. This makes the green to be the mean ray, and therefore the moſt outſtanding when the diſperſions are not proportional.

Dr Blair very properly calls theſe ſpectrums, H *h* and H *h'*, *ſecondary ſpectrums*, and ſeems to think that he is the firſt who has taken notice of them. But Mr Clairault was too accurate a mathematician, and too careful an obſerver, not to be aware of a circumſtance which was of primary conſequence to the whole inquiry. He could not but obſerve that the ſucceſs reſted on this very particular, and that the proportionality of diſperſion was indiſpenſably neceſſary.

This ſubject was therefore touched on by Clairault; and *fully* diſcuſſed by Boſcovich, firſt in his Diſſertations publiſhed at Vienna in 1759; then in the *Comment. Bononienſis;* and, laſtly, in his *Opuſcula*, publiſhed in 1785. Dr Blair, in his ingenious Diſſertation on Achromatic Glaſſes, read to the Royal Society of Edinburgh in 1793, ſeems not to have known of the labours of theſe writers; ſpeaks of it as a new diſcovery; and exhibits ſome of the conſequences of this principle in a ſingular point of view, as ſomething very paradoxical and inconſiſtent with the uſually received notions on theſe ſubjects. But they are by no means ſo. We are, however, much indebted to his ingenious reſearches, and his ſucceſsful endeavours to find ſome remedy for this imperfection of achromatic glaſſes. Some of his contrivances are exceedingly ingenious; but had the Doctor conſulted theſe writers, he would have ſaved himſelf a good deal of trouble. Teleſcope.

Boſcovich ſhows how to unite the two extremes with the moſt outſtanding colour of the ſecondary ſpectrum, by means of a third ſubſtance. When we have done this, the aberration occaſioned by the ſecondary ſpectrums muſt be prodigiouſly diminiſhed; for it is evidently equivalent to the union of the points H and *h* of our figure. Whatever cauſe produces this muſt diminiſh the curvature of the arches E *h* and *h* F: but even if theſe curvatures were not diminiſhed, their greateſt ordinates cannot exceed one-fourth of H *h;* and we may ſay, without heſitation, that by uniting the mean or moſt outſtanding ray with the two extremes, the remaining diſperſion will be as much leſs than the uncorrected colour of Dollond's achromatic glaſs, as this is leſs than four times the diſperſion of a common object-glaſs. It muſt therefore be altogether inſenſible.

Boſcovich aſſerts, that it is not poſſible to unite more than two colours by the oppoſite refraction of two ſubſtances, which do not diſperſe the light in the ſame proportions. Dr Blair makes light of this aſſertion, as he finds it made in general terms in the vague and paltry extract made by Prieſtley from Boſcovich in his Eſſay on the Hiſtory of Optics; but had he read this author in his own diſſertations, he would have ſeen that he was perfectly right. Dr Blair, however, has hit on a very ingenious and effectual method of producing this union of three colours. In the ſame way as we correct the diſperſion of a concave lens of crown-glaſs by the oppoſite diſperſion of a concave lens of flint-glaſs, we may correct the ſecondary diſperſion of an achromatic convex lens by the oppoſite ſecondary diſperſion of an achromatic concave lens. But the intelligent reader will obſerve, that this union does not contradict the aſſertion of Boſcovich, becauſe it is *neceſſarily* produced by means of three refracting ſubſtances.

The moſt eſſential ſervice which the public has received at the hands of Dr Blair is the diſcovery of fluid mediums of a proper diſperſive power. By compoſing the lenſes of ſuch ſubſtances, we are at once freed from the irregularities in the refraction and diſperſion of flint-glaſs, which the chemiſts have not been able to free it from. In whatever way this glaſs is made, it conſiſts of parts which differ both in refractive and diſperſive power; and when taken up from the pot, theſe parts mix in threads, which may be diſſeminated through the maſs in any degree of fineneſs. But they ſtill retain their properties; and when a piece of flint-glaſs has been formed into a lens, the eye, placed in its focus, ſees the whole ſurface occupied by gliſtening threads or broader veins running acroſs it. Great rewards have been offered for removing this defect, but hitherto to no purpoſe. We beg leave to propoſe the following method: Let the glaſs be reduced to powder, and then melted with a great proportion of alkaline ſalt, ſo as to make a liquor ſilicum. When precipitated from this by an acid, it muſt be in a ſtate of very uniform compoſition. If again melted into glaſs, we ſhould hope that it would be free from this defect; if not, the caſe ſeems to be deſperate.

But by uſing a fluid medium, Dr Blair was freed from all this embarraſſment; and he acquired another

Telescope. immense advantage, that of adjusting at pleasure both the refractive and dispersive powers of his lenses. In solid lenses, we do not know whether we have taken the curvatures suited to the refractions till our glass is finished; and if we have mistaken the proportions, all our labour is lost. But when fluids are used, it is enough that we know nearly the refractions. We suit our focal distances to these, and then select our curvature, so as to remove the aberration of figure, preserving the focal distances. Thus, by properly tempering the fluid mediums, we bring the lens to agree precisely with the theory, perfectly achromatic, and the aberration of figure as much corrected as is possible.

Dr Blair examined the refracted and dispersive powers of a great variety of substances, and found great varieties in their actions on the different colours. This is indeed what every well informed naturalist would expect. There is no doubt now among naturalists about the mechanical connection of the phenomena of nature; and all are agreed that the chemical actions of the particles of matter are perfectly like in kind to the action of gravitating bodies; that all these phenomena are the effects of forces like those which we call attractions and repulsions, and which we observe in magnets and electrified bodies; that light is refracted by forces of the same kind, but differing chiefly in the small extent of their sphere of activity. One who views things in this way will expect, that as the actions of the same acid for the different alkalies are different in degree, and as the different acids have also different actions on the same alkali, in like manner different substances differ in their general refractive powers, and also in the proportion of their action on the different colours. Nothing is more unlikely therefore than the proportional dispersion of the different colours by different substances; and it is surprising that this inquiry has been so long delayed. It is hoped that Dr Blair will oblige the public with an account of the experiments which he has made. This will enable others to co-operate in the improvement of achromatic glasses. We cannot derive much knowledge from what he has already published, because it was chiefly with the intention of giving a popular, though not an accurate, view of the subject. The constructions which are there mentioned are not those which he found most effectual, but those which would be most easily understood, or demonstrated by the slight theory which is contained in the dissertation; besides, the manner of expressing the difference of refrangibility, perhaps chosen for its paradoxical appearance, does not give us a clear notion of the characteristic differences of the substances examined. Those rays which are ultimately most deflected from their direction, are said to have become the most refrangible by the combination of different substances, although, in all the particular refractions by which this effect is produced, they are less refracted than the violet light. We can just gather this much, that common glass disperses the rays in such a manner, that the ray which is in the confine of the green and blue occupies the middle of the prismatic spectrum; but in glasses, and many other substances, which are more dispersive, this ray is nearer to the ruddy extremity of the spectrum. While therefore the straight line RC′ (fig. 13.) terminates the ordinates O o', YY′, G g', &c. which represent the dispersion of common glass, the ordinates which express the dispersions of these substances are terminated by a curve passing through R and C′, but lying below the line RC′. When therefore parallel heterogeneous light is made to converge to the axis of a convex lens of common glass, as happens at F in fig. 6. C, the light is dispersed, and the violet rays have a shorter focal distance. If we now apply a concave lens of greater dispersive power, the red and violet rays are brought to one focus F; but the green rays, not being so much refracted away from F, are left behind at φ, and have now a shorter focal distance. But Dr Blair afterwards found that this was not the case with the muriatic acid, and some solutions in it. He found that the ray which common glass caused to occupy the middle of the spectrum was much nearer to the blue extremity when refracted by these fluids. Therefore a concave lens formed of such fluids which united the red and violet rays in F′, refracted the green rays to f'.

Fig. 13.

Tele-

Fig. 6

Having observed this, it was an obvious conjecture, that a mixture of some of these fluids might produce a medium, whose action on the intermediate rays should have the same proportion that is observed on common glass; or that two of them might be found which formed spectra similarly divided, and yet differing sufficiently in dispersive power to enable us to destroy the dispersion by contrary refractions, without destroying the whole refraction. Dr Blair accordingly found a mixture of solutions of ammoniacal and mercurial salts, and also some other substances, which produced dispersions proportional to that of glass, with respect to the different colours.

And thus has the result of this intricate and laborious investigation corresponded to his utmost wishes. He has produced achromatic telescopes which seem as perfect as the thing will admit of; for he has been able to give them such apertures, that the *incorrigible* aberration arising from the spherical surfaces becomes a sensible quantity, and precludes farther amplification by the eye-glasses. We have examined one of his telescopes: The focal distance of the object-glass did not exceed 17 inches, and the aperture was fully $3\frac{1}{2}$ inches. We viewed some single and double stars and some common objects with this telescope; and found, that in magnifying power, brightness, and distinctness, it was manifestly superior to one of Mr Dollond's of 42 inches focal length. It also gave us an opportunity of admiring the dexterity of the London artists, who could work the glasses with such accuracy. We had most distinct vision of a star when using an erecting eye-piece, which made this telescope magnify more than a hundred times; and we found the field of vision as uniformly distinct as with Dollond's 42 inch telescope magnifying 46 times. The intelligent reader must admire the nice figuring and centering of the very deep eye-glasses which are necessary for this amplification.

It is to be hoped that Dr Blair will extend his views to *glasses* of different compositions, and thus give us object-glasses which are solid; for those composed of fluids have inconveniences which will hinder them from coming into general use, and will confine them to the museums of philosophers. We imagine that antimonial glasses bid fair to answer this purpose, if they could be made free of colour, so as to transmit enough of light. We recommend this dissertation to the careful perusal of our readers. Those who have not made themselves much acquainted with the delicate and abstruse theory of aberrations, will find it exhibited in such a popular

form

Teleſcope. form as will enable them to underſtand its general aim; and the well-informed reader will find many curious indications of inquiries and diſcoveries yet to be made.

We now proceed to conſider the eye-glaſſes or glaſſes of teleſcopes. The proper conſtruction of an eye-piece is not leſs eſſential than that of the object-glaſs. But our limits will not allow us to treat this ſubject in the ſame detail. We have already extended this article to a great length, becauſe we do not know of any performance in the Engliſh language which will enable our readers to underſtand the conſtruction of achromatic teleſcopes; an invention which reflects honour on our country, and has completed the diſcoveries of our illuſtrious Newton. Our readers will find abundant information in Dr Smith's Opties concerning the eye-glaſſes, chiefly deduced from Huyghen's fine theory of aberration (A). At the ſame time, we muſt again pay Mr Dollond the merited compliment of ſaying, that he was the firſt who made any ſcientific application of this theory to the compound eye-piece for erecting the object. His eye-pieces of five and ſix glaſſes are very ingenious reduplications of Huyghen's eye-pieces of two glaſſes, and would probably have ſuperſeded all others, had not his diſcovery of achromatic object-glaſſes cauſed opticians to conſider the chromatic diſperſion with more attention, and pointed out methods of correcting it in the eye-piece without any compound eye-glaſſes. They have found that this may be more conveniently done with four eye-glaſſes, without ſenſibly diminiſhing the advantages which Huyghens ſhowed to reſult from employing many ſmall refractions inſtead of a leſſer number of great ones. As this is a very curious ſubject, we ſhall give enough for making our readers fully acquainted with it, and content ourſelves with merely mentioning the principles of the other rules for conſtructing an eye-piece.

Such readers as are leſs familiarly acquainted with optical diſcuſſions will do well to keep in mind the following conſequences of the general focal theorem.

g. 15. If AB (fig. 15.) be a lens, R a radiant point or focus of incident rays, and a the focus of parallel rays coming from the oppoſite ſide; then,

1. Draw the perpendicular $a\,a'$ to the axis, meeting the incident ray in a', and a' A to the centre of the lens. The refracted ray BF is parallel to a' A; for R a' : a' A (= R a : a A) = RB : BF (=RA : AF), which is the focal theorem.

2. An oblique pencil BP b proceeding from any point P which is not in the axis, is collected to the point f, where the refracted ray BF cuts the line PA f drawn from P through the centre of the lens: for P a' : a' A = PB : Bf, which is alſo the focal theorem.

The Galilean teleſcope is ſuſceptible of ſo little improvement that we need not employ any time in illuſtrating its performance.

The ſimple aſtronomical teleſcope is repreſented in fig. 16. The beam of parallel rays, inclined to the axis, is made to converge to a point G, where it forms an image of the loweſt point of a very diſtant object. Theſe rays decuſſating from G fall on the eye-glaſs; the ray from the loweſt point B of the object-glaſs falls on the eye-glaſs at b; and the ray from A falls on a; and the ray from the centre O falls on o. Theſe rays are rendered parallel, or nearly ſo, by refraction through the eye-glaſs, and take the direction $b\,i'$, o I, $a\,i$. If the eye be placed ſo that this pencil of parallel rays may enter it, they converge to a point of the retina, and give diſtinct viſion to the loweſt point of the object. It appears inverted, becauſe the rays by which we ſee its loweſt point come in the direction which in ſimple viſion is connected with the upper point of an object. They come from above, and therefore are thought to proceed from above. We ſee the point as if ſituated in the direction I o. In like manner the eye placed at I, ſees the upper point of the object in the direction IP, and its middle in the direction IE. The proper place for the eye is I; if brought much nearer the glaſs, or removed much farther from it, ſome, or the whole, of this extreme pencil of rays will not enter the pupil. It is therefore of importance to determine this point. Becauſe the eye requires parallel rays for diſtinct viſion, it is plain that F muſt be the principal focus of the eye-glaſs. Therefore, by the common focal theorem, OF : OE = OE : OI, or OF : FE = OE : EI. Teleſcope. Fig. 16.

The magnifying power being meaſured by the magnitude of the viſual angle, compared with the magnitude of the viſual angle with the naked eye, we have

$$\frac{o\,\mathrm{I}\,p}{o\,\mathrm{O}p}, \text{ or } \frac{o\,\mathrm{IF}}{o\,\mathrm{OF}} \text{ for the meaſure of the magnifying power}$$

$$\text{This is very nearly} = \frac{\mathrm{OE}}{\mathrm{EI}}, \text{ or } \frac{\mathrm{OF}}{\mathrm{FI}}.$$

As the line OE, joining the centres of the lenſes, and perpendicular to their ſurfaces, is called the axis of the teleſcope, ſo the ray OG is called the axis of the oblique pencil, being really the axis of the cone of light which has the object glaſs for its baſe. This ray is through its whole courſe the axis of the oblique pencil; and when its courſe is determined, the amplification, the field of viſion, the apertures of the glaſſes, are all determined. For this purpoſe we have only to conſider the centre of the object-glaſs as a radical point, and trace the proceſs of a ray from this point through the other glaſſes: this will be the axis of ſome oblique pencil.

It is evident, therefore, that the field of viſion depends on the breadth of the eye-glaſs. Should we increaſe this, the extreme pencil will paſs through I, becauſe O and I are ſtill the conjugate foci of the eye-glaſs.

(A) While we thus repeatedly ſpeak of the theory of ſpherical aberration as coming from Mr Huyghens, we muſt not admit giving a due ſhare of the honour of it to Dr Barrow and Mr James Gregory. The firſt of theſe authors, in his Optical Lectures delivered at Cambridge, has given every propoſition which is employed by Huyghens, and has even proſecuted the matter much further. In particular, his theory of oblique ſlender pencils is of immenſe conſequence to the perfection of teleſcopes, by ſhowing the methods for making the image of an extended ſurface as flat as poſſible. Gregory, too, has given all the fundamental propoſitions in his *Optica Promota*. But Huyghens, by taking the ſubject together, and treating it in a ſyſtem, has greatly ſimplified it: and his manner of viewing the principal parts of it is incomparably more perſpicuous than the performances of Barrow and Gregory.

Teleſcope. glaſs. On the other hand, the angle reſolved on for the extent or field of viſion gives the breadth of the eye-glaſs.

We may here obſerve, by the way, that for all optical inſtruments there muſt be two optical figures conſidered. The firſt ſhows the progreſs of a pencil of rays coming from one point of the object. The various focuſes of this pencil ſhow the places of the different images, real or virtual. Such a figure is formed by the three rays AG *a i*, OG *o* I, BG *b i*.

The ſecond ſhows the progreſs of the axes of the different pencils proceeding through the centre of the object-glaſs. The focuſes of this pencil of axes ſhow the places where an image of the object glaſs is formed; and this pencil determines the field of viſion, the apertures of the lenſes, and the amplification or magnifying power. The three rays OG *o* I, OFEI, OHPI, form this figure.

See alſo fig. 24. where the progreſs of both ſets of pencils is more diverſified.

The perfection of a teleſcope is to repreſent an object in its proper ſhape, diſtinctly magnified, with a great field of viſion, and ſufficiently bright. But there are limits to all theſe qualities; and an increaſe of one of them, for the moſt part, diminiſhes the reſt. The brightneſs depends on the aperture of the object-glaſs, and will increaſe in the ſame proportion (becauſe *i i'* will always be to AB in the proportion of EF to FO), till the diameter of the emergent pencil is equal to that of the pupil of the eye. Increaſing the object-glaſs any more, can ſend no more light into the eye. But we cannot make the emergent pencil nearly ſo large as this when the teleſcope magnifies much; for the great aperture of the object-glaſs produces an indiſtinct image at GF, and its indiſtinctneſs is magnified by the eye-glaſs.

A great field of viſion is incompatible with the true ſhape of the object; for it is not ſtrictly true that all rays flowing from O are refracted to I. Thoſe rays which go to the margin of the eye-glaſs croſs the axis between E and I; and therefore they croſs it at a greater angle than if they paſſed through I. Now had they really paſſed through I, the object would have been repreſented in its due proportions. Therefore ſince the angles of the marginal parts are enlarged by the aberration of the eye-glaſs, the marginal parts themſelves will appear enlarged, or the object appear diſtorted. Thus a cheſs-board viewed through a reading glaſs appears drawn out at the corners, and the ſtraight lines are all changed into curves, as is repreſented in fig. 18. Fig. 18.

The circumſtance which moſt peremptorily limits the extent of field is the neceſſary diſtinctneſs. If the viſion be indiſtinct, it is uſeleſs, and no other quality can compenſate this defect. The diſtortion is very inconſiderable in much larger angles of viſion than we can admit, and is unworthy of the attention paid to it by optical writers. They have been induced to take notice of it, becauſe the means of correcting it in a conſiderable degree are attainable, and afford an opportunity of exhibiting their knowledge; whereas the indiſtinctneſs which accompanies a large field is a ſubject of moſt difficult diſcuſſion, and has hitherto baffled all their efforts to expreſs by any intelligible or manageable formulæ.

Quæque tractata niteſcere poſſe
Deſperat relinquit.

Teleſcop

This ſubject muſt, however be conſidered. The image at GF of a very remote object is not a plain ſurface perpendicular to the axis of the teleſcope, but is nearly ſpherical, having O for its centre. If a number of pencils of parallel rays croſſing each other in I fall on the eye-glaſs, they will form a picture on the oppoſite ſide, in the focus F. But this picture will by no means be flat, nor nearly ſo, but very concave towards E. Its exact form is of moſt difficult inveſtigation. The elements of it are given by Dr Barrow; and we have given the chief of them in the article Optics, when conſidering the foci of infinitely ſlender pencils of oblique rays. Therefore it is impoſſible that the picture formed by the object-glaſs can be ſeen diſtinctly in all its parts by the eye-glaſs. Even if it were flat, the points G and H (fig. 16.) are too far from the eye-glaſs when the middle F is at the proper diſtance for diſtinct viſion. When, therefore, the teleſcope is ſo adjuſted that we have diſtinct viſion of the middle of the field, in order to ſee the margin diſtinctly we muſt puſh in the eye-glaſs: and having ſo done, the middle of the field becomes indiſtinct. When the field of viſion exceeds 12 or 15 degrees, it is not poſſible by any contrivance to make it tolerably diſtinct all over; and we muſt turn the teleſcope ſucceſſively to the different parts of the field that we may ſee them agreeably. Fig. 16.

The cauſe of this indiſtinctneſs is, as we have already ſaid, the ſhortneſs of the lateral foci of lateral and oblique pencils refracted by the eye-glaſs. The oblique pencil *b* G *a*, by which an eye placed at I ſees the point G of the image, is a cone of light, having a circular baſe on the eye-glaſs; of which circle *a b* is one of the diameters. There is a diameter perpendicular to this, which, in this figure, is repreſented by the point *o*. Fig. 17. repreſents the baſe of the cone as ſeen by an eye placed in the axis of the teleſcope, with the object-glaſs as appearing behind it. The point *b* is formed by a ray which comes from the loweſt point B of the object-glaſs, and the point *a* is illuminated by a ray from A. The point *c* at the right hand of the circular baſe of this cone of light came from the point C on the left ſide of the object-glaſs; and the light comes to *d* from D. Now the laws of optics demonſtrate, that the rays which come through the points *c* and *d* are more convergent after refraction than the rays which come through *a* and *b*. The analogies, therefore, which aſcertain the foci of rays lying in planes paſſing through the axis do not determine the foci of the others. Of this we may be ſenſible by looking through a lens to a figure on which are drawn concentric circles croſſed by radii. When the teleſcope is ſo adjuſted that we ſee diſtinctly the extremity of one of the radii, we ſhall not ſee diſtinctly the circumference which croſſes the extremity with equal diſtinctneſs, and *vice verſa*. This difference, however, between the foci of the rays which come through *a* and *b*, and thoſe which come through *c* and *d*, is not conſiderable in the fields of viſion, which are otherwiſe admiſſible. But the ſame difference of foci obtains alſo with reſpect to the diſperſion of light, and is more remarkable. Both d'Alembert and Euler have attempted to introduce it into their formulæ; Fig. 17.

Teleſcope. mulæ; but they have made them uſeleſs for any practical purpoſe by their inextricable complication.

This muſt ſerve as a general indication of the difficulties which occur in the conſtruction of teleſcopes, even although the object-glaſs were perfect, forming an image without the ſmalleſt confuſion or diſtortion.

There is yet another difficulty or imperfection. The rays of the pencil *a* G *b*, when refracted through the eye-glaſs, are alſo ſeparated into their component colours. The edge of the lens muſt evidently perform the office of a priſm, and the white ray G *b* will be ſo diſperſed that if *b i* be the path of its red ray, the violet ray, which makes another part of it, will take ſuch a courſe *b n* that the angle *i' b n* will be nearly $\frac{1}{27}$th of *G' b i'*. The ray G *a* paſſing through a part of the lens whoſe ſurfaces are leſs inclined to each other, will be leſs refracted, and will be leſs diſperſed in the ſame proportion very nearly. Therefore the two violet rays will be very nearly parallel when the two red rays are rendered parallel.

Hence it muſt happen, that the object will appear bordered with coloured fringes. A black line ſeen near the margin on a white ground, will have a ruddy and orange border on the outſide and a blue border within: and this confuſion is altogether independent on the object-glaſs, and is ſo much the greater as the viſual angle *b* IE is greater.

Such are the difficulties: They would be unſurmountable were it not that ſome of them are ſo connected that, to a certain extent, the diminution of one is accompanied by a diminution of the other. What are called the *cauſtic curves* are the geometrical loci of the foci of infinitely ſlender pencils. Conſequently the point G is very nearly in the cauſtic formed by a beam of light conſiſting of rays parallel to I *o*, and occupying the whole ſurface of the eye-glaſs, becauſe the pencil of rays which are collected at G is very ſmall. Any thing therefore that diminiſhes the mutual inclination of the adjoining rays, puts their concourſe farther off. Now this is preciſely what we want: for the point G of the image formed by the object-glaſs is already beyond the focus of the oblique ſlender pencil of parallel rays *i a* and *i' b*; and therefore, if we could make this focus go a little farther from *a* and *b*, we ſhall bring it nearer to G, and obtain more diſtinct viſion of this point of the object. Now let it be recollected, that in moderate refractions through priſms, two rays which are inclined to each other in a ſmall angle are, after refraction, inclined to each other in the ſame angle. Therefore, if we can diminiſh the aberration of the ray *a i*, or *o* I, or *b i'*, we diminiſh their mutual inclination; and conſequently the mutual inclination of the rays G *a*, G *o*, G *b'*, and therefore lengthen the focus, and get more diſtinct viſion of the point G. Therefore we at once correct the diſtortion and the indiſtinctneſs: and this is the aim of Mr Huyghens's great principle of dividing the refractions.

The general method is as follows: Let *o* be the object-glaſs (fig. 19.) and E the eye-glaſs of a teleſcope, and F their common focus, and FG the image formed by the object-glaſs. The proportion of their focal diſtances is ſuppoſed to be ſuch as gives as great a magnifying power as the perfection of the object-glaſs will admit. Let BI be the axis of the emergent pencil. It is known by the focal theorem that GE is parallel to BI: therefore BGE is the whole refraction or deflection of the ray OHB from its former direction. Let it be propoſed to diminiſh the aberrations by dividing this into two parts by means of two glaſſes D and *e*, ſo as to make the ultimate angle of viſion *b i c* equal to BIE, and thus retain the ſame magnifying power and viſible field. Let it be propoſed to divide it into the parts BGC and CGE.

From G draw any line GD to the axis towards O; and draw the perpendicular DH, cutting OG in H; draw H *c* parallel to GC, cutting GD in *g*; draw *g f* perpendicular to the axis, and *g e* parallel to GE; draw *e b* perpendicular to the axis; draw D δ parallel to GC, and *d* δ perpendicular to the axis.

Then if there be placed at D a lens whoſe focal diſtance is D *d*, and another at *e* whoſe focal diſtance is *e f*, the thing is done. The ray OH will be refracted into H *b*, and this into *b i*, parallel to BI.

The demonſtration of this conſtruction is ſo evident by means of the common focal theorem, that we need not repeat it, nor the reaſons for its advantages. We have the ſame magnifying power, and the ſame field of viſion; we have leſs aberration, and therefore leſs diſtortion and indiſtinctneſs; and this is brought about by a lens HD of a ſmaller aperture and a greater focal diſtance than BE. Conſequently, if we are contented with the diſtinctneſs of the margin of the field with a ſingle eye-glaſs, we may greatly increaſe the field of viſion; for if we increaſe DH to the ſize of EB we ſhall have a greater field, and much greater diſtinctneſs in the margin; becauſe HD is of a longer focal diſtance, and will bear a greater aperture, preſerving the ſame diſtinctneſs at the edge. On this account the glaſs HD is commonly called the *Field-glaſs*.

It muſt be obſerved here, however, that although the diſtortion of the object is leſſened, there is a real diſtortion produced in the image *f g*. But this, when magnified by the glaſs *e*, is ſmaller than the diſtortion produced by the glaſs E, of greater aperture and ſhorter focus, on the undiſtorted image GF. But becauſe there is a diſtortion in the ſecond image *f g*, this conſtruction cannot be uſed for the teleſcopes of aſtronomical quadrants, and other graduated inſtruments; becauſe then equal diviſions of the micrometer would not correſpond to equal angles.

But the ſame conſtruction will anſwer in this caſe, by taking the point D on that ſide of F which is remote from O (fig. 20.) This is the form now employed in the teleſcopes of all graduated inſtruments.

The exact proportion in which the diſtortion and the indiſtinctneſs at the edges of the field are diminiſhed by this conſtruction, depends on the proportion in which the angle BGE is divided by GC; and is of pretty difficult inveſtigation. But it never deviates far (never $\frac{1}{8}$th in optical inſtruments) from the proportion of the ſquares of the angles. We may, without any ſenſible error, ſuppoſe it in this proportion. This gives us a practical rule of eaſy recollection, and of moſt extenſive uſe. When we would diminiſh an aberration by dividing the whole refraction into two parts, we ſhall do it moſt effectually by making them equal. In like manner, if we divide it into three parts by means of two additional

Telescope. ditional glasses, we must make each $= \frac{1}{3}d$ of the whole; and so on for a greater number.

This useful problem, even when limited, as we have done, to equal refractions, is as yet indeterminate; that is, susceptible of an infinity of solutions: for the point D, where the field-glass is placed, was taken at pleasure: yet there must be situations more proper than others. The aberrations which produce distortion, and those which produce indistinctness, do not follow the same proportions. To correct the indistinctness, we should not select such positions of the lens HD as will give a small focal distance to be; that is, we should not remove it very far from F. Huyghens recommends the proportion of 3 to 1 for that of the focal distances of the lens HD and eb, and says that the distance De should be $= 2Fe$. This will make $ei = \frac{1}{2}eF$, and will divide the whole refraction into two equal parts, as any one will readily see by constructing the common optical figure. Mr Short, the celebrated improver of reflecting telescopes, generally employed this proportion; and we shall presently see that it is a very good one.

It has been already observed that the great refractions which take place on the eye-glasses occasion very considerable dispersions, and disturb the vision by fringing every thing with colours. To remedy this, achromatic eye-glasses may be employed, constructed by the rules already delivered. This construction, however, is incomparably more intricate than that of object-glasses: for the equations must involve the distance of the radiant point, and be more complicated: and this complication is immensely increased on account of the great obliquity of the pencils.

Most fortunately the Huyghenian construction of an eye-piece enables us to correct this dispersion to a great degree of exactness. A heterogenous ray is dispersed at H, and the red ray belonging to it falls on the lens be at a greater distance from the centre than the violet ray coming from H. It will therefore be less refracted (*cæteris paribus*) by the lens be; and it is possible that the difference may be such that the red and violet rays dispersed at H may be rendered parallel at b, or even a little divergent, so as to unite accurately with the red ray at the bottom of the eye. How this may be effected, by a proper selection of the places and figures of the lenses, will appear by the following proposition, which we imagine is new, and not inelegant.

Fig. 21. Let the compound ray OP (fig. 21.) be dispersed by the lens PC; and let PV, PR be its violet and red rays, cutting the axis in G and g. It is required to place another lens RD in their way, so that the emergent rays Rr, Vv, shall be parallel.

Produce the incident ray OP to Z. The angles ZPR, ZPV, are given, (and RPV is nearly $= \frac{ZPR}{27}$) and the intersections G and g with the axis. Let F be the focus of parallel red light coming through the lens RD in the opposite direction. Then (by the common optical theorem), the perpendicular Fϱ will cut PR in such a point ϱ, that ϱF will be parallel to the emergent ray Rr, and to Vv. Therefore if ϱD cut PV in u, and uf be drawn perpendicular to the axis, we shall have (also by the common theorem) the point f for the focus of violet rays, and $DF : Df = D\varrho : Du = 28 : 27$ Telesco nearly, or in a given ratio.

The problem is therefore reduced to this, "To draw from a point D in the line CG a line Dϱ, which shall be cut by the lines PR and PV in the given ratio."

The following construction naturally offers itself: Make $GM : gM$ in the given ratio, and draw MK parallel to Pg. Through *any* point D of CG draw the straight line PDK, cutting MK in K. Join GK, and draw Dϱ parallel to KG. This will solve the problem; and, drawing ϱF perpendicular to the axis, we shall have F for the focus of the lens RD for parallel red rays.

The demonstration is evident: for MK being parallel to Pg, we have $GM : gM = GK : HK = \varrho D : uD = FD : fD$, in the ratio required.

This problem admits of an infinity of solutions; because the point D may be taken anywhere in the line CG. It may therefore be subjected to such conditions as may produce other advantages.

1. It may be restricted by the magnifying power, or by the division which we choose to make of the whole refraction which produces this magnifying power. Thus, if we have resolved to diminish the aberrations by making the two refractions equal, we have determined the angle RrD. Therefore draw GK, making the angle MGK equal to that which the emergent pencil must make with the axis, in order to produce this magnifying power. Then draw MK parallel to Pg, meeting GK in K. Then draw PK, cutting the axis in D, and Dϱ parallel to GK, and ϱF perpendicular to the axis. D is the place, and DF the focal distance of the eye-glass.

2. Particular circumstances may cause us to fix on a particular place D, and we only want the focal distance. In this case the first construction suffices.

3. We may have determined on a certain focal distance DF, and the place must be determined. In this case let

$$GF : F\varrho = 1 : \tan. G$$
$$F\varrho : fu = 1 : m, \text{ m being } = \tfrac{27}{28}$$
$$fu : fg = \tan. g : 1$$
$$\text{then } GF : fg = \tan. g : m \tan. G$$
$$\text{then } GF - fg : GF = \tan. g - m \tan. G : \tan. g$$
$$\text{or } Gg + Ff : GF = \tan. g - m \tan. G : \tan. g;$$

$$\text{and } GF = Gg + Ff \frac{\tan. g}{\tan. g - m \tan. G}, \text{ and is}$$

therefore given, and the place of F is determined; and since FD is given by supposition, D is determined.

The application of this problem to our purpose is difficult, if we take it in the most general terms; but the nature of the thing makes such limitations that it becomes very easy. In the case of the dispersion of light, the angle GPg is so small that MK may be drawn parallel to PG without any sensible error. If the ray OP were parallel to CG, then G would be the focus of the lens PC, and the point M would fall on C; because the focal distance of red rays is to that of violet rays in the same proportion for every lens, and therefore $CG : Cg = DF : Df$. Now, in a telescope which magnifies considerably, the angle at the object-glass is very small, and CG hardly exceeds the focal distance; and CG is to Cg very nearly in the same proportion of 28 to 27. We may therefore draw through C (fig. 22.) a line CK Fig. 22. parallel

Telescope. parallel to PG; then draw GK′ perpendicular to the axis of the lenses, and join PK′; draw K′BE parallel to CG, cutting PK in B; draw BHI parallel to GK, cutting GK′ in H: Join HD and PK. It is evident that CG is bisected in F′, and that K′B=2F′D: also K′H : HG=K′B : BE, =CD : DG. Therefore DH is parallel to CK′, or to PG. But because PF′=F′K′, PD is = DB; and IH=HB. Therefore ℓ D=HB, and FD=K′B, =2F′D; and FD is bisected in F′.

Therefore $CD=\frac{CG+FD}{2}$.

That is, in order that the eye-glass RD may correct the dispersion of the field-glass PC, *the distance between them must be equal to the half sum of their focal distances* very nearly. More exactly, *the distance between them must be equal to the half sum of the focal distance of the eye-glass, and the distance at which the field-glass would form an image of the object-glass.* For the point G is the focus to which a ray coming from the centre of the object-glass is refracted by the field-glass.

This is a very simple solution of this important problem. Huyghens's eye-piece corresponds with it exactly. If indeed the dispersion at P is not entirely produced by the refraction, but perhaps combined with
Fig. 21. some previous dispersion, the point M (fig. 21.) will not
Fig. 22. coincide with C (fig. 22.), and we shall have GC to GM, as the natural dispersion at P to the dispersion which really obtains there. This may destroy the equation $CD=\frac{CG+FD}{2}$.

Thus, in a manner rather unexpected, have we freed the eye-glasses from the greatest part of the effect of dispersion. We may do it entirely by pushing the eye-glass a little nearer to the field-glass. This will render the violet rays a little divergent from the red, so as to produce a perfect picture at the bottom of the eye. But by doing so we have hurt the distinctness of the whole picture, because F is not in the focus of RD. We remedy this by drawing both glasses out a little, and the telescope is made perfect.

This improvement cannot be applied to the con-
Fig. 20. struction of quadrant telescopes, such as fig. 20. Mr Ramsden has attempted it, however, in a very ingenious way, which merits a place here, and is also instructive in another way. The field-glass HD is a plano-convex, with its plane side next the image GF. It is placed very near this image. The consequence of this disposition is, that the image GF produces a vertical image gf, which is much less convex towards the glass. He then places a lens on the point C, where the red ray would cross the axis. The violet ray will pass on the other side of it. If the focal distance of this glass be fc, the vision will be distinct and free from colour. It has, however, the inconveniency of obliging the eye to be close to the glass, which is very troublesome.

This would be a good construction for a magic-lanthorn, or for the object-glass of a solar microscope, or indeed of any compound microscope.

We may presume that the reader is now pretty familiar with the different circumstances which must be considered in the construction of an eye-piece, and proceed to consider those which must be employed to erect the object. Telescope.

This may be done by placing the lens which receives the light from the object-glass in such a manner, that a second image (inverted with respect to the first) may be formed beyond it, and this may be viewed by an eye-glass. Such a construction is represented in fig. 23. But, besides many other defects, it tinges the object prodigiously with colour. The ray od is dispersed at d into the red ray dr, and the violet dv, v being farther from the centre than r, the refracted ray vv' crosses rr' both by reason of spherical aberration and its greater refrangibility. Plate DXXX. fig. 23.

But the common day telescope, invented by F. Rheita, has, in this respect, greatly the advantage of the one now described. The rays of compound light are dispersed at two points. The violet ray in its course falls without the red ray, but is accurately collected with it at a common focus, as we shall demonstrate by and by. Since they cross each other in the focus, the violet ray must fall within the red ray, and be less refracted than if it had fallen on the same point with the red ray. Had it fallen there it would have separated from it; but by a proper diminution of its refraction, it is kept parallel to it, or nearly so. And this is one excellence of this telescope: when constructed with three eye-glasses perfectly equal, the colour is sensibly diminished, and by using an eye-glass somewhat smaller, it may be removed entirely.—We say no more of it at present, because we shall find its construction included in another, which is still more perfect.

It is evident at first sight that this telescope may be improved, by substituting for the eye-glass the Huyghenian double eye-glass, or field-glass and eye-glass represented in fig. 19. and 20.; and that the first of these may be improved and rendered achromatic. This will require the two glasses ef and gh to be increased from their present dimensions to the size of a field-glass, suited to the magnifying power of the telescope, supposing it an astronomical telescope. Thus we shall have a telescope of four eye-glasses. The three first will be of a considerable focal distance, and two of them will have a common focus at b. But this is considerably different from the eye-piece of four glasses which are now used, and are far better. We are indebted for them to Mr Dollond, who was a mathematician as well as an artist, and in the course of his research discovered resources which had not been thought of. He had not then discovered the achromatic object-glass, and was busy in improving the eye-glasses by diminishing their spherical aberration. His first thought was to make the Huyghenian addition at both the images of the day telescope. This suggested to him the following eye-piece of five glasses.

Fig. 24. represents this eye-piece, but there is not Fig. 24.
room for the object-glass at its proper distance. A pencil of rays coming from the upper point of the object is made to converge (by the object-glass) to G, where it would form a picture of that part of the object. But it is intercepted by the lens A a, and its axis is bent towards the axis of the telescope in the direction ab. At the same time, the rays which converged to G converge to g, and there is formed an inverted picture of the object at gf. The axis of the pencil is again refracted at

Teleſcope. b, croſſes the axis of the teleſcope in H, is refracted again at c, at d, and at e, and at laſt croſſes the axis in I. The rays of this pencil, diverging from g, are made leſs diverging, and proceed as if they came from g', in the line $B\,g\,g'$. The lens c C cauſes them to converge to g', in the line $G''\,C\,g'$. The lens d D makes them converge ſtill more to G'', and there they form an erect picture G'' F''; diverging from G'', they are rendered parallel by the refraction at e.

At H the rays are nearly parallel. Had the glaſs B b been a little farther from A, they would have been accurately ſo, and the object-glaſs, with the glaſſes A and B, would have formed an aſtronomical teleſcope with the Huyghenian eye-piece. The glaſſes C, D, and E, are intended merely for bending the rays back again till they again croſs the axis in I. The glaſs C tends chiefly to diminiſh the great angle BH b; and then the two glaſſes D and E are another Huyghenian eye-piece.

The art in this conſtruction lies in the proper adjuſtment of the glaſſes, ſo as to divide the whole bending of the pencil pretty equally among them, and to form the laſt image in the focus of the eye-glaſs, and at a proper diſtance from the other glaſs. Bringing B nearer to A would bend the pencil more to the axis. Placing C farther from B would do the ſame thing; but this would be accompanied with more aberration, becauſe the rays would fall at a greater diſtance from the centres of the lenſes. The greateſt bending is made at the field-glaſs D; and we imagine that the teleſcope would be improved, and made more diſtinct at the edges of the field, by employing another glaſs of great focal diſtance between C and D.

There is an image formed at H of the object-glaſſes, and the whole light paſſes through a ſmall circle in this place. It is uſual to put a plate here pierced with a hole which has the diameter of this image. A ſecond image of the object-glaſs is formed at I, and indeed wherever the pencils croſs the axis. A lens placed at H makes no change in any of the angles, nor in the magnifying power, and affects only the place where the images are formed. And, on the other hand, a lens placed at f, or F'', where a real image is formed, makes no change in the places of the images, but affects the mutual inclination of the pencils. This affords a reſource to the artiſt, by which he may combine properties which ſeem incompatible.

The aperture of A determines the viſible field and all the other apertures.

We muſt avoid forming a real image, ſuch as $f\,g$, or F'' G'', on or very near any glaſs. For we cannot ſee this image without ſeeing along with it every particle of duſt and every ſcratch on the glaſs. We ſee them as making part of the object when the image is exactly on the glaſs, and we ſee them confuſedly, and ſo as to confuſe the object, when the image is near it. For when the image is on or very near any glaſs, the pencil of light occupies a very ſmall part of its ſurface, and a particle of duſt intercepts a great proportion of it.

It is plain that this conſtruction will not do for the teleſcope of graduated inſtruments, becauſe the micrometer cannot be applied to the ſecond image $f\,g$, on account of its being a little diſtorted, as has been obſerved of the Huyghenian eye-piece.

Alſo the interpoſition of the glaſs C makes it difficult to correct the diſperſion. Teleſc

By proper reaſoning from the correction in the Huyghenian eye-piece, we are led to the beſt conſtruction of one with three glaſſes; which we ſhall now conſider, taking it in a particular form, which ſhall make the diſcuſſion eaſy, and make us fully maſters of the principles which lead to a better form. Therefore let PA (fig. 25.) be the glaſs which firſt receives the light proceeding from the image formed by the object-glaſs, and let OP be the axis of the extreme pencil. This is refracted into PR, which is again refracted into R r by the next lens B r. Let b be the focus of parallel rays of the ſecond lens. Draw PB r. We know that A b : b B = PB : B r, and that rays of one kind diverging from P will be collected at r. But if PR, PV be a red and a violet ray, the violet ray will be more refracted at V, and will croſs the red ray in ſome intermediate point g of the line R r. If therefore the firſt image had been formed preciſely on the lens PA, we ſhould have a ſecond image at $f\,g$ free from all coloured fringes. Fig. 25

If the refractions at P and R are equal (as in the common day teleſcope), the diſperſion at V muſt be equal to that at P, or the angle v V r = VPR. But we have ultimately RPV : R r V = BC : AB, (= B b : A b by the focal theorem). Therefore g V r : $g\,r$ V, (or $g\,r$: g V, or C f : f B) = B b : A b, and AB : A b = R r : R g.

This ſhows by the way the advantage of the common day teleſcope. In this AB = 2 A b, and therefore f is the place of the laſt image which is free from coloured fringes. But this image will not be ſeen free from coloured fringes through the eye-glaſs C r, if f be its focus: For had $g\,r$, $g\,v$ been both red rays, they would have been parallel after refraction; but $g\,v$ being a violet ray, will be more refracted. It will not indeed be ſo much deflected from parallelifm as the violet ray, which naturally accompanies the red ray to r, becauſe it falls nearer the centre. By computation its diſperſion is diminiſhed about $\frac{1}{7}$th.

In order that $g\,v$ may be made parallel to $g\,r$ after refraction, the refraction at r muſt be ſuch that the diſperſion correſponding to it may be of a proper magnitude. How to determine this is the queſtion. Let the diſperſion at g be to the diſperſion produced by the refraction at r (which is required for producing the intended magnifying power) as 1 to 9. Make 9 : 1 = $f\,f'$: f' C, = f C : CD, and draw the perpendicular D r' meeting the refracted ray $r\,r'$ in r'. Then we know by the common focal theorem, that if f' be the focus of the lens C r, red rays diverging from g will be united in r'. But the violet ray $g\,v$ will be refracted into $v\,v'$ parallel to $r\,r'$. For the angle $v\,r'\,r$: $v\,g\,r$ = (ultimately) fC : CD, = 9 : 1. Therefore the angle $v\,r'\,r$ is equal to the diſperſion produced at r, and therefore equal to $r'\,v\,v'$, and $v\,v'$ is parallel to $r\,r'$.

But by this we have deſtroyed the diſtinct viſion of the image formed at $f\,g$, becauſe it is no longer at the focus of the eye-glaſs. But diſtinct viſion will be reſtored by puſhing the glaſſes nearer to the object-glaſs. This makes the rays of each particular pencil more divergent after refraction through A, but ſcarcely makes any change in the directions of the pencils themſelves. Thus the image comes to the focus f', and makes no ſenſible change in the diſperſions.

In

Teleſcope. In the common day teleſcope, the firſt image is formed in the anterior focus of the firſt eye-glaſs, and the ſecond image is at the anterior focus of the laſt eye-glaſs. If we change this laſt for one of half the focal diſtance, and puſh in the eye-piece till the image formed by the object-glaſs is half way between the firſt eye-glaſs and its focus, the laſt image will be formed at the focus of the new eye-glaſs, and the eye-piece will be achromatic. This is eaſily ſeen by making the uſual computations by the focal theorem. But the viſible field is diminiſhed, becauſe we cannot give the ſame aperture as before to the new eye-glaſs; but we can ſubſtitute for it two eye-glaſſes like the former, placed cloſe together. This will have the ſame focal diſtance with the new one, and will allow the ſame aperture that we had before.

On theſe principles may be demonſtrated the correction of colour in eye-pieces with three glaſſes of the following conſtruction.

Let the glaſſes A and B be placed ſo that the poſterior focus of the firſt nearly coincides with the anterior focus of the ſecond, or rather ſo that the anterior focus of B may be at the place where the image of the object-glaſs is formed, by which ſituation the aperture neceſſary for tranſmitting the whole light will be the ſmalleſt poſſible. Place the third C at a diſtance from the ſecond, which exceeds the ſum of their focal diſtances by a ſpace which is a third proportional to the diſtance of the firſt and ſecond, and the focal diſtance of the ſecond. The diſtance of the firſt eye-glaſs from the object-glaſs muſt be equal to the product of the focal diſtance of the firſt and ſecond divided by their ſum.

Let O o, A a, B b, C c, the focal diſtances of the glaſſes, be O, a, b, c. Then make $AB = a+b$ nearly; $BC = b+c+\frac{b^2}{b+c}$; $OA = \frac{bc}{b+c}$. The amplification or magnifying power will be $= \frac{ob}{ac}$; the equivalent eye-glaſs $= \frac{ac}{b}$; and the field of viſion $= 3438' \times \frac{\text{Aperture of A}}{\text{foc. diſt. ob. gl.}}$.

Theſe eye-pieces will admit the uſe of a micrometer at the place of the firſt image, becauſe it has no diſtortion.

Mr Dollond was anxious to combine this achromatiſm of the eye-pieces with the advantages which he had found in the eye-pieces with five glaſſes. This eye-piece of three glaſſes neceſſarily has a very great refraction at the glaſs B, where the pencil which has come from the other ſide of the axis muſt be rendered again convergent, or at leaſt parallel to it. This occaſions conſiderable aberrations. This may be avoided by giving part of this refraction to a glaſs put between the firſt and ſecond, in the ſame way as he has done by the glaſs B put between A and C in his five glaſs eye-piece. But this deranges the whole proceſs. His ingenuity, however, ſurmounted this difficulty, and he made eye-pieces of four glaſſes, which ſeem as perfect as can be deſired. He has not publiſhed his ingenious inveſtigation; and we obſerve the London artiſts work very much at random, probably copying the proportions of ſome of his beſt glaſſes, without underſtanding the principle, and therefore frequently miſtaking. We ſee many eye-pieces which are far from being achromatic. We imagine therefore that it will be an acceptable thing to the artiſts to have preciſe inſtructions how to proceed, nothing of this kind having appeared in our language, and the inveſtigations of Euler, d'Alembert, and even Boſcovich, being ſo abſtruſe as to be inacceſſible to all but experienced analyſts. We hope to render it extremely ſimple. Teleſcope.

It is evident, that if we make the rays of different colours unite on the ſurface of the laſt eye-glaſs but one, commonly called the *field-glaſs*, the thing will be done, becauſe the diſperſion from this point of union will then unite with the diſperſion produced by this glaſs alone; and this increaſed diſperſion may be corrected by the laſt eye-glaſs in the way already ſhown.

Therefore let A, B (fig. 26.) be the ſtations which we have fixed on for the firſt and ſecond eye-glaſſes, in order to give a proper portion of the whole refraction to the ſecond glaſs. Let b be the anterior focus of B. Draw PBr through the centre of B. Make $Ab : bB = AB : BK$. Draw the perpendicular Kr, meeting the refracted ray in r. We know by the focal theorem, that red rays diverging from P will converge to r; but the violet ray PV, being more refracted, will croſs Rr in ſome point g. Drawing the perpendicular fg, we get f for the proper place of the field-glaſs. Let the refracted ray Rr, produced backward, meet the ray OP coming from the centre of the object-glaſs in O. Let the angle of diſperſion RPV be called p, and the angle of diſperſion at V, that is, rVv, be v, and the angle VrR be r. Fig. 26.

It is evident that OR : OP $= p : v$, becauſe the diſperſions are proportional to the ſines of the refractions, which, in this caſe, are very nearly as the refractions themſelves.

Let $\frac{OP}{OR}$ (or $\frac{op}{pB}$ or $\frac{pB}{bB}$) be made $= m$. Then $v = mp$; alſo $p : r = BK : AB, = bB : Ab$, and $r = p.\frac{Ab}{bB}$, or making $\frac{Ab}{Bb} = n$, $r = np$; therefore $v : r = m : n$, $= \frac{pB}{bB} : \frac{Ab}{bB}$, $= pB : Ab$.

The angle RgV $= g$V$r + g$RrV $= p.\overline{m+n}$; and RgV : RrV $=$ Rr : Rg, or $m+n : n =$ Rr : Rg, and R$g = Rr\frac{n}{m+n}$. But Rr is ultimately $=$ BK $=$ AB $\frac{bB}{Ab} = \frac{AB}{n}$. Therefore R$g = \frac{AB}{n} \times \frac{n}{m+n} = \frac{n}{m+n}$, and B$f = \frac{AB}{m+n}$.

This value of Bf is evidently $= bB \times \frac{AB}{pB+Ab}$. Now bB being a conſtant quantity while the glaſs B is the ſame, the place of union varies with $\frac{AB}{pB+Ab}$. If we remove B a little farther from A, we increaſe AB, and pB, and Ab, each by the ſame quantity. This evidently diminiſhes Bf. On the other hand, bringing B nearer to A increaſes Bf. If we keep the diſtance between the glaſſes the ſame, but increaſe the focal diſtance bB, we augment Bf, becauſe this change aug-

Telescope. ments the numerator and diminishes the denominator of the fraction $\frac{b\mathrm{B}\times\mathrm{AB}}{p\mathrm{B}+\mathrm{A}b}$.

In this manner we can unite the colours at what distance we please, and consequently can unite them in the place of the intended field-glass, from which they will diverge with an increased dispersion, viz. with the dispersion competent to the refraction produced there, and the dispersion $p\times\overline{m+n}$ conjoined.

It only remains to determine the proper focal distances of the field-glass and eye-glass, and the place of the eye-glass, so that this dispersion may be finally corrected.

This is an indeterminate problem, admiting of an infinity of solutions. We shall limit it by an equal division of the two remaining refractions, which are necessary in order to produce the intended magnifying power. This construction has the advantage of diminishing the aberration. Thus we know the two refractions, and the dispersion competent to each; it being nearly $\frac{1}{27}$th of the refraction. Call this q. The whole dispersion at the field-glass consists of q, and of the angle K g V of fig. 19. which we also know to be $=p\times\overline{m+n}$. Call their sum s.

Fig. 27. Let fig. 27. represent this addition to the eye-piece. C g is the field-glass coming in the place of fg of fig. 26. and R g w is the red ray coming from the glass BR. Draw $g\,s$ parallel to the intended emergent pencil from the eye-glass; that is, making the angle C $s\,g$ with the axis correspond to the intended magnifying power. Bisect this angle by the line g K. Make $s\,g : g\,q = s : q$, and draw q K, cutting C g in t. Draw $t\,\delta$ D, cutting $g\,k$ in δ, and the axis in D. Draw $\delta\,d$ and D r perpendicular to the axis. Then a lens placed in D, having the focal distance D d, will destroy the dispersion at the lens $g\,c$, which refracts the ray $g\,w$ into $g\,r$.

Let $g\,v$ be the violet ray, making the angle $v\,g\,r = s$. It is plain, by the common optical theorem, that $g\,r$ will be refracted into $r\,r'$ parallel to δ D. Draw g D r' meeting $r\,r'$, and join $v\,r'$. By the focal theorem two red rays $g\,r\,g\,v$, will be united in r'. But the violet ray $g\,v$ will be more refracted, and will take the path $v\,v'$, making the angle of dispersion $r'\,v\,v = q$, very nearly, because the dispersion at v does not sensibly differ from that at r. Now, in the small angles of refraction which obtain in optical instruments, the angles $r\,r'\,v$, $r\,g\,v$ are very nearly as $g\,r$ and $r\,r'$, or as g D and D r', or as CD and DT; which, by the focal theorem, are as C d and dD; that is, D d : $dc = rg\,v : r\,r'\,v$. But D d : dC $=$ D δ : $\delta\,t$, $= s\,g : g\,q$, $= s : q$. But $r\,g\,v = s$; therefore $r\,r'\,v = q$, $= r'\,v\,v'$, and $v\,v'$ is parallel to $r\,r'$, and the whole dispersion at g is corrected by the lens D r. The focal distance C c of C g is had by drawing C $\varkappa$ parallel to K g, meeting R g in $\varkappa$, and drawing $\varkappa\,c$ perpendicular to the axis.

It is easy to see that this (not inelegant) construction is not limited to the equality of the refractions $w\,g\,r$, K $r\,r'$. In whatever proportion the whole refraction $w\,g\,s$ is divided, we always can tell the proportion of the dispersions which the two refractions occasion at g and r, and can therefore find the values of s and q. Indeed this solution includes the problem in p. 266. col. 2. par. ult.; but it had not occurred to us till the present occasion. Our readers will not be displeased with this variety of resource. Telesc

The intelligent reader will see, that in this solution some quantities and ratios are assumed as equal which are not strictly so, in the same manner as in all the elementary optical theorems. The parallelism, however, of $v\,v'$ and $r\,r'$ may be made accurate, by pushing the lens D r nearer to C g, or retiring it from it. We may also, by pushing it still nearer, induce a small divergency of the violet ray, so as to produce accurate vision in the eye, and may thus make the vision through a telescope more perfect than with the naked eye, where dispersion is by no means avoided. It would therefore be an improvement to have the eye-glass in a sliding tube for adjustment. Bring the telescope to distinct vision; and if any colour be visible about the edges of the field, shift the eye-glass till this colour is removed. The vision may now become indistinct: but this is corrected by shifting the place of the whole eye-piece.

We have examined trigonometrically the progress of a red and a violet ray through many eye-pieces of Dollond's and Ramsden's best telescopes; and we have found in all of them that the colours are united on or very near the field-glass; so that we presume that a theory somewhat analogous to ours has directed the ingenious inventors. We meet with many made by other artists, and even some of theirs, where a considerable degree of colour remains, sometimes in the natural order and often in the contrary order. This must happen in the hands of mere imitators, ignorant of principle. We presume that we have now made this principle sufficiently plain.

Fig. 28. represents the eye-piece of a very fine spy-glass by Mr Ramsden; the focal length of its object-glass is $8\frac{1}{2}$ inches, with $1\frac{1}{10}$th of aperture, 2° 05′ of visible field, and 15.4 magnifying power. The distances and focal lengths are of their proper dimensions, but the apertures are $\frac{1}{2}$ larger, that the progress of a lateral pencil might be more distinctly drawn. The dimensions are as follow: Fig. 2

Foc. lengths Aa = 0.775 Bb = 1.025 Cc = 1.01 Dd = 0.79.
Distances AB = 1.18 BC = 1.83 CD = 1.105.

It is perfectly achromatic, and the colours are united, not precisely at the lens C g, but about $\frac{1}{20}$th of an inch nearer the eye-glass.

It is obvious that this combination of glasses may be used as a microscope; for if, instead of the image formed by the object-glass at FG, we substitute a small object, illuminated from behind, as in compound microscopes; and if we draw the eye-piece a very small way from this object, the pencils of parallel rays emergent from the eye-glass D will become convergent to very distant points, and will there form an inverted and enlarged picture of the object, which may be viewed by a Huyghenian eye-piece; and we may thus get high magnifying powers without using very deep glasses. We tried the eye-piece of which we have given the dimensions in this way, and found that it might be made to magnify 180 times with very great distinctness. When used as the magnifier of a solar microscope, it infinitely surpasses every thing we have ever seen. The picture formed by a solar microscope is generally so indistinct, that it is fit only for amusing ladies; but with this magnifier it seem-

ed

Telescope. ed perfectly sharp. We therefore recommend this to the artists as a valuable article of their trade.

The only thing which remains to be considered in the theory of refracting telescopes is the forms of the different lenses. Hitherto we have had no occasion to consider any thing but their focal distances; but their aberrations depend greatly on the adjustment of their forms to their situations. When the conjugate focuses of a lens are determined by the services which it is to perform, there is a certain form or proportion between the curvatures of their anterior and posterior surfaces, which will make their aberrations the smallest possible.

It is evident that this proportion is to be obtained by making the fluxion of the quantity within the parenthesis in the formula at the top of col. 2. p. 248. equal to nothing. When this is done, we obtain this formula for a, the radius of curvature for the anterior surface of a lens. $\frac{1}{a}=\frac{2m^2+m}{2m+4}+\frac{4m+4}{2(m+4)r}$, where m is the ratio of the sine of incidence to the sine of refraction, and r is the distance of the focus of incident rays, positive or negative, according as they converge or diverge, all measured on a scale of which the unit is n, = half of the radius of the equivalent isosceles lens.

It will be sufficiently exact for our purpose to suppose $m=\frac{3}{2}$, though it is more nearly $\frac{31}{20}$. In this case $\frac{1}{a}=\frac{b}{7}+\frac{10}{7r}$, $=\frac{42r+70}{49r}$. Therefore $a=\frac{49r}{42r+70}$. And $\frac{1}{b}=\frac{1}{a}-1$, $=\frac{1-a}{a}$.

As an example, let it be required to give the radii of curvature in inches for the eye-glass be of page 262. col. 1. par. 4. which we shall suppose of $1\frac{1}{2}$ inches focal distance, and that ec ($=r$) is $3\frac{1}{4}$th inches.

The radius of curvature for the equivalent isosceles lens is 1.5, and its half is 0.75. Therefore $r=\frac{3\frac{1}{4}}{0.75}$, $=5$; and our formula is $a=\frac{49\times 5}{42\times 5+70}$, $=\frac{245}{280}$, $=0.875$; and $\frac{1}{b}=\frac{1-a}{a}$, $=\frac{0.125}{0.875}$, and $b=\frac{0.875}{0.125}$, $=7$.

These values are parts of a scale, of which the unit is 0.75 inches. Therefore

a, in inches, $=0.875\times 0.75$, $=0.65525$
b, in inches, $=7\times 0.75$, $=5.25$.

And here we must observe that the posterior surface is concave: for b is a positive quantity, because $1-a$ is a positive quantity as well as a; therefore the centre of sphericity of both surfaces lies beyond the lens.

And this determination is not very different from the usual practice, which commonly makes this lens a plane convex with its flat side next the eye: and there will not be much difference in the performance of these two lenses; for in all cases of maxima and minima, even a pretty considerable change of the best dimensions does not make a sensible change in the result.

The same consideration leads to a rule which is very simple, and sufficiently exact for ordinary situations. Telescope. This is to make the curvatures such, that the incident and emergent pencils may be nearly equally inclined to the surfaces of the lens. Thus in the eye-piece with five glasses, A and B should be most convex on their anterior sides; C should be most convex on the posterior side; D should be nearly isosceles; and E nearly plano-convex.

But this is not so easy a matter as appears at first sight. The lenses of an eye-piece have not only to bend the several pencils of light to and from the axis of the telescope; they have also to form images on the axes of these pencils. These offices frequently require opposite forms, as mentioned in par. 3. col. 2. p. 261. Thus the glass A, fig. 28. should be most convex on the side next the object, that it may produce little distortion of the pencils. But it should be most convex next the eye, that it may produce distinct vision of the image FG, which is very near it. This image should have its concavity turned towards A, whereas it is towards the object-glass. We must therefore endeavour to make the vertical image fg flatter, or even convex. This requires a glass very flat before and convex behind. For similar reasons the object-glass of a microscope and the simple eye-glass of an astronomical telescope should be formed the same way. Fig. 28.

This is a subject of most difficult discussion, and requires a theory which few of our readers would relish; nor does our limits afford room for it. The artists are obliged to grope their way. The proper method of experiment would be, to make eye-pieces of large dimensions, with extravagant apertures to increase the aberrations, and to provide for each station A, B, C, and D, a number of lenses of the same focal distance, but of different forms; and we would advise making the trial in the way of a solar microscope, and to have two eye-pieces on trial at once. Their pictures can be formed on the same screen, and accurately compared; whereas it is difficult to keep in remembrance the performance of one eye-piece, and compare it with another.

We have now treated the theory of refracting telescopes with considerable minuteness, and have perhaps exceeded the limits which some readers may think reasonable. But we have long regretted that there is not any theory on this subject from which a curious person can learn the improvements which have been made since the time of Dr Smith, or an artist learn how to proceed with intelligence in his profession. If we have accomplished either of these ends, we trust that the public will receive our labours with satisfaction.

We cannot add any thing to what Dr Smith has delivered on the theory of reflecting telescopes. There appears to be the same possibility of correcting the aberration of the great speculum by the contrary aberration of a convex small speculum, that we have practised in the compound object-glass of an achromatic refracting telescope. But this cannot be, unless we make the radius of the convex speculum exceedingly large, which destroys the magnifying power and the brightness. This therefore must be given up. Indeed their performance, when well executed, does already surpass all imagination. Dr Herschel has found great advantages in what he calls the *front view*, not using a plane mirror to throw the pencils to one side. But this cannot be

Teleſcope. be practiſed in any but teleſcopes ſo large, that the loſs of light, occaſioned by the interpoſition of the obſerver's head, may be diſregarded.

NOTHING remains but to deſcribe the mechaniſm of ſome of the moſt convenient forms.

To deſcribe all the varieties of ſhape and accommodation which may be given to a teleſcope, would be a taſk as trifling as prolix. The artiſts of London and of Paris have racked their inventions to pleaſe every fancy, and to ſuit every purpoſe. We ſhall content ourſelves with a few general maxims, deduced from the ſcientific conſideration of a teleſcope, as an inſtrument by which the viſual angle ſubtended by a diſtant object is greatly magnified.

The chief conſideration is to have a ſteady view of the diſtant object. This is unattainable, unleſs the axis of the inſtrument be kept conſtantly directed to the ſame point of it: for when the teleſcope is gently ſhifted from its poſition, the object *ſeems to move* in the ſame or in the oppoſite direction, according as the teleſcope inverts the object or ſhows it erect. This is owing to the magnifying power, becauſe the apparent angular motion is greater than what we naturally connect with the motion of the teleſcope. This does not happen when we look through a tube without glaſſes.

All ſhaking of the inſtrument therefore makes the object dance before the eye; and this is diſagreeable, and hinders us from ſeeing it diſtinctly. But a tremulous motion, however ſmall, is infinitely more prejudicial to the performance of a teleſcope, by making the object quiver before us. A perſon walking in the room prevents us from ſeeing diſtinctly; nay, the very pulſation in the body of the obſerver, agitates the floor enough to produce this effect, when the teleſcope has a great magnifying power: For the viſible motion of the object is then an imperceptible tremor, like that of an harpſichord wire, which produces an effect preciſely ſimilar to optical indiſtinctneſs; and every point of the object is diffuſed over the whole ſpace of the angular tremor, and appears coexiſtent in every part of this ſpace, juſt as a harpſichord wire does while it is ſounding. The more rapid this motion is, the indiſtinctneſs is the more complete. Therefore the more firm and elaſtic and well bound together the frame-work and apertures of our teleſcope is, the more hurtful will this conſequence be. A mounting of lead, were it practicable, would be preferable to wood, iron, or braſs. This is one great cauſe of the indiſtinctneſs of the very fineſt reflecting teleſcopes of the uſual conſtructions, and can never be totally removed. In the Gregorian form, it is hardly poſſible to damp the elaſtic tremor of the ſmall ſpeculum, carried by an arm ſupported at one end only, even though the tube were motionleſs. We were witneſſes of a great improvement made on a four-feet reflecting teleſcope, by ſupporting the ſmall ſpeculum by a ſtrong plate of lead placed acroſs the tube, and led by an adjuſting ſcrew at each end. But even the great mirror may vibrate enough to produce indiſtinctneſs. Refracting teleſcopes are free from this inconveniency, becauſe a ſmall angular motion of the object-glaſs round one of its own diameters has no ſenſible effect on the image in its focus. They are affected only by an angular motion of the axis of the teleſcope or of the eye-glaſſes.

This ſingle conſideration gives us great help towards judging of the merits of any particular apparatus. We Tele ſhould ſtudy it in this particular, and ſee whether its form makes the tube readily ſuſceptible of ſuch tremulous motions. If it does, the firmer it is and the more elaſtic it is, the worſe. All forms therefore where the tube is ſupported only near the middle, or where the whole immediately or remotely depend on one narrow joint, are defective.

Reaſoning in this way, we ſay with confidence, that of all the forms of a teleſcope apparatus, the old faſhioned ſimple ſtand repreſented in fig. 29. is by far the beſt, Fig. and that others are ſuperior according as the diſpoſition of the points of ſupport of the tube approaches to this. Let the pivots A, B, be fixed in the lintel and ſole of a window. Let the four braces terminate very near to theſe pivots. Let the teleſcope lie on the pin F*f*, reſting on the ſhoulder round the eye-piece, while the far end of it reſts on one of the pins 1, 2, 3, &c.; and let the diſtance of theſe pins from F very little exceed the length of the teleſcope. The trembling of the axis, even when conſiderable, cannot affect the poſition of the tube, becauſe the braces terminate almoſt at the pivots. The tremor of the brace CD does as little harm, becauſe it is nearly perpendicular to the tube. And if the object-glaſs were cloſe at the upper ſupporting pin, and the focus at the lower pin F, even the bending and trembling of the tube will have no effect on its optical axis. The inſtrument is only ſubject to horizontal tremors. Theſe may be almoſt annihilated by having a ſlender rod coming from a hook's joint in the ſide of the window, and paſſing through ſuch another joint cloſe by the pin F. We have ſeen an inſtrument of this form, having AB parallel to the earth's axis. The whole apparatus did not coſt 50 ſhillings, and we find it not in the leaſt ſenſible manner affected by a ſtorm of wind. It was by obſervations with this inſtrument that the tables of the motions of the Georgium Sidus, publiſhed in the Edinburgh Tranſactions, were conſtructed, and they are as accurate as any that have yet appeared. This is an excellent equatorial.

But this apparatus is not portable, and it is ſadly deficient in elegance. The following is the beſt method we have ſeen of combining theſe circumſtances with the indiſpenſable requiſites of a good teleſcope.

The pillar VX (fig. 30.) riſes from a firm ſtand, and Fig. 3 has a horizontal motion round a cone which completely fills it. This motion is regulated by a rack-work in the box at V. The ſcrew of this rack-work is turned by means of the handle P, of a convenient length, and the ſcrew may be diſengaged by the click or detent V, when we would turn the inſtrument a great way at once. The teleſcope has a vertical motion round the joint Q placed near the middle of the tube. The lower end of the tube is ſupported by the ſtay OT. This conſiſts of a tube RT, faſtened to the pillar by a joint T, which allows the ſtay to move in a vertical plane. Within this tube ſlides another, with a ſtiff motion. This tube is connected with the teleſcope by another joint O, alſo admitting motion in a vertical plane. The ſide M of this inner tube is formed into a rack, in which works a pinion fixed to the top of the tube RT, and turned by the flat finger-piece R. The reader will readily ſee the advantages and the remaining defects of this apparatus. It is very portable, becauſe the teleſcope is eaſily diſengaged from it, and the legs and ſtay fold up. If the joint

Telescope. joint Q were immediately under A, it would be much freer from all tremor in the vertical plane. But nothing can hinder other tremors arising from the long pillar and the three springy legs. These communicate all external agitations with great vigour. The instrument should be set on a stone pedestal, or, what is better, a cask filled with wet sand. This pedestal, which necessity perhaps suggested to our scientific navigators, is the best that can be imagined.

Fig. 31. Fig. 31. is the stand usually given to reflecting telescopes. The vertical tube FBG is fastened to the tube by finger screws, which pass through the slits at F and G. This arch turns round a joint in the head of the divided pillar, and has its edge cut into an oblique rack, which is acted on by the horizontal screw, furnished with the finger-piece A. This screw turns in a horizontal square frame. This frame turns round a horizontal joint in the off-side, which cannot be seen in this view. In the side of this frame next the eye there is a finger-screw *a*, which passes through the frame, and presses on the round horizontal plate D. By screwing down this finger-screw, the frame is brought up, and presses the horizontal screw to the rack. Thus the elevation of the telescope is fixed, and may be nicely changed by the finger applied to A and turning this screw. The horizontal round plate D moves stiffly round on another plate of nearly equal diameter. This under plate has a deep conical hollow socket, which is nicely fitted by grinding to a solid cone formed on the top of the great upright pillar, and they may be firmly fixed in any position by the finger-screw E. To the under plate is fastened a box *c*, containing a horizontal screw C, which always works in a rack cut in the edge of the upper plate, and cannot be disengaged from it. When a great vertical or horizontal motion is wanted, the screws *a* and E are slacked, and by tightening them the telescope may be fixed in any position, and then any small movements may be given it by the finger plates A and C.

This stand is very subject to brisk tremor, either from external agitation of the pedestal, or from the immediate action of the wind; and we have seldom seen distinctly through telescopes mounted in this manner, till one end of the tube was pressed against something that was very steady and unelastic. It is quite astonishing what a change this produces. We took a very fine telescope made by James Short, and laid the tube on a great lump of soft clay, pressing it firmly down into it. Several persons, ignorant of our purpose, looked through it, and read a table of logarithms at the distance of 310 yards. We then put the telescope on its stand, and pointed it at the same object; none of the company could read at a greater distance than 235 yards, although they could perceive no tremor. They thought the vision as sharp as before; but the incontrovertible proof of the contrary was, that they could not read at such a distance.

If the round plates were of much greater dimensions; and if the lower one, instead of being fixed to the pillar, were supported on four stout pillars standing on another plate; and if the vertical arch had a horizontal axis turning on two upright frames firmly fixed to the upper plate—the instrument would be much freer from tremor. Such stands were made formerly; but being much more bulky and inconvenient for package, they have gone into disuse. Telescope.

The high magnifying powers of Dr Herschel's telescopes made all the usual apparatus for their support extremely imperfect. But his judgment, and his ingenuity and fertility in resource, are as eminent as his philosophical ardour. He has contrived for his reflecting telescopes stands which have every property that can be desired. The tubes are all supported at the two ends. The motions, both vertical and horizontal, are contrived with the utmost simplicity and firmness. We cannot more properly conclude this article than with a description of his 40 feet telescope, the noblest monument of philosophical zeal and of princely munificence that the world can boast of.

Plate DXXXI, fig. 32. Fig. 32. represents a view of this instrument in a meridional situation, as it appears when seen from a convenient distance by a person placed to the south-west of it. The foundation in the ground consists of two concentric circular brick walls, the outermost of which is 42 feet in diameter, and the inside one 21 feet. They are two feet six inches deep under ground; two feet three inches broad at the bottom, and one foot two inches at the top; and are capped with paving stones about three inches thick, and twelve and three quarters broad. The bottom frame of the whole apparatus rests upon these two walls by twenty concentric rollers III, and is moveable upon a pivot, which gives a horizontal motion to the whole apparatus, as well as to the telescope.

The tube of the telescope, A, though very simple in its form, which is cylindrical, was attended with great difficulties in the construction. This is not to be wondered at; when its size, and the materials of which it is made, are considered. Its length is 39 feet four inches; it measures four feet ten inches in diameter; and every part of it is of iron. Upon a moderate computation, the weight of a wooden tube must have exceeded an iron one at least 3000 pounds; and its durability would have been far inferior to that of iron. It is made of rolled or sheet iron, which has been joined together without rivets, by a kind of seaming well known to those who make iron funnels for stoves.

Very great mechanical skill is used in the contrivance of the apparatus by which the telescope is supported and directed. In order to command every altitude, the point of support is moveable; and its motion is effected by mechanism, so that the telescope may be moved from its most backward point of support to the most forward, and, by means of the pulleys GG suspended from the great beam H, be set to any altitude, up to the very zenith. The tube is also made to rest with the point of support in a pivot, which permits it to be turned sidewise.

The concave face of the great mirror is 48 inches of polished surface in diameter. The thickness, which is equal in every part of it, remains now about three inches and a half; and its weight, when it came from the cast was 2118 pounds, of which it must have lost a small quantity in polishing. To put this speculum into the tube, it is suspended vertically by a crane in the laboratory, and placed on a small narrow carriage, which is drawn out, rolling upon planks, till it comes near the back of the tube; here it is again suspended

Teleſcope || Teller.

ſuſpended and placed in the tube by a peculiar apparatus.

The method of obſerving by this teleſcope is by what Dr Herſchel calls the *front view;* the obſerver being placed in a ſeat C, ſuſpended at the end of it, with his back towards the object he views. There is no ſmall ſpeculum, but the magnifiers are applied immediately to the firſt focal image.

From the opening of the teleſcope, near the place of the eye-glaſs, a ſpeaking pipe runs down to the bottom of the tube, where it goes into a turning joint; and after ſeveral other inflections, it at length divides into two branches, one going into the obſervatory D, and the other into the work-room E. By means of the ſpeaking pipe the communications of the obſerver are conveyed to the aſſiſtant in the obſervatory, and the workman is directed to perform the required motions.

In the obſervatory is placed a valuable ſidereal time-piece, made by Mr Shelton. Cloſe to it, and of the ſame height, is a polar diſtance-piece, which has a dial-plate of the ſame dimenſions with the time-piece: this piece may be made to ſhow polar diſtance, zenith diſtance, declination, or altitude, by ſetting it differently. The time and polar diſtance pieces are placed ſo that the aſſiſtants ſit before them at a table, with the ſpeaking pipe riſing between them; and in this manner obſervations may be written down very conveniently.

This noble inſtrument, with proper eye-glaſſes, magnifies above 6000 times, and is the largeſt that has ever been made. Such of our readers as wiſh for a fuller account of the machinery attached to it, viz. the ſtairs, ladders, and platform B, may have recourſe to the ſecond part of the Tranſactions of the Royal Society for 1795; in which, by means of 18 plates and 63 pages of letter-preſs, an ample detail is given of every circumſtance relating to joiner's work, carpenter's work, and ſmith's work, which attended the formation and erection of this teleſcope. It was completed on Auguſt the 28th 1789, and on the ſame day was the ſixth ſatellite of Saturn diſcovered.

TELL, WILLIAM, an illuſtrious Swiſs patriot, chief inſtrument of the revolution which delivered the Swiſs cantons from the German yoke in 1307. Griſler, the governor of theſe provinces for the emperor Albert, having ordered him, under pain of death, to ſhoot at an apple placed on the head of one of his children; he had the dexterity, though the diſtance was very conſiderable, to ſtrike it off without hitting the child. The tyrant, perceiving he had another arrow concealed under his cloak, aſked him for what purpoſe? To which he boldly replied, "To have ſhot you through the heart, if I had had the misfortune to kill my ſon." The enraged governor now ordered him to be hanged; but his fellow-citizens, animated by his fortitude and patriotiſm, flew to arms; attacked and vanquiſhed Griſler, who was ſhot to death by Tell; and the aſſociation for the independency took place that inſtant.

TELL-Tale, a name ſometimes given to the *Perpetual-LOG*. See that article.

TELLER, an officer of the exchequer, in ancient records called *tallier*. There are four of theſe officers, whoſe duty is to receive all ſums due to the king, and to give the clerk of the pells a bill to charge him therewith. They likewiſe pay all money due from the king, by warrant from the auditor of the receipt; and make weekly and yearly books both of their receipts and payments, which they deliver to the lord treaſurer. Tel || Tem

TELLINA, a genus of ſhell-fiſh. See CONCHOLOGY *Index*.

TEMISSA, a large town in Africa, about 120 miles north-eaſt of Mourzouk, the capital of Fezzan. Here the caravan of pilgrims from Bornou and Nigritia, which takes its departure from Mourzouk, and travels by the way of Cairo to Mecca, uſually provides the ſtores of corn and dates, and dried meat, that are requiſite for its dreary paſſage.

TEMPE, in *Ancient Geography*, a moſt pleaſant place or valley of Theſſaly. That it was there, appears from the epithets *Theſſalica* (Livy), *Theſſala* (Ovid); but in what particular diſtrict is the queſtion. From the Phthiotica of Catullus, it ſhould ſeem to be of Phthiotis: but the Peneus, which ran through Tempe, was at too great a diſtance, being ſeparated from it by Mount Othrys and others. Firſt, however, we ſhall define Tempe, previous to the determining the particular diſtrict in which it lay. The Peneus, according to Pliny, running down between Oſſa to the ſouth and Olympus to the north for 500 ſtadia, is for half that ſpace navigable: in the direction of this courſe lies what is called *Tempe*, extending in length for five miles, in breadth for about an acre and a half, with gentle convexities riſing on the right and left hand. Within glides the pure ſtream of the Peneus, charming in the graſs on its banks, and harmoniouſly vocal with the muſic of birds. In this deſcription Strabo and Ælian agree; the laſt adding, that it has an agreeable variety of places of retreat; and that it is not the work of man's hand, but the ſpontaneous production of nature; and Strabo ſays, that formerly the Peneus formed a lake in this ſpot, being checked in its courſe by the higher grounds about the ſea; but that an opening being made by an earthquake, and Mount Oſſa torn from Olympus, the Peneus gained a free courſe between them. But Livy, who calls Tempe a grove, remarks a degree of horror rather than amenity, with which the Roman army was ſtruck on marching over the narrow paſs; for, beſides the defile, difficult to go over, which runs on for five miles, there are ſteep rocks on each hand, down which the proſpect is apt to cauſe a dizzineſs, heightened by the noiſe and depth of the interfluent Peneus. Hence it appears that Tempe was in the Pelaſgiotis, whoſe extremity was formerly the Peneus, but afterwards, as is probable, allotted to Magneſia; and thus Pliny places the mouth of the Peneus not in Theſſaly itſelf, but in the Magneſia of Theſſaly.

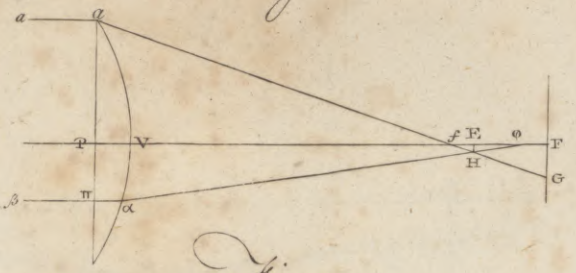
TEMPER, in a mechanical ſenſe. See TEMPERING.

TEMPER, in a moral ſenſe, the diſpoſition of mind, whether natural or acquired. The word is ſeldom uſed by good writers without an epithet, as a *good* or *bad* temper; though one of the moſt beautiful poems in the language is entitled *The Triumphs of Temper*.

It is well obſerved by an elegant Eſſayiſt, that more conſtant uneaſineſs ariſes from ill temper than from ill fortune; as a bad temper embitters every ſweet, and converts a paradiſe into a place of torment. For ſubduing the heart to ſoftneſs, and preſerving a due balance of the paſſions, a proper culture of the underſtanding and of the taſte is the beſt method. He who employs his

Fig. 7.

Fig. 6.



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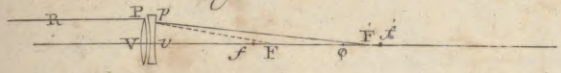
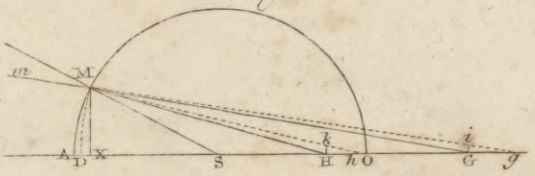


Fig. 10.

Fig. 9.



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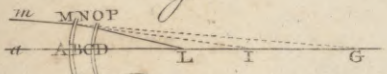

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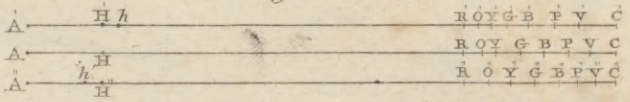

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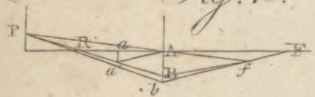

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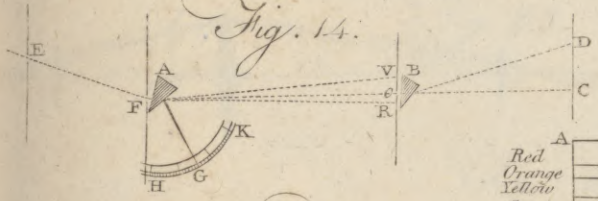

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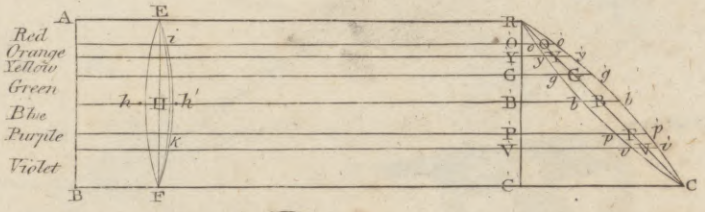
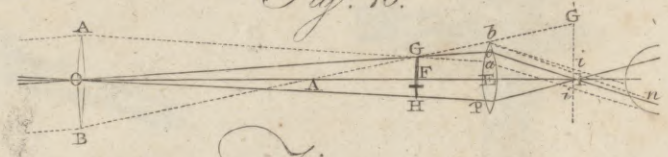


Fig. 18.

Fig. 17.

Fig. 16.



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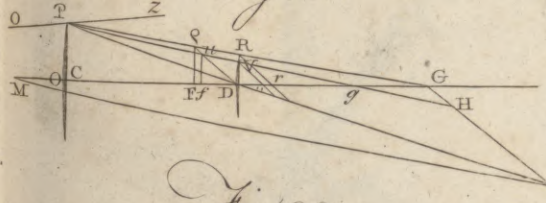

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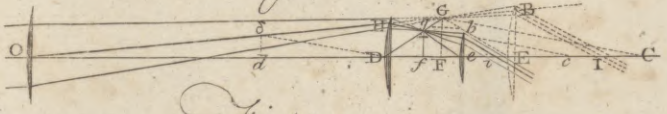

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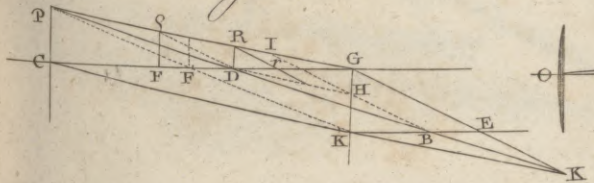

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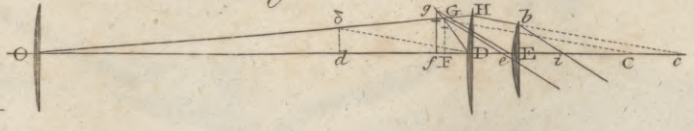

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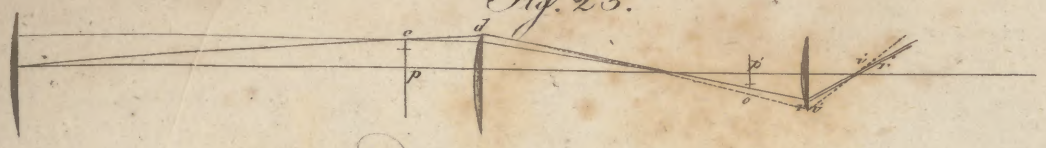

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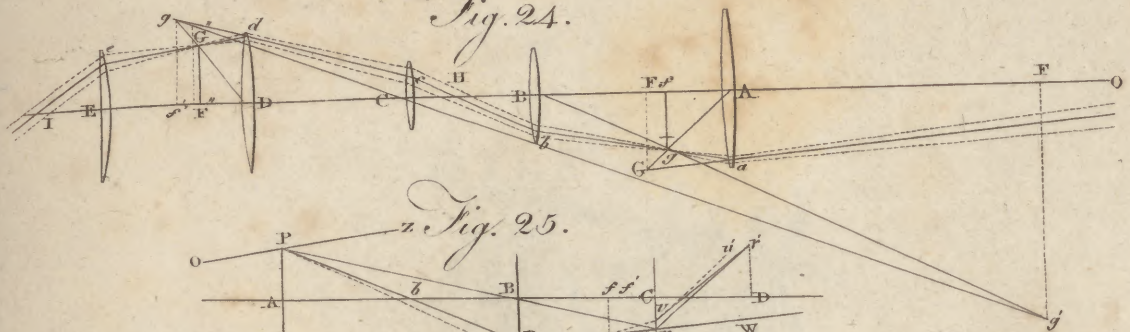

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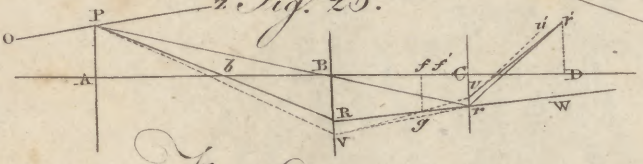

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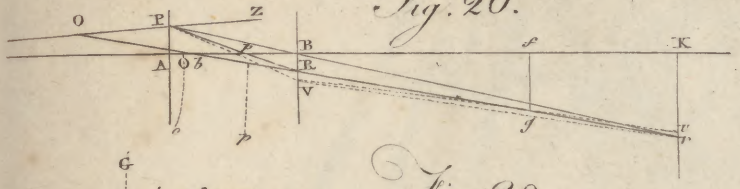

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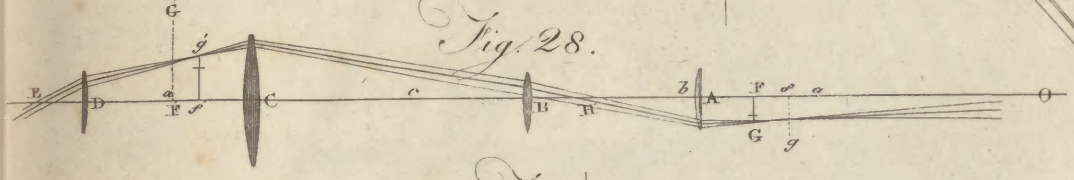

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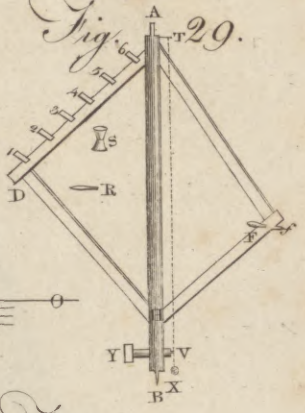

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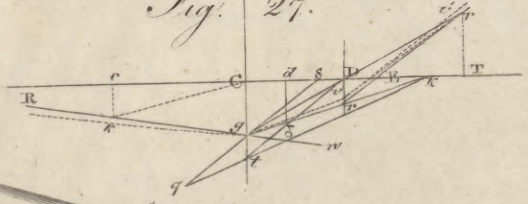

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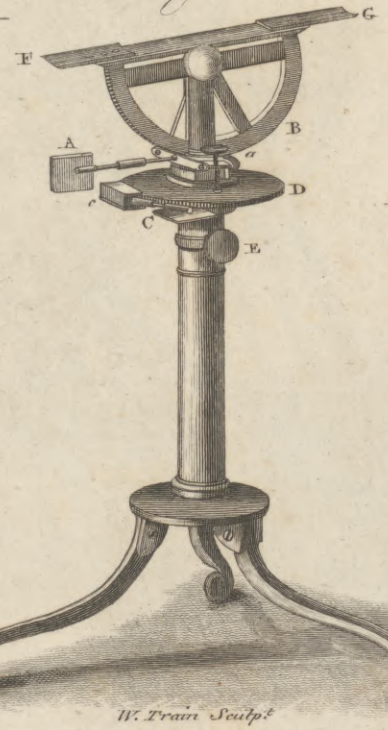

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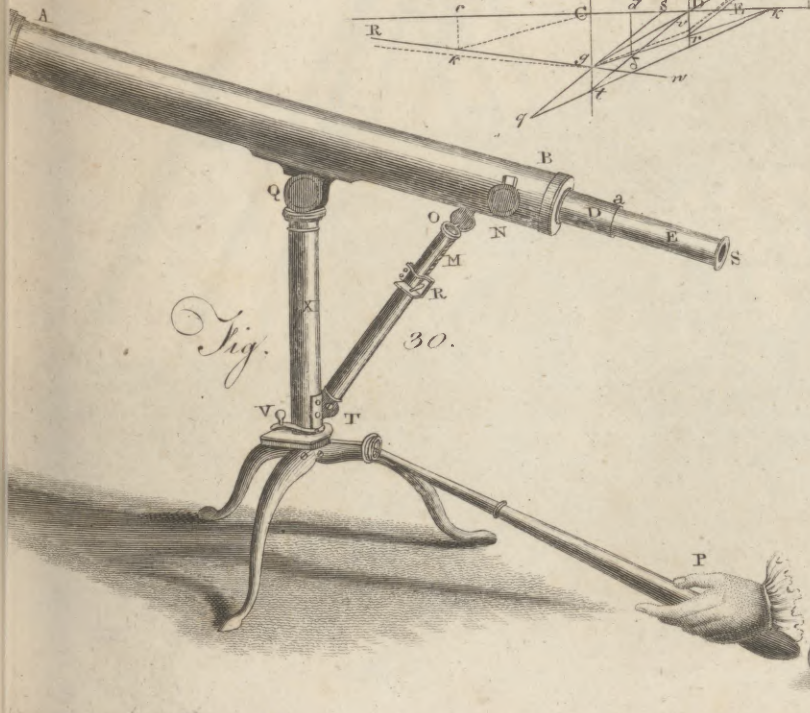
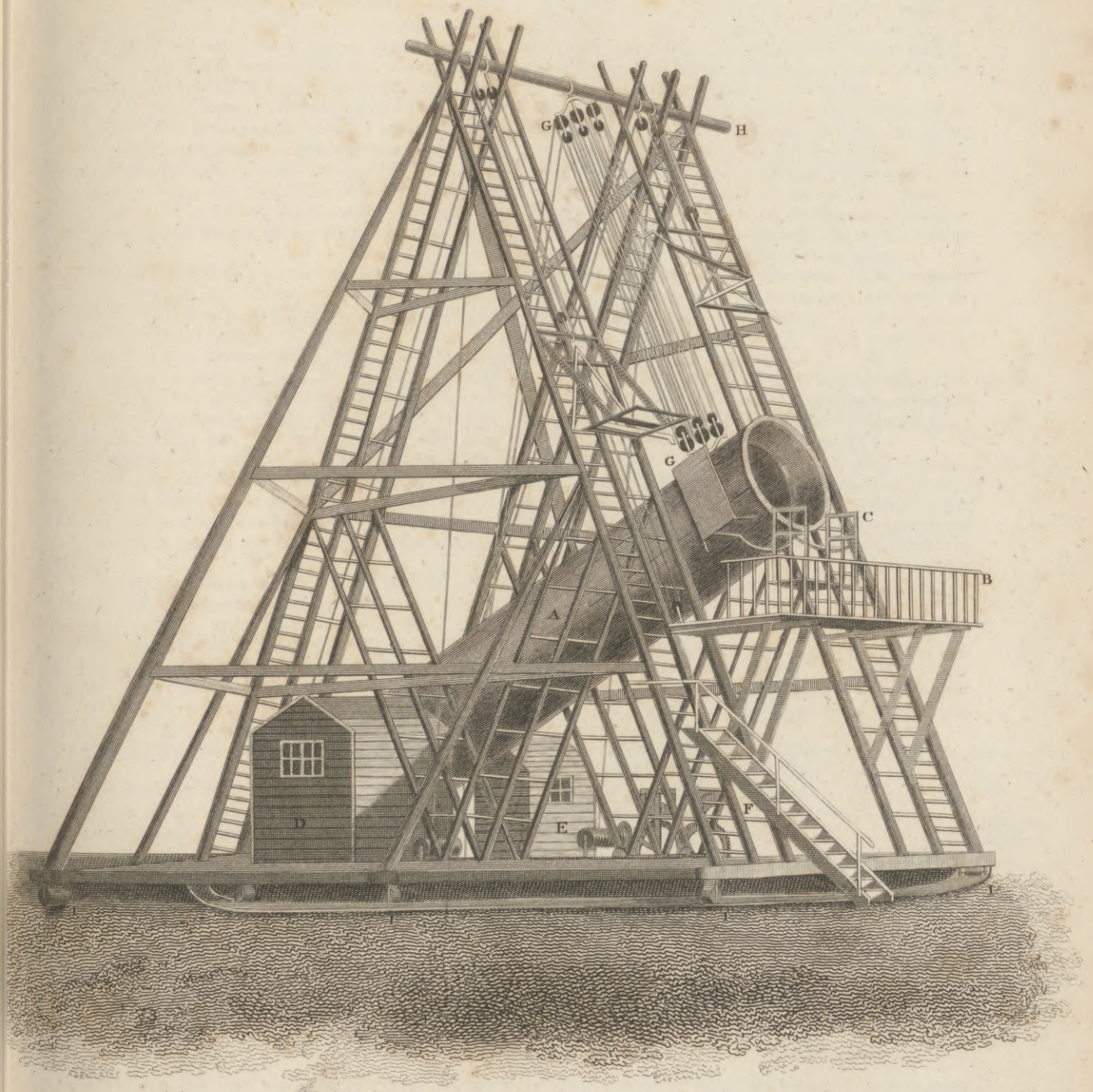


W. Train Sculp.t

Fig. 32.



E. Mitchell Sculp.t

emper, mperament. his time in the ſtudies of elegant literature, or the fine arts, has almoſt always a good temper; whilſt the man who is abſorbed in the purſuits of profound ſcience is apt to acquire a ſeverity of diſpoſition, little leſs diſagreeable, though generally much leſs pernicious, than the capriciouſneſs of the idler. Muſic, painting, and poetry, teach the mind to ſelect the agreeable parts of thoſe objects which ſurround us, and by habituating it to a pure and permanent delight, gradually ſuperinduce an habitual good humour. It is of infinite importance to happineſs to accuſtom the mind, from infancy, to turn from deformed and painful ſcenes, and to contemplate whatever can be found of moral and natural beauty.

So much of the happineſs of private life depends on the government of the temper, that the temper ought to be a principal object of regard in a well-conducted education. The ſuffering of children to tyrannize without controul over ſervants and inferiors, is the ruin of many an amiable diſpoſition. The virtues of humanity, benevolence, humility, cannot be too early enforced; at the ſame time, care ſhould be taken that an infant of two or three years old ſhould never be beaten or ſpoken to harſhly for any offence which it can poſſibly commit.

TEMPERAMENT, among phyſicians, the ſame with conſtitution, or a certain diſpoſition of the ſolids and fluids of the human body, by which it may be properly denominated ſtrong, weak, lax, &c.

In every perſon there are appearances of a temperament peculiar to himſelf, though the ancients only took notice of four, and ſome have imagined theſe were deduced from the theories of the four humours or four cardinal qualities; but it is more probable that they were firſt founded on obſervation, and afterwards adapted to thoſe theories, ſince we find that they have a real exiſtence, and are capable of receiving an explanation. The two that are moſt diſtinctly marked are the ſanguineous and melancholic, viz. the temperaments of youth and age.

1. *Sanguineous.* Here there is laxity of ſolids, diſcoverable by the ſoftneſs of hair and ſucculency; large ſyſtem of arteries, redundancy of fluids, florid complexion; ſenſibility of the nervous power, eſpecially to pleaſing objects; irritability from the plethora; mobility and levity from lax ſolids. Theſe characters are diſtinctly marked, and are proved by the diſeaſes incident to this age, as hæmorrhagies, fevers, &c. but theſe, as they proceed from a lax ſyſtem, are more eaſily cured.

2. *Melancholic Habit.* Here greater rigidity of ſolids occurs, diſcoverable by the hardneſs and criſpature of the hair; ſmall proportion of the fluids, hence dryneſs and leanneſs; ſmall arteries, hence pale colour; venous plethora, hence turgeſcency of theſe, and lividity; ſenſibility, frequently exquiſite; moderate irritability, with remarkable tenacity of impreſſions; ſteadineſs in action and ſlowneſs of motion, with great ſtrength; for exceſs of this conſtitution in maniacs gives the moſt extraordinary inſtance of human ſtrength we know. This temperament is moſt diſtinctly marked in old age, and in males. The ſanguineous temperament of youth makes us not diſtinguiſh the melancholic till the decline of life, when it is very evident, from diſeaſes of the veins, hæmorrhoids, apoplexy, cachexy, obſtructions of the viſcera, particularly of the liver, dropſies, affections of the alimentary canal, chiefly from weaker influence of the nervous power. So much for the ſanguineous and melancholic temperaments; the other two are not ſo eaſily explained. The choleric temperament takes place between youth and manhood. In the Tempera-ment.

3. *Choleric*, the diſtribution of the fluids is more exactly balanced; there is leſs ſenſibility, and leſs obeſity, with more irritability, proceeding from greater tenſion, leſs mobility and levity, and more ſteadineſs in the ſtrength of the nervous power. As to the

4. *Phlegmatic.* This temperament cannot be diſtinguiſhed by any characters of age or ſex. It agrees with the ſanguineous in laxity and ſucculency. It differs from that temperament, and the melancholic, by the more exact diſtribution of the fluids. Again, it differs from the ſanguineous, by having leſs ſenſibility, irritability, mobility, and perhaps ſtrength, though ſometimes indeed this laſt is found to be great.

Theſe are the ancient temperaments. The temperaments, indeed, are much more various; and very far from being eaſily marked and reduced to their genera and ſpecies, from the great variety which is obſervable in the conſtitutions of different men.

1 Definition.

TEMPERAMENT of the Muſical Scale, is that modification of the ſounds of a muſical inſtrument, by which theſe ſounds may be made to ſerve for different degrees of different ſcales. See MUSIC, Chap. VII.

Temperament, though intimately connected with muſic, is not, properly ſpeaking, a part of that ſcience. The objects of muſic, as a ſcience, are, to aſcertain the laws of muſical ſound, as depending on the powers of the human voice. The purpoſe of temperament is, to regulate, in a way leaſt adverſe to theſe laws, a certain departure from them, rendered neceſſary by the imperfections of inſtruments.

Although the temperament of the ſcale of inſtruments be practically familiar, the true principles on which it depends have been much diſputed. Various opinions have been hazarded, and ſyſtems propoſed. We offer an abridged view of that which appears to us to merit a preference (A).

2 Nature of the true ſcale.

Before conſideration of the tempered ſcale, a ſhort review of the nature of the true ſcale is neceſſary.

3 Notes, and their pitch.

From the conformation of the vocal organs, all nations, in ſinging, make uſe of the ſame inflections of voice. Theſe inflections, called *notes*, are ſaid to be *grave* or *acute*, in proportion to the degree of hoarſeneſs or ſhrillneſs with which they are ſung. The ſtate of voice with reſpect to gravity or acuteneſs with which any one note is ſung, is termed its *pitch*.

4 Uniſons and intervals.

Two notes having the ſame pitch are termed *uniſons*, or are ſaid to be *in uniſon* to one another. The difference of pitch between any note and another is denominated an *interval*.

(A) Amongſt the very numerous authors on the ſubject of temperament, we have ſelected, for our chief guides, the late Dr Robert Smith of Cambridge, and Profeſſor John Robiſon of Edinburgh.

Temperament.

In all attempts to ſing, the ear, either unconſciouſly, or from the direction of recently hearing it, ſelects a particular note, from the previous impreſſion of which the voice naturally forms other notes, at certain though unequal intervals. The note, thus ſelected, is termed the *key note* or *fundamental*. When choſen, it inſtantly aſſumes a particular and predominant character. The ear involuntarily refers to it the intonation of all other notes, readily recurs to it during performance, and is diſſatisfied unleſs the voice cloſe upon it.

5 Key note or fundamental.

6 Natural ſcale and its degrees.

Where the ſinger has aſſumed a key note, and, after ſinging that note, ſings the note neareſt in acuteneſs to it without forcing the voice, and ſo on, the ſeries of notes, thus naturally formed, conſtitutes what is called the *natural ſcale*. The notes of it are termed its *degrees;* thus the key note is the *firſt degree* of the ſcale; the natural note next in acuteneſs to it, is named the ſecond degree, or *ſecond of the ſcale*, and ſo on.

7 Difference of pitch of the male and female voice.

Two untaught men, attempting to ſing the ſame ſcale together, always ſing in uniſon. But a man and a woman, making the ſame attempt, ſing naturally in ſuch a difference of pitch, although they proceed by the ſame intervals, that the eighth note only of the male voice aſcending, is in uniſon with the key note of the female voice. Were the male voice to aſcend to a ninth note, it would be in uniſon with the ſecond of the female voice; the tenth note of the former would be in uniſon with the third of the latter, and ſo on.

We have thus two ſcales in ſucceſſion, perfectly ſimilar in the relation of the degrees of each to their reſpective key notes; but differing in pitch by the interval between theſe key notes.

8 Octave, what?

This interval, comprehending ſeven ſmaller intervals and eight degrees, is, from this laſt circumſtance, called an *octave:* and this term is alſo applied, ſomewhat inaccurately, to the ſeries of the eight degrees. Thus we ſay, that the *octave* formed by the female voice is an *octave* acuter than that which is produced by the male voice; meaning, that the eight degrees ſung by the woman are acuter by the interval of an octave, than thoſe ſung by the man.

Tempe ment

9 All oct are ſimi

Not only are the natural octaves of the male and female voice exactly ſimilar; but the ſame ſimilarity is found in the extremes of the human voice, and, beyond them, as far as muſical ſounds can be produced. Many men can ſing the ſecond octave below, and moſt women the ſecond octave above, a given key note common to both voices. Yet the graveſt octave of ſuch a male voice, and the acuteſt octave of ſuch a female voice, are equally ſimilar in their relations (although they differ in pitch by an interval of two octaves), as the two central octaves are.

10 All mu contain in one tave of natural ſcale.

All the different natural inflections of the human voice are thus contained in one octave, ſince all other octaves are only repetitions of the ſame inflections in a graver or acuter pitch.

11 Octave conſiſts eight d grees a ſeven i vals.

The octave, then, conſiſts of eight degrees and ſeven intervals. Two of theſe intervals, thoſe between the third and fourth, and the ſeventh and eighth degrees, are ſenſibly leſs different in pitch than the others. And although we have no direct meaſures of the pitch of ſounds, we term theſe ſmaller intervals *ſemitonic*, and the others *tonic* intervals, preſuming the latter to be equal to each other, and a ſemitonic interval to be equal to the half of a tonic one.

12 Repreſe tation the ſca by lett

The degrees of the natural ſcale are, by Britiſh muſicians, diſtinguiſhed by the firſt ſeven letters of the alphabet. The letter C, for ſome reaſon leſs important than difficult to explain, has been appropriated to the note moſt eaſily aſſumed as a key note by both the male and female voice; the ſecond of the ſcale is termed D, the third E, and ſo on. As the human voice, and conſequently moſt muſical compoſitions, comprehend four octaves, we repreſent the ordinary octave of the male voice by Roman capitals, and that of the female voice by Roman minuſcular letters. The graveſt male octave is diſtinguiſhed by Italic capitals, and the acuteſt female octave by minuſcular Italics. The whole natural ſcale may therefore be exhibited thus:

Graveſt Male Octave.	Ordinary Male Octave.	Ordinary Female Octave.	Acuteſt Female Octave.
C D* EF* G* A* BC* D* EF* G* A* B*	c* d* e f* g* a* b	*c* d* e f* g* a* b*	*c.*
1. 2. 34. 5. 6. 71.	2. 34. 5. 6. 71.	2. 34. 5. 6. 71.	2. 34. 5. 6. 78.

In this exhibition, the juxtapoſition of the thirds and fourths, and of the ſevenths and eighths or replicates of the firſt degree, indicates the ſemitonic intervals; and the aſteriſks repreſent the tonic intervals of the natural ſcale, or the artificial intercalary ſounds, which, as we ſhall preſently ſee, it becomes neceſſary to ſubſtitute in thoſe intervals.

13 Different voices require different ſcales.

Were all voices of the ſame compaſs, and were muſical feelings ſatisfied with the natural ſcale, we might reſt here. Being furniſhed with a key note adapted to all voices, and with inſtruments accurately tuned to that key note, it would be unneceſſary to examine whether any other note of the natural ſcale could be aſſumed as the key note of a different ſcale, and if it could, whether any agreeable effect reſulted from the diſcovery.

But the uſe of different ſcales, the key notes of which are derived from the different degrees of the natural ſcales, has been found not only to be one of the chief ſources of the pleaſure imparted by muſical performances, but to be indiſpenſably neceſſary, from the phyſical inequality of voices.

The central 'c' of the ſcale, called in muſic the tenor C, can be produced by every ſpecies of voice. The graveſt male voices, termed baſs, can form this note, but very few notes above it. The treble, or acuter female voice alſo produces it, but ſeldom deſcends farther. The acuter male voices, called tenor, have this 'c' ſcarcely above the middle of their compaſs, and it is not much below the middle of that of the counter-tenor or graveſt female voices. Now it is obvious that an air in the natural ſcale, which ſhould riſe above 'c', and fall below it in the ſame proportions, might be ſung by the tenor or counter-tenor voice, but would be too acute for the baſs voice, and too grave for the treble. Either of theſe voices, in order to execute the ſame air, muſt aſſume a different key note from 'c'; and as all the

Temperament. the degrees of the ſcale are regulated by the key note, the air muſt of courſe be executed in a ſcale different from that of 'c'.

Again, ſuppoſe a ſinger who can ſing a given air only in the ſcale of B, to be accompanied by an inſtrument tuned in the ſcale of 'c'. Should the lyriſt begin on his own key note, he is a ſemitone above the key note of the ſinger; and ſhould he begin on the note which is in uniſon with the ſinger's key note, the next degree is wrong, being but a ſemitonic interval by the inſtrument, and a tonic interval by the voice. In ſhort, all the degrees but one will be found wrong. This is an evident conſequence of the inequality of the ſemitonic to the tonic intervals; and if the tonic intervals, which we preſume to be equal, be not exactly ſo, the diſcordance will be ſtill greater.

14 Intercalary ſounds neceſſary. The remedy for this is apparently obvious. If the ſemitonic intervals are each equal to half of any of the tonic intervals, we need only to interpoſe other ſounds between each two of the degrees which form the tonic intervals; and then, in place of eight degrees and ſeven unequal intervals, we ſhall have twelve degrees and twelve equal intervals, each of them equal to a ſemitone. An inſtrument thus furniſhed, appears to be adapted to any voice, and to reſemble the modern harpſichord or organ, which have twelve ſeemingly equal intervals in the octave. Such were the practical reſources of the Greek muſicians, ſanctioned by the approbation of Ariſtoxenus, and of all thoſe who were ſatisfied with the deciſion of the ear alone.

15 Mathematical ratios of muſical intervals. But philoſophers and mathematicians aſcertained the exiſtence of a certain connexion between muſical intervals and mathematical proportions, and gradually opened the way to the diſcovery that the relations of the muſical ſcale, as naturally formed by the human voice, depend on principles equally plain and certain with the ſimpleſt geometrical propoſitions.

16 Ratios of the octave, fifth and fourth. Pythagoras is ſaid to have diſcovered, that if two muſical chords be in equal tenſion, and if one of them be half the length of the other, the ſhort one will ſound an octave above the long one; if one-third ſhorter, it will produce the fifth: if one-fourth ſhorter, it will give the fourth. Thus the relation of the key to its octave was diſcovered to correſpond to the ratio of 2 : 1; that of the key to its fifth to be in the ratio of 3 : 2; and that of the key to its fourth to be in the ratio of 4 : 3. For inſtance, if a chord of a given ſize and tenſion, and 12 inches long, produce 'c', another of the ſame ſize and tenſion, but only ſix inches long, will give the octave *c*; one eight inches long will ſound the fifth 'g'; and one nine inches long will produce the fourth 'f'. Now as the ſtring of eight inches giving the fifth, and that of ſix inches producing the octave, are in the ratio of 4 : 3, which is that of the fourth; it follows, that the interval between the fifth and octave is a fourth: and as the chord of nine inches producing the fourth, and the octave of ſix inches, are in the ratio of 3 : 2, the interval between the fourth and octave muſt be a fifth. Thus the octave 'c' *c*, is divided into a fifth 'c g', and a fourth 'g' *c*, or into a fourth 'c f', and a fifth 'f' *c*, both in ſucceſſion. The two fourths 'c f', and 'g' *c*, leave an interval 'f g', correſponding, as we have ſeen, to the ratio of 9 : 8.

Temperament.

17 Ratio of the major third, minor third, and ſemitone. We have thus the ratios of the octave, of the fifth, and of the fourth; and it does not appear that the ancient theoriſts proceeded farther. They ſeem to have preferred the harmony of fourths and fifths to that of thirds and ſixths, ſo eſſential in modern harmony. By purſuing the ſyſtem of the mathematical ratios, we find that 5 : 4 gives the major third 'ce'. And the fifth 'g' being already determined by the ratio 3 : 2, we aſcertain the ratio of the minor third 'e g' to be 6 : 5, which is the difference between 3 : 2 and 5 : 4. In the ſame way, the ratio of the third 'e' being 5 : 4. and that of the fourth 'f' being 4 : 3, we aſcertain the ratio of the ſemitone 'e f' to be 16 : 15, or 4 : 3—5 : 4.

18 Ratio of the major ſixth and major ſeventh. A note in the ratio of 5 : 4, or that of a major third to 'f', gives 'a', the major ſixth of the neutral ſcale; and a note in the ſame ratio of 5 : 4 to 'g' produces 'b', the major ſeventh of that ſcale. The ratio of 'g a' will thus be 10 : 9, and that of 'a b' 9 : 8, the ſame with that of 'f g'; and that of 'b' *c* will thus be 16 : 15 like 'e f'.

19 Ratio of the major ſecond. We have in this way the mathematical ratios of all the degrees of the natural ſcale except that of the ſecond 'd'. Conſidering, however, the ſecond to be a perfect fourth graver than the fifth, and having aſcertained the fifth 'g' to be a perfect fourth below *c*, as 2 : 1 is to 3 : 2; ſo 3 : 2 gives 9 : 8, which we take for the ratio of the ſecond.

20 Ariſtoxenean and Pythagorean ſyſtems. Thus have been formed two diſtinct ſyſtems of intonation of the natural ſcale; that of mean tones and ſemitones, founded on the rules of Ariſtoxenus, and the practice of ancient artiſts, and that of the ratios deduced from the diſcoveries of Pythagoras, and the calculations of mathematicians.

21 Circular repreſentation of the ſcale. The difference between the Ariſtoxenean ſyſtem of mean tones and ſemitones, and the Pythagorean ſyſtem of mathematical ratios, will beſt appear from the following conſtruction. Let the circumference of a circle (fig. 1.) be divided by dotted lines (according to the principles of Ariſtoxenus) into five larger and equal intervals, and two ſmaller intervals alſo equal. Let it alſo be divided by full lines into portions determined by means of the muſical ratios. Thus let the arches CD, FG, and AB be proportional to the logarithm of 9 : 8, GA and DE to thoſe of 10 : 9, and EF and BC to thoſe of 16 : 15 (B). Let us divide another circle in the ſame manner; but inſtead of having its points of diviſion marked C, D, &c. let them be marked 'key' 2d, 3d, 4th, 5th, 6th, 7th. This circle, which may be deſcribed on a piece of card, is to be placed on the other, and is to move round their common centre.

Plate DXXXII. fig. 1.

22 Inſufficiency of the natural ſcale for compoſition in different ſcales. In whatever point of the outer circle the point 'key' of the inner one be placed, it is obvious that the other points of the outer circle will ſhew what degrees of it, by correſponding with the other points 2d, 3d, &c. of the inner circle, will ſerve for degrees of the ſcale determined by the point 'key'. By this we ſee clearly the inſufficiency of the degrees of the natural ſcale, for the performance of compoſitions in different ſcales, and

(B) We may make CD=61°, 72; CE 155°, 9; CE=149°, 42; CG=210°, 58; CA=265°, 3; and CB 326° 48.

Temperament.

the inefficacy of the Ariſtoxenean remedy of mean tones.

23 Galileo's diſcovery of aerial undulation.

But although the errors of the Ariſtoxeneans were demonſtrated by the certainty of the ratios, and although the dependence of muſical intervals on the latter be ſaid to have been known ſince the days of Pythagoras, the nature of that relation remained unknown for ages. Galileo diſcovered that the ratios expreſs the frequency of the aërial undulation, by which the ſeveral ſounds are generated. He demonſtrated that the vibrations of two chords, of the ſame matter and thickneſs, and of equal tenſion, will be in the ratio of their lengths, and that the number of oſcillations made in a given time will be inverſely as their lengths. The frequency of the ſonorous undulations of the air is therefore inverſely as the length of the ſtring. Thus 2 : 1 being the ratio of the octave, the undulations which produce the acuter ſound are twice as frequent as thoſe which generate the graver. The ratio of the fifth, 3 : 2, indicates that in the ſame time that the ear receives three undulations from the upper ſound, it receives only two from the lower. This is not peculiar to ſounds produced by the vibration of ſtrings: thoſe produced from the vibration of bells, and from the undulation of the air in pipes, are regulated by the ſame law.

24 Pitch of ſound determined by aerial undulations.

Thus, it is demonſtrated that the pitch of muſical ſound is determined by the undulations of the air; and that a certain frequency of undulations produces a certain and unalterable muſical note. It has been found that any noiſe whatever, if repeated 240 times in a ſecond, at equal intervals, produces the tenor 'c'; if 360 times, the 'g', or fifth above. It had been imagined that muſical ſound was only to be produced by thoſe regular undulations, which are occaſioned by the vibrations of elaſtic bodies. We are aſſured that the ſame effect will be produced by any noiſe, if repeated not leſs than 30 or 40 times in a ſecond; and that the experiment has been tried with a quill ſnapping againſt the teeth of a wheel.

25. Chords, conſonant and diſſonant.

By Galileo's diſcovery, the principles on which the juſt intonation of the natural ſcale depends, are ſhown to be certain and plain. To proceed in our ſearch of an exact meaſure of temperament of this perfect intonation, we muſt conſider the nature and effects of conſonant and diſſonant chords.

A chord is a combination of two or more ſimultaneous muſical ſounds. If the coaleſcence be ſo complete that the compound ſounds cannot be diſtinguiſhed, the chord is ſaid to be conſonant; if the ſeparate ſounds are diſtinctly heard, the chord is termed diſſonant.

All conſonances are pleaſing, although ſome are more ſo than others. All diſſonances are unſatisfactory, and ſome are very harſh.

26 Beats, what?

In conſonances, no inequality of ſound is perceptible. In diſſonances, the ear is ſenſible of an alternate increaſe and diminution of the ſtrength of the ſound, without variation of pitch. This is occaſioned by the alternate coincidence and biſection of the vibrations of the component ſounds. For example, ſuppoſe two perfect uniſons produced from two pipes each 24 inches long. Each ſound has 240 vibrations in a ſecond, either exactly coincident, or exactly alternate. In either caſe, the vibrations are ſo frequent and uniform as not to be diſtinguiſhable, and the whole appears one ſound. But let one of the pipes be only 23 inches and ſeven-tenths long, it will give 243 vibrations in a ſecond. Therefore the 1ſt, the 80th, the 160th, and the 240th vibration of the longer pipe, will coincide with the 1ſt, the 81ſt, the 162d, and the 243d of the ſhorter. In the inſtant of coincidence, the aerial agitation produced by the one vibration is reinforced by that produced by the other. The deviations from coincidence gradually increaſe till the 40th vibration of the longer pipe, which will commence in the middle of the 41ſt vibration of the ſhorter one. The vibrations here biſecting each other, the aerial agitations of both will be weakened. The compounded ſound will conſequently be ſtronger at the coincidences and weaker at the biſections of the vibrations. The increaſe of ſtrength, which is termed the *beat*, will recur thrice in every ſecond. Thus the vibrations are in the ratio of 80 : 81, or of a *comma*; and the compounded ſound now ſuppoſed is an uniſon *imperfect by a comma*.

Temperament.

If a third pipe, tuned a perfect fifth to the longer of the two former, be ſounded at the ſame time with the ſhorter, the diſſonance will beat nine times in a ſecond; and is thus ſhown to be a fifth imperfect by a comma.

The perfection or imperfection of any conſonance may thus be aſcertained with equal facility and preciſion: and by this method, any perfect conſonance may be altered to any acquired ſtate of temperament.

27 Beats afford an exact meaſure of temperament.

The theory of beats is therefore valuable, as giving us the management of a phenomenon intimately connected with perfect harmony, as affording us preciſe and practicable meaſures of all deviations from it, and as thus forming the baſis of the moſt accurate ſyſtem of temperament.

For the preparatory proceſs of determining the exact degrees of the ſcale, let us attend to the following ingenious and amuſing experiment.

28 Fundamental experiment.

Let two harpſichord wires be exactly tuned in uniſon at the pitch of the tenor 'c,' to be acted on ſimultaneouſly by a wheel rubbed with roſin, like that of a *vielle*. Let a ſcale of 240 equal parts be deſcribed under one of the ſtrings, equal in length to the ſounding part of it, and numbered from the end at which the wheel is applied. Let a moveable bridge be placed under this ſtring, but ſo as not to alter the tenſion of it in the leaſt.

The two open ſtrings being in perfect uniſon, without any beating whatever, let the moveable bridge be advanced ſlowly from the nut, while the wheel is applied to both ſtrings. All kinds of chords, conſonant and diſſonant, will of courſe be ſucceſſively heard. Between the conſonances there will be a beating, which will increaſe as we approach the conſonance, ceaſe on our reaching it, appear again as we leave it, diminiſh as we recede from it, and again increaſe as we approach to the ſucceeding conſonance.

After this general view, let us more particularly examine the ſeveral degrees of the ſcale.

29 Determination of the octave.

On placing the moveable bridge at 120, we ſhall hear a perfect octave, without any beating. If the diviſion be not quite exact, there will be a little beating; but by ſhifting the bridge very gently to either ſide, the increaſe or diminution of the beating will guide us to the true place, where it will entirely ceaſe.

30 Determination of the perfect fifth.

On placing the bridge at 160, the perfect concord of the fifth.

Temperament. the key and fifth will be heard. Any alteration of the bridge to either ſide will produce a diſagreeable beating.

31 Determination of the perfect fifth. A rapid flutter in the vicinity of 180 will ceaſe at that point, and give place to the conſonance of the key and fourth.

32 Determination of the major third. On approaching 192, an angry waſpiſh beating is ſucceeded at that point by the animating concord of the key and major third.

33 Determination of the minor third. As we leave 192, the beating aſſumes a melancholy character, and ceaſes at 200, the place of the plaintive conſonance of the key and minor third.

34 Determination of the second. Between that point and the nut, we have only a ſucceſſion of diſcords. As we were at a loſs to aſcertain the mathematical ratio of the ſecond of the ſcale (art. 19), ſo we have ſome difficulty in determining its juſt place by the theory of beats, and the experiment under conſideration. We are uncertain whether we ſhall fix it at a minor tone, or at a major tone above the key. Both form a harſh diſſonance with the key. The major tone, however, is thought leſs diſagreeable: it admits of five more concords in the octave than the minor; and the ratio of it 9 : 8, is that ſuggeſted by the ſimilarity of its interval with the fifth, to the interval of the fifth and octave (art. 19). On theſe accounts we prefer it; and its place in the diviſion under our preciſe conſideration is $213\frac{4}{7}$.

35 Determination of the minor or ſixth. Let the bridge now be placed near, and ſlowly moved to 150: the beating ſubſide into a conſonance, ſlightly pleaſing, that of the key and minor ſixth.

36 Determination of the major or ſixth. At 144, we have the agreeable concord of the key and major ſixth. From 144 to 120 we hear nothing but diſcord.

37 Determination of the ſeventh. In this interval, however, we have to find the place of the ſenſible note or major ſeventh. The ear informs us, that the interval between the major ſeventh and the octave, muſt be ſimilar to that between the major third and the fourth. Applying to the former interval the ratio of the latter, that of 16 : 15, we place the moveable bridge at 128; for as 15 is to 16, ſo 120 gives 128. We alſo feel, that the interval between the fifth and major ſeventh is exactly ſimilar to that between the key and major third, of which the ratio is 5 : 4. Now, applying the ſame ratio to 160, the place of the fifth, we find 5 : 4 :: 160 : 128. We thus determine 128 to be the place of the major ſeventh of the ſcale. Temperament.

38 Ratios of ſimple intervals. The interval or difference between the minor tone 10 : 9, and the major tone 9 : 8, is 81 : 80, termed *comma*. This interval is not employed in practical muſic, but muſt be diſtinctly underſtood by theoriſts, and particularly in treating of temperament.

There are therefore four deſcriptions of ſimple intervals; that is, intervals which do not include more than a major tone. Theſe are, comma, of which the ratio is 81 : 80; hemitone, or 16 : 15; minor tone or 10 : 9; and major tone, or 9 : 8 (c).

39 Temperament neceſſary in keyed inſtruments. We have now to conſider how far the perfect intonation of the natural ſcale muſt be departed from in keyed inſtruments, ſuch as the organ and harpſichord; ſo that the ſame ſound may ſerve for different degrees of different ſcales.

Theſe inſtruments have twelve ſounds in every octave; that is, they have the eight natural degrees and four intercalary ſounds, viz. between C and D, D and E, F and G, G and A, and A and B.

The purpoſe of theſe intercalary ſounds is, that an air may be performed in any pitch; that is, that any ſound may be taken for a key note, and that other ſounds may be found to form the ſcale of that key note, at intervals correſponding to thoſe of the natural ſcale.

Thus, if inſtead of C, the key note of the natural ſcale, we take B for the key note required; A, which is the ſeventh to B, will by no means anſwer for the ſeventh of the aſſumed ſcale; for the interval between A and B is a major tone, of which the ratio is 9 : 8, whereas the interval between the ſeventh of the ſcale and the octave, can only be a hemitone, the ratio of which is 16 : 15. We muſt therefore employ the intercalary ſound between A and B, which in this employment we call A♯, or A ſharp. But we ſhall preſently ſee that we cannot tune even this ſound in the ratio of 16 : 15 with B. For, let us take F for the key note of another ſcale, we find that B will not ſerve for the fourth of that ſcale, being a major tone above A the third; whereas the fourth of the ſcale is only a hemitone above the third. We muſt therefore have recourſe to our intercalary ſound between A and B, which

(c) The logarithmic meaſures of theſe intervals, and of the compound intervals determined in the way which we have deſcribed, are

Comma,	54
Hemitone,	280
Minor tone,	458
Major tone,	512
Minor third,	792
Major third,	969
Fourth,	1249
Fifth,	1761
Minor ſixth,	2041
Major ſixth,	2219
Seventh,	2730
Octave,	3010

The octave being thus divided into 3010 equal parts, a circle of which the circumference is divided into 301 degrees, and a concentric moveable circle having a nonius ſubdividing each into ten parts, will form a convenient inſtrument for examining all temperaments of the ſcale.

Temperament.

which we must here call B♭, or B flat, and which ought in this state to be tuned a hemitone above A, or in the ratio of 16 : 15 with that note. Now, this intercalary sound cannot be both in the ratio of 16 : 15 with A, and in the same ratio of 16 : 15 with B. This would extend the whole interval between A and B, to the ratio of about 8 : 7; whereas it should only be in that of 9 : 8. We must therefore tune the intercalary found in such a diminished relation to A and to B, that it may serve either for A ♯ or B ♭.

But, even independent of these intercalary notes, some temperament of the natural scale is necessary.

Let the four-fifths, 'c g', 'g' *d*, '*d a*', and '*a ē*', be tuned all perfect. Then tune the two perfect octaves from '*ē*' downwards, '*ē e*', '*e* : e'. The major third 'c e' resulting from this process, will be too sharp by a comma, or 81 : 80, and will beat 15 times in a second. The minor third 'e g' and the major sixth 'c a' will be still more discordant.

It is therefore impossible to have perfect fifths, and at the same time perfect thirds and sixths. Now, although a perfect fifth, occasionally employed, be pleasing, yet the ear does not relish a succession of perfect fifths; such a succession not only renders the harmony languid, but creates a doubt as to the key, which is unsatisfactory. On the other hand, an alternate succession of major and minor thirds and sixths constitutes the chief and most brilliant part of our harmonics. We therefore find it necessary to sacrifice somewhat of the perfect harmony of the fifths to that of the third and sixths.

It is this accommodation which is properly called TEMPERAMENT; and to this system of it, by which the fifths are diminished, and the thirds and sixths preserved perfect, we give the preference.

We have just seen that four consecutive perfect fifths compose an interval, greater, by a comma, than two octaves and a major third. But in the tuning of our instruments requiring temperament, these intervals must be rendered equal. Because, as we have seven hemitonic intervals in the fifth, twelve in the octave, and four in the major third; so the interval of four-fifths contains twenty-eight hemitonic intervals, and that of two octaves and major third contain also twenty-eight, being twenty-four for the two octaves, and four for the major third. The real difference being, however, a comma, it is plain, that if we keep the major thirds perfect, we must diminish or flatten each of the four-fifths one-fourth of a comma.

It is not easy to ascertain with perfect exactness the quarter comma by which the first fifth 'c g' is to be diminished. We shall, however, be sufficiently accurate for practical purposes if we flatten 'g' till a beating of 9 beats in four seconds is produced (D).

Having in this manner tuned 'g', we diminish the next fifth 'g' *d*, one-fourth of a comma, by flattening *d* till 'g' *d* beat half as fast again as 'c g', or $13\frac{1}{2}$ beats in four seconds (E).

The next fifth, *d a*, must be diminished in the same proportion by flattening *a* till '*d a*' beat 15 times in six seconds.

Instead of tuning upward the fifth *a ē*, tune downward (F) the octave *a* 'a', and then tune upward the fifth 'a' *e*, and flatten it till it beat 15 times in eight seconds.

If we take 15 seconds for the common period of all these beats, we shall find

The beats of 'c g' = 34
G 'd' = 25
'd a' = $37\frac{1}{2}$
'a *e*' = 28

On tuning downwards the octave *e* 'e' we have the major third 'c e' perfect without any beating; and we proceed, tuning upwards a fifth flattened by one-fourth of a comma, and when the beating becomes too quick, tuning downward an octave. We may do this till we reach 'b' ♯, which should be the same with *c*, a perfect octave above 'c'.

It will be better, however, to stop at 'g' ♯, and then to tune fifths downward from 'c' and octaves upwards, when we get too low. Thus we have 'c' F, F 'f', 'f' B♭, 'B

(D) If any concord, whose perfect ratio is $\frac{m}{n}$ (*m* being the greatest term of the smallest integers expressing that ratio), be tempered sharp by the fraction $\frac{p}{q}$ of a comma, and if M and N be the pulses made by the acute and grave notes of the concord during any number of seconds, the number *b* of beats made in the same time by this concord will be $= \frac{2qmN}{161p-q}$, or $\frac{2qnM}{161p+q}$; and if it be tempered flat, then $b = \frac{2qmN}{161p+q}$, or $\frac{2qnM}{161p-q}$. (Smith's Harm. 2d edit. p. 82, &c.). Now, let $\frac{m}{n}$ be $= \frac{1}{2}$, the ratio of the fifth; $q=1$, $p=4$; therefore, $\frac{p}{q}$ = one-fourth of a comma, and N = 'c' or 240 pulses in a second. Therefore, $\frac{2qmN}{161\times p+q} = \frac{2\times 3\times 240}{161\times 4+5} = \frac{1440}{645} = 2.25$ beats in four seconds very nearly.

(E) Because fifths, being in the ratio to each other of 3 : 2, N in this fifth = 360.

(F) The grave octaves of the upper terms of each of these tempered fifths may be determined with perfect accuracy, by making the grave octave beat with the lower term of the tempered fifth as often as the upper term does with it; for instance, by making G 'c' beat as often as 'c g', &c. For, it has been demonstrated by Dr Smith, that the upper term of a minor concord beats equally with the lower term, and with the acuter octave of that term; but that the upper term of a major concord beats twice as fast with the acuter octave of the lower term, as it does with the lower term itself. Therefore, as 'g' beats twice as fast with *c* as with 'c', and is with its grave octave G in the ratio of 2 : 1, G 'c' beats precisely as often as 'c g'.

Temperament. 'B ♭ 'b ♭', 'b ♭ e ♭'; and this method is preferable, because the notes marked ♯ or ♭, are, when tuned in this way, in the beſt relation to thoſe with which they are moſt frequently employed as major thirds, and the major third is the harmonic interval moſt in uſe (G).

Another ſyſtem of temperament is that which divides the

(G) The proceſs of temperament thus recommended, will be greatly facilitated by employing a pendulum made of a ball of about two ounces weight, ſliding on a light deal rod, having at one end a ſmall ring. Let this pendulum be hung by the ring on a peg, and the ball adjuſted ſo as to make 20 vibrations in 15 ſeconds. This done, mark the rod at the upper edge of the ball, and adjuſt it in the ſame manner for 24, 28, 32, 36, 40, 44, and 48 vibrations. Then having calculated the beats of the different fifths, ſet the ball at the correſponding mark, and temper the ſound till the beats keep pace exactly with the pendulum.

In order to diſcover, ſhould it be neceſſary, the number of pulſes made in a ſecond by the tuning fork, by which we tune the tenor 'c' of our inſtrument, let a wire be ſtretched by a weight till it be uniſon or octave below the fork; let $\frac{1}{40}$th then be added to the weight. Being thus tempered by a comma, the contemporaneous ſounding of the fork and wire will produce a beating; and on multiplying the beats by 80, the product gives the number of pulſes of the fork, and conſequently of the 'c' of the inſtrument tuned from it. But the common 'c' tuning forks are ſo nearly conſonant to 240 pulſes, that this proceſs is ſcarcely neceſſary.

On the ſyſtem of temperament now propoſed, Dr Smith makes the following uſeful obſervation and deduction.

The octave conſiſting of five mean tones and two limmas, it is obvious that by enlarging the tones we diminiſh the limmas, and that the increment of the tone is two-fifths of the contemporaneous diminution of the limma. Let v repreſent any minute variation of this temperament: the increment of a mean tone is $2v$, and the contemporaneous diminution of the limma $-5v$. Again, if the tone be diminiſhed by $-2v$, the limma will increaſe by $-5v$. Let us obſerve the variations of the intervals in the latter caſe.

The perfect fifth conſiſting of three tones and a limma, its variation will be $-6v+5v$, or $-v$. That is, the fifth is flattened by the quantity v. Conſequently the fourth is ſharpened by that quantity.

The ſecond, being a tone above the key note, and being therefore flattened by $-2v$, the minor ſeventh is increaſed by $2v$.

The minor third conſiſting of a tone and a limma, its variation is $-2v+5v$ or $3v$. Accordingly, that of the major ſixth is $-3v$.

The major third, or two tones, is therefore diminiſhed by $-4v$. Conſequently the minor ſixth is increaſed by $4v$.

The major ſeventh, being the inverſion of the limma, is therefore varied by $-5v$.

The tritone being diminiſhed $-6v$, the falſe fifth is accordingly $6v$.

On this obſervation, Dr Smith has founded the following geometrical conſtruction: Divide the ſtraight line CE (fig. 2.) into ſix equal parts C g, g d, d a, a E, E b, b t, and interſect the points of diviſion with the ſix parallel lines g G, d D, &c. repreſenting the intervals arranged according to the ſyſtem of mean tones and limmas.

Let any length g G, on the firſt line to the right of the line CE, repreſent a quarter of a comma, G will thus mark the place of the perfect fifth, and g that of the tempered fifth, flattened by a comma.

Take d D, double of g G, on the ſecond parallel alſo on the right hand; D will mark the place of the perfect ſecond, and d that of the tempered ſecond, flattened by the half comma d D.

By ſetting off a A on the third parallel to the left, equal to g G, we have A′ the perfect major ſixth, and a the transferred major ſixth, ſharpened by the quarter comma A a.

The major third being in the ſyſtem of mean tones kept perfect, the place of that degree will be e.

By taking b B on the fifth line, on the right, equal to g G, we find B to be the place of the perfect major ſeventh, and b to be that of the tempered major ſeventh flattened by the quarter comma b B.

And by making t T on the ſixth line, to the right, equal to d D, we have the contemporaneous temperament of the tritone flattened by the half comma t T, and of the falſe fifth, ſharpened by that quantity.

Any other ſtraight line C t' drawn from C, acroſs theſe parallels, will repreſent, by the intervals g' G, d' D, &c. the temperaments of another ſyſtem of mean tones and limmas. Since it is plain that the ſimultaneous variations $g\,g'$, $d\,d$, &c. from the former temperament, are in the juſt proportions to each other. The ſtraight line thus employed, (C e', or C e''), has therefore been termed the *temperer*.

As the arrangement of the ſounds of keyed inſtruments having only twelve keys for an octave, and meant to be uſed in different ſcales, muſt approach nearly to a ſyſtem of mean tones, or rather mean limmas, this conſtruction of Dr Smith's is very uſeful. The temperer points out, not only all the temperaments of the notes with the key note, but alſo the temperaments of the harmonic concords. Thus it will be ſeen, that the temperament of the minor third forming the interval between the major third and fifth, is in all caſes the ſame with that of the major ſixth and octave, and that the temperament of the major third forming the interval between the fourth and major ſixth, is equal to that of the key and major third of the ſcale.

It has been propoſed, in order to render Dr Smith's conſtruction ſtill more uſeful, that it ſhould be drawn of ſuch a ſize as to admit of the following ſupplementary ſcales.

1. A ſcale of g G divided into thirteen parts and a half, expreſſing the logarithmic meaſures of the temperaments mentioned in the note (C), a comma being $= 54$.

2. A ſcale of g G divided into 36 parts, giving the beats made in 16 ſeconds by the notes c, g, when tempered by any quantity G g'.

3. A

Temperament, Temperance.

the alterations between the fifths and major thirds, flattening the fifths and sharpening the major thirds; and making both beat equally fast along with the key: and since enlarging the fifth increases the tone, and consequently diminishes the limma, the intercalary sounds become thus better suited for their double service of the sharp of the note below, and the flat of the note above. Much, however, is lost in the brilliancy of the major thirds, which are the most effective concords. The fifths are not much improved, and the sixths are evidently hurt by this temperament (H).

These methods of tuning by beats are incomparably more exact than by the ear. We cannot mistake above one beat, that is, in the fifth $\frac{1}{108}$th, and in the major third $\frac{1}{180}$th of a comma.

We have offered a short view of what appears to us to be the preferable system of temperament. It has been deduced from the observations of the most able theorists, and will greatly assist a tuner; but to him there are farther necessary, as to a musical performer, a correct ear, patient attention, and long practice.

TEMPERANCE, that virtue which a man is said to possess who moderates and restrains his sensual appetites. It is often, however, used in a much more general sense, as synonymous with moderation, and is then applied indiscriminately to all the passions.

Temperance (says Mr Nelson) is the virtue that bridles our irregular desires; it is nearly allied to prudence, and has a close connection with justice; it calms revenge, and quenches the fire of unjust resentment; it checks the epicure, and stops the riotous hand of the Bacchanalian; it extinguishes or abates the flames of lust, and banishes every lawless action; it silences the slippant detracting tongue, and gives in its stead a pleasing moderation of speech; it shuts the door against avarice, and proves experimentally, that happiness does not consist in the eager pursuit or acquisition of riches, but in a contented mind; it curbs the strongest of all other passions, gaming, and distinguishes justly the absurdity and folly of making that a dangerous trade, which was only designed as a relaxation and an amusement: temperance, in a word, is the parent of many virtues; the parent of peace, prosperity, health, and joy.

Nothing can be more strange to all observation than the practice of forsaking temperance; since every day's experience proves to us, that intemperance produces the opposite to what we seek. Suppose, when a child is born, we ask the parents what it is they wish in that child; they will answer, life. But as life alone, that is, mere existence, may, by infirmity or other accidents, be very wretched, they will naturally wish for health and happiness. Well then, life, health, and happiness, are the general wishes of parents for their children. Now let us see how their wishes are likely to succeed. Their first step is usually a shameful neglect of the food of nature, the breast; the next, a blind gratification of their will; the third, an almost total neglect of their manners; and a fourth, the cherishing them in every irregular affection. Where then is the wonder that parents are disappointed? Life and health depend on proper food and other judicious management on one part; and if sick, an obedience to remedies on the other part: and happiness essentially depends in the first place on health; in the next, on the due government of our senses, affections, and passions. See here how much mankind deviate from themselves; how far they depart from their own

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3. A scale of *g* G divided into 60 parts, for the beats of the major third C *e*.
4. A scale of *g* G divided into 72 parts, for the beats of the minor third C *e b*.
5. A scale of *g* G divided into 48 parts, for the beats of the fourth *c f*.
6. A scale of *g* G divided into 89 parts, for the beats of the minor third *g e*.
7. And, *g* G divided into 80 parts, for the beats of the major third *f a*.

Thus provided, and having determined by Dr Smith's construction, the temperament of 'g' 'd', 'a', 'e', 'b', and 'f', the accurate tuning of the whole octave as a system of mean tones with perfect major thirds may be completed as follows.

Let 'f ♯' be tuned a perfect major third above 'd'; 'g ♯' a perfect major third above 'e', and *c* ♯ a perfect major third above 'a'.

Let 'b ♭' be tuned a perfect major third below 'd' and 'e ♭' a perfect major third below 'g'.

(H) To adjust the temperer to this mode, let EG (fig. 2.) be divided in *p*, so that E *p* may be to *p* G, as 3 to 5. Then draw C *p*, cutting *g* C in *g'*, and C *t'* shall be the temperer required. It will be found that E *e'* and G *g'* are each of them 32 of their respective scales.

Let therefore 'c g' beat 32 times in 16 seconds

G 'c'	32;
G 'd'	24;
G 'b'	24, and tune 'b' *b*;
'd' *a*	36, and tune *a* 'a'
'd' 'f ♯'	36;
'a' *e*	27;
'a' *c* ♯	27;
e b	$40\frac{1}{2}$, proving 'b' *b*;
e g ♯	$40\frac{1}{2}$;
F 'c'	$21\frac{1}{3}$, and tune F 'f';
F A	$21\frac{1}{3}$, proving A 'a';
B ♭ 'f'	$28\frac{1}{4}$, and tune B ♭ 'b ♭'
'e ♭ b ♭'	$38\frac{1}{4}$;
'C' *c*	perfect.

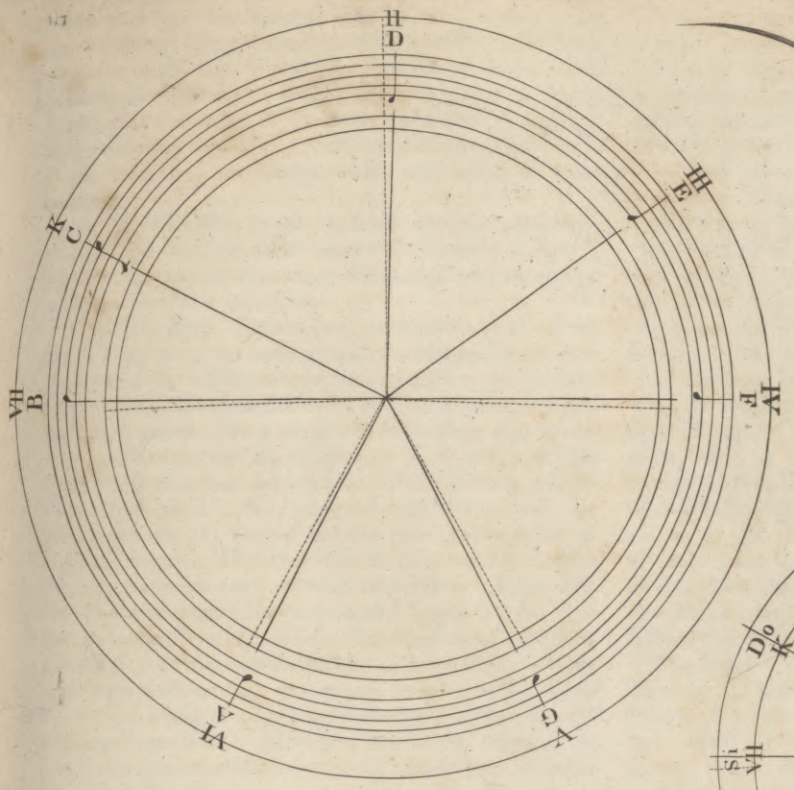


Fig. 1.

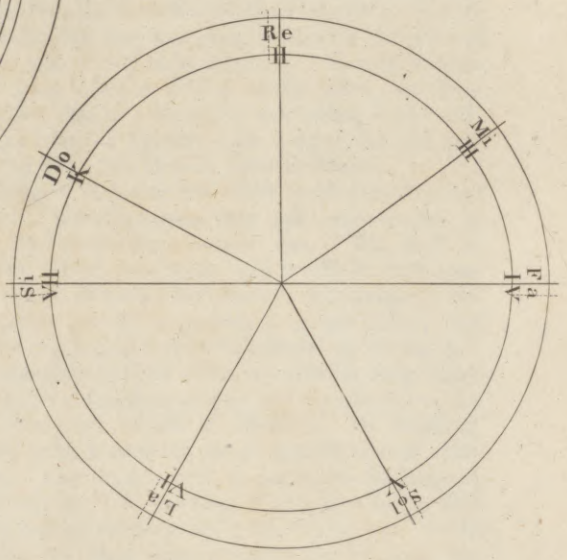
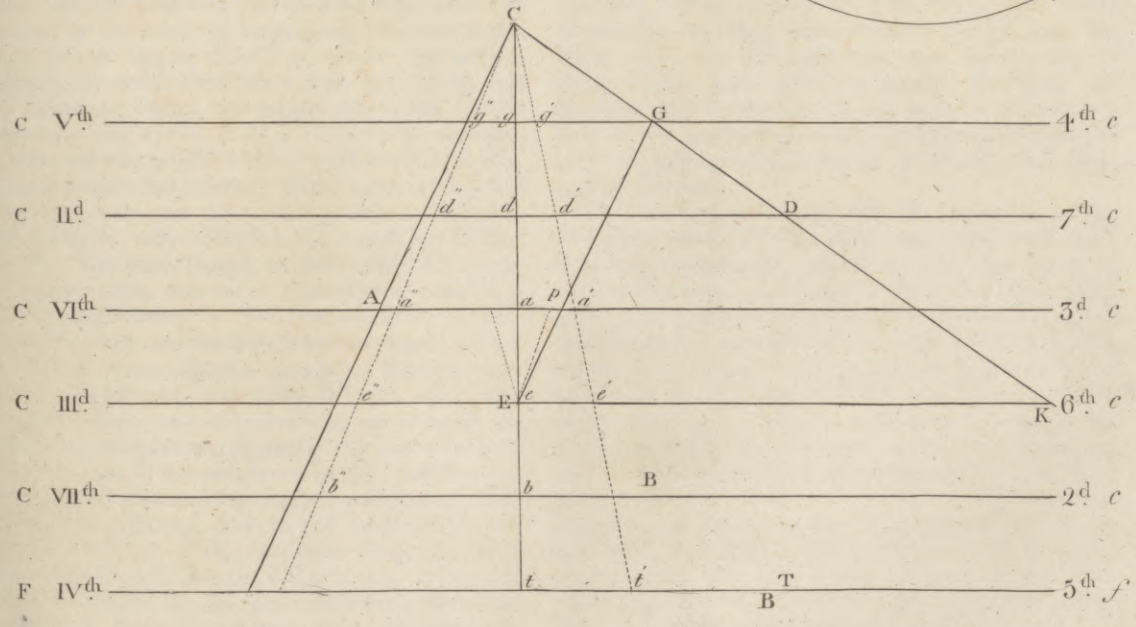


Fig. 2.



E. Mitchell sculp.t

own principles. But what is the remedy? Nothing more obvious. Let parents exercise their reason in all the steps they take for their children's welfare; let them examine right and wrong; let them not only avoid passion, but labour to correct their own errors of judgement, that they may be the better enabled to prevent them in their children; but, particularly, let them fix in them the knowledge, love, and habit, of temperance.

TEMPERING, in the mechanic arts, the preparing of steel and iron, so as to render them more compact, hard, and firm; or even more soft and pliant, according to their respective occasions.

TEMPLARS, Templers, or *Knights of the Temple*, a religious order instituted at Jerusalem in the beginning of the 12th century, for the defence of the holy sepulchre and the protection of Christian pilgrims. They were first called *The poor of the Holy City*, and afterwards assumed the appellation of *Templars*, because their house was near the temple. The order was founded by Baldwin II. then king of Jerusalem, with the concurrence of the pope; and the principal articles of their rule were: That they should hear the holy office throughout every day; or that, when their military duties should prevent this, they should supply it by a certain number of pater nosters: that they should abstain from flesh four days in the week, and on Fridays from eggs and milk-meats: that each knight might have three horses, and one esquire: and that they should neither hunt nor fowl. After the ruin of the kingdom of Jerusalem about 1186, they spread themselves through Germany and other countries of Europe, to which they were invited by the liberality of the Christians. In the year 1228, this order acquired stability, by being confirmed in the council of Troyes, and subjected to a rule of discipline drawn up by St Bernard. In every nation they had a particular governor, called *master of the Temple*, or of the *militia of the Temple*. Their grand-master had his residence at Paris.

The order of Templars flourished for some time, and acquired, by the valour of its knights, immense riches and an eminent degree of military renown: but as their prosperity increased, their vices were multiplied, and their arrogance, luxury, and cruelty rose at last to such a monstrous height, that their privileges were revoked, and their order suppressed with the most terrible circumstances of infamy and severity. Their accusers were two of their own body, and their chief prosecutor Philip the Fair of France, who addressed his complaints to Clement V. The pope, though at first unwilling to proceed against them, was under a necessity of complying with the king's desire; so that, in the year 1307, upon an appointed day, and for some time afterwards, all the knights, who were dispersed throughout Europe, were seized and imprisoned, and many of them, after trials for capital crimes, were convicted and put to death. In 1312 the whole order was suppressed by the council of Vienne. A part of the rich revenues they possessed was bestowed upon other orders, especially on the knights of St John, now of Malta, and the rest confiscated to the respective treasuries of the sovereign princes in whose dominions their possessions lay.—The knights Templars, in order to justify the severity with which they were treated, were charged with apostasy to the Saracens, and holding correspondence with them, with insulting the majesty of God, turning into derision the gospel of Christ, and trampling upon the obligation of all laws human and divine. Candidates, it is said, upon admission to this order, were commanded to spit, in token of contempt, upon an image of Christ, and after admission to worship either a cat or a wooden head crowned with gold. It is farther affirmed, that, among them, the odious and unnatural act of sodomy was a matter of obligation; and they are charged with other crimes too horrible to be mentioned, or even imagined. However, though there be reason to believe, that in this order, as well as others of the same period, there were shocking examples of impiety and profligacy; yet that the whole order was thus enormously corrupt, there is no reason to believe. The pope indeed, though he acted with severity, acted with justice. He sent two cardinals to Paris, who, publishing his bull against the order, condemned those Templars who had made the voluntary confession to be burnt by a slow fire. The criminals recanted their former confessions, but acknowledged themselves worthy of death, because they had unjustly accused the order of crimes of which they were innocent. Several authors of those times wrote in defence of the order; and Boccace alleges, that its extirpation was owing to the avarice of the king of France, who coveted the rich possessions the Templars then enjoyed in France.

The king of Arragon was much pressed to treat the Templars in his kingdom as they had been treated in France; but his constant answer was, "We must be first convinced of their guilt, and it will be then time enough to talk of their punishment." The people, however, were in general so provoked against them, that they were compelled to shut themselves up in the fortresses belonging to their order, to prevent their being torn in pieces; which precaution was represented to the king of Arragon as an act of rebellion. He marched, therefore, with a corps of troops against one of these fortresses. The knight who commanded surrendered immediately, and told the king the truth, assuring him that they desired nothing but a fair trial; with which declaration the king was extremely moved, took the whole order into his protection, and forbade any to abuse or insult them under the heaviest penalties. At the same time he declared he was ready to receive any informations against them that were supported by proofs; but if the informers failed therein, he would punish them as they deserved.

These facts plead strongly for the innocence of the Templars, or at least they prove that their guilt must have been exaggerated; and if we add, that many of the accusations advanced against them flatly contradict each other, and that many members of this unfortunate order solemnly avowed their innocence while languishing under the severest tortures, and even with their dying breath—it would seem probable, that King Philip set on foot this bloody tragedy, with a view to gratify his avarice, and glut his resentment against the Templars, and especially against their grand-master, who had highly offended him. The principal cause of his invincible hatred against them was, that in his quarrel with Boniface VIII. the knights espoused the cause of the pope, and furnished him with money to carry on the war. They originally wore a white habit, with red crosses sewed upon their cloaks as a mark of distinction.

TEMPLE, Sir William, was born in London in the

Temple. the year 1628. The family from which he ſprung was ancient, and is ſaid to have aſſumed the ſurname of Temple from the manor of Temple, in the hundred of Sparken-Hall, in Leiceſterſhire. He was firſt ſent to ſchool at Penſehurſt, in Kent, under the care of his uncle, the celebrated Dr Hammond, then miniſter of that pariſh; but at the age of ten he was removed thence to a ſchool at Biſhop-Stortford, in Hertfordſhire. When he had acquired a ſufficient knowledge of the Greek and Latin, he returned home at the age of fifteen, and, two years after, he went to Cambridge, where he was placed under the tuition of the learned Dr Cudworth, then fellow of Emanuel college. His father, Sir John Temple, being a ſtateſman, ſeems to have deſigned him for the ſame way of life; and on this account, after reſiding at Cambridge two years, which were principally ſpent in acquiring a competency of French and Spaniſh, both languages exceedingly uſeful for his intended purſuits, he was ſent abroad to finiſh his education.

Mr Temple began his travels by viſiting France in 1648. As he choſe to paſs through the Iſle of Wight, where his majeſty was detained a priſoner, he there accidentally met with the ſecond daughter of Sir Peter Oſborn of Chickſand, in Bedfordſhire, then governor of Guernſey for the king; and his lady being on a journey with her brother to St Maloes, where their father then was, our young traveller joined their party. This gave riſe to an honourable attachment, which, at the end of ſeven years, concluded in a happy marriage. Having reſided two years in France, and learned the French language perfectly, Mr Temple made a tour through Holland, Flanders, and Germany, during which he became completely maſter of the Spaniſh. In 1654 he returned from the continent, and, marrying Miſs Oſborn, paſſed his time in retirement with his father, his two brothers, and a ſiſter, then in Ireland, happy in that perfect harmony which has been ſo often remarked in their family.

As he rejected all offers made him of employment under Cromwell, the five years which he lived in Ireland were ſpent chiefly in improving himſelf in hiſtory and philoſophy; but at the Reſtoration, in 1660, being choſen a member of the convention there, while others were trying to make their court to the king, Mr Temple oppoſed the poll-bill with ſo much ſpirit, that his conduct ſoon attracted the attention of the public, and brought him into notice. In the ſucceeding parliament, in 1661, he was elected with his father for the county of Carlow; and in the year following, he was choſen one of the commiſſioners to be ſent from that parliament to the king, which gave him an opportunity of waiting on the duke of Ormond, the new lord lieutenant, then at London. Soon after he went back to Ireland, but with a reſolution of quitting that kingdom, and of removing with his family to England.

On his return he met with a very favourable reception from the duke of Ormond; and ſoon acquired ſuch a conſiderable ſhare in his eſteem, that the duke complained of him as the only man in Ireland that had never aſked any thing from him. When he mentioned his deſign of carrying his family to England, his grace ſaid, that he hoped he would at leaſt give him leave to write in his favour to the two great miniſters, Clarendon then lord chancellor, and the earl of Arlington, who was ſecretary of ſtate. This the duke did in ſuch ſtrong terms, as procured him the friendſhip of theſe two noble- Temple men, as well as the good opinion of the king. Mr Temple, however, made no other uſe of this advantage than to tell Lord Arlington, that if his majeſty had any employment abroad, which he was fit for, he ſhould be happy to undertake it; but, at the ſame time, he requeſted that he might not be ſent into any of the northern climates, to which he had a very great averſion. Lord Arlington replied, he was very ſorry he had made ſuch an objection, as there was no other employment then undiſpoſed of except that of going envoy to Sweden. However, in 1665, about the beginning of the firſt Dutch war, Lord Arlington ſent a meſſenger to acquaint him that he muſt immediately come to his houſe; which he did, and found that his lordſhip's buſineſs was to tell him, that the king had occaſion to ſend ſome perſon abroad upon an affair of the utmoſt importance, and that he had reſolved to make him the firſt offer; but that he muſt know, without delay, and without telling him what it was, whether he would accept of it, and that he muſt be ready to ſet out in two or three days, without mentioning it to any of his friends. After a little conſideration, Mr Temple told his lordſhip, that, as he took him to be his friend, and as he had adviſed him not to refuſe, as it would be an entrance into his majeſty's ſervice, he ſhould conſult no farther. This buſineſs was to carry a ſecret commiſſion to the biſhop of Munſter; which he ſet out with on the ſecond of Auguſt, and executed it ſo much to the ſatisfaction of Charles II. that, on his return to Bruſſels, his majeſty appointed him reſident there, and created him a baronet. As Bruſſels was a place which he had long wiſhed to reſide at, in April 1666 he ſent for his family; but, before their arrival, he had been again obliged to depart upon buſineſs to the prelate's court: for the biſhop having liſtened to terms of accommodation with France, Sir William wrote two letters to diſſuade him from that alliance; and theſe not having the deſired effect, he went in diſguiſe to Munſter, where, though he arrived too late to ſecure the prince in his firſt engagement, yet he prevailed on him to permit five or ſix thouſand of his beſt troops to enter into the Spaniſh ſervice. In this journey he paſſed for a Spaniſh envoy, having twenty Spaniſh guards to attend him. In this manner he firſt went to Duſſeldorp, where the duke of Newburgh, though in the French intereſt, gave him a guard to Dortmund; but when he reached that place, finding the gates ſhut, he was forced to proceed to a village, at the diſtance of a league, which being full of Brandenburgh troops, he was under the neceſſity of lodging in a barn, upon a ſtraw bed, with his page for a pillow. Next day he was entertained at a caſtle belonging to the biſhop of Munſter, by one Gorges a Scotch lieutenant-general in that prelate's ſervice, with what he calls a very epiſcopal way of drinking. The general coming to the large hall, in which ſtood a great many flaggons ready charged, he called for wine to drink the king's health. A ſilver bell, that might hold about two quarts, was upon this brought him; and, as ſoon as he received it, he pulled out the clapper, and giving it to Sir William, to whom he intended to drink, ordered the bell to be filled. When he was done, he drank off the contents to his majeſty's health; and aſked Sir William for the clapper, put it on, and turning down the bell, rang it, to ſhew that he had drank fair,

and

Temple. and left nothing in it. He then took out the clapper, desired Sir William to give it to whomsoever he pleased; and, ordering the bell to be filled again, presented it to Sir William: but as the latter seldom used to drink, he had generally some gentleman with him to supply his place in this respect whenever it might be necessary. Having finished his business at Munster, he returned to Brussels, where he passed a year with great pleasure and satisfaction.

Two months after the conclusion of the peace with the Dutch at Breda, Sir William's sister, who resided with him at Brussels, being very desirous of seeing Holland, he went thither incognito to gratify her desire; but while he was at the Hague, he paid a private visit to Mr De Witt, in which he laid the foundation of that close intimacy which afterwards subsisted between them.

In the spring of 1667, a new war breaking out between France and Spain, which exposed Brussels to the danger of falling into the hands of the former, Sir William sent his lady and family to England; but he himself remained there with his sister till the Christmas following, when he was ordered by the king to come over privately to London. Taking the Hague in his way, he paid another visit to De Witt, and, pursuant to his instructions, proposed those overtures to him which produced the triple alliance. Soon after his arrival at the British court, he returned, on the 16th of January 1668, with the character of envoy extraordinary and plenipotentiary to Holland; where a conference being opened, he brought that treaty to a perfect conclusion in the short space of five days. The ratifications of this alliance being exchanged on the 15th of February, he repaired to Brussels; and a treaty being set on foot between France and Spain at Aix-la-Chapelle, he set out for that place on the 24th of April in quality of his majesty's ambassador extraordinary and mediator. Here he arrived on the 27th: and it was chiefly owing to his assistance that the Spaniards were brought to sign the articles of that peace on the second of May. This service being completed, he returned to Brussels, with a view of remaining there in his former station of resident; but he received letters from the earl of Arlington, with the king's order to continue as ambassador, and to serve his country in that quality in Holland, as on account of the late alliances, his majesty was resolved to renew a character which the crown of England had discontinued there since the time of King James. Sir William being now left at liberty to return to England, embraced the opportunity; and, upon his arrival at London, he was received with every possible demonstration of favour both by the king and the court.

Setting out again for Holland, with his new character of the king's ambassador, he arrived at the Hague in the end of August 1668. Here he enjoyed the confidence of that great minister De Witt, and lived in great intimacy with the prince of Orange, who was then only eighteen years of age; but, in September 1669, he was hurried back to England by Lord Arlington, who ordered him to put his foot in the stirrup as soon as he should receive his letter. When Sir William waited on the earl, he found that he had not one word to say to him; for, after making him attend a long time, he only asked a few indifferent questions respecting his journey. Next day he was received as coolly by the king; but the secret soon came out, and he pressed Temple. to return to the Hague, and pave the way for a war with Holland. This, however, he excused himself from having any hand in; which so much provoked the lord treasurer Clifford, that he refused to him an arrear of two thousand pounds due from his embassy. Disgusted with Arlington's behaviour, which was so unlike the friendship he had formerly professed, Sir William now retired to his house at Sheen near Richmond, in Surry; and in his retreat, when free from the hurry of business, he wrote his Observations on the United Provinces, and one part of his Miscellanies, in the time of the second Dutch war. About the end of summer, however, 1673, the king wishing to put an end to the war, sent for Sir William, and desired him to go to Holland to negociate a peace; but powers having been sent from thence at this time to the Marquis de Fresno, the Spanish ambassador at London, Sir William was ordered to confer with him; and a treaty was accordingly concluded in three days, and the point carried respecting the superiority of the British flag, which had been so long contested. In June 1674 he was again sent ambassador to Holland to offer the king's mediation between France and the confederates, then at war, which was accepted not long after; Lord Berkeley, Sir William Temple, and Sir Leoline Jenkins, being declared ambassadors and mediators; and Nimeguen, which Sir William had proposed, was at length agreed upon by all parties to be the place of treaty. During his stay at the Hague, the prince of Orange, who was fond of the English language, and of the plain English way of eating, constantly dined and supped once or twice a week at his house; and by this familiarity he so much gained the prince's confidence and esteem, that he had a considerable hand in his marriage with the Princess Mary, daughter of James II.

In July 1676 he removed his family to Nimeguen, where he spent the remainder of that year without making any progress in the treaty; and the year following his son was sent over with letters from the lord treasurer, ordering him to return, and succeed Mr Coventry as secretary of state. In consequence of this order, Sir William came over to England in the spring of 1677; and though the affair of the secretary's place was dropped at his desire, he did not return to Nimeguen that year. About this time, the prince having the king's leave to come over, he soon after married the Princess Mary; and this gave occasion for a new coolness between Lord Arlington and Sir William, as he and the lord-treasurer Osborn, who was related to Sir William's lady, were only privy to that affair. After the prince and princess were gone to Holland, as the court always seemed inclined to favour France, the king wished to engage Sir William in some negociations with that crown: but he was so ill satisfied with this proposal, that he offered to give up all pretensions to the office of secretary; and desiring the lord-treasurer to acquaint his majesty with his intentions, retired to Sheen, in hopes of being taken at his word. Upon a discovery, however, of the French designs not to evacuate the Spanish towns agreed by the treaty to be delivered up, the king commanded him to go upon a third embassy to the states; with whom he concluded a treaty: by which England engaged, in case France refused to evacuate the towns in forty days, to declare war immediately

Temple

ately againſt that nation; but before half that time was elapſed, one Du Croſs was ſent from the Engliſh court to Holland upon a buſineſs which damped all the good humour excited by the treaty there, and which produced ſuch ſudden and aſtoniſhing changes in this country, as gave Sir William a diſtaſte for all public employments.

In 1679 he went back to Nimeguen, where the French delayed to ſign the treaty till the laſt hour; but having concluded it, he returned to the Hague, whence he was ſoon after ſent for to enter upon the ſecretary's office, which Mr Coventry at length reſolved to reſign. He accordingly came over, and went to court, as all his friends hoped, with a full intention of aſſuming his office; but he ſtarted ſome difficulty, becauſe he had not a ſeat in the houſe of commons, thinking that, by his not being a member, the public buſineſs would ſuffer at ſuch a critical time, when the conteſts between the two parties ran ſo high that the king thought fit to ſend the duke of York into Flanders, and the parliament to put the lord treaſurer Danby into the Tower. After this his majeſty ſtill preſſed Sir William to be ſecretary of ſtate; uſing as an argument for his compliance, that he had nobody to conſult with at a time when he had the greateſt need of the beſt advice. Notwithſtanding all this, Sir William declined the king's offer, adviſing him to chooſe a council in whom he could confide, and upon whoſe abilities he could depend. This advice the king followed; and the choice of the perſons being concerted between his majeſty and Sir William, the old council was diſſolved four days after, and the new one eſtabliſhed, of which the latter was a member.

In 1680 the councils began again to be changed, on the king's illneſs, at the end of ſummer, and the duke of York's return privately to court. In this juncture Sir William, endeavouring to bring to the king's favour and buſineſs ſome perſons to whom his majeſty had taken a diſlike, if not an averſion, he met with ſuch treatment from them as gave him a freſh diſtaſte to the court, at which he ſeldom made his appearance; ſo that he reſided principally at Sheen. Soon after this the king ſent for him again; and having propoſed that he ſhould go as ambaſſador into Spain, Sir William conſented: but when his equipage was almoſt ready, and part of the money paid down for it, the king changed his mind, and told him that he would have him defer his journey till the end of the ſeſſion of parliament, in which he was choſen a member for the univerſity of Cambridge. In this ſeſſion the ſpirit of party ran ſo high that it was impoſſible to bring the houſe to any kind of temper. The duke was ſent into Scotland; but this would not ſatisfy them, nor any thing but a bill of excluſion; which Sir William ſtrenuouſly oppoſed, ſaying, that "His endeavour ever ſhould be to unite the royal family, and that he would never enter into any councils to divide them." Not long after this period, the parliament being diſſolved by his majeſty, without the advice of his privy council, and contrary to what he had promiſed, Sir William made a bold ſpeech againſt it; for which he was very ill uſed by ſome of thoſe friends who had been moſt earneſt in promoting the laſt change in the miniſtry. Upon this he grew quite tired of public buſineſs, declined the offer he had of again ſerving for the univerſity in the next parliament, that was ſoon after called, and met at Oxford; and ſeeing his majeſty reſolved to govern without his parliament, and to ſupply his treaſury through another channel, he retired to Sheen a few days after, whence he ſent word by his ſon, that "he would paſs the reſt of his days like a good ſubject, but would never more meddle with public affairs." From that time Sir William lived at this place till the end of that reign and for ſome time in the next; when having purchaſed a ſmall ſeat, called *Moor Park*, near Farnham in Surry, which he conceived a great fondneſs for, on account of its ſolitude and retirement, and its healthy and pleaſant ſituation, and being much afflicted with the gout, and broken with age and infirmities, he reſolved to ſpend the remainder of his life in this agreeable retreat. In his way thither, therefore, he waited on King James, who was then at Windſor, and begged his favour and protection to one "that would always live as a good ſubject, but, whatever might happen, never again enter upon any public employment;" deſiring his majeſty to give no credit to any thing he might hear to the contrary. The king, who uſed to ſay that Sir William Temple's character was always to be believed, promiſed him whatever he deſired, gently reproached him for not entering into his ſervice, which, he ſaid, was his own fault; and kept his word as faithfully to Sir William as Sir William did to his majeſty, during the ſurpriſing turn of affairs that ſoon after followed by the arrival of the prince of Orange. At the time of this happy revolution, in 1688, Moor Park becoming unſafe, as it lay in the way of both armies, he went back to the houſe at Sheen, which he had given up to his ſon; to whom he refuſed leave, though importunately begged, to go and meet the prince of Orange at his landing: but after King James's abdication, when the prince reached Windſor, he went thither to wait upon his highneſs, and carried his ſon along with him. The prince preſſed him to enter into his ſervice, and to be ſecretary of ſtate; but his age and infirmities confirming him in the reſolution he had made not to meddle any more with public affairs, he was ſatisfied that his ſon alone ſhould enjoy his majeſty's favour. Mr John Temple was upon this appointed ſecretary at war; but he had hardly been a week in that office, when he reſolved to put an end to his own exiſtence; which he did on the 14th of April 1689, by throwing himſelf out of a boat, hired for that purpoſe, in ſhooting London-bridge; having firſt put ſtones into his pocket to make him ſink ſpeedily.

Templ

In 1694 Sir William had the misfortune to loſe his lady, who was a very extraordinary woman, as well as an affectionate wife. He was then conſiderably turned of ſixty; at which age he practiſed what he had ſo often declared to be his opinion, that "an old man ought then to conſider himſelf of no farther uſe in the world except to himſelf and his friends." After this he lived four years very much afflicted with the gout; and his ſtrength and ſpirits being worn out by the infirmities of age, he expired in the month of January 1698. He died at Moor-Park, where his heart was buried in a ſilver box under the ſun dial in his garden, oppoſite to a window from which he uſed to contemplate and admire the works of nature, with his ſiſter, the ingenious Lady Gifford. This was according to his will; in purſuance of which his body was privately interred in Weſtminſter Abbey, and a marble monument erected in 1722, after the

the death of Lady Gifford, who reſembled him in genius as well as in perſon, and left behind her the character of one of the beſt and moſt conſtant friends in the world.

Sir William Temple's principal works are, 1. Memoirs from 1672 to 1692: They are very uſeful for thoſe who wiſh to be acquainted with the affairs of that period. 2. Remarks upon the State of the United Provinces. 3. An Introduction to the Hiſtory of England: This is a Sketch of a General Hiſtory. 4. Letters written during his laſt embaſſies. And, 5. Miſcellanies, which contain a great many curious pieces that diſplay conſiderable depth of thought. He was an accompliſhed gentleman, a ſound politician, a patriot, and a great ſcholar. And if this great idea ſhould perchance be ſhaded by ſome touches of *vanity* and *ſpleen*, the reader will be ſo candid as to conſider, that the greateſt, wiſeſt, and the beſt of men, have ſtill ſome failings and imperfections which are inſeparable from human nature.

TEMPLE, *Templum*, a public building, erected in honour of ſome deity, either true or falſe; and wherein the people meet to pay religious worſhip to the ſame. The word is formed from the Latin *templum*, which ſome derive from the Greek τεμενος, ſignifying the ſame thing; and others from τεμνω, *abſcindo*, "I cut off, I ſeparate," in regard a temple is a place ſeparated from common uſes; others with more probability derive it from the old Latin word *templare*, "to contemplate." It is certain the ancient augurs gave the name *templa* to thoſe parts of the heavens which were marked out for the obſervation of the flight of birds. Their formula was this: *Templa teſqua ſunto.* Temples were originally all open, and hence received their name. See Phil. Tranſ. N° 471. ſect. 5. where we have an account of an ancient temple in Ireland of the ſame ſort as our famous Stonehenge. The word *templum*, in its primary ſenſe among the old Romans, ſignified nothing more than a place ſet apart and conſecrated by the augurs, whether incloſed or open, in the city or in the fields.

Clemens Alexandrinus and Euſebius refer the origin of temples to the ſepulchres built for the dead. This notion has been lately illuſtrated and confirmed by a variety of teſtimonies by Mr Farmer in his Treatiſe on the Worſhip of Human Spirits, p. 373, &c. Herodotus and Strabo will have the Egyptians to have been the firſt who built temples to the gods. The firſt erected in Greece is aſcribed to Deucalion, by Apollonius, Argonaut. lib. iii. In antiquity we meet with many people who would not build any temples to their gods for fear of confining them to too narrow bounds. They performed their ſacrifices in all places indifferently, from a perſuaſion that the whole world is the temple of God, and that he required no other. This was the doctrine of the magi, followed by the Perſians, the Scythians, the Numidians, and many other nations mentioned by Herodotus, lib. i. Strabo, lib. xv. and Cicero in his ſecond oration againſt Verres.

The Perſians, who worſhipped the ſun, believed it would wrong his power to incloſe him in the walls of a temple, who had the whole world for his habitation; and hence, when Xerxes ravaged Greece, the magi exhorted him to deſtroy all the temples he met with.

The Sicyonians would build no temple to their goddeſs Coronis; nor the Athenians, for the like reaſon, erect any ſtatue to Clemency, who, they ſaid, was to live in the hearts of men, not within ſtone walls. Temple.

The Bithynians had no temples but the mountains to worſhip on; nor had the ancient Germans any other but the woods.

Even ſome philoſophers have blamed the uſe and building of temples, particularly Diogenes, Zeno, and his followers the Stoics. But it may be ſaid, that if God hath no need of temples, men have need of places to meet in for the public offices of religion: accordingly temples may be traced back even into the remoteſt antiquity. See *Hoſpinian de Origine Templorum.*

The Romans had ſeveral kinds of temples; whereof thoſe built by the kings, &c. conſecrated by the augurs, and wherein the exerciſe of religion was regularly performed, were called, by way of eminence, *templa*, "temples." Thoſe that were not conſecrated, were called *ædes*. The little temples, that were covered or roofed, they called *ædiculæ*. Thoſe open, *ſacella*. Some other edifices, conſecrated to particular myſteries of religion, they called *fana* and *delubra*.

All theſe kinds of temples, Vitruvius tells us, had other particular denominations, according to the form and manner of their conſtruction, as will be hereafter ſpecified.

Indeed the Romans outdid all nations with regard to temples: they not only built temples to their gods, to their virtues, to their diſeaſes, &c. but alſo to their emperors, and that in their life time; inſtances whereof we meet with in medals, inſcriptions, and other monuments. Horace compliments Auguſtus hereupon, and ſets him above Hercules and all the heroes of fable; becauſe thoſe were admitted into temples only after their death, whereas Auguſtus had his temples and altars while living.

Præſenti tibi maturos largimur honores;
Jurandaſque tuum per nomen ponimus aras.
Epiſt. ad Aug.

Suetonius, on this occaſion, gives an inſtance of the modeſty of that emperor, who would allow of no *temples* being erected to him in the city; and even in the provinces, where he knew it was uſual to raiſe temples to the very proconſuls, refuſed any but thoſe erected in the name of Rome as well as his own.

The moſt celebrated temples among the Romans were the Capitol and Pantheon. They had alſo the temple of Saturn, which ſerved for the public treaſury; and the temple of Janus.

The temple at Jeruſalem was ſimilar in its plan to the TABERNACLE. The firſt temple was begun by Solomon about the year of the world 2992, and before Chriſt 1012 according to ſome chronologers, and finiſhed in eight years. Great miſtakes have been committed reſpecting the dimenſions of this temple, by confounding the emblematical deſcription of Ezekiel with the plain account of it in the books of Kings and Chronicles. It conſiſted of the holy of holies, the ſanctuary, and a portico. The holy of holies was a ſquare room of 20 cubits; the ſanctuary, or holy place, was 40 cubits long and 20 broad, conſequently the length of both theſe together was 60 cubits. The portico, which ſtood before the ſanctuary, was 20 cubits long and 10 cubits broad. Whether the portico was ſeparated by a wall from

Temple. from the reſt of the temple or not, is not mentioned in ſcripture. If it was, the whole length of the temple, computing the cubit at 22 inches, did not exceed 110 feet in length and 36 feet 8 inches in breadth. In the portico ſtood the two brazen pillars called *Jachin* and *Boaz*, which, upon comparing and reconciling the ſeemingly different accounts in different places, appear to have been 40 cubits high and about 4 cubits diameter. The court probably at firſt extended all round the temple. Now we are told, that the court about the tabernacle was 100 cubits long and 50 broad; and as Solomon made every part of the temple about twice as large as the correſponding part in the tabernacle, we have reaſon to conclude, that the court around the temple was 200 cubits long and 100 broad. According to this deſcription, which is taken from the ſcripture hiſtory, the temple of Solomon was by no means ſo large as it is commonly repreſented. Still, however, it was very magnificent in ſize and ſplendid in ornament. It was plundered of its treaſures in the reign of Rehoboam, and repaired by Joaſh; it was again ſpoiled in the time of Ahaz and of Hezekiah; and after being reſtored by Joſiah, was demoliſhed by Nebuchadnezzar in the year of the world 3416, after it had ſtood 476 years according to Joſephus, and according to Uſher 428 years.

The ſecond temple was built by the Jews, after their return from the Babyloniſh captivity, under the direction and influence of Zerubbabel their governor, and of Joſhua the high-prieſt, with the leave and encouragement of Cyrus the Perſian emperor, to whom Judea was now become a tributary kingdom. According to the Jews, this temple was deſtitute of five remarkable appendages, which were the chief glory of the firſt temple; viz. the ark and mercy-ſeat, the Shechinah, the holy fire on the altar, which had been firſt kindled from heaven, the urim and thummim, and the ſpirit of prophecy. This temple was plundered and profaned by Antiochus Epiphanes, who alſo cauſed the public worſhip in it to ceaſe; and afterwards purified by Judas Maccabæus, who reſtored the divine worſhip; and after having ſtood 500 years, rebuilt by Herod, with a magnificence approaching to that of Solomon's. Tacitus calls it *immenſæ opulentiæ templum;* and Joſephus ſays, it was the moſt aſtoniſhing ſtructure he had ever ſeen, as well on account of its architecture as its magnitude, and likewiſe the richneſs and magnificence of its various parts and the reputation of its ſacred appurtenances. This temple, which Herod began to build about 16 years before the birth of Chriſt, and ſo far completed in nine years and a half as to be fit for divine ſervice, was at length deſtroyed by the Romans on the ſame month and day of the month on which Solomon's temple was deſtroyed by the Babylonians.

Maurice's Indian Antiquities, vol. iii. p. 352.

The Indian temples, or pagodas, are ſometimes of a prodigious ſize. They are commonly erected near the banks of the Ganges, Kiſtna, or other ſacred rivers, for the benefit of ablution in the purifying ſtream. Where no river flows near the foot of the pagoda, there is invariably in the front of it a large tank or reſervoir of water. Theſe are, for the moſt part, of a quadrangular form, are lined with freeſtone or marble, have ſteps regularly deſcending from the margin to the bottom, and

Crauford's Sketches, vol. i. p. 106.

Mr Crauford obſerved many between three and four hundred feet in breadth. At the entrance of all the more conſiderable pagodas there is a portico, ſupported by rows of lofty columns, and aſcended by a handſome flight of ſtone ſteps; ſometimes, as in the inſtance of Tripetti *, to the number of more than a hundred. Under this portico, and in the courts that generally incloſe the whole building, an innumerable multitude aſſemble at the riſing of the ſun; and, having bathed in the ſtream below, and, in conformity to an immemorial cuſtom over all the Eaſt, having left their ſandals on the border of the tank, impatiently await the unfolding of the gates by the miniſtering brahmin. The gate of the pagoda univerſally fronts the eaſt, to admit the ray of the ſolar orb; and, opening, preſents to the view an edifice partitioned out, according to Mr Thevenot in his account of Chitanagar, in the manner of the ancient cave-temples of Elora, having a central nave or body; a gallery ranging on each ſide; and, at the farther end, a ſanctuary, or chapel of the deity adored, ſurrounded by a ſtone baluſtrade to keep off the populace. Thoſe who wiſh to peruſe a more particular account of the Indian temples may conſult Maurice's Indian Antiquities. See alſo PAGODA and SERINGHAM.

Temple. * *Voyag des Inde* tom. iii.

TEMPLE, in *Architecture*. The ancient temples were diſtinguiſhed, with regard to their conſtruction, into various kinds; as, *Temple in antæ*, *Ædes in antis*. Theſe, according to Vitruvius, were the moſt ſimple of all temples, having only angular pilaſters, called *antæ* or *paraſtatæ*, at the corners, and two Tuſcan columns on each ſide of the doors. *Temple tetraſtyle*, or ſimple *tetraſtyle*, was a temple that had four columns in front, and as many behind. Such was the temple of Fortuna Virilis at Rome. *Temple proſtyle*, that which had only columns in its front or foreſide; as that of Ceres at Eleuſis in Greece. *Temple amphiproſtyle*, or *double proſtyle*, that which had columns both before and behind, and which was alſo tetraſtyle. *Temple periptere*, that which had four rows of inſulated columns around, and was hexaſtyle, i. e. had ſix columns in front; as the temple of Honour at Rome. *Temple diptere*, that which had two wings and two rows of columns around, and was alſo octoſtyle, or had eight columns in front; as that of Diana at Epheſus.

TEMPLES, among us, denote two inns of court in London, thus called, becauſe anciently the dwelling-houſe of the knight's templars. At the ſuppreſſion of that order, they were purchaſed by the profeſſors of the common law, and converted into *hoſpitia* or inns. They are called the *inner* and *middle temple*, in relation to Eſſex-houſe; which was alſo a part of the houſe of the templars, and called the *outer temple*, becauſe ſituated without Temple-Bar. In the middle temple, during the time of the templars, the king's treaſure was kept; as was alſo that of the kings of France in the houſe of the templars at Paris. The chief officer was the maſter of the temple, who was ſummoned to parliament in 47 Hen. III. and from him the chief miniſter of the temple-church is ſtill called *maſter of the temple*.

TEMPLES, in *Anatomy*, a double part of the head, reaching from the forehead and eyes to the two ears. The temples are chiefly formed of two bones called *oſſa temporis*. Theſe parts, according to phyſicians, were called *tempora*, from their ſhowing the age or time of a man by the colour of the hair, which turns white in this part before any other; which Homer ſeems to have been aware of, by his calling men *poliocrotaphi*, q. d. "grey-templed."

TEMPORAL,

TEMPORAL, a term generally uſed for ſecular, as a diſtinction from eccleſiaſtical. Thus we ſay temporal lords, and ſpiritual or eccleſiaſtical lords.

TEMPORALITIES *of* BISHOPS, are the revenues, lands, tenements, and lay-fees, belonging to biſhops, as they are barons and lords of parliament.

The cuſtody of the temporalities of biſhops forms a branch of the king's ordinary revenues (ſee REVENUE). Theſe, upon the vacancy of the biſhopric, are immediately the right of the king, as a conſequence of his prerogative in church matters; whereby he is conſidered as the founder of all archbiſhoprics and biſhoprics, to whom, during the vacancy, they revert. And for the ſame reaſon, before the diſſolution of abbeys, the king had the cuſtody of the temporalities of all ſuch abbeys and priories as were of royal foundation (but not of thoſe founded by ſubjects), on the death of the abbot or prior. Another reaſon may alſo be given why the policy of the law hath veſted this cuſtody in the king; becauſe, as the ſucceſſor is not known, the lands and poſſeſſions of the ſee would be liable to ſpoil and devaſtation if no one had a property therein. Therefore the law has given the king, not the temporalities themſelves, but the cuſtody of the temporalities, till ſuch time as a ſucceſſor is appointed; with power of taking to himſelf all the intermediate profits, without giving any account to the ſucceſſor; and with the right of preſenting (which the crown very frequently exerciſes) to ſuch benefices and other preferments as fall within the time of vacation. This revenue is of ſo high a nature, that it could not be granted out to a ſubject, before or even after it accrued: but now, by the ſtatute 15 Edw. III. ſtat. 4. cap. 4. and 5. the king may, after the vacancy, leaſe the temporalities to the dean and chapter; ſaving to himſelf all advowſons, eſcheats, and the like. Our ancient kings, and particularly William Rufus, were not only remarkable for keeping the biſhoprics a long time vacant, for the ſake of enjoying the temporalities, but alſo committed horrible waſtes on the woods and other parts of the eſtate; and to crown all, would never, when the ſee was filled up, reſtore to the biſhop his temporalities again, unleſs he purchaſed them at an exorbitant price. To remedy which, King Hen. I. granted a charter at the beginning of his reign, promiſing neither to ſell, nor let to farm, or take any thing from, the domains of the church, till the ſucceſſor was inſtalled. And it was made one of the articles of the great charter, that no waſte ſhould be committed in the temporalities of biſhoprics, neither ſhould the cuſtody of them be ſold. The ſame is ordained by the ſtatute of Weſtminſter the firſt; and the ſtatute 14 Edward III. ſtat. 4. cap. 4. (which permits a leaſe to the dean and chapter) is ſtill more explicit in prohibiting the other exactions. It was alſo a frequent abuſe, that the king would, for trifling or no cauſes, ſeize the temporalities of biſhops, even during their lives, into his own hands: but this is guarded againſt by ſtatute 1 Edw. III. ſtat. 2. cap. 2.

This revenue of the king, which was formerly very conſiderable, is now by a cuſtomary indulgence almoſt reduced to nothing: for, at preſent, as ſoon as the new biſhop is conſecrated and confirmed, he uſually receives the reſtitution of his temporalities quite entire and untouched from the king; and then, and not ſooner, he has a fee-ſimple in his biſhopric, and may maintain an action for the profits. Temporalities || Tenedos.

TENACITY, in *Natural Philoſophy*, that quality of bodies by which they ſuſtain a conſiderable preſſure or force of any kind without breaking. It is the quality oppoſite to fragility or brittleneſs. See *STRENGTH of Materials*.

TENACULUM, in *Surgery*, an inſtrument uſed in amputation, for pulling out bleeding veſſels that are to be tied by ligatures. See SURGERY.

TENAILLES and TENAILLIONS. } See FORTIFICATION, Sect. I. § 3. and 5.

TENANT, one that holds lands or tenements of ſome lord or landlord, by rent, fealty, &c. See TENURE.

TENAWIT. See LOXIA, ORNITHOLOGY *Index*.

TENCH. See CYPRINUS, ICHTHYOLOGY *Index*.

TENDER, a ſmall ſhip in the ſervice of men of war, for carrying men, proviſions, or any thing elſe that is neceſſary.

TENDONS, in *Anatomy*, are white, firm, and tenacious parts, contiguous to the muſcles, and uſually forming their extremities. See ANATOMY, N° 85.

TENEBRIO, in *Natural Hiſtory*, a genus of inſects belonging to the order of coleoptera. See ENTOMOLOGY *Index*.

TENEDOS, in *Ancient Geography*, an iſland on the coaſt of Troas, at the diſtance of 40 ſtadia from the continent, and 80 in compaſs; with a cognominal Æolian town, and a temple of Apollo Smintheus. Its origin is derived from Tennes or Tenes, who being expoſed in a coffer or bog by his father Cygnus the Thracian, at the inſtigation of the mother-in-law, was by fate carried to this iſland, made king of it, and at length worſhipped as a god on account of his virtues. The iſland was famous for its earthen ware, for which purpoſe it had an excellent red clay; and hence Bochart would derive the appellation from *tinedom*, a "red clay." *Tenedia ſecuris*, is a proverbial ſaying to denote ſeverity; from a law there paſſed, that perſons found in the act of adultery ſhould be put to death; a ſeverity executed on the king's ſon; and therefore, in the coins of Tenedos on one ſide are two heads, in memorial of the king and his ſon, and on the reverſe an axe, (Ariſtotle). This iſland ſtill retains its ancient name; and is one of the ſmalleſt iſlands of the Archipelago, ſituated near the coaſt of Leſſer Aſia, weſt of the ruins of Troy. It is chiefly rocky, but fertile, being remarkable for producing the beſt Muſcadine wine in the Levant; and its poſition, thus near the mouth of the Helleſpont, has given it importance in all ages; veſſels bound towards Conſtantinople finding ſhelter in its port, or ſafe anchorage in the road, during the Eteſian or contrary winds, and in foul weather. The emperor Juſtinian erected a magazine to receive the cargoes of the corn ſhips from Alexandria, when detained there. This was a lofty building, 280 feet long, and 90 broad. The voyage from Egypt was rendered leſs precarious, and the grain preſerved until it could be tranſported to the capital. Afterwards, during the troubles of the Greek empire, Tenedos experienced a variety of fortune. The pirates, who infeſted theſe ſeas, made it for many years their place of rendezvous; and Othman ſeized it in 1302, procured veſſels, and thence ſubdued the other iſlands of the Archipelago.

In

Tenedos, Teneriff.

It has continued in the poſſeſſion of the Turks ever ſince: and on the eaſtern ſide is a pretty large town, ſeated at the foot of a mountain, with a fine harbour commanded by a caſtle. E. Long. 27. 0. N. Lat. 29. 30.

TENERIFF, an iſland of Africa, and one of the Canaries, being the moſt conſiderable for riches, trade, and extent. It lies to the ſouth of the iſland of Salvages, to the weſt of the Grand Canary, to the north of the iſland of Gomera, and to the eaſt of that of Palma. It is of a triangular form, being about 45 miles in length and 20 in breadth; and in the centre is the famous *peak*, called by the natives *El Pico de Teyde*, which in clear weather may be ſeen at the diſtance of 120 miles, like a thin blue vapour very little darker than the ſky.

The moſt frequented harbour is called *Santa Cruz*, which is on the ſouth ſide of the iſland, and where ſhips with good anchors and cables may be ſafe in all weathers. At this port is the principal commercial town in the iſland, called alſo *Santa Cruz*, in the middle of which is a mole, built at a vaſt expence for the convenience of landing; between the mole and the town is a fort called *St Philip's*, and near it is a ſteep rocky den or valley, beginning at the ſea ſhore, and running far in land, which would render the attack of an enemy very difficult; there are alſo other forts for its defence, all joined together by a thick ſtone wall, and mounted with cannon.

Glas's Hiſtorical Account of the Canary Iſlands.

Santa Cruz is a large town, containing ſeveral churches and convents, an hoſpital, and the beſt conſtructed private buildings of any in the Canary iſlands. It contains about 7000 inhabitants; it is not fortified on the land ſide, and all the country near it is dry, ſtony, and barren.

About four leagues to the ſouth of Santa Cruz, cloſe to the ſea, there is a cave, with a church called the *chapel of our Lady of Candelaria*, in which is an image of the Virgin Mary, that is held in as much reverence here as that of Diana was at Epheſus. This chapel is endowed with ſo many ornaments that it is the richeſt place in all the ſeven iſlands. At a certain ſeaſon of the year almoſt all the inhabitants go thither on pilgrimage, and innumerable and incredible ſtories are related and univerſally believed concerning this image.

About four miles in land from Santa Cruz ſtands the city of St Chryſtobal de la Laguna, which is the metropolis of the iſland, and contains two pariſh churches and five convents, but has no trade, being inhabited principally by the gentry of the iſland; the inhabitants are numerous, yet nobody is ſeen in the ſtreets, which are ſolitary and deſolate, ſo that graſs grows in thoſe that are moſt frequented. There are many other towns in the iſland which contain a great number of people, but none are more than three leagues from the ſea.

All the fertile ground within a league of the ſea is covered with vines; that of the next league is ſown with corn, the third is adorned with woods, and above the woods are the clouds, for the iſland gradually aſcends from the ſea, riſing on all ſides till it terminates in the peak, which is the centre.

On the ſouth-eaſt of the iſland inland from *Candelaria* is a town called *Guimar*, where there are ſome families which know themſelves to be the genuine unmixed offſpring of the original natives; but they know nothing of the manners of their anceſtors, nor have they preſerved any remains of their language. They are fairer than the Spaniards of Andaluſia. Teneriff

Teneriff contains about 96,000 perſons, ſuppoſed to be equal to the number of inhabitants of all the reſt of the ſeven iſlands put together. The peaſants in general are wretchedly clothed; when they do appear better, they are habited in the Spaniſh faſhion. The men, in a genteeler line, dreſs very gayly, and are ſeldom ſeen without long ſwords. It is remarked, that few of them walk with dignity and eaſe; which may be attributed to the long cloaks they uſually wear. The women wear veils; thoſe worn by the lower ranks are of black ſtuff, thoſe of the higher of black ſilk; and ſuch among the latter as have any claim to beauty are far from being over careful in concealing their faces by them. The young ladies wear their fine long black hair plaited, and faſtened with a comb or a ribband on the top of the head. *White's Voyage to New South Wales*, p. 18.

The common people, and in this they reſemble the inhabitants of moſt of the iſlands in the Pacific ocean lately diſcovered, have in them a ſtrong tendency to thieving; they are beſides lazy, and the moſt importunate beggars in the world. "I obſerved likewiſe (ſays Mr White) that the itch was ſo common among them, and had attained ſuch a degree of virulence, that one would almoſt be led to believe it was epidemic there. Some of the women are ſo abandoned and ſhameleſs, that it would be doing an injuſtice to the proſtitutes met with in the ſtreets of London to ſay they are like them. The females of every degree are ſaid to be of an amorous conſtitution, and addicted to intrigue; for which no houſes could be better adapted than thoſe in Teneriff.

"The manufactures carried on here are very few, and the product of them little more than ſufficient for their own conſumption. They conſiſt of taffeties, gauze, coarſe linens, blankets, a little ſilk, and curious garters. The principal dependence of the inhabitants is on their wine (their ſtaple commodity), oil, corn, and every kind of ſtock for ſhipping. With theſe the iſland abounds: and, in their ſeaſon, produces not only the tropical fruits, but the vegetable productions of the European gardens, in the greateſt plenty. Teneriff enjoys an agreeable and healthful mediocrity of climate. Indeed none ſeems better adapted for the reſtoration of a valetudinarian; as, by going into the mountains, he may graduate the air, and chooſe that ſtate of it which beſt ſuits his complaint. But although the inhabitants are thus healthy, and have ſo little occaſion for medical aid, they loudly complain of the want of knowledge in the profeſſional gentlemen of the iſland."

The height of the peak of Teneriff has been ſo variouſly eſtimated and calculated by different travellers and geographers, that we can only take the mean between the two extremes of their deciſions. Dr Halley allows but two miles and a quarter from the level of the ſea to the ſummit of the ſugar-loaf, whilſt the Spaniſh account of the Canary iſlands, tranſlated by Mr Glas in 1763, makes it no leſs than five miles; and others have aſſigned a height different from both theſe. That it is an extinguiſhed volcano is univerſally known. *Rye's Exciſion to the Peak of Teneriff.*

"The crater of the peak of Teneriff (ſays Mongez) is a true ſulphur-pit, ſimilar to thoſe of Italy. It is about 50 fathoms long and 40 broad, riſing abruptly from

from east to west. At the edges of the crater, particularly on the under side, are many spiracles, or natural chimneys, from which there exhale aqueous vapours and sulphureous acids, which are so hot as to make the thermometer rise from 9° to 34° of Reaumur. The inside of the crater is covered with yellow, red, or white, argillaceous earth, and blocks of lava partly decomposed. Under these blocks are found superb crystals of sulphur; these are eight-sided rhomboidal crystals, sometimes an inch in length, and, I suppose, they are the finest crystals of volcanic sulphur that have ever been found. The water that exhales from the spiracles is perfectly pure, and not in the least acid, as I was convinced by several experiments. The elevation of the peak above the level of the sea is near 1900 toises." W. Long. 16. 18. N. Lat. 28. 29.

TENESMUS, in *Medicine*, is a continual desire of going to stool, but without any stool being ready to be voided. See MEDICINE, N° 111.

TENIERS, DAVID, the Elder, a Flemish painter, born at Antwerp in 1582. He received the first rudiments of his art from the famous Rubens, who highly esteemed him for his promising genius, and with great satisfaction examined and commended his designs. From the school of that celebrated painter Teniers went to finish his studies at Rome. He attached himself to Adam Elsheimer for six years; and from the instructions of two such incomparable masters, he formed to himself a peculiar style, which his son cultivated so happily afterward as to bring it to the utmost perfection. His pictures were small; and his subjects usually shops, elaboratories, humorous conversations, and rural festivities. The demand for his pieces was universal; and even his master Rubens thought them an ornament to his cabinet. He died at Antwerp in 1640.

TENIERS, *David*, the Younger, also an admirable painter, was the son of the former, and was born at Antwerp in 1610. He obtained the name of *Ape of Painting*, from his imitating the manner of different painters with such exactness as to deceive even the nicest judges. He improved greatly under his father, and obtained such reputation as introduced him to the favour of the great. The archduke Leopold William made him gentleman of his bedchamber; and all the pictures of his gallery were copied by Teniers, and engraved by his direction. The king of Spain and Don Juan of Austria set so high a value on his pictures, that they built a gallery on purpose for them. William prince of Orange honoured him with his friendship; and Rubens not only esteemed his works, but assisted him with his advice. His principal talent lay in landscapes, adorned with small figures. He also painted men drinking and smoking, chemists elaboratories, country fairs, and the like. His small figures are superior to his large ones. He died in 1694.

The works of the father and son are thus distinguished: The latter discover a finer touch and fresher pencil, greater variety of attitudes, and a better disposition of the figures. The father retained something of the tone of Italy in his colouring, which was stronger than the son's; besides, the son used to put at the bottom of his pictures, David Teniers, junior.

Abraham, another son of David the Elder, was equal, if not superior, to his father and brother in the expression of his characters, and his understanding the *claro obscuro*; though he was inferior in the sprightliness of his touch, and the lightness of his pencil. Teniers || Tennis.

TENISON, DR THOMAS, archbishop of Canterbury, was born at Cottenham in Cambridgeshire in 1636; and studied at Corpus Christi college in Cambridge. In his youth, while the fanatical government lasted, he applied himself to physic; but afterward went into orders, and was some time minister of St Andrew's church, Cambridge; where he attended the sick during the plague in 1665, which his parishioners acknowledged by the present of a piece of plate. He showed himself very active against the growth of Popery, by his writings both in King Charles and in King James's reigns: in 1680 he was presented to the vicarage of St Martin's in the Fields, London, to which parish he made several donations; and among others, endowed a free school, and built a handsome library, which he furnished with useful books. King William and Queen Mary, in 1689, presented him to the archdeaconry of London; in 1691, he was nominated to the see of Lincoln, and in 1694 he succeeded Dr Tillotson as archbishop of Canterbury. He performed all the duties of a good primate for 20 years, and died in 1715.

TENNIS, a play at which a ball is driven by a racket.

As many persons would become players at tennis, provided they could easily understand the rudiments of the game, so as to form some judgment of the players, or at least to know who wins and who loses, we have here attempted to give so plain a description of it, that no one can be at a loss, if ever he should bett or play. As to the executive part, it requires great practice to make a good player, so that nothing can be done without it; all we presume to do is to give an insight into the game, whereby a person may not seem a total stranger to it when he happens to be in a tennis court. *Hoyle's Games improved by Beaufort.*

The game of tennis is played in most capital cities in Europe, particularly in France, from whence we may venture to derive its origin. It is esteemed with many to be one of the most ancient games in Christendom, and long before King Charles I.'s time it was played in England.

This game is as intricate as any game whatever; a person who is totally ignorant of it may look on for a month together, without being able to make out how the game is decided. Therefore we shall begin by describing the court in which it is played.

The size of a tennis court is generally about 96 or 97 feet by 33 or 34, there being no exact dimension ascribed to its proportion, a foot more or less in length or width being of no consequence. A line or net hangs exactly across the middle, over which the ball must be struck, either with a racket or board to make the stroke good. Upon the entrance of a tennis-court, there is a long gallery which goes to the dedans, that is, a kind of front gallery, where spectators usually stand, into which, whenever a ball is struck, it tells for a certain stroke. This long gallery is divided into different compartiments or galleries, each of which has its particular name, as follows; from the line towards the dedans are the *first gallery*, *door*, *second gallery*, and the *last gallery*, which is called the *service side*. From the dedans to the last gallery are the figures 1, 2, 3, 4, 5, 6, at a yard distance each, by which the chaces are marked, and is one of the most essential parts of the game, as will appear in the following description.

Tennis. On the other ſide of the line are alſo the *firſt gallery*, *door*, *ſecond gallery*, and *laſt gallery*; which is called the *hazard-ſide*. Every ball ſtruck into the laſt gallery on this ſide reckons for a certain ſtroke the ſame as the dedans. Between the ſecond and this laſt gallery are the figures 1, 2, to mark the chaces on the hazard-ſide. Over this long gallery, or theſe compartiments, is a covering, called the pent-houſe, on which they play the ball from the ſervice-ſide, in order to begin a ſet of tennis, from which it is called a *ſervice*. When they miſs putting the ball (ſo as to rebound from the pent-houſe) over a certain line on the ſervice-ſide, it is deemed a fault, two of which are reckoned for a ſtroke. If the ball rolls round the pent-houſe, on the oppoſite ſide of the court, ſo as to fall beyond a certain line deſcribed for that purpoſe, it is called *paſſe*, reckons for nothing on either ſide, and the player muſt ſerve again.

On the right-hand ſide of the court from the dedans is what they call the *tambour*, a part of the wall which projects, and is ſo contrived in order to make a variety in the ſtroke, and render it more difficult to be returned by the adverſary; for when a ball ſtrikes the *tambour*, it varies its direction, and requires ſome extraordinary judgment to return it over the line. The laſt thing on the right hand ſide is called the *grill*, wherein if the ball is ſtruck, it is alſo 15, or a certain ſtroke.

The game of tennis is played by what they call *ſets*; a ſet of tennis conſiſts of ſix games: but if they play what is called an advantage-ſet, two above five games muſt be won on one ſide or the other ſucceſſively, in order to decide; or, if it comes to ſix games all, two games muſt ſtill be won on one ſide to conclude the ſet; ſo that an advantage-ſet may laſt a conſiderable time; for which kind of ſets the court is paid more than for any other.

We muſt now deſcribe the uſe of the chaces, and by what means theſe chaces decide or interfere ſo much in the game When the player gives his ſervice at the beginning of a ſet, his adverſary is ſuppoſed to return the ball; and wherever it falls after the firſt rebound untouched, the chace is called accordingly; for example, if the ball falls at the figure 1, the chace is called at a yard, that is to ſay, at a yard from the dedans: this chace remains till a ſecond ſervice is given; and if the player on the ſervice ſide lets the ball go after his adverſary returns it, and if the ball falls on or between any of theſe figures or chaces, they muſt change ſides, there being two chaces; and he who then will be on the hazard ſide, muſt play to win the firſt chace; which if he wins by ſtriking the ball ſo as to fall, after its firſt rebound, nearer to the dedans than the figure 1, without his adverſary's being able to return it from its firſt hop, he wins a ſtroke, and then proceeds in like manner to win the ſecond chace, wherever it ſhould happen to be. If a ball falls on the line with the firſt gallery door, ſecond gallery, or laſt gallery, the chace is likewiſe called at ſuch or ſuch a place, naming the gallery, door, &c. When it is juſt put over the line, it is called a chace at the line. If the player on the ſervice-ſide returns a ball with ſuch force as to ſtrike the wall on the hazard-ſide ſo as to rebound, after the firſt hop over the line, it is alſo called a chace at the line.

The chaces on the hazard-ſide proceed from the ball being returned either too hard or not quite hard enough; ſo that the ball after its firſt rebound falls on this ſide of the blue line, or line which deſcribes the hazard-ſide chaces; in which caſe it is a chace at 1, 2, &c. provided there is no chace depending. When they change ſides, the player, in order to win this chace, muſt put the ball over the line anywhere, ſo that his adverſary does not return it. When there is no chace on the hazard-ſide, all balls put over the line from the ſervice-ſide, without being returned, reckon for a ſtroke. Tennis.

As the game depends chiefly upon the marking, it will be neceſſary to explain it, and to recommend thoſe who play at tennis to have a good and unbiaſſed marker, for on him the whole ſet may depend: he can mark in favour of the one and againſt the other in ſuch a manner, as will render it two to one at ſtarting, though even players. Inſtead of which the marker ſhould be very attentive to the chaces, and not be anyway partial to either of the players.

This game is marked in a very ſingular manner, which makes it at firſt ſomewhat difficult to underſtand. The firſt ſtroke is called 15, the ſecond 30, the third 40, and the fourth game, unleſs the players get four ſtrokes each; in that caſe, inſtead of calling it 40 all, is is called *deuce*; after which, as ſoon as any ſtroke is got, it is called *advantage*; and in caſe the ſtrokes become equal again, *deuce* again, till one or the other gets two ſtrokes following, which win the game; and as the games are won, ſo they are marked and called; as one game love, two games to one, &c. towards the ſet, of which ſo many of theſe games it conſiſts.

Although but one ball at a time is played with, a number of balls are made uſe of at this game to avoid trouble, and are handed to the players in baſkets for that purpoſe; by which means they can play as long as they pleaſe, without ever having occaſion to ſtoop for a ball.

As to the odds at tennis, they are by no means fixed, but are generally laid as follow:

Upon the firſt ſtroke being won between even players, that is, fifteen love, the odds are of the

Single game	7	to 4
Thirty love	4	1
Forty love	8	1
Thirty fifteen	2	1
Forty fifteen	5	1
Forty thirty	3	1
The odds of a four game ſet when the firſt game is won, are	7	4
When two games love	4	1
Three games love	8	1
When two games to one	2	1
Three games to one	5	1
The odds of a ſix game ſet when the firſt game is won, are	3	2
When two games love	2	1
Three games love	4	1
Four games love	10	1
Five games love	21	1
When two games to one	8	5
Three games to one	5	2
Four games to one	5	1
Five games to one	15	1
When three games to two	7	4
Four games to two	4	1
Five games to two	10	1
When four games to three	2	1

Five

Five games to three	5	1
The odds of an advantage ſet when the first game is won, are	5	4
When two games love	7	4
Three games love	3	1
Four games love	5	1
Five games love	15	1
When two games to one	4	3
Three games to one	2	1
Four games to one	7	2
Five games to one	10	1
When three games to two	3	2
Four games to two	3	1
Five games to two	8	1
When four games to three	8	5
Five games to three	3	1
When five games to four	2	1
When ſix games to five	5	2

The foregoing odds, as beforeſaid, are generally laid, but the chaces interfering makes the odds very precarious; for example, when there is a chace at half a yard, and a ſet is five games all, and in every other reſpect equal, the odds are a good five to four; and if it were ſix games to five, and forty thirty with the ſame chace, the odds then would be a guinea to a ſhilling; ſo that it is plain that the odds at this game differ from thoſe of any other: for one ſtroke will reduce a ſet, ſuppoſing the players to be five games all, from an even wager to three to two, and ſo on in proportion to the ſtage of the ſet.

There are various methods of giving odds at tennis, in order to make a match equal; and that they may be underſtood, we ſhall give the following liſt of them, with their meanings, ſo that any perſon may form a judgement of the advantage received or given.

The loweſt odds that can be given, excepting the choice of the ſides, is what they call a *biſque*, that is, a ſtroke to be taken or ſcored whenever the player, who receives the advantage, thinks proper: for inſtance, ſuppoſe a critical game of the ſet to be forty thirty, by taking the *biſque*, he who is forty becomes game, and ſo in reſpect of two *biſques*, &c.

The next greater odds are *fifteen*, that is, a certain ſtroke given at the beginning of each game.

After theſe, *half thirty*, that is, fifteen one game, and thirty the next. Then follow the whole *thirty*, *forty*, &c.

There are alſo the following kind of odds which are given, viz.

Round ſervices; thoſe are ſervices given round the pent-houſe, ſo as to render it eaſy for the *ſtriker-out* (the player who is on the hazard ſide) to return the ball.

Half-court, that is, being obliged or confined to play into the adverſary's half-court; ſometimes it is played ſtraightwiſe, and at other times acroſs; both which are great advantages given by him ſo confined, but the ſtrait half-court is the greateſt.

Touch no-wall, that is, being obliged to play within the compaſs of the walls, or ſides of the court. This is a conſiderable advantage to him who receives it; as all the balls muſt be played gently, and conſequently they are much eaſier to take than thoſe which are played hard, or according to the uſual method of play.

Barring the hazards, that is, barring the dedans, tambour, grill, or the laſt gallery on the hazard-ſide, or any particular one or more of them.

Theſe are the common kind of odds or advantages given; but there are many others, which are according to what is agreed by the players: ſuch as playing with *board* againſt *racket*, *cricket-bat* againſt *racket*, &c.

The game of tennis is alſo played by four perſons, two partners on each ſide. In this caſe, they are generally confined to their particular quarters, and one of each ſide appointed to ſerve and ſtrike out; in every other reſpect, the game is played in the ſame manner as when two only play.

Any thing more to be ſaid upon this ſubject would be needleſs, as nothing can be recommended after reading this ſhort account of tennis, but practice and attention, without which no one can become a proficient at the game.

TENOR, or TENOUR, the purport or content of a writing or inſtrument in law, &c.

TENOR, in *Muſic*, the firſt mean, or middle part, or that which is the ordinary pitch of the voice, when neither raiſed to a treble nor lowered to a baſs.

TENSE, in *Grammar*, an inflection of verbs, whereby they are made to ſignify or diſtinguiſh the circumſtance of time in what they affirm. See GRAMMAR.

TENT, in *War*, a pavilion or portable houſe. Tents are made of canvas, for officers and ſoldiers to lie under when in the field. The ſize of the officers tents is not fixed; ſome regiments have them of one ſize and ſome of another; a captain's tent and marquee is generally $10\frac{1}{2}$ feet broad, 14 deep, and 8 high: the ſubalterns are a foot leſs; the major's and lieutenant-colonel's a foot larger; and the colonel's two feet larger. The ſubalterns of foot lie two in a tent, and thoſe of horſe but one. The tents of private men are $6\frac{1}{2}$ feet ſquare, and 5 feet high, and hold five ſoldiers each. The tents for horſe are 7 feet broad and 9 feet deep: they hold likewiſe five men and their horſe accoutrements.—The word is formed from the Latin *tentorium*, of *tendo*, "I ſtretch," becauſe tents are uſually made of canvas ſtretched out, and ſuſtained by poles, with cords and pegs.

TENT, in *Surgery*, a roll of lint made into the ſhape of a nail with a broad flat head, chiefly uſed in deep wounds and ulcers. They are of ſervice, not only in conveying medicines to the moſt intimate receſſes and ſinuſes of the wound, but to prevent the lips of the wound from uniting before it is healed from the bottom; and by their aſſiſtance grumous blood, ſordes, &c. are readily evacuated.

TENTER, TRIER, or *Prover*, a machine uſed in the cloth manufactory, to ſtretch out the pieces of cloth, ſtuff, &c. or only to make them even and ſet them ſquare.

It is uſually about $4\frac{1}{2}$ feet high, and for length exceeds that of the longeſt piece of cloth. It conſiſts of ſeveral long ſquare pieces of wood, placed like thoſe which form the barriers of a manege; ſo, however, as that the lower croſs pieces of wood may be raiſed or lowered as is found requiſite, to be fixed at any height by means of pins. Along the croſs pieces, both the upper and the under one, are hooked nails, called *tenter-hooks*, driven in from ſpace to ſpace.

To put a piece of cloth on the TENTER. While the piece is yet quite wet, one end is faſtened to one of the

Tenter ‖ Tenths.

ends of the tenter; then it is pulled by force of arms towards the other end, to bring it to the length required: that other end being faſtened, the upper liſt is hooked on to the upper croſs-piece, and the loweſt liſt to the loweſt croſs-piece, which is afterwards lowered by force till the piece have its deſired breadth. Being thus well ſtretched, both as to length and breadth, they bruſh it with a ſtiff hair bruſh, and thus let it dry. Then they take it off; and, till they wet it again, it will retain the length and breadth the tenter gave it.

TENTHREDO, the SAW-FLY; a genus of inſects belonging to the order of *hymenoptera*. See ENTOMOLOGY *Index*.

TENTHS, and *FIRST FRUITS of Spiritual Preferments*, a branch of the king's revenue. See REVENUE.

Theſe were originally a part of the Papal uſurpations over the clergy of this kingdom; firſt introduced by Pandulph the pope's legate, during the reigns of King John and Henry III. in the ſee of Norwich; and afterwards attempted to be made univerſal by the popes Clement V. and John XXII. about the beginning of the 14th century. The firſt fruits, *primitiæ* or *annates*, were the firſt year's whole profits of the ſpiritual preferment, according to a rate or *valor* made under the direction of Pope Innocent IV. by Walter biſhop of Norwich in 38 Hen. III. and afterwards advanced in value by commiſſion from Pope Nicholas III. A. D. 1202, 20 Edw. I.; which valuation of Pope Nicholas is ſtill preſerved in the exchequer. The tenths, or *decimæ*, were the tenth part of the annual profit of each living by the ſame valuation; which was alſo claimed by the holy ſee, under no better pretence than a ſtrange miſapplication of that precept of the Levitical law, which directs, that the Levites "ſhould offer the tenth part of their tithes as a heave offering to the Lord, and give it to Aaron the highprieſt." But this claim of the pope met with vigorous reſiſtance from the Engliſh parliament; and a variety of acts were paſſed to prevent and reſtrain it, particularly the ſtatute 6 Hen. IV. c. 1. which calls it a *horrible miſchief and damnable cuſtom*. But the Popiſh clergy, blindly devoted to the will of a foreign maſter, ſtill kept it on foot; ſometimes more ſecretly, ſometimes more openly and avowedly: ſo that in the reign of Henry VIII. it was computed, that in the compaſs of 50 years 800,000 ducats had been ſent to Rome for firſt fruits only. And as the clergy expreſſed this willingneſs to contribute ſo much of their income to the head of the church, it was thought proper (when in the ſame reign the papal power was aboliſhed, and the king was declared the head of the church of England) to annex this revenue to the crown; which was done by ſtatute 26 Hen. VIII. c. 3. (confirmed by ſtatute 1 Eliz. c. 4.); and a new *valor beneficiorum* was then made, by which the clergy are at preſent rated.

Blackſt. Comment. vol. i.

By theſe laſt-mentioned ſtatutes all vicarages under ten pounds a year, and all rectories under ten marks, are diſcharged from the payment of firſt fruits: and if, in ſuch livings as continue chargeable with this payment, the incumbent lives but half a year, he ſhall pay only one quarter of his firſt fruits; if but one whole year, then half of them; if a year and a half, three quarters; and if two years, then the whole, and not otherwiſe. Likewiſe by the ſtatute 27 Hen. VIII. c. 8. no tenths are to be paid for the firſt year, for then the firſt fruits are due: and by other ſtatutes of Queen Anne, in the fifth and ſixth years of her reign, if a benefice be under 50l. per annum clear yearly value, it ſhall be diſcharged of the payment of firſt fruits and tenths. Tenth Tenur

Thus the richer clergy being, by the criminal bigotry of their Popiſh predeceſſors, ſubjected at firſt to a foreign exaction, were afterwards, when that yoke was ſhaken off, liable to a like miſapplication of their revenues through the rapacious diſpoſition of the then reigning monarch; till at length the piety of Queen Anne reſtored to the church what had been thus indirectly taken from it. This ſhe did, not by remitting the tenths and firſt fruits entirely; but, in a ſpirit of the trueſt equity, by applying theſe ſuperfluities of the larger benefices to make up the deficiencies of the ſmaller. And to this end ſhe granted her royal charter, which was confirmed by the ſtatute 2 Ann. c. 11. whereby all the revenue of firſt fruits and tenths is veſted in truſtees for ever, to form a perpetual fund for the augmentation of poor livings. This is uſually called *Queen Anne's bounty;* which has been ſtill farther regulated by ſubſequent ſtatutes.

TENURE, in *Law*, ſignifies the manner whereby lands or tenements are held, or the ſervice that the tenant owes to his lord.

Of this kingdom almoſt all the real property is by the policy of our laws ſuppoſed to be granted by, dependent upon, and holden of, ſome ſuperior lord, by and in conſideration of certain ſervices to be rendered to the lord by the tenant or poſſeſſor of this property. The thing holden is therefore ſtyled a *tenement*, the poſſeſſors thereof *tenants*, and the manner of their poſſeſſion a *tenure*. Thus all the lands in the kingdom are ſuppoſed to be holden, mediately or immediately, of the king; who is ſtyled the *lord paramount*, or above all. Such tenants as held under the king immediately, when they granted out portions of the lands to inferior perſons, became alſo lords with reſpect to thoſe inferior perſons, as they were ſtill tenants with reſpect to the king; and thus partaking of a middle nature, were called *meſne* or *middle lords*. So that if the king granted a manor to A, and he granted a portion of the land to B, now B was ſaid to hold of A, and A of the king; or, in other words, B held his lands immediately of A, but mediately of the king. The king therefore was ſtyled *lord paramount:* A was both tenant and lord, or was a meſne lord; and B was called *tenant paravail* or the *loweſt tenant*, being he who was ſuppoſed to make avail or profit of the land. In this manner are all the lands of the kingdom holden which are in the hands of ſubjects: for, according to Sir Edward Coke, in the law of England we have not properly *allodium*, which is the name by which the feudiſts abroad diſtinguiſh ſuch eſtates of the ſubject as are not holden of any ſuperior. So that at the firſt glance we may obſerve, that our lands are either plainly feuds, or partake very ſtrongly of the feodal nature. *Blackſt. Comment.* vol. ii.

All tenures being thus derived, or ſuppoſed to be derived, from the king, thoſe that held immediately under him, in right of his crown and dignity, were called his *tenants in capite*, or *in chief;* which was the moſt honourable ſpecies of tenure, but at the ſame time ſubjected the tenants to greater and more burdenſome ſervices than inferior tenures did. And this diſtinction ran through all the different ſorts of tenure.

There ſeem to have ſubſiſted among our anceſtors four principal ſpecies of lay-tenures, to which all other may be reduced: the grand criteria of which were the natures of

Tenure. the ſeveral ſervices or renders that were due to the lords from their tenants. The ſervices, in reſpect of their quality, were either *free* or *baſe* ſervices: in reſpect of their quantity and the time of exacting them, were either *certain* or *uncertain*. Free ſervices were ſuch as were not unbecoming the character of a ſoldier or a freeman to perform; as to ſerve under his lord in the wars, to pay a ſum of money, and the like. Baſe ſervices were ſuch as were fit only for peaſants or perſons of a ſervile rank; as to plough the lord's land, to make his hedges, to carry out his dung, or other mean employments. The certain ſervices, whether free or baſe, were ſuch as were ſtinted in quantity, and could not be exceeded on any pretence; as, to pay a ſtated annual-rent, or to plough ſuch a field for three days. The uncertain depended upon unknown contingencies; as, to do military ſervice in perſon, or pay an aſſeſſment in lieu of it when called upon; or to wind a horn upon the appearance of invaders: which are free ſervices; or to do whatever the lord ſhould command; which is a baſe or villein ſervice.

From the various combinations of theſe ſervices have ariſen the four kinds of lay-tenure which ſubſiſted in England till the middle of the laſt century; and three of which ſubſiſt to this day. Of theſe Bracton (who wrote under Henry III.) ſeems to give the cleareſt and moſt compendious account of any author ancient or modern; of which the following is the outline or abſtract: "Tenements are of two kinds, *frank-tenement*, and *villenage*. And of frank-tenements, ſome are held freely in conſideration of homage and knight-ſervice; others in free-ſocage, with the ſervice of fealty only. And again, of villenages, ſome are *pure*, and others *privileged*. He that holds in pure villenage ſhall do whatſoever is commanded him, and always be bound to an uncertain ſervice. The other kind of villenage is called *villein-ſocage*; and theſe villein-ſocmen do villein ſervices, but ſuch as are certain and determined." Of which the ſenſe ſeems to be as follows; firſt, where the ſervice was free, but uncertain, as military ſervice with homage, that tenure was called the *tenure in chivalry*, *per ſervitium militare*, or by knight-ſervice. Secondly, where the ſervice was not only free, but alſo certain, as by fealty only, by rent and fealty, &c. that tenure was called *liberum ſocagium*, or *free ſocage*. Theſe were the only free holdings or tenements; the others were villenous or ſervile: as, thirdly, where the ſervice was baſe in its nature, and uncertain as to time and quantity, the tenure was *purum villenagium*, abſolute or pure villenage. Laſtly, where the ſervice was baſe in its nature, but reduced to a certainty, this was ſtill villenage, but diſtinguiſhed from the other by the name of *privileged villenage*, *villenagium privilegiatum*; or it might be ſtill called *ſocage* (from the certainty of its ſervices), but degraded by their baſeneſs into the inferior title of *villanum ſocagium*, villein-ſocage.

1. The military tenure, or that by knight-ſervice, was done away by ſtat. 12 Car. II. For an account of this ſpecies of tenure ſee *FEODAL System*, and *KNIGHT-Service*; and for its incidents, ſee RELIEF, PRIMER-SEISIN, WARDSHIP, MARRIAGE, FINES, and ESCHEAT.

2. The ſecond ſpecies of tenure or free-ſocage, not only ſubſiſts to this day, but has in a manner abſorbed and ſwallowed up (ſince the ſtatute of Charles the Second) almoſt every other ſpecies of tenure. See SOCAGE. Tenure.

The other grand diviſion of tenure, mentioned by Bracton, is that of villenage, as contradiſtinguiſhed from *liberum tenementum*, or frank-tenure. And this (we may remember) he ſubdivides into two claſſes, pure and privileged villenage: from whence have ariſen two other ſpecies of our modern tenures.

3. From the tenure of pure villenage have ſprung our preſent copyhold-tenures, or tenure by copy of court-roll at the will of the lord; in order to obtain a clear idea of which, it will be previouſly neceſſary to conſult the articles MANOR and VILLENAGE.

As a farther conſequence of what has been there explained, we may collect theſe two main principles, which are held to be the ſupporters of a copyhold-tenure, and without which it cannot exiſt: 1. That the lands be parcel of and ſituate within that manor under which it is held. 2. That they have been demiſed, or demiſable, by copy of court-roll immemorially. For immemorial cuſtom is the life of all tenures by copy; ſo that no new copyhold can, ſtrictly ſpeaking, be granted at this day.

In ſome manors, where the cuſtom hath been to permit the heir to ſucceed the anceſtor in his tenure, the eſtates are ſtyled *copyholds of inheritance*; in others, where the lords have been more vigilant to maintain their rights, they remain copyholds for life only; for the cuſtom of the manor has in both caſes ſo far ſuperſeded the will of the lord, that, provided the ſervices be performed or ſtipulated for by fealty, he cannot in the firſt inſtance refuſe to admit the heir of his tenant upon his death; nor, in the ſecond, can he remove his preſent tenant ſo long as he lives, though he holds nominally by the precarious tenure of his lord's will.

The fruits and appendages of a copyhold-tenure, that it hath in common with free tenures, are fealty, ſervices (as well in rents as otherwiſe), reliefs, and eſcheats. The two latter belong only to copyholds of inheritance; the former to thoſe for life alſo. But, beſides theſe, copyholds have alſo heriots, wardſhip, and fines. Heriots, which are agreed to be a Daniſh cuſtom, are a render of the beſt beaſt or other good (as the cuſtom may be) to the lord on the death of the tenant. This is plainly a relic of villein tenure; there being originally leſs hardſhip in it, when all the goods and chattels belonged to the lord, and he might have ſeized them even in the villein's lifetime. Theſe are incident to both ſpecies of copyhold; but wardſhip and fines to thoſe of inheritance only. Wardſhip, in copyhold-eſtates, partakes both of that in chivalry and that in ſocage. Like that in chivalry, the lord is the legal guardian, who uſually aſſigns ſome relation of the infant tenant to act in his ſtead: and he, like guardian in ſocage, is accountable to his ward for the profits. Of fines, ſome are in the nature of primer-ſeiſins, due on the death of each tenant, others are mere fines for alienations of the lands; in ſome manors, only one of thoſe ſorts can be demanded, in ſome both, and in others neither. They are ſometimes arbitrary and at the will of the lord, ſometimes fixed by cuſtom; but, even when arbitrary, the courts of law, in favour of the liberty of copyholders, have tied them down to be reaſonable in their extent; otherwiſe they might amount to diſheriſon of

Tenure. of the eſtate. No fine therefore is allowed to be taken upon deſcents and alienations (unleſs in particular circumſtances) of more than two years improved values of the eſtate. From this inſtance we may judge of the favourable diſpoſition that the law of England (which is a law of liberty) hath always ſhown to this ſpecies of tenants, by removing, as far as poſſible, every real badge of ſlavery from them, however ſome nominal ones may continue. It ſuffered cuſtom very early to get the better of the expreſs terms upon which they held their lands; by declaring that the will of the lord was to be interpreted by the cuſtom of the manor; and, where no cuſtom has been ſuffered to grow up to the prejudice of the lord, as in this caſe of arbitrary fines, the law itſelf interpoſes in an equitable method, and will not ſuffer the lord to extend his power ſo far as to diſinherit the tenant.

4. There is yet a fourth ſpecies of tenure, deſcribed by Bracton, under the name ſometimes of *privileged villenage*, and ſometimes of *villein ſocage*. See *Privileged* VILLENAGE.

Having in the preſent article, and thoſe referred to, taken a compendious view of the principal and fundamental points of the doctrine of tenures, both ancient and modern, we cannot but remark the mutual connection and dependence that all of them have upon each other. And upon the whole it appears, that, whatever changes and alterations theſe tenures have in proceſs of time undergone, from the Saxon era to the 12 Car. II. all lay-tenures are now in effect reduced to two ſpecies; free tenure in common ſocage, and baſe tenure by copy of court-roll. But there is ſtill behind one other ſpecies of tenure, reſerved by the ſtatute of Charles II. which is of a ſpiritual nature, and called the tenure in *FRANK-Almoign*; ſee that article.

A particular account of the ancient tenures would to many perſons be highly amuſing. We can only ſelect a few of the moſt ſingular, referring the curious reader for more information to Anderſon's Origin of Commerce, Henry's Hiſtory of Britain, and Blount's *Fragmenta Antiquitates*.

In the 19th of Henry III. Walter Gately held the manor of Weſtcourt, in Bedington in Surry, yielding yearly to the king one croſs-bow, *baliſtam*, value twelve pence.

Anno tertio Edw. I. Oſbert de Lonchamp, knight, held his lands of Ovenhelle in Kent, for perſonally guarding the king forty days into Wales at his own expence, with one horſe of five ſhillings value, one ſack worth ſixpence, and one broch for that ſack. N. B. All perſonal ſervices, or attendances on our kings in thoſe times, were limited to forty days, at their own expence.

The like the ſame year of Laurence de Broke, who for his hamlet of Renham in Middleſex, found the king one ſoldier, a horſe worth five ſhillings, a ſack worth fivepence, and a broch worth twopence (this broch was a kind of cup, jug, pot, or baſon), for forty days, at his own expence, wherever his army ſhall be within the four ſeas. This was ſettled (ſays Mr Blount) at the Stone Croſs, which ſtood near the May-pole in the Strand, London, where the judges-itinerant uſed in old times to ſit.

Robert Maunſel's tenure of lands in Peverel paid the ſame ſervice, and the horſe, ſack, and broch of the ſame prices. Tenure.

13*mo* Edw. I. Henry de Averning's tenor of the manor of Morton in Eſſex, was to find a man, a horſe worth ten ſhillings, four horſe-ſhoes, a leather ſack, and an iron broch.

The year following three perſons held thirty acres of land in Carleton in Norfolk, by the ſervice of bringing the king, whenever he ſhall be in England, twenty-four paſties of freſh herrings at their firſt coming in.

Another held his manor in Norfolk of that king, by annually ſupplying him at his exchequer with two veſſels, called *mues*, of wine made of pearmains. "Here (ſays our author) it is worth obſerving, that in King Edward the Firſt's time pearmain cyder was called *wine*." This therefore ſeems to account for the mention of vineyards in old times in Kent, Suſſex, and other parts of England, which has ſo often puzzled many people to elucidate.

Another perſon, in the 21ſt of the ſaid king, held thirty acres of land, valued at ten ſhillings yearly in the exchequer, or four-pence per acre, in Cambridgeſhire, for furniſhing a truſs of hay for the king's neceſſary-houſe or privy, whenever he ſhall come into that county.

Another, in the 34th of that king, held a manor in Kent for providing a man to lead three greyhounds when the king ſhall go into Gaſcony, ſo long as a pair of ſhoes of fourpence ſhould laſt.

And that we may not again recur to theſe old tenures, we ſhall further add, from the ſame author, that in the firſt year of King Edward II. Peter Spileman made fine to the king for his lands by ſerjeanty, to find one to ſerve as a ſoldier for forty days in England, with a coat of mail; alſo to find ſtraw for the king's bed, and hay for his horſe.

This article of ſtraw for the king's bed we did not ſo much wonder at, when we found it in an article in William the Conqueror's time; but it is ſomewhat more remarkable ſo late as the days of King Edward II.

Several others, we find, held their lands of the crown in thoſe times by very different tenures. One, by paying two white capons annually; another, by carrying the king's ſtandard whenever he happens to be in the county of Suſſex; another, by carrying a rod or batoon before the king on certain occaſions; another, by ſerving the office of chamberlain of the exchequer, a very good place at preſent; another, by building and upholding a bridge; another, by being marechal (*meretricum*), i. e. as Mr Blount tranſlates it, of the laundreſſes in the king's army; another, by acting as a ſerjeant at arms for the king's army whilſt in England; one ſupplies a ſervant for the king's larder; another, for his wardrobe; others, to find ſervants for this or that foreſt; another, a hawk; one preſents the king a pair of ſcarlet hoſe annually; others are bound to ſupply ſoldiers with armour for certain days, for the keeping this or that caſtle; one, viz. for the manor of Elſton in Nottinghamſhire, pays yearly rent of one pound weight of cummin ſeed, two pair of gloves, and a ſteel needle; another, is to repair the iron-work of the king's ploughs; Ela counteſs of Warwick, in the 13th year of King Edward I. held the manor of Hokenorton in Oxfordſhire, in the barony of D'Oyly, by the ſerjeanty

of

ure
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of carving at the king's table on his birth-day, and ſhe to have the knife the king then uſes at table.

TEOS, one of the twelve Ionian cities, was ſituated on the ſouth ſide of the Ionian peninſula, and diſtinguiſhed by being the place where the poet Anacreon and the hiſtorian Hecatæus were born.

TERAPHIM, or THERAPHIM, a word in the Hebrew language, which has exerciſed much the ingenuity of the critics. It occurs 13 or 14 times in the Old Teſtament, and is commonly interpreted *idols*. We will not trouble our readers with the numerous conjectures which have been formed reſpecting the meaning of this word. The only way to determine it, if it be at all poſſible, would be to examine and compare all the paſſages in which it occurs, and to conſult the ancient tranſlations. Conjectures are uſeleſs; every man may make a new one, which will have juſt as good a title to belief as thoſe which have been already propoſed.

TERCERY, or TERCERA, one of the largeſt iſlands of the Azores, or Weſtern iſlands, lying in the Atlantic ocean. It is about 40 miles in circumference; and ſurrounded with craggy rocks, which render it almoſt inacceſſible. The ſoil is fertile, abounding in corn, wine, and fruits; and they have plenty of cattle to ſupply the ſhips which call there. Their principal trade is wood. The inhabitants are lively, addicted to gallantry, and are ſaid to be extremely revengeful. It is ſubject to Portugal; and Angra is the capital town. W. Long. 27. 1. N. Lat. 28. 45.

TEREBELLA, the PIERCER, a genus of inſects belonging to the claſs of vermes, and order of molluſca. See HELMINTHOLOGY *Index*.

TEREBINTHUS. See PISTACIA, BOTANY *Index*.

TEREDO, a genus of vermes belonging to the order of teſtacea. See CONCHOLOGY *Index*.

TERENCE, or PUBLIUS TERENTIUS AFER, a celebrated comic poet of ancient Rome, was born at Carthage in Africa. He was ſlave to Terentius Lucanus the ſenator; who gave him his liberty on account of his wit, his good mien, and great abilities. Terence, on his becoming a freed man, applied himſelf to the writing of comedies; in the execution of which he imitated Menander and the other celebrated comic poets of Greece. Cicero gives him the moſt pompous eulogiums, both for the purity of his language and the perſpicuity and beauty of his compoſitions, which he conſiders as the rule and ſtandard of the Latin tongue; and obſerves, that they were eſteemed ſo fine and elegant, that they were thought to have been written by Scipio and Lelius, who were then the greateſt perſonages and the moſt eloquent of the Roman people. Terence died while on a voyage into Greece, about the 15th year before the Chriſtian era. There are ſix of his comedies extant, of which the beſt editions are the Elzevir one 1635, 12mo; that *cum integris notis Donati, et ſelectis variorum*, 1686, 8vo; Weſterhovius's, in two vols 4to, 1726; and that of Bentley the ſame year, 4to. Madame Dacier has given a beautiful French verſion of this author; and a very good Engliſh tranſlation was publiſhed in 4to, 1768, by Mr Colman.

TERM, in *Law*, is generally taken for a limitation of time or eſtate; as, a leaſe for term of life or years.

Term, however, is more particularly uſed for that time wherein our courts of juſtice are open: in oppoſition to which, the reſt of the year is called *vacation*. Term.

TERM, in *Grammar*, denotes ſome word or expreſſion in a language.

The word *term*, *terminus*, is borrowed metaphorically, by the grammarians and philoſophers, from the meaſurers or ſurveyors of lands: as a field is defined and diſtinguiſhed by its *termini*, or limits, ſo is a thing or matter ſpoken of by the word or term it is denoted by.

TERM in the Arts, or *TERM of Art*, is a word, which, beſides the literal and popular meaning which it has or may have in common language, bears a further and peculiar meaning in ſome art or ſcience.

TERMS, the ſeveral times or ſeaſons of the year, wherein the tribunals, or courts of judicature, are open to all who think fit to complain of wrong, or to ſeek their rights by due courſe of law, or action; and during which the courts in Weſtminſter-hall ſit and give judgement. But the high court of parliament, the chancery, and inferior courts, do not obſerve the terms; only the courts of king's-bench, common-pleas, and exchequer, which are the higheſt courts at common law. In contradiſtinction to theſe, the reſt of the year is called *vacation*.

Of theſe terms there are four in every year, during which time matters of juſtice are diſpatched. *Hilary-term*, which, at London, begins the 23d day of January, or if that be Sunday, the next day after; and ends the 12th of February following. *Eaſter-term*, which begins the Wedneſday fortnight after Eaſter-day, and ends the Monday next after Aſcenſion-day. *Trinity-term*, beginning the Friday next after Trinity-Sunday, and ending the Wedneſday fortnight after. *Michaelmas-term*, which begins the ſixth day of November, and ends the 28th of November following. Each of theſe terms have alſo their returns. Theſe terms are ſuppoſed by Mr Selden to have been inſtituted by William the Conqueror; but Sir H. Spelman hath ſhewn, that they were gradually formed from the canonical conſtitutions of the church; being no other than thoſe leiſure ſeaſons of the year which were not occupied by the great feſtivals or faſts, or which were not liable to the general avocations of rural buſineſs. Throughout all Chriſtendom, in very early times, the whole year was one continual term for hearing and deciding cauſes. For the Chriſtian magiſtrates, in order to diſtinguiſh themſelves from the heathens, who were very ſuperſtitious in the obſervation of their *dies faſti* and *nefaſti*, adminiſtered juſtice upon all days alike; till at length the church interpoſed, and exempted certain holy ſeaſons from being profaned by the tumult of forenſic litigations; as, particularly, the time of Advent and Chriſtmas, which gave riſe to the winter vacation; the time of Lent and Eaſter, which created that in the ſpring; the time of Pentecoſt, which produced the third; and the long vacation, between midſummer and Michaelmas, which was allowed for the hay-time and harveſt. All Sundays alſo, and ſome peculiar feſtivals, as the days of the purification, aſcenſion, &c. were included in the ſame prohibition, which was eſtabliſhed by a canon of the church, A. D. 517, and fortified by an imperial conſtitution of the younger Theodoſius, compriſed in the Theodoſian code. Afterwards, when our own legal conſtitution was eſtabliſhed, the commencement and duration of our law-

Terms. terms were appointed, with a view to theſe canonical prohibitions; and it was ordered by the laws of King Edward the Confeſſor, that from Advent to the octave of the Epiphany, from Septuageſima to the octave of Eaſter, from the Aſcenſion to the octave of Pentecoſt, and from three in the afternoon of all Saturdays till Monday morning, the peace of God and holy church ſhall be kept throughout the whole kingdom.

And ſo extravagant was afterwards the regard paid to theſe holy times, that though the author of the Mirror mentions only one vacation of conſiderable length, containing the months of Auguſt and September, yet Britton ſays, that in the reign of King Edward I. no ſecular plea could be held, nor any man ſworn on the Evangeliſts, in the time of Advent, Lent, Pentecoſt, harveſt, and vintage, the days of the great litanies, and all ſolemn feſtivals. He adds, that the biſhops and prelates granted diſpenſations for taking aſſizes and juries in ſome of theſe holy ſeaſons, upon reaſonable occaſions; and ſoon after a general diſpenſation was eſtabliſhed in parliament by ſtat. Weſtm. 1. 3 Edw. I. cap. 51. that aſſizes of novel diſſeiſin, *mort d'anceſtor*, and darrein preſentment, ſhould be taken in Advent, Septuageſima, and Lent, as well as inqueſts; at the ſpecial requeſt of the king to the biſhops. The portions of time that were not included within theſe prohibited ſeaſons fell naturally into a fourfold diviſion; and from ſome feſtival, or ſaint's day, that immediately preceded their commencement, were denominated the terms of *St Hilary*, of *Eaſter*, of the *Holy Trinity*, and of *St Michael:* which terms have been ſince regulated and abbreviated by ſeveral acts of parliament; particularly Trinity-term by ſtat. 32 Hen. VIII. cap. 2. and Michaelmas-term by ſtat. 16 Car. I. cap. 6. and again by ſtat. 24 Geo. II. cap. 48.

Terms, *Oxford*. Hilary or Lent-term begins January 14th, and ends the Saturday before Palm-Sunday. Eaſter-term begins the tenth day after Eaſter, and ends the Thurſday before Whitſunday. Trinity-term begins the Wedneſday after Trinity-Sunday, and ends after the act, or 6th of July, ſooner or later, as the vice chancellor and convocation pleaſe. Michaelmas-term begins October the 10th, and ends December the 17th.

Terms, *Cambridge*. Lent term begins January the 14th, and ends Friday before Palm-Sunday. Eaſter-term begins the Wedneſday after Eaſter-week, and ends the week before Whitſunday. Trinity-term begins the Wedneſday after Trinity-Sunday, and ends the Friday after the commencement, or 2d of July. Michaelmas-term begins October the 10th, and ends December the 16th.

Terms, *Scottiſh*. The court of ſeſſion has two terms, the winter and ſummer. The winter begins on 12th November, and ends 11th March, only there is a receſs of three weeks at Chriſtmas. The ſummer term commences, 12th May, and ends 11th July. The court of exchequer has four terms: 1. Candlemas term begins 15th January, and ends 3d February; 2. Whitſuntide term begins 12th May, and ends 2d June; 3. Lammas term begins 17th June, and ends 5th July; 4. Martinmas term begins 24th November, and ends 20th December.

Terms, *Iriſh*. In Ireland the terms are the ſame as at London, except Michaelmas term, which begins October the 13th, and adjourns to November the 3d, and thence to the 6th. Terms

TERMES, a genus of inſects belonging to the order of aptera. See Entomology *Index*. Termes

TERMINALIA, in antiquity, feaſts celebrated by the Romans in honour of the god Terminus.

Terminalia, a genus of plants belonging to the claſs polygamia. See Botany *Index*.

TERMINI, in *Architecture*, denote a kind of ſtatues or columns, adorned on the top with the figure of a man's, woman's, or ſatyr's head, as a capital; and the lower part ending in a kind of ſheath or ſcabbard.

TERMINUS, in Pagan worſhip, an ancient deity among the Romans, who preſided over the ſtones or landmarks, called *termini*, which were held ſo ſacred, that it was accounted ſacrilege to move them; and as the criminal became devoted to the gods, it was lawful for any man to kill him. The worſhip of this deity was inſtituted by Numa Pompilius, who, to render landmarks, and conſequently the property of the people, ſacred, erected a temple on the Tarpeian mount to Terminus.

TERN. See Sterna, Ornithology *Index*.

TERNATE, the moſt northerly of the Molucca or Clove iſlands in the Eaſt Indies. It abounds in cocoanuts, bananas, citrons, oranges, and other fruits peculiar to the torrid zone; but cloves are the moſt valuable produce. It is in the poſſeſſion of the Dutch. Malaya is the capital town. E. Long. 129. 0. N. Lat. 1. 0.

TERNI, a town of Italy in the pope's territories, and in the duchy of Spoletto, with a biſhop's ſee. It is but a ſmall place; though there are very beautiful ruins of antiquity, it having been a very conſiderable Roman colony. It is ſituated on the top of a high mountain, and to the weſt of it are fields which are extremely fertile. E. Long. 12. 40. N. Lat. 42. 34.

TERNSTROMIA, a genus of plants belonging to the claſs polyandria. See Botany *Index*.

TERPANDER, a celebrated Greek poet and muſician. The Oxford marbles tell us that he was the ſon of Derdeneus of Leſbos, and that he flouriſhed in the 381ſt year of theſe records; which nearly anſwers to the 27th Olympiad, and 671ſt year B. C. The marbles inform us likewiſe, that he taught the *nomes*, or airs, of the lyre and flute, which he performed himſelf upon this laſt inſtrument, in concert with other players on the flute. Several writers tell us that he added three ſtrings to the lyre, which before his time had but four; and in confirmation of this, Euclid and Strabo quote two verſes, which they attribute to Terpander himſelf. Terpand

> The tetrachord's reſtraint we now deſpiſe,
> The ſeven-ſtring'd lyre a nobler ſtrain ſupplies.

Among the many ſignal ſervices which Terpander is ſaid to have done to muſic, none was of more importance than the notation that is aſcribed to him for aſcertaining and preſerving melody, which before was traditional, and wholly dependent on memory. The invention, indeed, of muſical characters has been attributed by Alypius and Gaudentius, two Greek writers on muſic, and upon their authority by Boethius, to Pythagoras, who flouriſhed full two centuries after Terpander. But Plutarch, from Heraclides of Pontus, aſſures us that Terpander, the inventor of nomes for the cithara, in hexameter

Terpander, Terra.

hexameter verſe, ſet them to muſic, as well as the verſes of Homer, in order to ſing them at the public games: And Clemens Alexandrinus, in telling us that this muſician wrote the laws of Lycurgus in verſe, and ſet them to muſic, makes uſe of the ſame expreſſion as Plutarch; which ſeems clearly to imply a written melody.

After enumerating the airs which Terpander had compoſed and to which he had given names, Plutarch continues to ſpeak of his other compoſitions; among which he deſcribes the proems, or hymns for the cithara, in heroic verſe. Theſe were uſed in after-times by the rhapſodiſts, as prologues or introductions to the poems of Homer and other ancient writers. But Terpander rendered his name illuſtrious, no leſs by his performances upon the flute and cithara than by his compoſitions. This appears by the marbles already mentioned; by a paſſage in Athenæus, from Hellanicus, which informs us that he obtained the firſt prize in the muſical conteſts at the Carnean games; and by the teſtimony of Plutarch, who ſays, that "no other proof need be urged of the excellence of Terpander in the art of playing upon the cithara, than the regiſter of the Pythic games, from which it appears that he gained four prizes ſucceſſively at thoſe ſolemnities. Of the works of this poet only a few fragments now remain.

TERRA AUSTRALIS INCOGNITA, a name for a large unknown continent, ſuppoſed to lie towards the ſouth pole, and which for a long time was ſought after by navigators. The voyages of Captain Cook have aſcertained this matter as much as it probably ever will be. (See *SOUTH Sea*; *COOK'S Diſcoveries*, N° 47, 48, 68, 69; and AMERICA, N° 4). On this ſubject Captain Cook expreſſes himſelf as follows: "I had now made the circuit of the Southern ocean in a high latitude, and traverſed it in ſuch a manner as to leave not the leaſt room for the poſſibility of there being a continent, unleſs near the pole, and out of the reach of navigation. By twice viſiting the tropical ſea, I had not only ſettled the ſituation of ſome old diſcoveries, but made there many new ones, and left, I conceive, very little more to be done even in that part. Thus I flatter myſelf, that the intention of the voyage has in every reſpect been fully anſwered; the ſouthern hemiſphere ſufficiently explored; and a final end put to the ſearching after a ſouthern continent, which has at times engroſſed the attention of ſome of the maritime powers for near two centuries paſt, and been a favourite theory amongſt the geographers of all ages. That there may be a continent, or large tract of land near the pole, I will not deny: on the contrary, I am of opinion there is; and it is probable that we have ſeen a part of it. The exceſſive cold, the many iſlands, and vaſt floats of ice, all tend to prove that there muſt be land to the ſouth; and for my perſuaſion that this ſouthern land muſt lie or extend fartheſt to the north, oppoſite to the ſouthern Atlantic and Indian oceans, I have already aſſigned ſome reaſons; to which I may add, the greater degree of cold experienced by us in theſe ſeas than in the Southern Pacific ocean under the ſame parallels of latitude."

TERRA Firma, in *Geography*, is ſometimes uſed for a continent, in contradiſtinction to iſlands.

TERRA Firma, otherwiſe called *New Caſtile*, or *Caſtella del Oro*, a country of America, bounded on the north by the North ſea and part of the Atlantic ocean, by the ſame ſea and Guiana on the eaſt, by the country of the Amazons and Peru on the ſouth, and by the Pacific ocean and Veragua on the weſt. It lies between 62 and 83 degrees of weſt longitude, and between the equator and 12 degrees of north latitude; being upwards of 1200 miles in length from eaſt to weſt, and 800 in breadth from north to ſouth. It had the name of *Caſtella del Oro* from the quantity of gold found in the diſtricts of Uraba and other parts; and was firſt diſcovered by the celebrated Columbus in his third voyage. Terra.

The climate is neither pleaſant nor healthy; the inhabitants one part of the year being ſcorched by the moſt intenſe and burning heat, and the other almoſt drowned with perpetual floods of rain, pouring from the ſky with ſuch violence as if a general deluge was to enſue.

In ſo large a tract of country the ſoil muſt neceſſarily vary. Accordingly, in ſome parts it is a barren ſand, or drowned mangrove land, that will ſcarce produce any kind of grain; in others it yields Indian corn, balms, gums, and drugs, almoſt all manner of fruits as well of Old as of New Spain, ſugar, tobacco, Braſil wood, and ſeveral other kinds of dyeing woods; a variety of precious ſtones, particularly emeralds and ſapphires; veniſon and other game. The plantations of cacao, or chocolate nuts, in the diſtrict of the Caraccas, are eſteemed the beſt in America. The mountains abound with tygers, and, according to ſome, with lions, and great numbers of other wild beaſts. The rivers, ſeas, and lakes, teem with fiſh, and alſo with alligators; and the bowels of the earth were once furniſhed with the richeſt treaſures, now almoſt exhauſted. The ſame may be ſaid of the pearl fiſheries on the coaſt, which are far from being ſo profitable now as formerly.

Terra Firma is a very mountainous country. Terra Firma Proper, in particular, conſiſts of prodigious high mountains, and deep valleys flooded more than half the year. The mountains in the provinces of Carthagena and St Martha, according to Dampier, are the higheſt in the world: being ſeen at ſea 200 miles off: from theſe runs a chain of hills of almoſt equal height, quite through South America, as far as the ſtraits of Magellan, called the *Cordilleras des Andes*. The province of Venezuela alſo, and diſtrict of the Caraccas, the moſt northerly parts of South America, are almoſt a continued chain of hills, ſeparated by ſmall valleys, pointing upon the coaſt of the North ſea. A chain of barren mountains, almoſt impaſſable, runs through the province of Popayan from north to ſouth, ſome whereof are volcanoes; but towards the ſhores of the Pacific ocean it is a low country, flooded great part of the year.

The principal rivers of Terra Firma are, the Darien, Chagtre, Santa Maria, Conception, Rio Grande or Magdalena, Maricaibo, and Oroonoko.

Terra Firma contains the provinces of Terra Firma Proper or Darien, of Carthagena, St Martha, Rio de la Hacha, Venezuela, Comana, New Andaluſia or Paria, New Granada, and Popayan.

Terra Firma Proper lies in the form of a creſcent, about the ſpacious bay of Panama, being the iſthmus which joins South and North America; and extending in length between the two ſeas 300 miles, but in breadth, where the iſthmus is narroweſt, only 60. Here are found gold mines, gold ſands, and fine pearls; and though the land is generally rough, there are ſome fruitful valleys, watered by rivers, brooks, and ſprings. The chief places are Panama and Porto Bello.

The inhabitants of Terra Firma have never been thoroughly ſubdued, and in all probability never will; as they

Terra ‖ Terre Verte.

they are a brave and warlike people, have retreats inacceſſible to Europeans, and bear an inveterate enmity to the Spaniards. See DARIEN.

TERRA Japonica, or *Catechu*, a drug which was formerly ſuppoſed to be an extract from the ſeeds of the areca catechu, is obtained from the mimoſa catechu. See MATERIA MEDICA *Index*.

TERRA Puzzolana. See PUZZOLANA.

TERRÆ Filius, *Son of the Earth*, a ſtudent of the univerſity of Oxford, formerly appointed in public acts to make ſatirical and jeſting ſpeeches againſt the members thereof, to tax them with any growing corruptions, &c.

TERRACE, a walk or bank of earth, raiſed in a garden or court to a due elevation for a proſpect. The name is alſo given to the roofs of houſes that are flat, and whereon we may walk.

TERRAQUEOUS, in *Geography*, a name given to our globe, becauſe conſiſting of land and water.

TERRAS, or TARRAS, in *Mineralogy*, a ſpecies of argillaceous earth, differing little from puzzolana, but in being more compact and hard, porous and ſpongy. It is generally of a whitiſh yellow colour, and contains more heterogeneous particles, as ſpar, quartz, ſhoerl, &c. and ſomething more calcareous earth; it effervesces with acids, is magnetic, and fuſible *per ſe*. When pulverized, it ſerves as a cement, like puzzolana. It is found in Germany and Sweden.

Kirwan's Mineralogy.

A ſpecies of red earth has been found in the pariſh of St Elizabeth in Jamaica, which turns out to be an excellent ſubſtitute for terras or puzzolana earth, and may therefore be of great value to the inhabitants of the Weſt Indies.

Society for Arts, &c. vol. v.

One meaſure of this earth, mixed with two of well ſlaked lime, and one of ſand, forms a cement that anſwers extremely well for buildings in water, for it ſoon hardens and becomes like a ſtone.

TERRASON, ABBE JOHN, a French writer, born at Lyons in 1669. He diſtinguiſhed himſelf in the diſpute concerning Homer, between La Motte and Madame Dacier, by writing a *Diſſertation contre l'Iliade*. He wrote a political and moral romance called *Sethos*, full of learning and philoſophy; and another capital work of his is a French tranſlation of Diodorus Siculus. He died in 1750.

TERRE *Verte*, in the colour-trade, the name of a green earth much uſed by painters, both ſingly for a good ſtanding green, and in mixture with other colours. The name is French, and ſignifies, "green earth."

It is an indurated clay, of a deep bluiſh green colour, and is found in the earth, not in continued ſtrata or beds, as moſt of the other earths are, but in large flat maſſes of different ſizes, imbedded in other ſtrata; theſe break irregularly in the cutting, and the earth is generally brought out of the pit in lumps of different ſizes. It is of a fine, regular, and even ſtructure, and not very hard. It is of an even and gloſſy ſurface, very ſmooth to the touch, and in ſome degree reſembling the morochthus or French chalk, but adhering firmly to the tongue. It does not ſtain the hand in touching it; but being drawn along a rough ſurface, it leaves an even white line, with a greeniſh caſt.

It does not effervesce with acids, and burns to a duſky brown colour. It is dug in the iſland of Cyprus, and in many parts of France and Italy. That from the neighbourhood of Verona has been eſteemed the beſt in the world; but of late there has been ſome dug in France that equals it. There is alſo an earth dug on Mendip Hills, in the ſinking for coal, which, though wholly unobſerved, is nearly, if not wholly, of equal value. When ſcraped, and the finer parts ſeparated, it is ready to be made up with oil for the uſe of the painters, and makes the moſt true and laſting green of any ſimple body they uſe.

Ter Ver ‖ Teſſ

TERRESTRIAL, ſomething partaking of the nature of earth, or belonging to the globe of earth; thus we ſay, the terreſtrial globe, &c.

TERRIER, a ſmall hound to hunt the fox or badger; ſo called becauſe he creeps into the ground, as ferrets do into the coney-burrows, after the fox, &c.

TERRITORY, in *Geography*, denotes an extent or compaſs of land, within the bounds or belonging to the juriſdiction of any ſtate, city, or other ſubdiviſion of a country.

TERROR. See FEAR and FRIGHT.

TERTIAN FEVER. See MEDICINE, N° 126.

TERTULLIAN, or QUINTUS SEPTIMUS FLORENS TERTULLIANUS, a celebrated prieſt of Carthage, was the ſon of a centurion in the militia, who ſerved as proconſul of Africa. He was educated in the Pagan religion; but being convinced of its errors, embraced Chriſtianity, and became a zealous defender of the faith. He married, it is thought, after his baptiſm. Afterwards he took orders, and went to Rome; where, during the perſecution under the emperor Severus, he publiſhed his Apology for the Chriſtians, which is, in its kind, a maſterpiece of eloquence and learning; and at the beginning of the third century he embraced the ſect of the Montaniſts. He lived to a very great age, and died under the reign of Antoninus Caracalla, about the year 216. Many of his works are ſtill extant, in all of which he diſcovers a great knowledge of the Holy Scriptures, a lively imagination, a ſtrong, elevated, and impetuous ſtyle, great eloquence and ſtrength of reaſoning; but is ſometimes obſcure. His Apology and Preſcriptions are moſt eſteemed. The beſt editions of his works are thoſe of Rigault: eſpecially that of Venice in 1746, folio. Pamelius and Alix, Mr Thomas, and the Sieur du Foſſé, have written his life; and Rigault, M. de l'Aube Epine, Father Petau, and other learned men, have publiſhed notes on his works.

TERUNCIUS, in antiquity, a very ſmall braſs coin in uſe among the Romans.

The inconvenience of ſuch very ſmall pieces being ſoon found, the teruncius became diſuſed, but its name is ſtill retained in reckoning, and thus it became a money of account. The teruncius at firſt was a quarter of the as, or libra; hence, as the as contained twelve ounces, the teruncius contained three, whence the name, which is formed of the Latin *tres unciæ*. Teruncius was alſo uſed for the quarter of the denarius; ſo that when the denarius was at ten aſes, the teruncius was worth two and a half; and when the denarius was riſen to ſixteen, the teruncius was worth four. See DENARIUS.

TESSELATED PAVEMENTS, thoſe of rich moſaic work, made of curious ſquare marbles, bricks, or tiles, called *teſſelæ* from their reſembling dice.

TESSERA, in Roman antiquity, denoted in its primary ſenſe a cube or dye; ſo called from the Greek word τέσσαρα or τέσσερα, *four*; reſpect being had to its number

number of ſides, diſtinct from the two horizontal planes above and below. And it was thus diſtinguiſhed from the talus, which being round at each end, contained only four planes or faces on which it could ſtand; and therefore when thrown had no more than two ſide faces in view. Hence *ludere talis et ludere teſſeris*, are ſpoken of by Roman writers as two different games. The ſyllable TES occurs often in Roman inſcriptions. The word *teſſera* was applied to many other things, not ſo much from a ſimilitude in the figure, as from the relation they bore to ſome other thing of which they were the ſign or token; as the points on the upper plane of the dye denoted the good or ill ſucceſs of the caſt.

The *teſſera hoſpitalis* was either public or private. As to the former, we find among the inſcriptions publiſhed by Gruter inſtances of two municipal towns which put themſelves under the patronage of the Roman governor; and the reciprocal engagement between them, engraved on two copperplates, in the form of an oblong ſquare, with a pediment at the top, is called in both *teſſera hoſpitalis*. The deſign of it was to cultivate or maintain a laſting friendſhip between private perſons and their families; and gave a mutual claim to the contracting parties and their deſcendants of a reception and kind treatment at each other's houſes, as occaſion offered. For which end thoſe teſſeræ were ſo contrived as beſt to preſerve the memory of that tranſaction to poſterity. And one method of doing this was by dividing one of them lengthwiſe into two equal parts; upon each of which one of the parties wrote his name, and interchanged it with the other. From this cuſtom came the prevailing expreſſion *teſſeram hoſpitalem confringere*, applied to perſons who had violated their engagements.

The *teſſeræ frumentariæ* were ſmall tallies given by the emperors to the populace at Rome, entitling them to the reception of a quantity of corn from the public at ſtated ſeaſons. The perſon who had the inſpection of theſe was called *teſſerarius*. They were made of wood and of ſtone.

There was another kind of teſſera which intitled perſons to a ſight of the public games and other diverſions, uſually made in the form of an oblong ſquare.

The *teſſera militaris* was a ſignal given by the general or chief commander of an army, as a direction to the ſoldiers for executing any duty or ſervice required of them. This, upon urgent occaſions, was only vocal; but, in ordinary caſes, it was written on a tablet, commonly made of wood. Beſide theſe civil and military teſſeræ, there are others which relate to religious affairs, and may be called *ſacred*.

TESSON, or TESTON. See TESTER.

TESSOUWA, a conſiderable town in Africa, ſituated eaſt of Mourzouk, the capital of the kingdom of Fezzan. Near this town a deep and rapid ſtream is ſaid to have exiſted, but was overwhelmed by the moving ſands ſo frequent in Africa.

TEST, a veſſel uſed in metallurgy for abſorbing the ſcoriæ of metallic bodies when melted. See CUPEL, under ORES, *Reduction of*.

TEST-Act, in *Law*, is the ſtatute 25 Car. II. cap. 2. which directs all officers, civil and military, to take the oaths, and make the declaration againſt tranſubſtantiation, in the court of King's Bench, or Chancery, the next term, or at the next quarter-ſeſſions, or (by ſubſequent ſtatutes) within ſix months after their admiſſion; and alſo within the ſame time to receive the ſacrament of the Lord's Supper, according to the uſage of the church of England, in ſome public church, immediately after divine ſervice or ſermon, and to deliver into court a certificate thereof ſigned by the miniſter and church warden, and alſo to prove the ſame by two credible witneſſes, upon forfeiture of 500l. and diſability to hold the ſaid office. Teſt.

The avowed object of this act was to exclude from places of truſt all members of the church of Rome; and hence the diſſenters of that age, if they did not ſupport the bill when paſſing through the two houſes of parliament, gave it no oppoſition. For this part of their conduct they have been often cenſured with ſeverity, as having betrayed their rights from reſentment to their enemies. But is this a fair ſtate of the caſe? Were any rights in reality betrayed? That the dread of a popiſh ſucceſſor and of popiſh influence was the immediate and urgent cauſe of paſſing the *teſt-act*, is indeed true; but that the legiſlature, when guarding againſt an impending evil, had not likewiſe a retroſpect to another from which they had ſo recently been delivered, is not ſo evident. If it be proper to ſupport an eſtabliſhed church as a branch of the conſtitution, and if the teſt-act be calculated to afford that ſupport to the church of England, it is probable that the deliberations of parliament were as much influenced by the dread of puritanic fury, and a renewal of the covenant, as by apprehenſions of a perſecution from a popiſh king and popiſh councils. That the members of the church eſtabliſhed by law in England had as much reaſon to dread the effects of power in the hands of Puritans as in the hands of Papiſts, no impartial man will controvert, who is not a ſtranger to that period of our national hiſtory; and that it was the duty of the legiſlature by every method in their power to provide for the ſecurity of the conſtitution againſt the machinations of both its enemies, will be admitted by all but ſuch as are in love with anarchy on the one hand, or with deſpotiſm on the other.

Many people, when they talk or write of the *teſt-act*, ſeem to think that it was framed in oppoſition to the *religious* opinions of the church of Rome; and finding the Proteſtant diſſenters, who abhor theſe opinions, deprived by it of their civil *rights*, they ſpeak with indignation of a law which confounds the innocent with the guilty. But all this proceeds from a palpable miſtake of the purpoſe of the teſt. As the legiſlature had no authority to make laws againſt *any opinions whatever*, on account of their being falſe in theology; ſo it is not to be ſuppoſed that, in their deliberations on the TEST-ACT, the members of that auguſt body took into their conſideration the comparative orthodoxy of the diſtinguiſhing tenets of the Catholics and Puritans. As a religious ſect they might eſteem the latter much more than the former; but if they found that both had combined with their theological doctrines opinions reſpecting civil and eccleſiaſtical government, inconſiſtent with the fundamental principles of the Engliſh conſtitution, they had an undoubted right to enact a law, by which none ſhould be admitted to offices, in the execution of which they could injure the conſtitution, without previouſly giving ſecurity that their adminiſtration ſhould ſupport it in all its branches. It had not then been doubted, nor is there reaſon to doubt yet, but that an eſtabliſhed religion is neceſſary, in conjunction with civil govern-

Teſt. ment, to preſerve the peace of ſociety; and therefore in every well regulated ſtate an eſtabliſhed religion muſt be ſupported, not becauſe it is the duty of the civil magiſtrate to conduct his ſubjects to future happineſs, but becauſe he cannot without ſuch an eſtabliſhment preſerve among them preſent tranquillity. The eſtabliſhment which muſt beſt anſwer this purpoſe, is that which, teaching the great and unchangeable duties of morality, is moſt acceptable in its government and forms of worſhip to the majority of the people; and therefore in giving a legal eſtabliſhment to one conſtitution of the church in preference to all others, it is only this circumſtance, and not the comparative purity of the rival churches, viewed merely as eccleſiaſtical corporations, to which it is the buſineſs of the legiſlature to pay attention. At the time when the *teſt-act* paſſed the two houſes of parliament, the eſtabliſhed church of England was certainly more acceptable to the great body of the people and to all ranks in the ſtate, than any one of the ſects, whether Catholic or Proteſtant, which diſſented from her; and therefore it was the duty of the legiſlature to preſerve to that church all her privileges and immunities, and to prevent thoſe hoſtile ſectaries from doing her injury in the diſcharge of any civil office with which they might be entruſted. It was with this view that the *teſt-act* was formed; and it is with the ſame view that the legiſlature has hitherto rejected every petition for its repeal. In doing ſo, it deprives no man of his *rights*, far leſs of rights which *conſcience* calls upon him to maintain at every hazard; for the rights of individuals to hold civil offices are not inherent, but derived from the legiſlature, which of courſe muſt be the judge upon what terms they are to be held. The legiſlature of England has excluded from many offices, civil and military, every man who will not give ſecurity, that in the diſcharge of his public duty he will ſupport the church eſtabliſhed by law; and as the teſt of his intention it requires him, before he enters upon his office, to renounce the doctrine of tranſubſtantiation, and receive the ſacrament of the Lord's Supper in ſome public church, according to the liturgy of the church of England. Whether this be the moſt proper teſt that could have been enacted, may well be queſtioned; but that in a country abounding with ſectaries of various denominations, who agree in nothing but venomous hoſtility to the religious eſtabliſhment, *ſome* teſt is neceſſary, ſeems incontrovertible, if it be the buſineſs of the legiſlature to preſerve the public peace.

To this it will be replied, That the public peace in Scotland is preſerved without a teſt, and that therefore a teſt cannot be neceſſary in England. This is plauſible, but not concluſive. For 40 years after the Revolution, there was in Scotland no denomination of Chriſtians but thoſe of the Preſbyterian church, eſtabliſhed by law, the Proteſtant Epiſcopalians, whoſe church had been eſtabliſhed prior to that event, and the adherents to the church of Rome. The Epiſcopalians and Papiſts were effectually excluded from every office in which they could injure the eccleſiaſtical eſtabliſhment, by the ſeveral reſtrictions under which they were laid, on account of their attachment, real or ſuppoſed, to the abdicated family of Stuart. The penal laws operated upon them more powerfully than a religious teſt. It is to be obſerved too that in the church of Scotland, though her clergy are better provided for than any other parochial clergy perhaps in Europe (A), there is nothing of that ſplendour and temporal power which in England excite envy to clamour againſt the eſtabliſhment, under the pretence of maintaining the cauſe of religious liberty. Yet even in Scotland a religious teſt is occaſionally exacted of civil officers. In the royal boroughs of that part of the united kingdom, no man can hold the office of a magiſtrate without previouſly ſwearing the burgeſs-oath (ſee SECEDER, N° 8.); and every inſtructor of youth, whether in ſchools or colleges, may be called upon to qualify himſelf for his office, by ſubſcribing the eſtabliſhed Confeſſion of Faith. The burgeſs-oath is a more effectual teſt than that which is required of magiſtrates in England; for a man might with a ſafe conſcience receive the ſacrament of the Lord's Supper occaſionally in a church "at which he would not ſwear to abide and defend the ſame to his *life's end*." This teſt appears to us to be neceſſary in boroughs, where faction is commonly blended with fanaticiſm; and if thoſe ſectaries which, at their firſt appearance in 1732, were inſignificant, if not contemptible, continue to multiply, and to imbibe principles much more pernicious than thoſe which were held by their fathers, it may perhaps be found expedient to extend ſome teſt over the whole country. Teſt.

We do not, however, by any means, wiſh to ſee the ſacramental teſt introduced into Scotland. A teſt may be neceſſary to ſecure to the church all her rights and immunities; but to receive the ſacrament can give her no ſuch ſecurity, whilſt it leads inevitably to the profanation of a ſacred ordinance. A much better teſt would be, to require every man, before he be admitted to an executive office, to ſwear that in the diſcharge of it he will be careful to maintain all the rights and privileges of the church eſtabliſhed by law. Such an oath no ſenſible and peaceable diſſenter could refuſe; for it would not bind him to communicate with the eſtabliſhed church; and he cannot be ignorant that it belongs not to the executive government, but to the legiſlature, to determine what ſhall be the religion of the ſtate. On this account, we cannot help thinking that the members of

(A) There are indeed many livings in the church of England, and probably in other churches, to which nothing in the church of Scotland can be compared in reſpect of emolument; but theſe rich benefices bear no proportion to the number of thoſe which, in this age of unavoidable expence, cannot afford to the incumbents the means of decent ſubſiſtence as gentlemen. In the church of Scotland many livings amount to 200l. each annually; and we have reaſon to hope, that when the preſent plan for augmenting the ſtipends of the clergy has been extended over Scotland, very few will be below 100l.; whilſt in England the vicarages and ſmall rectories, from which we have reaſon to believe that the incumbents reap not 80l. a-year, greatly exceed in number all the livings in Scotland? Nay we doubt if there be not upwards of a thouſand livings in England and Wales from which the rector or vicar derives not above 50l. annually.

of the legiſlative body ſhould be ſubjected to no religious teſt whatever, that they may be at freedom to reform the corruptions of the church, or to exchange one eſtabliſhment for another, ſhould they find ſuch exchange expedient. If this reaſoning be juſt, it will be difficult to vindicate that clauſe of 25 Car. II. and of 1 Geo. I. in which it is enacted, that no member ſhall vote or ſit in either houſe of parliament, till he hath, in the preſence of the houſe, ſubſcribed and repeated the declaration againſt tranſubſtantiation, the invocation of ſaints, and the ſacrifice of the maſs. The church of Rome is indeed a very corrupt ſociety; but if it be not for the purity of her doctrines and government that any church is eſtabliſhed in preference to all others, why ſhould that particular church be precluded from the poſſibility of obtaining a legal eſtabliſhment in Great Britain, even though ſhe were to become moſt acceptable to the majority of all ranks in the kingdom? The Engliſh Catholics have unqueſtionably greater reaſon to complain of this teſt, than either they or the diſſenters have to complain of the law which requires every civil and military officer to receive the Lord's Supper in the eſtabliſhed church.

TEST for Acids and Alkalies. See CHEMISTRY.

TEST Liquors for Wines. See WINE.

TESTACEA, in the Linnæan ſyſtem, comprehends the third order of vermes, or ſhell-fiſh. See CONCHOLOGY *Index*.

TESTACEOUS, in *Natural Hiſtory*, an epithet ſynonymous with TESTACEA. See above.

TESTAMENT, or LAST WILL. Teſtaments both Juſtinian and Sir Edward Coke agree to be ſo called, becauſe they are *teſtatio mentis:* an etymon which ſeems to favour too much of conceit; it being plainly a ſubſtantive derived from the verb *teſtari*, in like manner as *juramentum*, *incrementum*, and others, from other verbs. The definition of the old Roman lawyers is much better than their etymology; *voluntatis noſtræ juſta ſententia de eo, quod quis poſt mortem ſuam fieri velit:* which may be thus rendered into Engliſh, "the legal declaration of a man's intentions, which he wills to be performed after his death." It is called *ſententia*, to denote the circumſpection and prudence with which it is ſuppoſed to be made: it is *voluntatis noſtræ ſententia*, becauſe its efficacy depends on its declaring the teſtator's intention, whence in Engliſh it is emphatically ſtyled his *will;* it is *juſta ſententia;* that is, drawn, atteſted, and publiſhed, with all due ſolemnities and forms of law: it is *de eo, quod quis poſt mortem ſuam fieri velit*, becauſe a teſtament is of no force till after the death of the teſtator.

Theſe teſtaments are divided into two ſorts; written, and verbal or nuncupative; of which the former is committed to writing: the latter depends merely upon oral evidence, being declared by the teſtator in *extremis*, before a ſufficient number of witneſſes, and afterwards reduced to writing.

But as nuncupative wills and CODICILS (which were formerly more in uſe than at preſent when the art of writing is become more general) are liable to great impoſitions, and may occaſion many perjuries, the ſtatute of frauds, 29 Car. II. c. 3. enacts, 1. That no written will ſhall be revoked or altered by a ſubſequent nuncupative one, except the ſame be in the lifetime of the teſtator reduced to writing, and read over to him, and approved; and unleſs the ſame be proved to have been ſo done by the oaths of three witneſſes at the leaſt, who, by ſtatute 4 and 5 Anne, c. 16. muſt be ſuch as are admiſſible upon trials at common law. 2. That no nuncupative will ſhall in anywiſe be good, where the eſtate bequeathed exceeds 30l. unleſs proved by three ſuch witneſſes, preſent at the making thereof (the Roman law requiring ſeven), and unleſs they or ſome of them were ſpecially required to bear witneſs thereto by the teſtator himſelf; and unleſs it was made in his laſt ſickneſs, in his own habitation or dwelling-houſe, or where he had been previouſly reſident ten days at the leaſt, except he be ſurpriſed with ſickneſs on a journey, or from home, and dies without returning to his dwelling. 3. That no nuncupative will ſhall be proved by the witneſſes after ſix months from the making, unleſs it were put in writing within ſix days. Nor ſhall it be proved till fourteen days after the death of the teſtator, nor till proceſs hath firſt iſſued to call in the widow, or next of kin, to conteſt it if they think proper. Thus hath the legiſlature provided againſt any fraud in ſetting up nuncupative wills, by ſo numerous a train of requiſites, that the thing itſelf has fallen into diſuſe; and hardly ever heard of, but in the only inſtance where favour ought to be ſhown to it, when the teſtator is ſurpriſed by ſudden and violent ſickneſs. The teſtamentary words muſt be ſpoken with an intent to bequeath, not any looſe idle diſcourſe in his illneſs; for he muſt require the byſtanders to bear witneſs of ſuch his intention; the will muſt be made at home, or among his family or friends, unleſs by unavoidable accident, to prevent impoſitions from ſtrangers: it muſt be in his laſt ſickneſs; for if he recovers, he may alter his diſpoſitions, and have time to make a written will: it muſt not be proved at too long a diſtance from the teſtator's death, leſt the words ſhould eſcape the memory of the witneſſes; nor yet too haſtily and without notice, leſt the family of the teſtator ſhould be put to inconvenience or ſurpriſe.

As to written wills, they need not any witneſs of their publication. We ſpeak not here of devices of lands, which are entirely another thing, a conveyance by ſtatute, unknown to the feodal or common law, and not under the ſame juriſdiction as perſonal teſtaments. But a teſtament of chattels, written in the teſtator's own hand, though it has neither his name nor ſeal to it, nor witneſſes preſent at its publication, is good; provided ſufficient proof can be had that it is his hand-writing. And though written in another man's hand, and never ſigned by the teſtator, yet if proved to be according to his inſtructions and approved by him, it hath been held a good teſtament of the perſonal eſtate. Yet it is the ſafer and more prudent way, and leaves leſs in the breaſt of the eccleſiaſtical judge, if it be ſigned or ſealed by the teſtator, and publiſhed in the preſence of witneſſes; which laſt was always required in the time of Bracton; or rather he in this reſpect has implicitly copied the rule of the civil law.

No teſtament is of any effect till after the death of the teſtator: *Nam omne teſtamentum morte conſummatum eſt, et voluntas teſtatoris eſt ambulatoria uſque ad mortem.* And therefore, if there be many teſtaments, the laſt will overthrows all the former; but the republication of a former will revoke one of a later date, and eſtabliſhes the firſt again.

Regularly, every perſon hath full power and liberty to make a will, that is not under ſome ſpecial prohibition by

Teſtament. by law or cuſtom: which prohibitions are principally upon three accounts; for want of ſufficient diſcretion; for want of ſufficient liberty and free-will; and on account of criminal conduct.

1. In the firſt ſpecies are to be reckoned infants, under the age of 14 if males, and 12 if females; which is the rule of the civil law. For though ſome of our common lawyers have held that an infant of any age (even four years old) might make a teſtament, and others have denied that under 18 he is capable; yet as the eccleſiaſtical court is the judge of every teſtator's capacity, this caſe muſt be governed by the rules of the eccleſiaſtical law. So that no objection can be admitted to the will of an infant of 14, merely for want of age; but if the teſtator was not of ſufficient diſcretion, whether at the age of 14 or 24, that will overthrow his teſtament. Madmen, or otherwiſe *non compotes*, idiots or natural fools, perſons grown childiſh by reaſon of old age or diſtemper, ſuch as have their ſenſes beſotted with drunkenneſs,—all theſe are incapable, by reaſon of mental diſability, to make any will ſo long as ſuch diſability laſts. To this claſs alſo may be referred ſuch perſons as are born deaf, blind, and dumb; who, as they have always wanted the common inlets of underſtanding, are incapable of having *animum teſtandi*, and their teſtaments are therefore void.

2. Such perſons as are inteſtable for want of liberty or freedom of will, by the civil law are of various kinds; as priſoners, captives, and the like. But the law of England does not make ſuch perſons abſolutely inteſtable; but only leaves it to the diſcretion of that court to judge upon the conſideration of their particular circumſtances of dureſs, whether or no ſuch perſons could be ſuppoſed to have *liberum animum teſtandi*. And with regard to feme-coverts, our laws differ ſtill more materially from the civil. Among the Romans there was no diſtinction; a married woman was as capable of bequeathing as a feme-ſole. But with us a married woman is not only utterly incapable of deviſing lands, being excepted out of the ſtatute of wills, 34 and 35 Hen. VIII. c. 5. but alſo ſhe is incapable of making a teſtament of chattels, without the licenſe of her huſband. For all her perſonal chattels are abſolutely his own; and he may diſpoſe of her chattels real, or ſhall have them to himſelf, if he ſurvives her: it would be therefore extremely inconſiſtent to give her a power of defeating that proviſion of the law, by bequeathing thoſe chattels to another. The queen-conſort is an exception to this general rule, for ſhe may diſpoſe of her chattels by will, without the conſent of her lord; and any feme-covert may make her will of goods which are in her poſſeſſion *in auter droit*, as executrix or adminiſtratrix; for theſe can never be the property of the huſband: and if ſhe has any pin-money or ſeparate maintenance, it is ſaid ſhe may diſpoſe of her ſavings thereout by teſtament, without the controul of her huſband. But if a female ſole makes her will, and afterwards marries, ſuch ſubſequent marriage is eſteemed a revocation in law, and entirely vacates the will.

3. Perſons incapable of making teſtaments on account of their criminal conduct, are in the firſt place all traitors and felons, from the time of conviction; for then their goods and chattels are no longer at their own diſpoſal, but forfeited to the king. Neither can a *felo de ſe* make a will of goods and chattels, for they are forfeited by the act and manner of his death; but he may make a deviſe of his lands, for they are not ſubject to any forfeiture. Outlaws alſo, though it be but for debt, are incapable of making a will ſo long as the outlawry ſubſiſts, for their goods and chattels are forfeited during that time. As for perſons guilty of other crimes, ſhort of felony, who are by the civil law precluded from making teſtaments (as uſurpers, libellers, and others of a worſe ſtamp), at the common law their teſtaments may be good. And in general the rule is, and has been ſo at leaſt ever ſince Glanvil's time, *quod libera ſit cujuſcunque ultima voluntas*. Teſtat. || Teſt.

Teſtaments may be avoided three ways: 1. If made by a perſon labouring under any of the incapacities before-mentioned; 2. By making another teſtament of a later date; and, 3. By cancelling or revoking it. For though I make a laſt will and teſtament irrevocable in the ſtrongeſt words, yet I am at liberty to revoke it; becauſe mine own act or words cannot alter the diſpoſition of law, ſo as to make that irrevocable which is in its own nature revocable. For this, ſaith Lord Bacon, would be for a man to deprive himſelf of that which, of all other things, is moſt incident to human condition; and that is, alteration or repentance. It hath alſo been held, that, without an expreſs revocation, if a man, who hath made his will, afterwards marries and hath a child, this is a preſumptive or implied revocation of his former will which he made in his ſtate of celibacy. The Romans were alſo wont to lay aſide teſtaments as being *inofficioſa*, deficient in natural duty, if they diſinherited or totally paſſed by (without aſſigning a true and ſufficient reaſon) any of the children of the teſtator. But if the child had any legacy, though ever ſo ſmall, it was a proof that the teſtator had not loſt his memory or his reaſon, which otherwiſe the law preſumed; but was then ſuppoſed to have acted thus for ſome ſubſtantial cauſe: and in ſuch caſe no *querela inofficioſi teſtamenti* was allowed. Hence probably has ariſen that groundleſs vulgar error of the neceſſity of leaving the heir a ſhilling, or ſome other expreſs legacy, in order to diſinherit him effectually; whereas the law of England makes no ſuch wild ſuppoſition of forgetfulneſs or inſanity; and therefore, though the heir or next of kin be totally omitted, it admits no *inofficioſi* to ſet aſide ſuch a teſtament.

TESTAMENT, in *Scots Law*. See LAW, N° clxxxi. 2. &c.

TESTAMENT, *Old* and *New*. See BIBLE and SCRIPTURE.

TESTATOR, the perſon who makes his will and teſtament.

TESTER, TESTON, the name of a coin ſtruck in France by Louis XII. in 1513, and in Scotland in the time of Francis II. and Mary queen of Scotland, ſo called from the head of the king, which was engraved upon it. The ſilver it contained was 11 deniers 18 grains, its weight ſeven deniers 11½ grains, and its value 10 ſols. The coinage of it was prohibited by Henry III. in 1575, when the value of it was augmented to 14 ſols ſix deniers. The teſton or teſter among us was rated at 12d. in the reign of Henry VIII. and afterwards reduced to 6d.

TESTES, in *Anatomy*, the teſticles. See the next article.

TESTICLE

TESTICLE (*teſtis*), a double part in animals of the male kind, ſerving for the office of generation. See ANATOMY, N° 107.

TESTIMONY. See LOGIC, N° 29, and METAPHYSICS, N° 135—138.

TESTIMONY, in *Law*. See EVIDENCE.

TESTUDO, the TORTOISE, a genus of animals belonging to the claſs of amphibia, and order of reptilia. See ERPETOLOGY *Index*.

TESTUDO, in antiquity, was particularly uſed among the poets, &c. for the ancient lyre; becauſe it was originally made by its inventor Mercury, of the back or hollow of the teſtudo aquatica, or ſea-tortoiſe, which he accidentally found on the banks of the river Nile. See LYRE.

TESTUDO, in the military art of the ancients, was a kind of cover or ſcreen which the ſoldiers, *e. gr.* a whole company, made themſelves of their bucklers, by holding them up over their heads, and ſtanding cloſe to each other. This expedient ſerved to ſhelter them from darts, ſtones, &c. thrown upon them, eſpecially thoſe thrown from above, when they went to the aſſault.

TESTUDO, was alſo a kind of large wooden tower which moved on ſeveral wheels, and was covered with bullock-hides, ſerving to ſhelter the ſoldiers when they approached the walls to mine them, or to batter them with rams. It was called *teſtudo*, from the ſtrength of its roof, which covered the workmen as the ſhell does the tortoiſe.

TETANUS, a dreadful ſpaſmodic diſorder, in which the whole body becomes rigid and inflexible. It moſt commonly proves mortal. See MEDICINE, N° 279.

TETHYS, a genus of inſects belonging to the claſs of vermes, and order of molluſca. See HELMINTHOLOGY *Index*.

TETRACERA, a genus of plants belonging to the claſs polyandria; and in the natural ſyſtem ranging under the doubtful. See BOTANY *Index*.

TETRADYNAMIA, (τεσσαρες "four," and δυναμις "power"), four powers; the name of the 15th claſs in Linnæus's Sexual Syſtem. See BOTANY *Index*.

TETRAGONIA, a genus of plants belonging to the claſs icoſandria; and in the natural method ranging under the 13th order, *ſucculentæ*. See BOTANY *Index*.

TETRAGRAMMATON, τετραγραμματον, a denomination given by the Greeks to the Hebrew name of God יהוה, "*Jehova*," becauſe in the Hebrew it conſiſts of four letters.

TETRAGYNIA, (τεσσαρες, "four," and γυνη, "a woman"); the name of an order, or ſecondary diviſion, in the Sexual Syſtem. See BOTANY *Index*.

TETRANDRIA, (τεσσαρες, "four," and ανηρ, "a man or huſband"); the name of the fourth claſs in the Linnæan Syſtem. See BOTANY *Index*.

TETRAO, a genus of birds belonging to the order of gallinæ. See ORNITHOLOGY *Index*.

TETRODON, a genus of fiſhes arranged by Linnæus under the claſs of *amphibia*, and order of *nantes*; but placed by Gmelin under the claſs of *piſces*, and order of *branchioſtegi*. See ICHTHYOLOGY *Index*.

TETRARCH, a prince who holds and governs a fourth part of a kingdom. Such originally was the import of the title *tetrarch*; but it was afterwards applied to any petty king or ſovereign; and became ſynonymous with ethnarch, as appears from the following conſiderations: 1. That Pliny makes mention of ſix tetrarchies within the city of Decapolis. 2. That Herod's kingdom was only divided into three parts, which yet were called *tetrarchies*, and the ſovereigns thereof, Luke iii. 1. *tetrarchs*. 3. Joſephus tells us, that, after the battle of Philippi, Antony, going into Syria, conſtituted Herod *tetrarch*; and on medals the ſame Herod is called *ethnarch*.

TETRASTYLE, in the ancient architecture, a building, and particularly a temple, with four columns in its front.

TETUAN, an ancient and pleaſant town of Africa, in the kingdom of Fez, and in the province of Habata. It is pretty well built, and the inhabitants are about 15,000 in number, who call themſelves *Andaluſians*, and almoſt all ſpeak Spaniſh, but they are great pirates. Some ſay there are 30,000 Mooriſh inhabitants, and 5000 Jews. W. Long. 5. 26. N. Lat. 35. 27. *Joſephus's Antiq.* b. xiv. c. 23.

TEUCRIUM, GERMANDER, a genus of plants belonging to the claſs didynamia; and in the natural ſyſtem ranging under the 42d order, *Verticillatæ*. See BOTANY *Index*.

TEUTHIS, a genus of fiſhes belonging to the order of abdominales. See ICHTHYOLOGY *Index*.

TEUTONES, or TEUTONI, in *Ancient Geography*, a people always by hiſtorians joined with the Cimbri; both ſeated, according to Mela, beyond the Elbe, on the Sinus Codanus, or Baltic; and there it is ſuppoſed, lay the country of the Teutones, now *Ditmarſh*; diverſity of dialects producing the different terms *Teut*, *Tut*, *Dit*, *Tid*, and *Thod*, which in the ancient German language ſignified *people*. Of theſe Teutones, Virgil is to be underſtood in the epithet *Teutonicus*, an appellation which more lately came to be applied to the Germans in general, and later ſtill the appellation *Alemanni*.

The Teutones, in conjunction with the Cimbri and Ambrones, made war on the Romans, and marched towards Italy in the year 101 B. C. We are told, that the Teutones alone were ſo numerous, that they were ſix whole days without intermiſſion in paſſing by the Roman camp. In Tranſalpine Gaul they engaged the Roman conſul Marius; but were defeated with incredible ſlaughter; 100,000 of them, according to the loweſt calculations, being killed on the ſpot. According to others, the number of thoſe killed and taken priſoners amounted to 290,000. The inhabitants made fences for vineyards of their bones. Their king Teutobochus, ſaid to be a monſtrous giant, was taken priſoner and carried to Rome. See GIANT.

TEUTONIC, ſomething belonging to the Teutones. The Teutonic language is ſuppoſed to have been the language of the ancient Germans, and hence is reckoned amongſt the mother-tongues. See PHILOLOGY N° 219.

TEUTONIC Order, an order of military knights, eſtabliſhed towards the cloſe of the twelfth century, on the following occaſion.—When the emperor Barbaroſſa engaged in a cruſade for the recovery of the Holy Land out of the hands of Saladin, he was followed by great numbers of German volunteers, who from various motives enliſted under his banners. After the death of Barbaroſſa, the Germans, who had ſignalized themſelves before Acre or Ptolemais, reſolved to chooſe another leader; and at laſt fixed their choice upon Frederic duke

Teutonic ‖ Texture.

duke of Suabia, second son to the emperor, and Henry duke of Brabant. Under these generals they behaved with so much bravery, that Henry king of Jerusalem, the patriarch, and several other princes, determined to reward their valour by instituting an order of knighthood in their favour. This was accordingly done; and our new knights had at first the title of the *knights of St George;* afterwards it was thought proper to put them under the tutelage of the Virgin Mary, to whom there was already an hospital dedicated on Mount Zion, for the relief of German pilgrims. From this time they were called *Equites Mariani*, or knights of St Mary. Laws, regulations, and statutes, were drawn up for them by the Christian kings in Syria and the patriarch; and among other obligations it was required, that every person admitted to the privileges of the order should be of noble parentage; that the order should defend the Christian religion and the Holy Land; that they should exercise hospitality towards the Christians in general, but particularly those of their own country; and that they should with all their power endeavour to propagate and extend the Christian faith and the religion of Jesus. In the year 1190, having become rich by donations from the superstitious, they elected their first grandmaster, Henry Walpot, a German, who had distinguished himself by his zeal and valour; and their choice was confirmed by the emperor. The following year, Pope Celestine III. confirmed their privileges already granted, giving them the title of the *Teutonic knights of the hospital of St Mary the Virgin*. By the conditions of this bull, they vowed perpetual continence, obedience, and poverty; obligations which it may well be imagined were not very strictly kept. See Poland, N° 59, 61, 67—69, and Prussia, N° 3, 4.

TEWIT. See Tringa, Ornithology *Index*.

TEWKESBURY, a town in Gloucestershire, formerly noted for its monastery, and now containing about 500 houses, with a magnificent church. It is seated at the confluence of the rivers Severn and Avon, has a cotton manufactory, and sends two members to parliament. W. Long. 2. 13. N. Lat. 52. 0.

TEXEL, a town of the United Provinces, in North Holland, seated at the mouth of the Zuyder-Zee, with a good harbour, and a strong fort. It is seated in a fruitful island, known all over the world by the great number of ships that pass this way every day from all parts; it is about six miles long and five broad, lying a little northward of the continent of Holland, between which and the island is one of the principal passages out of the Zuyder-Zee into the ocean. It is defended from the sea by sand hills and strong banks. Most of the soil is applied to feed sheep, of which they have great flocks; and the cheese made of their milk is said to vie with the Parmesan. This island contains several fair villages, and a town on the east side, called *Burch*, strongly fortified and garrisoned, and inhabited chiefly by fishermen. N. Lat. 53. 8. E. Long. 4. 51.

Nugent's Grand Tour, vol. i.

TEXT, a relative term, contradistinguished to gloss or commentary, and signifying an original discourse exclusive of any note or interpretation. This word is particularly used for a certain passage of Scripture, chosen by a preacher to be the subject of his sermon.

TEXTURE, properly denotes the arrangement and cohesion of several slender bodies or threads interwoven or entangled among each other, as in the webs of spiders, or in the cloths, stuffs, &c.

Texture ‖ Thalia

Texture is also used in speaking of any union or constituent particles of a concrete body, whether by weaving, hooking, knitting, tying, chaining, indenting, intruding, compressing, attracting, or any other way. In which sense we say, a close compact texture, a lax porous texture, a regular or irregular texture, &c.

THABOR. See Tabor.

THALES, a celebrated Greek philosopher, and the first of the seven wise men of Greece, was born at Miletus about 640 B. C. In order to improve himself in the knowledge of the sciences, he travelled into Egypt, where he discoursed with the priests and other learned men. Some say that he married; but others observe, that he eluded the solicitations of his mother on this head, by telling her, when he was young, that it was too soon; and afterwards, that it was too late. Thales acquired great reputation by his wisdom and learning: he was the first among the Greeks who foretold eclipses of the sun, and made extraordinary discoveries in astronomy. Thales was the author of the Ionian sect of philosophers, who were thus called from his being born at Miletus, a city of Ionia. He maintained that water was the principle of which all the bodies in the universe are composed; that the world was the work of God; and that God sees the most secret thoughts in the heart of man. He said, "That the most difficult thing in the world is to know ourselves; the most easy to advise others; and the most sweet to accomplish our desires. That, in order to live well, we ought to abstain from what we find fault with in others. That the bodily felicity consists in health, and that of the mind in knowledge. That the most ancient of beings is God, because he is uncreated: that nothing is more beautiful than the world, because it is the work of God; nothing more extensive than space, quicker than spirit, stronger than necessity, wiser than time." It was also one of his sentences, "That we ought never to say that to any one that may be turned to our prejudice; and that we should live with our friends as with persons that may become our enemies." He thanked God for three things; that he was born of the human, not of the brute species; a man, and not a woman; a Greek, and not a barbarian. None of the ancient philosophers ever applied themselves more earnestly to the study of astronomy than Thales. Diogenes Laertius reports, that leaving his lodging with an old woman to contemplate the stars, he fell into a ditch; on which the good woman cried, "How canst thou know what is doing in the heavens, when thou canst not perceive what is at thy feet?" He went to see Crœsus, who was marching with a powerful army into Cappadocia, and enabled him to pass the river Halys without making a bridge. Thales died soon after, at about 90 years of age. He composed several treatises in verse, on meteors, the equinoxes, &c. but they are all lost.

THALIA, in Pagan mythology, one of the nine muses. She presided over Comedy; and is represented crowned with a garland of ivy, holding a mask in her hand, and wearing buskins on her feet.

Thalia, a genus of plants belonging to the class monandria; and in the natural system ranging under the 8th order, *Scitamineæ*. See Botany *Index*.

THALICTRUM,

alic- am, mes.

THALICTRUM, MEADOW-RUE, a genus of plants belonging to the claſs polyandria; and in the natural ſyſtem ranging under the 26th order, *Multiſiliquæ*. See BOTANY *Index*.

THAMES, the fineſt river in Great Britain, which takes its riſe from a copious ſpring, called *Thames Head*, two miles ſouth-weſt of Cirenceſter in Glouceſterſhire. It has been erroneouſly ſaid, that its name is Iſis till it arrives at Dorcheſter, 15 miles below Oxford, when, being joined by the Thame or Tame, it aſſumes the name of the Thames, which, it has been obſerved, is formed from a combination of the words Thame and Iſis. What was the origin of this vulgar error, cannot now be traced. Poetical fiction, however, has perpetuated this error, and inveſted it with a kind of claſſical ſanctity. "It plainly appears (ſays Camden), that the river was always called *Thames* or *Tems*, before it came near the Thame; and in ſeveral ancient charters granted to the abbey of Malmſbury, as well as that of Enſham, and in the old deeds relating to Cricklade, it is never conſidered under any other name than that of *Thames*." He likewiſe ſays, that it occurs nowhere under the name of Iſis. All the hiſtorians who mention the incurſions of Ethelwold into Wiltſhire in the year 905, or of Canute in 1016, concur likewiſe in the ſame opinion, by declaring, that they paſſed over the Thames at Cricklade in Wiltſhire. It is not probable, moreover, that Thames Head, an appellation by which the ſource has uſually been diſtinguiſhed, ſhould give riſe to a river of the name of Iſis; which river, after having run half its courſe, ſhould reaſſume the name of Thames, the appellation of its parent ſpring. About a mile below the ſource of the river is the firſt corn-mill, which is called *Kemble Mill*. Here the river may properly be ſaid to form a conſtant current; which, though not more than nine feet wide in the ſummer, yet in the winter becomes ſuch a torrent as to overflow the meadows for many miles around. But, in the ſummer, the Thames Head is ſo dry, as to appear nothing but a large dell, interſperſed with ſtones and weeds. From Somerford the ſtream winds to Cricklade, where it unites with many other rivulets. Approaching Kemsford, it again enters its native county, dividing it from Berkſhire at Ingleſham. It widens conſiderably in its way to Lechlade; and being there joined by the Lech and Coln, at the diſtance of 138 miles from London, it becomes navigable for veſſels of 90 tons. At Enſham, in its courſe north-eaſt, to Oxford, is the firſt bridge of ſtone; a handſome one, of three arches, built by the earl of Abingdon. Paſſing by the ruins of Godſtow nunnery, where the celebrated Fair Roſamond was interred, the river reaches Oxford, in whoſe academic groves its poetical name of Iſis has been ſo often invoked. Being there joined by the Charwell, it proceeds ſouth-eaſt to Abingdon, and thence to Dorcheſter, where it receives the Tame. Continuing its courſe ſouth-eaſt by Wallingford to Reading, and forming a boundary to the counties of Berks, Bucks, Surry, Middleſex, Eſſex, and Kent, it waſhes the towns of Henley, Marlow, Maidenhead, Windſor, Eton, Egham, Staines, Laleham, Chertſey, Weybridge, Shepperton, Walton, Sunbury, Eaſt and Weſt Moulſey, Hampton, Thames Ditton, Kingſton, Teddington, Twickenham, Richmond, Iſleworth, Brentford, Kew, Mortlake, Barnes, Chiſwick, Hammerſmith, Putney, Fulham, Wandſworth, Batterſea, Chelſea, and Lambeth. Then, on the north bank of the river, are Weſtminſter and London, and, on the oppoſite ſide, Southwark; forming together one continued city, extending to Limehouſe and Deptford; and hence the river proceeds to Greenwich, Erith, Greenhithe, Gray's Thurrock, Graveſend, and Leigh, into the ocean. It receives in its courſe from Dorcheſter the rivers Kennet, Loddon, Coln, Wey, Mole, Wandle, Lea, Roding, Darent, and Medway. The juriſdiction of the lord mayor of London over the Thames extends from Coln ditch, a little to the weſt of Staines, to Yendal or Yenleet to the eaſt, including part of the rivers Medway and Lea, and he has a deputy, named the water bailiff, who is to ſearch for and puniſh all offenders againſt the laws for the preſervation of the river and its fiſh. Eight times a-year the lord mayor and aldermen hold courts of conſervance for the four counties of Surry, Middleſex, Eſſex, and Kent. Though the Thames is ſaid to be navigable 138 miles above the bridge, yet there are ſo many flats, that in ſummer the navigation weſtward would be entirely ſtopped, when the ſprings are low, were it not for a number of locks. But theſe are attended with conſiderable expence; for a barge from Lechlade to London pays for paſſing through them 13l. 15s. 6d. and from Oxford to London 12l. 18s. This charge, however, is in ſummer only, when the water is low; and there is no lock from London bridge to Bolter's lock; that is, for 51½ miles above the bridge. The plan of new cuts has been adopted, in ſome places, to ſhorten and facilitate the navigation. There is one near Lechlade, which runs nearly parallel to the old river, and contiguous to St John's bridge; and there is another a mile from Abingdon, which has rendered the old ſtream toward Culham bridge uſeleſs. But a much more important undertaking has lately been accompliſhed; namely, the junction of this river with the Severn. A canal had been made, by virtue of an act of parliament in 1730, from the Severn to Wallbridge, near Stroud. A new canal now aſcends by Stroud, through the vale of Chalford, to the height of 343 feet, by means of 28 locks, and thence to the entrance of a tunnel near Sapperton, a diſtance of near eight miles. The canal is 42 feet in width at top and 30 at the bottom. The tunnel (which is extended under Sapperton hill, and under that part of Earl Bathurſt's grounds called *Halley wood*, making a diſtance of two miles and three furlongs) is near 15 feet in width, and can navigate barges of 70 tons. The canal deſcending hence 134 feet, by 14 locks, joins the Thames at Lechlade, a diſtance of above 20 miles. In the courſe of this vaſt undertaking, the canal, from the Severn at Froomlade to Ingleſham, where it joins the Thames, is a diſtance of more than 30 miles. The expence of it exceeded the ſum of 200,000l. of which 3000l. are ſaid to have been expended in gunpowder alone, uſed for the blowing up of the rock. This new canal was completed in 1789, in leſs than ſeven years from its commencement. A communication, not only with the Trent, but with the Merſey, has likewiſe been effected by a canal from Oxford to Coventry; and an act of parliament has paſſed to extend another canal from this, at Braunſton, to the Thames at Brentford. This is to be called *The Grand Junction Canal*. On the extenſive advantages reſulting from theſe navigable communications from the metropolis with the ports of Briſtol, Liverpool, Hull, &c. and

Bryce's Gazetteer.

Thames.

Thames, Thane.

and the principal manufacturing towns in the inland parts of the kingdom, it is needleſs to expatiate. The tide flows up the Thames as high as Richmond, which, following the winding of the river, is 70 miles from the ocean; a greater diſtance than the tide is carried by any other river in Europe. The water is eſteemed extremely wholeſome, and fit for uſe in very long voyages, during which it will work itſelf perfectly fine.

THAMES is alſo the name of a river in the ſtate of Connecticut in America. See the article CONNECTICUT.

THANE, or THANUS, a name given to the nobility in Britain before the time of William the Conqueror. It ſignifies a miniſter or honourable retainer, from the verb *thenian*, "to miniſter." There were ſeveral degrees of nobility among the Anglo-Saxons; but thoſe moſt commonly mentioned are the king's thanes and the alderman's thanes. The king's thanes ſeem to have been of three different degrees, according to their different degrees of wealth or favour at court. The alderman's thanes ſeem to have been of the loweſt degree of nobility, and next to them thoſe who were promoted to that dignity from their advancement in the church, from their valour, ſucceſs in agriculture or commerce: for if a ceorl or farmer applied to learning and attained to prieſts orders; if he acquitted himſelf ſo well as to obtain from a nobleman five hythes of land, or a gilt ſword, helmet, and breaſt-plate, the reward of his valour; or if by his induſtry he had acquired the property of five hythes of land; or if he applied to trade, and made three voyages beyond ſea in a ſhip of his own, and a cargo belonging to himſelf, he was denominated a *thane*.

The thanes, who were the only nobility among the Anglo-Saxons, were a very numerous body of men, comprehending all the conſiderable landholders in England, and filling up that ſpace in ſociety between the ceorls or yeomanry on the one hand, and the royal family on the other; which is now occupied both by the nobility and gentry. In times of war, they conſtituted the flower of their armies, and in times of peace they ſwelled the trains of their kings, and added greatly to the ſplendour of their courts, eſpecially at the three great feſtivals of Chriſtmas, Eaſter, and Whitſuntide. From this body all the chief officers, both civil and military, as aldermen, greeves, earls, heretogens, &c. were taken; and to obtain ſome of theſe offices was the great object of their ambition. Before they obtained an office, their lands were their only ſupport; and they lived in greater or leſs affluence, according to the extent of their eſtates. Theſe they divided into two parts; one of which they called their *inlands*, and the other their *outlands*. Their inlands they kept in their own immediate poſſeſſion, and cultivated them by the hands of their ſlaves and villains, in order to raiſe proviſions for their families; their outlands they granted to ceorls or farmers, either for one year, or for a term of years; for which they received a certain ſtipulated proportion of their produce annually. Theſe cuſtoms had long prevailed among their anceſtors in Germany, and were adhered to by their poſterity in England till the conqueſt.

Henry's Hiſtory of Great Britain, vol. ii.

The thanes were under no obligations on account of their lands, except the three following, which were indiſpenſably neceſſary to the defence and improvement of their country: To attend the king with their followers in military expeditions, to aſſiſt in building and defending the royal caſtles, and in keeping the bridges and highways in proper repair. To theſe obligations all proprietors of land (even the churchmen for a long time not excepted) were ſubjected; and theſe ſervices were conſidered as due to their country, rather than to the perſons of their kings; and were agreed to by all as being neceſſary to their own preſervation and convenience.

Thane || Theatre

This title of thane was aboliſhed in England at the conqueſt, upon the introduction of the feudal ſyſtem by William. The titles of earl and baron were about the ſame period introduced into Scotland by Malcolm Canmore, when the title of thane fell into diſuſe.

THANET, an iſland of the county of Kent, ſurrounded by the ſea except on the north-eaſt ſide, where it is bounded by the branches of the river Stour, now inconſiderable to what they were formerly. It contains ſeveral villages, and the ſea port towns of Margate and Ramſgate, and has the title of an earldom. It is celebrated for being the ſpot through which arts, ſciences, and divine knowledge, came into this happy iſle. The Britons called it *Richborough*, from its vicinity to the city of that name, now only a venerable ruin; but the Saxons called it *Thanet*, from fire, having ſo many beacons erected on it. It is in the north-eaſt part of the county, lies open to the ſea on the north and eaſt, with the river Wantſum on the weſt and ſouth, is about 10 miles long from the North Foreland to Sarre-Bridge, and about 8 broad from Weſtgate to Sandwich-Ferry. The north part of it is chiefly arable; and the ſouth and weſt parts conſiſt of marſh or paſture-lands. The ſoil is generally very fertile, eſpecially in producing the beſt barley, of which it is computed above 20,000 quarters are annually ſent to London.

Lucombe's England's Gazetteer

THAPSIA, the DEADLY CARROT, a genus of plants belonging to the claſs *pentandria*, and in the natural ſyſtem ranging under the 45th order, *Umbellatæ*. See BOTANY *Index*.

THAWING, the reſolution of ice into its former fluid ſtate by the warmth of the air. See CONGELATION and FROST.

THEA. See TEA.

THEATINES, a religious order in the Romiſh church, ſo called from their principal founder John Peter Caraffa, then biſhop of Theate, or Chieti, in the kingdom of Naples, and afterwards pope, under the name of Paul IV. The names of the other founders were Gaetan, Boniface, and Conſiglieri. Theſe four pious men deſiring to reform the eccleſiaſtical ſtate, laid the foundation of an order of regular clerks at Rome in the year 1524. Pope Clement VII. approved the inſtitution, and permitted the brethren to make the three religious vows, to elect a ſuperior every three years, and to draw up ſtatutes for the regulation of the order. They were the firſt who endeavoured, by their example, to revive among the clergy the poverty of the apoſtles and firſt diſciples of our Saviour, and were alſo the firſt who aſſumed the title of *regular clerks*.

THEATRE, a place in which ſhows or dramatic repreſentations are exhibited.

For the origin of the dramatic art we always turn our eyes to Greece, the nurſery of the arts and ſciences. It may indeed have been known among more ancient nations,

nations, but no records remain sufficient to support this opinion. The different states of Greece asserted their claim to the honour of having given it birth, but the account of the Athenians is most generally received. It derived its origin from the hymns which were sung in the festivals of Bacchus in honour of that deity. While these resounded in the ears of the multitude, choruses of Bacchants and Fauns, ranged round certain obscene images which they carried in triumphal procession, chanted lascivious songs, and sometimes sacrificed individuals to public ridicule.

This was the practice in the cities; but a still greater licentiousness reigned in the worship paid to the same divinity by the inhabitants of the country, and especially at the season when they gathered the fruits of his beneficence. Vintagers, besmeared with wine lees, and intoxicated with joy and the juice of the grape, rode forth in their carts, and attacked each other on the road with gross sarcasms, revenging themselves on their neighbours with ridicule, and on the rich by publishing their injustice.

Among the poets who flourished at that time, some celebrated the great actions and adventures of gods and heroes, and others attacked with asperity the vices and absurdities of individuals. The former took Homer for their model, and supported themselves by his example, of which they made an improper use. Homer, the most tragic of poets, the model of all who have succeeded him, had in the Iliad and the Odyssey brought to perfection the heroic poem, and in his Margites had employed pleasantry. But as the charm of his works depends in a great measure on the passions and motion with which he knew to animate them, the poets who came after him endeavoured to introduce into theirs an action which might excite emotion or mirth in the spectators: some even attempted to produce both, and ventured certain rude essays, which have since been styled indifferently either tragedies or comedies, because they unite the characters of those two dramas. The authors of these sketches have been distinguished by no discovery; they only form in the history of the art a succession of names which it would be useless to recal to light.

The necessity and power of theatrical interest was already known. The hymns in honour of Bacchus, while they described his rapid progress and splendid conquests, became imitative; and in the contests of the Pythian games, the players on the flute who entered into competition were enjoined by an express law to represent successively the circumstances that had preceded, accompanied, and followed the victory of Apollo over Python.

Some years after this regulation, Susarion and Thespis, both born in a small borough of Attica, named *Icaria*, appeared each at the head of a company of actors, the one on a kind of stage, the other in a cart (A). The former attacked the vices and absurdities of his time; and the latter treated more noble subjects, which he took from history.

The comedies of Susarion were in the same taste with those indecent and satirical farces which were afterwards performed in some of the cities of Greece. They were long the favourite entertainment of the country people. Athens did not adopt this species of exhibition until after it was brought to perfection in Sicily.

Thespis had more than once seen in the festivals, in which as yet hymns only were sung, one of the singers, mounted on a table, form a kind of dialogue with the chorus. From this hint he conceived the idea of introducing into the tragedies an actor who, by simple recitals introduced at intervals, should give relief to the chorus, divide the action, and render it more interesting. This happy innovation, together with some other liberties in which he had allowed himself, gave alarm to the legislator of Athens, who was more able than any other person to discern the value or danger of the novelty. Solon condemned a species of composition in which the ancient traditions were disguised by fictions. "If we applaud falsehood in our public exhibitions (said he to Thespis), we shall soon find that it will insinuate itself into our most sacred engagements."

The excessive approbation and delight with which both the city and country received the pieces of Thespis and Susarion, at once justified and rendered useless the suspicious foresight of Solon. The poets, who till then had only exercised their genius in dithyrambics and licentious satire, struck with the elegant forms which these species of composition began to assume, dedicated their talents to tragedy and comedy. Soon after a greater variety was introduced in the subjects of the former of these poems. Those who judged of their pleasures only from habit exclaimed, that these subjects were foreign to the worship of Bacchus; but the greater number thronged with still more eagerness after the new pieces.

Phrynichus, the disciple of Thespis, made choice of that kind of verse which is most suitable to the drama, was the author of some other changes, and left tragedy in its infancy.

Æschylus received it from his hands enveloped in a rude vestment, its visage covered with false colours, or a mask inexpressive of character, without either grace or dignity in its motions, inspiring the desire of an interest which it with difficulty excited, still attached to the buffooneries which had amused its infant years, and expressing its conceptions sometimes with elegance and dignity, but frequently in a feeble and low style, polluted with gross obscenities.

In his first tragedies he introduced a second actor; and afterwards, copying the example of Sophocles, who had just entered on his theatrical career, he admitted a third, and sometimes even a fourth. By this multiplicity of personages, one of his actors became the hero of the piece, and attracted to himself the principal interest; and as the chorus now held only a subaltern station, Æschylus took care to shorten its part, and perhaps even carried this precaution too far.

He is censured for having admitted mute characters into his drama. Achilles, after the death of his friend, and Niobe, after the destruction of her children, appear

(A) Susarion represented his first pieces towards the year 580 before Christ. Some years after, Thespis made his first attempts in tragedy, and acted his Alcestis in 536.

Theatre. on the ſtage, and remain during ſeveral ſcenes motionleſs, with their heads covered with a veil, and without uttering a word; but if their eyes had overflown with tears, and they had poured forth the bittereſt lamentations, could they have produced an effect ſo terrible as this veil, this ſilence, and this abandonment to grief?

It was not ſufficient that the noble and elevated ſtyle of tragedy ſhould leave in the minds of the auditors a ſtrong impreſſion of grandeur; to captivate the multitude, it was requiſite that every part of the ſpectacle ſhould concur to produce the ſame effect. It was then the general opinion that nature, by beſtowing on the ancient heroes a more lofty ſtature, had impreſſed on their perſons a majeſty which procured them as much reſpect from the people as the enſigns of dignity by which they were attended. Æſchylus therefore raiſed his actors on high ſtilts or buſkins. He covered their features, which were frequently diſagreeable, with a maſk that concealed their irregularity. He clothed them in flowing and magnificent robes, the form of which was ſo decent, that the prieſts of Ceres have not bluſhed to adopt it. The inferior actors were alſo provided with maſks and dreſſes ſuited to their parts.

Inſtead of thoſe wretched ſcaffolds which were formerly erected in haſte, he obtained a theatre furniſhed with machines, and embelliſhed with decorations. Here the ſound of the trumpet was reverberated, incenſe was ſeen to burn on the altars, the ſhades of the dead to ariſe from the tomb, and the furies to ruſh from the gulfs of Tartarus. In one of his pieces theſe infernal divinities appeared, for the firſt time, with maſks of a horrid paleneſs, torches in their hands, ſerpents intertwined in their hair, and followed by a numerous retinue of dreadful ſpectres. It is ſaid that, at the ſight of them, and the ſound of their terrific howlings, terror ſeized on the whole aſſembly, women miſcarried, and children expired with fear; and that the magiſtrates, to prevent ſimilar accidents in future, commanded that the chorus ſhould conſiſt only of fifteen actors inſtead of fifty.

The effect of ſo many new objects could not but aſtoniſh the ſpectators; nor were they leſs ſurpriſed and delighted at the intelligence diſplayed in the performance of the actors, whom Æſchylus almoſt always exerciſed himſelf. He regulated their ſteps, and taught them to give additional force to the action by new and expreſſive geſtures.

The progreſs of the art was extremely rapid. Æſchylus was born 525 years before Chriſt, 11 years after Theſpis had acted his Alceſtis. He had for competitors Chœrilus Pratenas, and Phrynichus, whoſe glory he eclipſed, and Sophocles, who rivalled his own. Sophocles was born about the year 497 B. C. about 14 years before Euripides. Theſe carried tragedy to the higheſt perfection to which it attained among the Greeks. Æſchylus painted men greater than they can be, Sophocles as they ought to be, and Euripides as they are.

Invented towards the 50th Olympiad (about 580 B. C.), and adapted to the rude manners of the ruſtics, comedy ventured not to approach the capital; and if by chance ſome companies of actors, who were unconnected with any others, found their way into the city, and performed their indecent farces, they were leſs authoriſed than tolerated by the government. It was not till after a long infancy that this ſpecies of drama began ſuddenly to make a rapid improvement in Sicily. Inſtead of a ſucceſſion of ſcenes without connection or tendency, the philoſopher Epicharmus introduced an action, all the parts of which had a dependence on each other; and conducted his ſubject, without wandering from it, through a juſt extent to a determinate end. His pieces, ſubjected to the ſame laws of tragedy, were known in Greece, where they were conſidered as models; and comedy ſoon ſhared with her rival the ſuffrages of the public, and the homage due to genius. The Athenians, eſpecially, received her with the ſame tranſports as they would have teſtified at the news of a victory: many of their poets exerciſed their genius in this novel ſpecies of compoſition; and their names adorn the numerous liſt of writers who have been diſtinguiſhed in comedy from the time of Epicharmus. Such were, among the more ancient, Magnes, Cratinus, Crates, Pherecrates, Eupolis, and Ariſtophanes. They all flouriſhed in the age of Pericles. Theatre.

If we peruſe the comic pieces which have come down to us, we ſhall be convinced that the ſole object of the authors was to pleaſe the multitude. The gods and heroes were traveſtied, groſs and obſcene language was often employed, and virulent invectives were often thrown out againſt individuals of the firſt rank for genius and virtue. Towards the end of the Peloponneſian war the licentiouſneſs of comedy was reſtrained. The chorus was laid aſide, becauſe the rich citizens were alarmed, and would no longer contribute money to ſupport it, nor provide maſks with portraits for expoſing individuals.

The poets being thus reſtrained from mentioning names of living perſons on the ſtage, invented falſe names. They ſtill expoſed real and known characters; and thus gave a more exquiſite gratification to the ſpectators, who were highly amuſed with finding out the perſons intended. The conſequence of the law was only to make that done with delicacy which was formerly done in the moſt indecent and ſcurrilous manner. Ariſtophanes, in ſome of his lateſt pieces, has given us ſome good examples of this kind of comedy, which is ſometimes called the middle comedy.

Comedy was ſtill liable to abuſe, and therefore required farther reformation. As the uſe of real names had formerly been prohibited, real ſubjects were alſo forbidden; and comedy from that time was no longer a fury armed with torches, or a firebrand ſcattering miſchief, but a pleaſing and inſtructive companion. This is called the new comedy. The moſt eminent among the Greeks in this improved ſpecies was Menander. His writings are now loſt; but we may form a good eſtimate of their merit from the comedies of Terence, which are ſaid to have been borrowed from Menander, and to have nearly reſembled the original, though inferior in that *vis comica* by which the elegant Grecian was diſtinguiſhed. The comedy of Menander is that which has been cultivated in modern times.

To give ſome idea of a Grecian theatre, we ſhall deſcribe very ſhortly the theatre of Bacchus in Athens, which was built by the famous architect Philos in the time of Pericles. The part intended for the ſpectators was of a ſemicircular form, at the diameter of which was erected the ſtage. The orcheſtra occupied the ſpace where the pit in modern theatres is ſituated, where

the

Theatre.

the muſic, the chorus, and the mimi were placed. It was four feet elevated above the ground. The ſpectators were arranged in three galleries round all the ſides of the orcheſtra except that next the ſtage, each gallery containing eight rows of ſeats. At the farther end of the orcheſtra, where the ſtage is erected in modern theatres, ſtood the thymele or logeon, but projecting a little towards the audience. It was a little higher than the orcheſtra, and did not extend the whole breadth of it. In ſome theatres it was only ſix feet ſquare. Here the principal part of the chorus made their recitations, and in comical interludes the mimi performed. Behind the thymele appeared the ſtage or proſcenion, conſiderably elevated. No part of this theatre was covered except the ſtage, and a high gallery called *circys* ſet apart for the women. The Athenians, being expoſed to the weather, came uſually with great cloaks, to ſecure them from the rain or the cold; and for defence againſt the ſun they had the *ſciadion*, a kind of paraſol, which the Romans uſed alſo in the theatres by the name of *umbellæ*; but when a ſudden ſtorm aroſe, the play was interrupted, and the ſpectators diſperſed.

A ſort of tent-work over the entire area of the edifice might have been contrived as a ſhelter from the rain and a ſhade from the ſun. Such a covering would have obviated the inconveniences of roofed theatres, which obſtruct the free communication of the air, and of unroofed theatres, which do not keep out the weather. At Athens the plays were always repreſented in the daytime, which made the unroofed theatres leſs inconvenient.

Plays were repreſented only during the three feſtivals ſolemnized in honour of Bacchus. The firſt of theſe was celebrated at the Piræus, where ſome of Euripides's pieces were firſt performed. The ſecond, which laſted only one day, was kept at the end of January or beginning of February. The third, called the greater *Dionyſia*, was celebrated a month after. It continued ſeveral days, and attracted a great multitude of ſpectators. In the feſtivals which laſted only one day, five or ſix dramatic pieces, either tragedies or comedies, were performed. But in the greater Dionyſia, which continued longer, 12 or 15, and ſometimes more, were acted. The performance began early in the morning, and ſometimes laſted the whole day.

The chorus, according as the ſubject demanded, was compoſed of men and women, old men or youths, citizens or ſlaves, prieſts, ſoldiers, &c. to the number of 15 in tragedy, and 24 in comedy. The chorus came upon the ſtage preceded by a flute-player, who regulated their ſteps; ſometimes one after the other, but in tragedy more frequently three in front and five in depth, or five in front and three in depth.

The ſame perſons performed both in tragedy and comedy; but, as among ourſelves, it was rare to meet with any who excelled in both. The pay of thoſe who had acquired great reputation was conſiderable. Polus gained a talent in two days (equal to 225l. ſterling *). Players of eminence were ſolicited by different actors of Greece to attend their feſtivals. If, after making an engagement, they failed, they were obliged to pay a certain ſum of money; and if they were abſent during the feſtivals of their own republic, they were condemned to a heavy fine.

The actors had habits and ſymbols ſuited to their parts. Kings wore a diadem, leaned on a ſceptre which ſupported an eagle on its top, and were dreſſed in long robes of purple or other ſplendid colours ornamented with gold. Heroes, beſides having their ſtature frequently increaſed to ſix feet Engliſh †, and their bulk in proportion, were frequently covered with the ſkin of a lion or a tyger, and armed with ſwords, quivers, and clubs. All who ſuffered misfortunes wore a black, brown, or dirty white garment, which frequently hung in tatters. There were various kinds of maſks for tragedy, comedy, and ſatire. Theſe certainly took away the pleaſure ariſing from the expreſſion of the countenance; but at any rate, little pleaſure could be derived from this circumſtance in a Grecian theatre, from its immenſe ſize, and the great diſtance of the audience from the ſtage.

† *Ariſt. in Ran.* v. 1046. *Athen.* lib. v. cap. 7.

Dramatic entertainments were introduced at Rome in the year of the city 391. They were called *ludi ſcenici*, becauſe they were firſt acted in a ſhade formed by the branches and leaves of trees. They were borrowed immediately from Etruria, whence alſo they received their firſt players. Theſe Etrurians at firſt only danced to a flute, without either ſinging or acting. The Roman youth ſoon imitated them at their ſolemn feſtivals, adding raillery in rude verſes, and geſtures adapted to the ſubject. Theſe verſes were called *Feſcennini*, from Feſcennia, a city of Etruria. Livius Andronicus was the firſt poet who wrote a regular play in Latin. This happened in the year of Rome 512 or 514, about 160 years after the death of Sophocles and Euripides, and 52 after that of Menander. The Grecian model was afterwards introduced and cultivated much by ſucceeding dramatic writers. This was the model of Menander, for the old and middle comedy was unknown at Rome. As the Romans were only imitators of the Greeks in the dramatic art, as well as in moſt of the arts and ſciences, nothing more is neceſſary to be ſaid in addition to the account which we have already given of the Grecian ſtage.

The origin of the Engliſh ſtage is hid in obſcurity. It was not, however, copied from the Grecian or Roman; for it was evidently different in form as well as in matter, and may with more propriety be deduced from a Gothic original. It appears that there were theatrical entertainments in England almoſt as early as the conqueſt; for we are told by William Stephanides or Fitz-Stephen, a monk, who in the reign of Henry II. wrote his *Deſcriptio Nobiliſſimæ Civitatis Londoniæ*, that "London, inſtead of the common interludes of the theatre, had plays of a more holy kind; repreſentations of the miracles of confeſſors, and the ſufferings of martyrs." At this time there were alſo certain ſets of idle people, who travelled the countries and were called *Mummers*, a kind of vagrant comedians, whoſe excellence conſiſted altogether in mimickry and humour.

Gentleman's Magazine for 1761.

It is probable that, ſoon after this time, the dramatic repreſentations called *Myſteries* were exhibited: Theſe myſteries were taken from ſcripture-hiſtory: ſome repreſented the creation of the world, with the fall of Adam and Eve; ſome the ſtory of Joſeph; and others even the incarnation and ſufferings of the Son of God. Theſe pieces were exhibited in a manner ſo ridiculous as to favour libertiniſm and infidelity, as appears by a petition of the chaunters of St Paul's cathedral to Richard II. in 1378, praying, that "ſome unexpert people might be

Cibber's Apology for his Life.

Theatre.

be prohibited from repreſenting the hiſtory of the Old Teſtament to the prejudice of the ſaid clergy, who had been at great expence to repreſent it publicly at Chriſtmas."

In the year 1390, the pariſh clerks of London are ſaid to have played interludes at Skinner's-well on three ſucceſſive days in July; and, in 1409, to have acted for eight days ſucceſſively a play concerning the creation of the world, at the ſame place which thence acquired the name of *Clerkenwell*.

Theſe Myſteries were ſucceeded by Moralities, in which there were ſome rude traces of a fable and a moral; and ſome alſo of poetry, the virtues, vices, and other affections of the mind being frequently perſonified.

After theſe Moralities came what were called Interludes, which made ſome approaches to wit and humour. Many of theſe pieces were written by John Heywood, jeſter to Henry VIII.

In the time of Henry VIII. one or two pieces had been publiſhed under the claſſical names of *Comedy* and *Tragedy*, but they appear not to have been intended for popular uſe. It was not till the religious ferments had ſubſided that the public had leiſure to attend to dramatic poetry. In the reign of Elizabeth, tragedies and comedies began to appear in form, and could the poets have perſevered, the firſt models were good. *Gorboduc*, a regular tragedy, was acted in 1561; and Gaſcoigne, in 1566, exhibited *Jocaſta*, a tranſlation from Euripides, as alſo *The Suppoſes*, a regular comedy, from Arioſto, near 30 years before any of Shakeſpeare's were printed.

Percy's Relics of Ancient Engliſh Poetry.

The people, however, ſtill retained a reliſh for their old myſteries and moralities, and the popular dramatic poets ſeem to have made them their models. The graver ſort of moralities appear to have given birth to our modern tragedy; as our comedy evidently took its riſe from the lighter interludes of that kind. And as moſt of theſe pieces contain an abſurd mixture of religion and buffoonery, an eminent critic has well deduced from thence the origin of our unnatural tragi-comedies. Even after the people had been accuſtomed to tragedies and comedies, moralities ſtill kept their ground. One of them, intitled *The New Cuſtom*, was printed ſo late as 1573. At length they aſſumed the name of *maſques*, and, with ſome claſſical improvements, became in the two following reigns the favourite entertainments of the court.

As for the old myſteries, which ceaſed to be acted after the reformation, they ſeem to have given riſe to a third ſpecies of ſtage exhibition; which, though now confounded with tragedy or comedy, was by our firſt dramatic writers conſidered as quite diſtinct from them both: theſe were hiſtorical plays, or hiſtories; a ſpecies of dramatic writing which reſembled the old myſteries in repreſenting a ſeries of hiſtorical events ſimply in the order of time in which they happened, without any regard to the three great unities. Theſe pieces ſeem to differ from tragedy juſt as much as hiſtorical poems do from epic: as the Pharſalia does from the Æneid. What might contribute to make dramatic poetry take this turn was, that ſoon after the myſteries ceaſed to be exhibited, there was publiſhed a large collection of poetical narratives, called *the Mirror for Magiſtrates*, wherein a great number of the moſt eminent characters in Engliſh hiſtory are drawn relating their own misfortunes. This book was popular and of a dramatic caſt; and therefore, as an elegant writer has well obſerved, might have its influence in producing hiſtoric plays. Theſe narratives probably furniſhed the ſubjects, and the ancient myſteries ſuggeſted the plan.

That our old writers conſidered hiſtorical plays as ſomewhat diſtinct from tragedy and comedy, appears from numberleſs paſſages of their works. "Of late days (ſays Stow in his Survey of London), inſtead of thoſe ſtage plays have been uſed comedies, tragedies, interludes, and hiſtories, both true and fained." Beaumont and Fletcher, in the prologue to the *Captain*, ſay,

> "This is nor comedy, nor tragedy,
> "Nor *hiſtory*."

Polonius in Hamlet commends the actors as the beſt in the world, either for tragedie, comedie, hiſtorie, paſtoral, &c. And Shakeſpeare's friends, Heminge and Condell, in the firſt folio edition of his plays, in 1623, have not only intitled their book "Mr William Shakeſpeare's Comedies, Hiſtories, and Tragedies," but, in their table of contents, have arranged them under thoſe three ſeveral heads; placing in the claſs of hiſtories, "King John, Richard II. Henry IV. two parts, Henry V. Henry VI. three parts, Richard III. and Henry VIII."

This diſtinction deſerves the attention of the critics: for if it be the firſt canon of ſound criticiſm to examine any work by thoſe rules the author preſcribed for his firſt obſervance; then we ought to try Shakeſpeare's hiſtories by the general laws of tragedy and comedy. Whether the rule itſelf be vicious or not, is another inquiry; but certainly we ought to examine a work only by thoſe principles according to which it was compoſed. This would ſave much impertinent criticiſm.

Not fewer than 19 playhouſes had been opened before the year 1633, when Prynne publiſhed his *Hiſtrio-maſtix*. From this writer we learn that tobacco, wine, and beer, were in thoſe days the uſual accommodations in the theatre, as now at Sadlers Wells. With regard to the ancient prices of admiſſion, the playhouſe called the *Hope* had five different priced ſeats, from ſixpence to half-a-crown. Some houſes had penny benches. The two-penny gallery is mentioned in the prologue to Beaumont and Fletcher's *Woman-hater*; and ſeats of threepence and a groat in the paſſage of Prynne laſt referred to. But the general price of what is now called the *Pitt* ſeems to have been a ſhilling. The time of exhibition was early in the afternoon, their plays being generally acted by day-light. All female parts were performed by men, no actreſs being ever ſeen on the public ſtage before the civil wars. And as for the playhouſe furniture and ornaments, they had no other ſcenes nor decorations of the ſtage, but only old tapeſtry, and the ſtage ſtrewed with ruſhes, with habits accordingly; as we are aſſured in a ſhort Diſcourſe on the Engliſh Stage, ſubjoined to Flecknoe's *Love's-Kingdom*, 1674, 12mo.

(B) For the ſtate of the theatre during the time of Shakeſpeare, ſee PLAYHOUSE; where a full account of it

(B) We have been anxious to give as full an account of the ancient Engliſh drama as we could: we muſt not omit

Theatre. it is given from the late valuable edition of our illuſtrious poet's works by Mr Malone. During the whole reign of James I. the theatre was in great proſperity and reputation: dramatic authors abounded, and every year produced a number of new plays; it became a faſhion for the nobility to celebrate their weddings, birthdays, and other occaſions of rejoicing, with maſques and interludes, which were exhibited with ſurpriſing expence; our great architect, Inigo Jones, being frequently employed to furniſh decorations, with all the luxuriance of his invention and magnificence of his art. The king and his lords, and the queen and her ladies, frequently performed in theſe maſques at court, and the nobility at their private houſes; nor was any public entertainment thought complete without them. This taſte for theatrical entertainments continued during great part of the reign of King Charles I.; but, in the year 1633, it began to be oppoſed by the Puritans from the preſs; and the troubles that ſoon after followed entirely ſuſpended them till the reſtoration of King Charles II. in 1660.

The king, at his reſtoration, granted two patents, one to Henry Killigrew, Eſq. and the other to Sir William Davenant, and their heirs and aſſigns, for forming two diſtinct companies of comedians. Killigrew's were called the *King's Servants*, and Davenant's the *Duke's Company*. About ten of the company called the *King's Servants* were on the royal houſehold eſtabliſhment, having each ten yards of ſcarlet cloth, with a proper quantity of lace allowed them for liveries; and in their warrants from the lord chamberlain they were ſtyled *gentlemen of the great chamber*.

Till this time no woman had been ſeen upon the Engliſh ſtage, the characters of women having always been performed by boys, or young men of an effeminate aſpect, which probably induced Shakeſpeare to make ſo few of his plays depend upon female characters, as they muſt have been performed to great diſadvantage. The principal characters of his women are innocence and ſimplicity, ſuch are Deſdemona and Ophelia; and his ſpecimen of fondneſs and virtue in Portia is very ſhort. But the power of real and beautiful women was now added to the ſtage; and all the capital plays of Shakeſpeare, Fletcher, and Ben Jonſon, were divided between the two companies, by their own alternate choice, and the approbation of the court.

The king's ſervants ſeem to have been allowed to be the beſt company; and when the variety of plays began to be exhauſted, they drew the greater audiences. Davenant, therefore, to make head againſt them, firſt added ſpectacle and muſic to action, and introduced a new ſpecies of plays, ſince called *dramatic operas*; among theſe were, *The Tempeſt*, *Pſyche*, and *Circe*; which, with many others, were ſet off with the moſt expenſive decorations of ſcenes and habits, and with the beſt voices and dancers.

In 1684 the two houſes united, and continued together for ten years. In 1690 the play began at four o'clock; and, we are told, the ladies of faſhion uſed to take the evening air in Hyde-park after the repreſentation; by which it appears that the exhibitions were in ſummer too. The principal actors were, Betterton, Montfort, Kynaſton, Sandford, Nokes, Underhill, and Leigh, commonly called *Tony Leigh*; the actreſſes were, Mrs Betterton, Barry, Leigh, Butler, Montfort, and Bracegirdle; and to this company, in this year, old Cibber was admitted as a performer in the loweſt rank. It was a rule with the patentees, that no young perſon, who offered himſelf as an actor, ſhould be admitted into pay till after at leaſt half a year's probation; and Cibber waited full three quarters of a year before he was taken into a ſalary of 10s. a-week. Theatre.

In 1695 a new theatre was opened with Mr Congreve's comedy of Love for Love, which had ſuch extraordinary ſucceſs (ſays Cibber) that ſcarce any other play was acted there till the end of the ſeaſon; but when the ſeaſon ended, which appears to have begun in June, he does not tell us, and it is indeed difficult to gueſs; for though the company acted in ſummer, it ſeems improbable that they ſhould ſhut up the houſe in winter, as it is difficult to conceive any reaſon for ſo doing. Congreve was then in ſuch high reputation, that this company offered him a whole ſhare (but into how many ſhares the whole was divided Colley has not told us) upon condition he would give them a new play every year. This offer he accepted, and received the advantage, though he never fulfilled the condition; for it was three years before he produced the *Mourning Bride*, and three more before he gave them the *Way of the World*.

It is not neceſſary that we give in detail the remaining hiſtory of the Engliſh ſtage: thoſe who are anxious to be acquainted with it may conſult Cibber's hiſtory of the ſtage, continued by Victor, under the title of *A Hiſtory of the Theatres of London and Dublin from the year* 1730. We ſhall only mention a few facts reſpecting the ſalaries of the players about that period, and the riſe of the price of play tickets.

A difference having ariſen in 1733 between the managers and actors, moſt of the actors ſet up for themſelves at the little theatre in the Haymarket. Upon this the managers publiſhed the following account of their ſalaries, to ſhow the public how little room they had to mutiny. To Mr Colley Cibber, from the time of letting his ſhare till he left the ſtage, 12l. 12s. per week. Mr The. Cibber 5l. and his wife's whole ſalary till her death, without doing the company any ſervice the greateſt part of the winter; and his own alſo, during the time of his being ill, who performed but ſeldom till after Chriſtmas. Mr Mills jun. 3l. under the ſame circumſtances with regard to his wife. Mr Mills ſen. 1l. per day for 200 days certain, and a benefit clear of all charges. Mr Johnſton 5l. Mr Miller 5l. paid him eight weeks before he acted, beſides a preſent of 10 guineas. Mr Harper 4l. and a preſent of 10 guineas. Mr Griffin 4l. and a preſent. Mr Shepard 3l. Mr Hallam, for himſelf and father (though the latter is of little or no ſervice) 3l. Mrs Heron 5l. raiſed from 40s. laſt winter, yet refuſed to play ſeveral parts aſſigned her, *Gentleman's Magazine* for 1733.

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omit, however, to inform our readers what Mr Malone ſays of the old plays, viz. that not one play publiſhed before 1592 will bear a ſecond reading; and that excluſive of myſteries, moralities, and tranſlations, there are but 34 pieces extant which were publiſhed before that period.

Theatre || Thebes.

her, and acted but ſeldom this ſeaſon. Mrs Butler 3l. per week. By theſe and other ſalaries, with the incident charges (beſides clothes and ſcenes), the patentees are at the daily charge of 49l. odd money, each acting-day.

Till about the ſame time, the prices at the theatre were 4s. the boxes, 2s. 6d. the pit, 1s. 6d. the firſt gallery, and 1s. the ſecond, except upon the firſt run of a new play or pantomime, when the boxes were 5s. the pit 3s. the firſt gallery 2s. and the ſecond 1s. But Fleetwood thought fit to raiſe the prices for an old pantomime, which was revived without expence. This produced a riot for ſeveral nights, and at laſt a number deputed by the pit had an interview with the manager in the green room, where it was agreed, that the advanced prices ſhould be conſtantly paid at the doors, and that ſuch perſons as did not chooſe to ſtay the entertainment ſhould have the advanced part of their money returned. This was a very advantageous agreement for the manager; becauſe, when the audience had once paid their money, and were ſeated, very few went out at the end of the play, and demanded their advanced money; the few that did it at firſt, ſoon grew tired, and at laſt it ſettled in the quiet payment of the advanced price, as at this day.

It has been frequently a ſubject of debate, whether the ſtage be favourable to morals. We do not mean to enter into the controverſy; but we ſhall make an obſervation or two. It will be allowed by all, that the intention of the players in acting, is to procure money; and the intention of the audience in attending the theatre, is to ſeek amuſement. The players then will only act ſuch plays as they believe will anſwer their intention. And what ſort of plays are theſe? They are ſuch as correſpond with the opinions, manners, and taſte, of the audience. If the taſte of the audience be groſs, therefore the plays will be groſs; if delicate and refined, they will be the ſame. And if we go back to the time of Shakeſpeare, we ſhall find that this has been uniformly the caſe. The concluſion, then, which we draw, is this, if the taſte of the audience be pure, free from licentiouſneſs, the plays will be the ſame, and the ſtage will be favourable to virtue.

THEBAID, a celebrated heroic poem of Statius, the ſubject of which is the civil war of Thebes, between the two brothers Eteocles and Polynices; or Thebes taken by Theſeus.

THEBES, the name of a celebrated city of ancient Greece. It is ſuppoſed to have been built by Cadmus, about the year of the world 2555. This Cadmus, according to the Greeks, was the ſon of Agenor king of Sidon or of Tyre; but the Sidonians allow him to have been of no higher quality than his cook, and tell us that his wife was a muſician at court, with whom he ran away into Greece. The Greek writers tell us, that being commanded by his father to go in ſearch of his daughter Europa, whom Jupiter in the ſhape of a bull had carried off, and forbid to return without her, he built, or rebuilt, the city of Thebes, after having long ſought her in vain. He was at firſt oppoſed by the Hyantes and Aones; the former of whom he defeated in battle, and forced to retire into Locris; the latter ſubmitted, and were incorporated among his ſubjects.

1 Account of Cadmus the founder of Thebes.

Thoſe who endeavour to extract ſome truth from the multitude of fables in which the early part of the Grecian hiſtory is obſcured, are of opinion that Cadmus was one of the Canaanites expelled by Joſhua; and that he was of the family of the Cadmonites mentioned by Moſes and Joſhua. He is univerſally allowed to have introduced the Phœnician letters into Greece, ſet up the firſt ſchools, and introduced braſs; which, from him, had the name of *Cadmean* given to it. The government of Thebes continued for a long time monarchical; and the names of a number of its kings have been tranſmitted to us, with ſome account of their tranſactions; but very much obſcured by fable.

Thebes 2 Suppoſed be one of the exiled Canaanit

Though the Thebans had been famed in the early period of their hiſtory for their martial achievements, yet in proceſs of time they ſeem to have degenerated. At the time of the invaſion of Xerxes, they were the firſt people in Greece who were gained over to the Perſian intereſt. On account of this conduct, they became very obnoxious to the other ſtates, eſpecially to the Athenians, whoſe power and renown increaſed every day, and threatened at laſt to ſwallow them up altogether. The Thebans being in no condition to oppoſe ſuch a formidable power, put themſelves under the protection of the Spartans, who, out of jealouſy of the Athenians, readily forgave them; and ſo grateful were the Thebans for the kindneſs ſhown them at this time, that during the whole of the Peleponneſian war Sparta had not a more faithful ally. By theſe means they not only recovered the government of Bœotia, of which they had been formerly in poſſeſſion, till deprived of it on account of their ſiding with the Perſians, but their city became one of the firſt in Greece. By this proſperity the Thebans were ſo much elated, that, when the peace of Antalcidas came to be ſigned, they refuſed to agree to it, as they were thus once more deprived of the government of Bœotia; ſo that it was not without the utmoſt difficulty that they were overawed into it by the other ſtates. Not content with forcing them to give up this point, however, the Spartans undertook to change the form of the Theban government, which at this time was a democracy, and accompliſhed through the treachery of thoſe who had the care of the citadel.

3 The Thebans a degenerate ſtupid people.

4 Put themſelves under the protection of the Spartans.

5 The form of government changed, and the citadel ſeized by the Spartans.

The Thebans continued under the power of the Spartans for four years; at the end of which term a conſpiracy being formed againſt them by ſome of the principal people in the city, among whom was a young nobleman named *Pelopidas*, the Spartans were maſſacred and driven out, and the citadel regained. During the tumult Epaminondas, afterwards the celebrated general, with a number of the beſt citizens, joined the party of Pelopidas; and the latter having called a general aſſembly of the Thebans, proclaimed liberty to them, and exhorted them in the ſtrongeſt manner to fight for their country. This ſpeech was received with the greateſt acclamations; Pelopidas was unanimouſly proclaimed the preſerver of Thebes, and was charged with the management of the war which was then to be declared againſt Sparta.

6 The Thebans recover their liberty under Pelopidas.

Theſe tranſactions ſo much exaſperated the Spartans, that they immediately ſent their king Cleombrotus againſt them, though it was then the depth of winter. The Athenians, in the mean time, who had hitherto aſſiſted the Thebans, declined any farther connection, leſt they ſhould draw upon themſelves the reſentment of

7 War with Sparta.

the

ebes. the Spartans. But they were ſoon after determined to act again on the ſame ſide, by an attempt which the Spartan general, Sphodnas, had raſhly made on the Pyræus or harbour of Athens. Thus, by means of the Athenians, a powerful diverſion was made in favour of the Thebans, who gradually recovered all the towns of Bœotia, and at length began to act offenſively againſt their enemies, and made a powerful invaſion in Phocis. They had now many ſharp encounters with them; which, though they did not amount to deciſive battles, yet did not fail to raiſe their courage, and depreſs that of the Spartans. In theſe encounters Pelopidas always ſignalized himſelf; and in the battle of Tanagra, where the Lacedæmonians were entirely defeated by the Athenians and their allies, Pelopidas had a principal ſhare in the victory, and killed the Spartan general with his own hand. Soon after this, with a body of only 300 Thebans, he entirely routed and diſperſed near 1000 Spartans; which was the greateſt diſgrace the latter had ever known; for till that time, whether in war with the Greeks or barbarians, they had never been overcome by an equal, much leſs by ſuch an inferior number of troops.

Theſe ſucceſſes of the Thebans greatly alarmed the Athenians, who continually ſought to oppoſe their growing power. In this oppoſition they were joined by the Platæans, who on this account became extremely obnoxious to the Thebans, ſo that they at laſt came to a reſolution to ſurpriſe their city. This they accompliſhed, and entirely deſtroyed it, together with Theſpia, another city extremely well affected to Athens. Soon after this, the Thebans, encouraged by their ſucceſs, began to think of enlarging their territories, and of making encroachments on their neighbours, as they ſaw other ſtates had done before them. This ſpirit of conqueſt is ſaid to have been raiſed by their general Pelopidas; in which he was ſeconded by Epaminondas, a perſon who, though like him endowed with all the neceſſary qualities to make a complete captain or patriot, had till then preferred a private life, and lived in a conſtant courſe of virtue and the ſtudy of philoſophy. He had as yet ſeldom appeared in public, except to get himſelf excuſed from thoſe ſtate employments which were ſo eagerly courted by others. This, however, had not hindered him from contracting an intimate friendſhip with Pelopidas, which had been daily improved by the correſpondence of their tempers and principles, as well as by that zeal which both diſplayed for the good of their country; which laſt had made them, even before this time, appear together in action, and to ſuch advantage, that Epaminondas's merit could be no longer concealed, nor indeed ſuffer him to continue longer in his beloved retirement: ſo that he ſaw himſelf, at length, deſervedly placed at the head of the Theban troops; where he gave ſuch early proofs of his future proweſs and abilities, as juſtly gave him the next rank to Pelopidas. Both came now to be conſidered in the ſame light, as generals in the field, as governors at home, and as complete ſtateſmen in the council. When the general treaty for reſtoring peace to Greece came to be propoſed by the Athenians, and was upon the point of being executed by the reſt of the ſtates, the Thebans refuſed to agree to it, unleſs they were comprehended in it under the name of *Bœotians*. This demand was as ſtrenuouſly oppoſed by the other contracting powers as

inſiſted on by Epaminondas, who was there as ambaſſador on the part of the Thebans. Ageſilaus, in particular, told him in plain terms, that the Thebans ought to evacuate Bœotia, and leave the cities of it free and independent. To which it was anſwered by him, that the Lacedæmonians would do well to ſet them the example, by reſtoring Meſſenia to its ancient proprietors, and Laconia to its ancient freedom; for that the pretenſions of the city of Thebes to Bœotia were as well founded, at leaſt, as thoſe of Sparta to thoſe two countries. After this he went on, and ſhowed how far Sparta had aggrandized herſelf at the expence of her neighbours: that peace might be indeed obtained, and upon a ſolid and laſting footing; but that this could not be otherwiſe than by bringing all to an equality. This bold though juſt remonſtrance, in which not only Thebes, but Greece in general was concerned, failed not, however, to exaſperate the haughty Spartan monarch; and the Athenians, who had till now looked upon the Thebans as dependents either on them or on the Macedonians, were not a little offended to hear their ambaſſadors talk in ſuch high terms. The reſult of the conference was, that Ageſilaus ſtruck the name of *Thebes* out of the treaty, and declared war againſt them, about the year 371 B. C.

Thebes.

11 His difference with Ageſilaus king of Sparta.

The Thebans were in no ſmall conſternation to ſee themſelves engaged in a war with the powerful Spartans, without any ally to aſſiſt them; and the reſt of the Grecian ſtates having made peace with the latter, began to look upon the ruin of the former as unavoidable. However, they reſolved to make the beſt defence they could; and put their army under the command of Epaminondas, aſſigning him, at his own requeſt, ſix others to act as counſellors or aſſiſtants. The Theban army conſiſted at moſt but of 6000 men, whereas that of the enemy was at leaſt thrice that number; but Epaminondas truſted moſt to his horſe, wherein he had much the advantage both in quality and good management: the reſt he endeavoured to ſupply by the diſpoſition of his men, and the vigour of the attack. He even refuſed to ſuffer any to ſerve under him in the engagement, but ſuch as he knew to be fully reſolved to conquer or die. The two armies met at Leuctra, where the Spartans were defeated with great ſlaughter, as related under that article.

12 The Spartans declare war againſt Thebes.

13 Are entirely defeated at Leuctra.

The victorious general, deſirous to improve this great victory, ſent an herald, crowned with garlands, to communicate it in form to the Athenians, in hopes that this would be an effectual means to reunite them to the Theban intereſt. But it proved quite otherwiſe. Athens, which now looked upon them with a jealous eye, and had then in view the ſovereignty of Greece, choſe rather, if they could not wholly obtain it, to ſhare it with Sparta, than to let the Thebans into the whole; and therefore even declined giving their herald audience. However, the Thebans took care to ſtrengthen themſelves by alliances; and, beſides the Arcadians and Eleans, had got the Phocians, Locrians, Acarnanians, Eubœans, and other ſtates, under their dependence: ſo that they were now in a condition to act offenſively againſt the Spartans. Accordingly, under pretence of aſſiſting the Arcadians, they entered Peloponneſus with a gallant army, with Epaminondas and Pelopidas at their head. Here they were joined by the Arcadian and other confederate forces; ſo that the whole amounted to 40,000, ſome

14 The Athenians jealous of the Thebans.

15 The Thebans invade Peloponneſus with a formidable army, but are repulſed.

Thebes. ſome ſay 50,000 men, beſides great numbers of thoſe who followed the camp, rather for plunder than fighting, and were computed about 20,000 more. The army was divided into four columns, and moved ſtraight towards Sellaſia, the place of rendezvous, from which they purſued their journey with fire and ſword towards Sparta. But here they were repulſed by Ageſilaus, who was then returned to that metropolis.

To repair, in ſome meaſure, this diſgrace, and at the ſame time to leave ſome laſting monument which ſhould redound as much to his glory as to the mortification of the Spartans, Epaminondas left not their territories till he had reſtored the poſterity of the old Meſſenians to their ancient dominions, out of which they had been baniſhed near 300 years; rebuilt their capital, and left a ſtrong garriſon for its defence. He was, however, nearly cut off in his return by Iphicrates, whom the Athenians had ſent with 12,000 men to intercept him; but this laſt loitered ſo long at Corinth, that the Thebans had paſſed the defiles of Cenchreæ, the chief place where he could have obſtructed his retreat had he taken poſſeſſion of it in proper time. Epaminondas continued his march till he came in full view of the city of Corinth. He found the roads choked up with trees, rocks, ſtones, and every thing that could render them impaſſable; and the Corinthians well fortified, and reſolute on a ſtout defence. But he came ſo furiouſly upon them, notwithſtanding all theſe difficulties, that they abandoned all their entrenchments and outworks to the Thebans, and fled into the city. Thither theſe purſued them ſword in hand, and made an horrid ſlaughter of them; inſomuch that Corinth muſt have unavoidably fallen into their hands, had their generals thought fit to purſue theſe advantages; but whether they were afraid of the Athenians falling upon them, or apprehended ſome dangerous ambuſh in a country with which they were but indifferently acquainted, or whether the army was too much weakened through ſo many fatigues, or laſtly, whether the coldneſs of the ſeaſon, it being then the depth of winter, would not permit them to proceed farther, they immediately marched towards Bœotia. This gave ſuch an advantage to their enemies, that they met with a very mortifying reception at their return to Thebes, where they were both arreſted, and ſeized as ſtate-priſoners, for having preſumed to prolong their command four months longer than the time limited by law, which time took in almoſt the whole of their expedition from their firſt entrance into Peloponneſus. However, at laſt, the judges being aſhamed to proceed any farther, they were both honourably acquitted.

16 The Meſſenians reſtored to their ancient dominions.

17 The Corinthians defeated.

18 Epaminondas and Pelopidas diſgraced at Thebes.

This proſecution had been chiefly carried on and encouraged by Meneclides a diſcontented Theban, and a bold and able ſpeaker, who, by his artful calumnies at the trial, had ſo far prevailed with the judges as to get Epaminondas deprived of the government of Bœotia for a whole year, though he could not gain the ſame advantage againſt Pelopidas, who was a greater favourite of the people, as being his ſenior.

19 War renewed with Sparta.

By this delay the Spartans, with much difficulty, had recovered themſelves from their great defeat at Leuctra, and ſettled their affairs in as good a poſture as they could; but though they had repulſed the Thebans in Peloponneſus, yet from the exploits they had performed there, eſpecially in the diſmembering the whole kingdom of Meſſenia from them, they had ſtill cauſe to fear what their forces might do under two ſuch generals; and had accordingly taken due care to ſtrengthen themſelves againſt them, and to provide themſelves with a great number of auxiliaries from other ſtates, eſpecially from that of Athens, with whom they had renewed their old treaty, and had agreed that each ſhould have the command five days alternately. Soon after this treaty the Arcadians renewed the war, and took Pallene in Laconia by ſtorm, put the garriſon to the ſword, and were preſently aſſiſted by the Argives and Eleans, and eſpecially by the Thebans, who ſent to them 7000 foot and 500 horſe under the command of Epaminondas. This ſo alarmed the Athenians likewiſe, that they immediately ſent Gobrias with ſome forces to oppoſe his paſſage in good earneſt; and he ſo behaved himſelf againſt the Thebans, that they were forced to abandon Peloponneſus a ſecond time. This ill ſucceſs gave freſh occaſion to the enemies of Epaminondas to blame his conduct in the higheſt terms, notwithſtanding the ſingular bravery with which he and his troops had forced the paſs. Even his friends could not but ſuſpect him of partiality for the Spartans, in not purſuing his advantage over them, and making a greater ſlaughter of them when he had it in his power; whilſt his enemies made it amount to no leſs than treachery to his country: ſo that their brave general was once more deprived of the government of Bœotia, and reduced to the condition of a private man. He did not continue long under this diſgrace, before an occaſion offered to make his ſervices again of ſuch neceſſity to the ſtate, as to give him an opportunity to retrieve his fame, and wipe off the ſtain which his enemies had thrown upon him.

20 The Thebans repulſed.

21 Epaminondas degraded.

The Theſſalians, who had groaned ſome time under the tyranny of the uſurper Alexander, ſurnamed the *Pheræan*, ſent an embaſſy to Thebes to implore their aid and protection; upon which Pelopidas was immediately ſent as ambaſſador to expoſtulate with him on their behalf. He was then in Macedon, from whence he took the young prince Philip, afterwards the celebrated monarch, in order to protect and educate him; and, upon his return, marched directly to Pharſalus in Theſſaly, in order to puniſh the treachery of ſome mercenaries, who had deſerted the Thebans in that expedition; but when he came thither, he was ſurpriſed to be met by the tyrant at the head of a numerous army before that city, whilſt his own was but as an handful of men in compariſon of it. However, whether he ſuppoſed, or would be thought to do ſo, that Alexander came thither to juſtify himſelf, and anſwer to the complaints alleged againſt him, he went, with Iſmenias his colleague, to him unarmed and unattended, not doubting but his character as ambaſſador from ſo powerful a republic, joined to his own character and authority, would protect them from inſult or violence: but he found himſelf miſtaken; for Alexander had no ſooner got them into his hands, than he cauſed them to be ſeized and ſent priſoners to Pheræa.

22 Pelopidas ſeized by Alexander of Pheræa.

The Thebans highly reſenting the indignity offered to their ambaſſadors, ſent immediately an army into Theſſaly: but the generals were repulſed with great loſs by the Pheræan uſurper; and it was owing to Epaminondas, who was among them only as a private centinel, that they were not totally cut off. For the Thebans, finding

23 A Theban army ſent to reſcue him, defeated.

finding themſelves in ſuch imminent danger, which they attributed to the incapacity of their generals, had immediately recourſe to him, whoſe valour and experience had been ſo often tried; and, partly by perſuaſions and intreaties, and partly by threats, obliged him to take the command. This ſoon gave a different turn to their affairs, and converted their flight into a ſafe and regular retreat; for he took the horſe and light-armed foot, and placed himſelf at their head in the rear, and charged the enemy with ſuch vigour and bravery, that he obliged them to deſiſt from their purſuit.

However, as the army had ſuffered ſuch loſs before as not to be able to purſue them in their turn, he was obliged to return with them to Thebes, with their puſillanimous generals; where the latter were fined 12,000 drachms each, and the former was reinſtated in the command, and ſent with a new reinforcement to repair the late diſhonour, and proſecute their revenge. The news of his being in full march on this errand greatly alarmed the tyrant; but Epaminondas, preferring the ſafety of his impriſoned colleague to all other conſiderations, forbore puſhing hoſtilities to extremes, for fear of provoking the enemy to wreak all his fury on him: to prevent which, he contented himſelf for a while hovering about with his army, and now and then with ſuch ſlight ſkirmiſhes as ſhould intimidate the tyrant, and bring him the ſooner to make ſome ſatisfactory offers. Alexander being fully convinced of the ſuperiority of the Theban general, was glad to accept of a truce of 30 days, and to reſtore Pelopidas and Iſmenias to him; upon which he immediately withdrew his forces, and returned with them to Thebes.

By this time Thebes was raiſed to a ſufficient height of reputation and glory to begin to aim in earneſt at the ſovereignty of Greece. The main obſtacle to it was, that the other ſtates grew ſo jealous of her preſent greatneſs, as to enter into the ſtrongeſt alliances and confederacies to prevent its farther growth; ſo that not being able now to procure many allies at home, they made no difficulty to ſeek for them abroad; and the Lacedæmonians, by leading the van, gave them a plauſible pretence to follow their ſteps, and procure an alliance with Perſia, which at that time they found was ready to accept of the offers on any terms; the only queſtion was, which of the three ſtates ſhould be preferred, Sparta, Athens, or Thebes. At the ſame time, the Thebans propoſed to their new confederates to ſend likewiſe proper deputies to the Perſian court, in order to ſupport their reſpective intereſts; which they readily agreed to. Theſe were the Arcadians, Eleans, and Argives; at the head of whoſe deputation Pelopidas was ſent on the behalf of the Thebans; which the Athenians being appriſed of, appointed two on their part. Theſe being all arrived at the Perſian court, began to purſue each their reſpective intereſts; but Pelopidas had by that time gained ſuch credit there, both for his ſingular addreſs and his extraordinary exploits, that he was diſtinguiſhed in a particular manner from all the other deputies, and was received by the king with manifeſt marks of honour and eſteem, who freely owned himſelf convinced that the Thebans were the people on whom he could moſt ſafely depend; and after having greatly applauded the equity of his demands, ratified and confirmed them with great readineſs, to the no ſmall mortification of the other ſtates. The ſubſtance of them was, that the liberties formerly granted to the other towns of Greece ſhould be confirmed; that Meſſenia, in particular, ſhould continue free and independent on the juriſdiction of Sparta; that the Athenians ſhould lay up their fleet; and that the Thebans ſhould be looked upon as the ancient and hereditary friends of Perſia. Thebes.

The Thebans took advantage of the diſſenſions which prevailed among the Greeks as a pretence for increaſing their forces; and Epaminondas thought it a proper opportunity for his countrymen to make a bold effort to obtain the dominion at ſea, as they had obtained it in a great meaſure at land. He propoſed it to them in a public aſſembly, and encouraged their hopes from the experience of the Lacedæmonians, who in Xerxes's time had, with ten ſhips only at ſea, gained the ſuperiority over the Athenians, who had no fewer than 200; and added, that it would be a diſgrace now to Thebes to ſuffer two ſuch republics to engroſs the empire of ſo extenſive an element, without putting in at leaſt for their ſhare of it. The people readily came into his propoſal, not without extraordinary applauſe, and immediately ordered 100 galleys to be equipped; and in the mean while ſent him to Rhodes, Chios, and Byzantium, to ſecure thoſe ſtates in their intereſt, and get what aſſiſtance he could from them. His negotiations had all the ſucceſs that could be wiſhed for, notwithſtanding the ſtrenuous oppoſition of the Athenians, and of their admiral Laches, who was ſent with a powerful ſquadron againſt him. But what more effectually thwarted all his meaſures, was the work that they found for him at land, and the obliging the Thebans to take part in the quarrels that then reigned among their neighbours: ſo that whatever projects they had concerted, proved abortive for the preſent; and the death of Epaminondas, which happened not long after, put an effectual ſtop to them. 27 The Thebans propoſe to build a fleet.

During the abſence of that general, and of his colleague Pelopidas, the Orchomenians, being ſpirited up by ſome Theban fugitives, had formed a deſign to change the Theban government into an ariſtocracy; and 300 horſemen of the former had been actually ſent to put it in execution. Their project, however, was timely diſcovered by the vigilance of the magiſtrates, who cauſed them to be ſeized, and put immediately to death. They next ſent a ſufficient force againſt the city of Orchomenos, with orders to put all the men to death, and to ſell the women and children for ſlaves, which was punctually done; after which they razed that noble city to the ground. Pelopidas was then on his way to Theſſaly, at the head of a powerful army, whither he had been ſent to aſſiſt the Theſſalians, who ſtill groaned under the tyranny of Alexander the Pheræan, and had made ſeveral brave efforts to recover their liberty, but had been ſtill overpowered by that uſurper. Being joined by the Theſſalians, he encamped in the face of the enemy, though far ſuperior in number, and conſiſting of above 20,000 men. A fierce engagement ſoon enſued, in which both ſides fought with uncommon bravery. The place where the battle was fought was called *Cynocephala*, from ſeveral little hills on it, between which there ran a large plain. Both ſides endeavoured at firſt to poſt themſelves on theſe eminences with their foot, whilſt Pelopidas ordered his cavalry to charge that of the enemy below; which they did with ſuch ſucceſs, that they ſoon put them to the rout, and purſued them over the plain. This obliged the tyrant to gain the tops of the hills, where he 28 The city of Orchomenos razed. 29 Pelopidas marches againſt the Theſſalian tyrant.

Thebes. greatly annoyed the Theſſalians that endeavoured to force thoſe aſcents; ſo that Pelopidas was obliged to give over his purſuit to come to their relief. This immediately inſpired the Theſſalians with freſh courage, who began again to charge the enemy at ſeveral onſets; and ſoon threw them into ſuch diſorder, that they were forced to give way. Pelopidas no ſooner perceived the advantage, than he began to look about for Alexander, with a deſign of engaging him. Having found him out as he was commanding his right wing, and endeavouring to rally his men, he moved directly to him; and being got near enough to be heard by him, challenged him to decide the battle by ſingle combat with him. Alexander, inſtead of accepting the offer, turned about, and with all the ſpeed he could ran to ſcreen himſelf amongſt his guards. Upon this Pelopidas charged him with ſuch furious ſpeed, that he obliged him to retire farther, and ſhelter himſelf within the thickeſt ranks; the ſight of which made him attack with freſh vigour, and fight more deſperately againſt him. He tried in vain ſeveral times to break through their ranks to reach him, cutting down great numbers of thoſe that came forward to oppoſe him: his eagerneſs at length expoſed him ſo far to the darts that were ſhot at him at a di-

30 Is killed. ſtance, that ſome of them went quite through his armour, and gave him a deſperate wound or two, while the reſt advanced and ſtabbed him in the breaſt with their ſpears.

It is ſcarcely poſſible for words to expreſs the grief and deſpair which not only his brave Thebans, but likewiſe the Theſſalians and other allies, ſhowed at the ſight of their ſlain general: ſome of the latter, who had perceived the danger he was expoſed to, came down the hill with all poſſible ſpeed to his relief; but when they perceived that they were come too late to ſave him, both they and the reſt of the little army thought on nothing now but to revenge his death. They rallied accordingly both horſe and foot, as quick as poſſible, and began to charge the enemy afreſh, and with ſuch deſperate fury,

31 Alexander defeated, that they at length gained a complete victory over them, and killed above 3000 of them in the purſuit, beſides a much greater number which they had ſlain on the field of battle, though they ſtill looked upon all theſe advantages as vaſtly too ſmall to compenſate the loſs of their brave general.

The news of his death had no ſooner reached Thebes, than the whole city was ſeen in as deep a mourning as his army. However, they ſent a reinforcement to it of 7000 foot and 700 horſe, as well to revenge the death of that general, as to improve the victory he had gained over the enemy; by the help of which they fell ſo furiouſly on them, that they quickly broke and totally defeated the ſhattered remains of Alexander's army. Hereupon he was forced to ſue for peace, and to accept it on

32 and at laſt murdered. ſuch conditions as the conquerors thought fit to impoſe. He was at length diſpatched in his bed by his wife Thebe, aſſiſted by her brothers, about ſeven years after his defeat. His body was afterwards dragged along the ſtreets, trodden under foot, and left a prey to the dogs.

33 Ambition of the Thebans. All this while the Thebans were watching to improve every commotion that happened, every ſucceſs they met with, to the forwarding of their then reigning and favourite project, of increaſing their power above all the reſt, and in their turn to give laws to Greece. Their

late ſucceſs in Theſſaly, and the rupture between the Thebes. Arcadians and Mantineans at the ſame time, about ſome conſecrated money which the former had taken out of the temple of Olympias to pay their troops employed againſt the Eleans, and which the latter called a downright ſacrilege, beſides other diſcords that reigned in the other ſtates of Greece, gave freſh encouragement to Thebes to ſet up for arbitreſs in thoſe diſputes; and ſo much the more, as thoſe who had embezzled the ſacred money, and wanted rather to embroil matters than to have them brought to light, ſent that republic word that the Arcadians were juſt upon the point of revolting to the Spartans, and adviſed them to come and put an immediate ſtop to it. At the ſame time they diſpatched ſome private directions to a Theban officer at Tegea, to apprehend ſeveral of their own people as diſturbers of the peace. This was accordingly done, and ſeveral eminent perſons were confined as priſoners of ſtate: they were ſoon after diſcharged, and loud complaints were made againſt ſuch arbitrary and unjuſt proceedings. The officer was accuſed before the Theban ſenate of having intermeddled in their affairs, and endeavoured to interrupt the good correſpondence between the two ſtates. It was even inſiſted on by ſome of the Tegeans, that he ſhould be indicted and proceeded againſt by his principals; whilſt the more moderate ſort, who foreſaw the conſequences that were likely to attend ſuch appeals, and that it would infallibly bring the Thebans upon them, loudly proteſted againſt their marching into their territories, and did all they could to prevent it. The Thebans, however, were become too powerful and ambitious to miſs ſo fair an opportunity of getting once more footing in Peloponneſus, as they had long ago premeditated; and Epaminondas was ſo far from making a

34 Epaminondas diſplaces the ſtates of Greece. ſecret of their deſign, that he told the Arcadian deputies in juſtification of it, that as it was on their account that the Thebans engaged in the war, they had acted treacherouſly with them in making peace with Athens without their conſent: however, that when he had joined his army on his march into Peloponneſus to aſſiſt his friends, he would ſoon ſee what proofs the Arcadians would give of their fidelity. This ſpeech did not fail to alarm them greatly; eſpecially as it was ſpoken in ſuch a magiſterial ſtyle and threatening tone. Even thoſe who were beſt affected to the Thebans could not forbear expreſſing their diſlike of it; and all that had the welfare of Peloponneſus at heart readily agreed with the Mantineans, that there was no time to be loſt to uſe all proper means to prevent the impending ſtorm.

35 A combination againſt Thebes. Athens and Sparta were accordingly applied to, and were eaſily prevailed upon to aſſiſt the Mantineans, and to come into a ſtrict confederacy againſt the Thebans; and to prevent all diſputes about the command of the army, it was agreed that each ſtate ſhould have it in its own territories; which plainly ſhows how terrified they all were at the apprehenſion of a freſh invaſion of the Thebans: for this was a point which neither the Spartans nor Athenians would have ſo readily given up to the Arcadians, though theſe had formerly as ſtrenuouſly inſiſted upon it, even when they were almoſt reduced to the laſt extremity, and had never been able to obtain it till now. But Epaminondas was then in full march at the head of his Bœotian troops, with ſome Eubœan auxiliaries, and a body of ſtout Theſſalian horſe; and was moreover to be joined by the Meſſenians, Argives, and

ſeveral

several other nations, as soon as he had entered Peloponnesus. The confederate army against him had ordered their rendezvous at Mantinea, the place which they naturally concluded would be first attacked, as being the chief seat of those who had revolted from the Thebans. But whilst they were securing themselves on that side, Epaminondas, who wisely considered how far this confederacy and expedition must have drained the city of Sparta of its main strength, broke up privately from Nemæa, where he had lain for some time encamped, and marched all that night with a design to have surprised that important capital: but, his project being timely discovered, the vigilant king took care to disconcert it; so that, though the Theban general made several vigorous assaults on that city, he was so stoutly repulsed, and the Spartans behaved with such intrepid valour, that he was forced to retire and turn his thoughts against Mantinea, which he judged by this time to have been quite defenceless. He judged rightly indeed; for the place was not only drained of its troops, but likewise of its inhabitants, who took that opportunity, whilst the scene of war was in Lacedæmon, to gather in their harvest, and were scattered all over the country; so that he would not have met with any difficulty in gaining the town, had not the Athenian auxiliaries come unexpectedly to its relief, and given him a fresh repulse.

These two last defeats greatly exasperated the Theban general, who had never before experienced such disasters, and could not but foresee that they would not only lessen his reputation with his allies, but, if not timely retrieved, would fully the glory of all his former exploits. What added to his present difficulties was, that the time allotted him for his expedition was almost expired; so that he had but a short space left to undertake some brave atchievement, which might recover his and his country's honour, and keep up the spirits of his auxiliaries, and those under his protection. He was moreover got very far into his enemy's country, and saw plain enough how narrowly they watched all his motions, and how well prepared they were to oppose him whatever attempt he resolved upon, whether to attack them or to retreat. Under all these difficulties, he rightly considered, that he must immediately resolve upon a decisive battle; in which, if his pristine fortune followed him, he might at once retrieve his affairs, and make himself master of Peloponnesus; or, if that failed him, as it lately had done, fall honourably in the attempt. In this engagement Epaminondas made the wisest disposition of his troops, attacked and fought with the most intrepid courage and conduct, and had opened himself a way through the Spartan phalanxes, thrown them into the utmost confusion, and made a terrible slaughter of them, insomuch that the field of battle was covered with their wounded and slain, when, in the heat of the fight, having ventured himself too far in order to give them a total overthrow, the enemy rallied again, pouring with their whole fury three volleys of darts at him, some of which he drew out and returned to them, till at length, being covered with wounds, and weakened with the loss of so much blood, he received a mortal wound from a javelin, and was with great difficulty rescued from the enemy by his brave Thebans, and brought alive, though speechless, into his tent. As soon as he had recovered himself, he asked his friends that were about him what was become of his shield; and being told that it was safe, he beckoned to have it brought to him, and kissed it. He next inquired which side had gained the victory; and being answered, The Thebans; he replied, Then all is well: and upon observing some of his friends bewail his untimely death, and leaving no children behind him, he is said to have answered, Yes; I have left two fair daughters, the victory of Leuctra, and this of Mantinea, to perpetuate my memory. Soon after this, upon drawing the point of the javelin out of his body, he expired. Thebes.

The consequence of this great general's fall, and of this bloody fight in which neither party could boast any great advantage over the other, but a great loss of men on both sides, insomuch that Xenophon makes it a drawn battle, was, that both parties agreed on a cessation of arms, and parted, as it were by consent, to take care of their wounded and slain. The Thebans indeed thus far gained the greater share of glory, that they renewed the fight, and after a most desperate contest, gained the victory over those Spartans that opposed them, and rescued the body of their dying general out of their hands. However, an effectual end was put to this bloody war, and a general peace agreed on by all but Sparta; who refused it only because the Messenians were included in it. But as to the Thebans, they had no great reason to boast of this dear-bought victory, since their power and glory began to decline from that very time; so that it may be truly said, that it rose and set with their great general. 40 Peace concluded.

41 State of Thebes to the present time.

On the death of Epaminondas, the Thebans relapsed into their former state of inactivity and indolence; and at last having ventured to oppose Alexander the Great, their city was taken, and the inhabitants slaughtered for several hours, after which the buildings were destroyed. It was rebuilt by Cassander, but never afterwards made any considerable figure among the states of Greece. About the year 146 B. C. it fell under the power of the Romans, under which it continued till the extinction of their empire by the Turks. It is now called *Thive*, and is nothing to what it was formerly; yet it is four miles in circumference, but so full of the ruins, that there are not above 4000 Turks and Christians in it. It is now famous for a fine sort of white clay, of which they make bowls for pipes after the Turkish fashion. They are never burnt, but dry naturally, and become as hard as a stone. There are two mosques in Thebes, and a great many Greek churches. It is seated between two small rivers, in E. Long. 23. 40. N. Lat. 38. 17.

THEBES, in Egypt, one of the most renowned cities of the ancient world. It was also called *Diospolis*, or the city of Jupiter, and was built, according to some, by Osiris, according to others by Busiris. Its length, in Strabo's time, was 80 furlongs, or ten miles; but this was nothing in comparison of its ancient extent, before it was ruined by Cambyses, which, we are told, was no less than 420 stadia, or 52 miles and an half. The wealth of this city was so great, that, after it had been plundered by the Persians, what was found, on burning the remains of the pillage, amounted to above 300 talents of gold and 2300 of silver. *Ancient Universal History*, vol. i.

Mr Bruce visited the ruins of this celebrated city; but informs us that nothing now remains except four temples, and these neither so entire nor magnificent as some others at a place called *Dendera*. Thebes has been

Thebes, Theft.

been celebrated by Homer for its hundred gates; but Mr Bruce informs us, that no veſtiges of theſe are now remaining, neither can we diſcover the foundation of any wall it ever had; "and as for the horſemen and chariots it is ſaid to have ſent out, all the Thebaid ſown with wheat would not have maintained one half of them. Thebes, at leaſt the ruins of the temples called *Medinet Tabu*, are built in a long ſtretch of about a mile broad, moſt parſimoniouſly choſen at the ſandy foot of the mountains. The *Horti Penſiles*, or hanging gardens, were ſurely formed upon the ſides of theſe hills, then ſupplied with water by mechanical devices. The utmoſt is done to ſpare the plain, and with great reaſon; for all the ſpace of ground this ancient city has had to maintain its myriads of horſes and men, is a plain of three quarters of a mile broad between the town and the river, upon which plain the water riſes to the height of four and five feet. All this pretended populouſneſs of ancient Thebes I therefore believe to be fabulous."

Bruce's Travels.

Mr Bruce, after examining the ground on which Thebes is ſuppoſed to have ſtood, thinks that it had no walls, and that conſequently Homer's ſtory of its having an hundred gates is miſunderſtood. The mountains of the Thebaid ſtand cloſe behind the town, not in a ridge, but ſtanding ſingle, ſo that you can go round each of them. A hundred of theſe are ſaid to be hollowed out for ſepulchres and other purpoſes. Theſe, he thinks, were the hundred gates of Homer; in proof of this they are ſtill called by the natives *Beeban el Meluke*, "the ports or gates of the kings."

All that is ſaid of Thebes by poets or hiſtorians after the days of Homer is meant of Dioſpolis, which was built by the Greeks long after Thebes was deſtroyed, as its name teſtifies; though Diodorus ſays it was built by Buſiris. It was on the eaſt ſide of the Nile, whereas ancient Thebes was on the weſt, though both are conſidered as one city; and Strabo ſays, that the river runs through the middle of Thebes, by which he means between Old Thebes and Dioſpolis.

THEFT, or SIMPLE LARCENY, is "the felonious taking and carrying away of the perſonal goods of another." This offence certainly commenced then, whenever it was, that the bounds of property, or laws of *meum* and *tuum*, were eſtabliſhed. How far ſuch an offence can exiſt in a ſtate of nature, where all things are held to be common, is a queſtion that may be ſolved with very little difficulty. The diſturbance of any individual in the occupation of what he has ſeized to his preſent uſe, ſeems to be the only offence of this kind incident to ſuch a ſtate. But, unqueſtionably, in ſocial communities, when property is eſtabliſhed, any violation of that property is ſubject to be puniſhed by the laws of ſociety; though how far that puniſhment ſhould extend is matter of conſiderable doubt.

By the Jewiſh law it was only puniſhed with a pecuniary fine, and ſatisfaction to the party injured; and, in the civil law, till ſome very late conſtitutions, we never find the puniſhment capital. The laws of Draco at Athens puniſhed it with death: but his laws were ſaid to be written with blood; and Solon afterwards changed the penalty to a pecuniary mulct. And ſo the Attic law in general continued; except that once, in a time of dearth, it was made capital to break into a garden and ſteal figs: but this law, and the informers againſt the offence, grew ſo odious, that from them all malicious informers were ſtyled *ſycophants*; a name which we have much perverted from its original meaning. From theſe examples, as well as the reaſon of the thing, many learned and ſcrupulous men have queſtioned the propriety, if not lawfulneſs, of inflicting capital puniſhment for ſimple theft. And certainly the natural puniſhment for injuries to property ſeems to be the loſs of the offender's own property; which ought to be univerſally the caſe, were all men's fortunes equal. But as thoſe who have no property themſelves are generally the moſt ready to attack the property of others, it has been found neceſſary, inſtead of a pecuniary, to ſubſtitute a corporal puniſhment; yet how far this corporal puniſhment ought to extend, is what has occaſioned the doubt. Sir Thomas More and the Marquis Beccaria, at the diſtance of more than two centuries, have very ſenſibly propoſed that kind of corporal puniſhment which approaches the neareſt to a pecuniary ſatisfaction, viz. a temporary impriſonment, with an obligation to labour, firſt for the party robbed, and afterwards for the public, in works of the moſt ſlaviſh kind; in order to oblige the offender to repair, by his induſtry and diligence, the depredations he had committed upon private property and public order. But, notwithſtanding all the remonſtrances of ſpeculative politicians and moraliſts, the puniſhment of theft ſtill continues throughout the greateſt part of Europe to be capital: and Puffendorf, together with Sir Matthew Hale, are of opinion that this muſt always be referred to the prudence of the legiſlature; who are to judge, ſay they, when crimes are become ſo enormous as to require ſuch ſanguinary reſtrictions. Yet both theſe writers agree, that ſuch puniſhment ſhould be cautiouſly inflicted, and never without the utmoſt neceſſity.

Theft

The Anglo-Saxon laws nominally puniſhed theft with death, if above the value of twelvepence: but the criminal was permitted to redeem his life by a pecuniary ranſom; as, among their anceſtors the Germans, by a ſtated number of cattle. But in the 9th year of Henry I. this power of redemption was taken away, and all perſons guilty of larceny above the value of twelvepence were directed to be hanged; which law continues in force to this day. For though the inferior ſpecies of theft, or petit larceny, is only puniſhed by whipping at common law, or (by ſtat. 4 Geo. I. c. 11.) may be extended to tranſportation for ſeven years, as is alſo expreſsly directed in the caſe of the Plate-glaſs Company; yet the puniſhment of grand larceny, or the ſtealing above the value of twelvepence (which ſum was the ſtandard in the time of King Athelſtan, 800 years ago), is at common law regularly death: which, conſidering the great intermediate alteration in the price or denomination of money, is undoubtedly a very rigorous conſtitution; and made Sir Henry Spelman (above a century ſince, when money was at twice its preſent rate) complain, that while every thing elſe was riſen in its nominal value, and become dearer, the life of man had continually grown cheaper. It is true, that the mercy of juries will often make them ſtrain a point, and bring in larceny to be under the value of twelvepence, when it is really of much greater value: but this, though evidently juſtifiable and proper when it only reduces the preſent nominal value of money to the ancient ſtandard, is otherwiſe a kind of pious perjury, and does not at all excuſe our common law in this reſpect from the imputation of ſeverity,

verity, but rather ſtrongly confeſſes the charge. It is likewiſe true, that by the merciful extenſions of the benefit of clergy by our modern ſtatute-law, a perſon who commits a ſimple larceny to the value of thirteen pence or thirteen hundred pounds, though guilty of a capital offence, ſhall be excuſed the pains of death; but this is only for the firſt offence. And in many caſes of ſimple larceny the benefit of clergy is taken away by ſtatute: as from horſe-ſtealing in the principals and acceſſories both *before* and *after* the fact; theft by great and notorious thieves in Northumberland and Cumberland; taking woollen cloth from off the tenters, or linens, fuſtians, calicoes, or cotton goods, from the place of manufacture (which extends, in the laſt caſe, to aiders, aſſiſters, procurers, buyers, and receivers); feloniouſly driving away, or otherwiſe ſtealing one or more ſheep or other cattle ſpecified in the acts, or killing them with intent to ſteal the whole or any part of the carcaſe, or aiding or aſſiſting therein; thefts on navigable rivers above the value of forty ſhillings, or being preſent, aiding and aſſiſting thereat; plundering veſſels, in diſtreſs, or that have ſuffered ſhipwreck; ſtealing letters ſent by the poſt; and alſo ſtealing deer, hares, and conies, under the peculiar circumſtances mentioned in the Waltham black act. Which additional ſeverity is owing to the great malice and miſchief of the theft in ſome of theſe inſtances; and others, to the difficulties men would otherwiſe lie under to preſerve thoſe goods, which are ſo eaſily carried off. Upon which laſt principle the Roman law puniſhed mere ſeverely than other thieves the *Abigei* or ſtealers of cattle, and the *Balnearii* or ſuch as ſtole the clothes of perſons who were waſhing in the public baths; both which conſtitutions ſeem to be borrowed from the laws of Athens. And ſo, too, the ancient Goths puniſhed with unrelenting ſeverity thefts of cattle, or of corn that was reaped and left in the field: ſuch kind of property (which no human induſtry can ſufficiently guard) being eſteemed under the peculiar cuſtody of heaven.

THEFT-*Bote* (from the Saxon *theof*, i. e. *fur*, and *bate*, *compenſatio*), is the receiving of a man's goods again from a thief, after ſtolen, or other amends not to proſecute the felon, and to the intent the thief may eſcape; which is an offence puniſhable with fine and impriſonment, &c.

THELIGONUM, a genus of plants belonging to the claſs monœcia, and order of polyandria; and in the natural ſyſtem ranging under the 53d order, *Scabridæ*. See BOTANY *Index*.

THEME, denotes the ſubject of an exerciſe for young ſtudents to write or compoſe on.

THEMISON, a phyſician of Laodicea, a diſciple of Aſclepiades. He founded the methodic ſect, with a view to the more eaſily teaching and practiſing the art of medicine. See MEDICINE, N° 37.). Themiſon gave the firſt account of diacodium, which was prepared of the juice and decoction of poppy-heads and honey.

THEMISTIUS, an ancient Greek orator and philoſopher who flouriſhed in the 4th century, was a native of Paphlagonia. He had great intereſt and favour with the emperors in his time, and though a heathen, was of a very tolerating ſpirit. He taught for many years at Conſtantinople, of which city he was made præfect by Julian and Theodoſius; and lived to a great age. More than 30 of his orations are ſtill extant, beſide commentaries on ſeveral parts of Ariſtotle's works.

THEMISTOCLES, the renowned Athenian admiral, general, and patriot, who gained the battle of Salamis againſt the Perſians. Being baniſhed his country by his ungrateful fellow-citizens, he fled to Artaxerxes king of Perſia: but, in order to avoid taking up arms againſt his country, he ſlew himſelf, 464 B. C. See ATTICA, N° 76, *et ſeq.* Themiſtocles || Theocritus.

THEOBALD, LEWIS, the ſon of an attorney at Sittingbourn in Kent, was a well-known writer and critic in the early part of the 18th century. He engaged in a paper called the *Cenſor*, publiſhed in Miſt's Journal, wherein, by delivering his opinions with too little reſerve concerning ſome eminent wits, he expoſed himſelf to their reſentment. Upon the publication of Pope's Homer, he praiſed it in terms of extravagant admiration, yet afterwards thought proper to abuſe it as carneſtly; for which Pope at firſt made him the hero of his Dunciad, though he afterwards laid him aſide for another. Mr Theobald not only expoſed himſelf to the laſhes of Pope, but waged war with Mr Dennis, who treated him more roughly, though with leſs ſatire. He nevertheleſs publiſhed an edition of Shakeſpeare, in which he corrected, with great pains and ingenuity, many faults that had crept into that poet's writings. This edition is ſtill in great eſteem; being in general preferred to thoſe publiſhed by Pope, Warburton, and Hanmer. He alſo wrote ſome plays, and tranſlated others from the ancients.

THEOBROMA, a genus of plants belonging to the claſs of polyadelphia, and order of pentandria; and in the natural ſyſtem ranging under the 37th order, *Columniferæ*. See BOTANY *Index*.

THEOCRACY, in matters of government, a ſtate governed by the immediate direction of God alone: ſuch was the ancient government of the Jews before the time of Saul.

THEOCRITUS, the father of paſtoral poetry, was born at Syracuſe in Sicily. Two of his poems aſcertain his age; one addreſſed to Hiero king of Syracuſe, who began his reign about 275 years before Chriſt; and the other to Ptolemy Philadelphus king of Egypt. Hiero, though a prince diſtinguiſhed in arms and political wiſdom, does not ſeem to have been a patron of learning. This is ſuppoſed to have given birth to the 16th Idyllium. From Syracuſe Theocritus went to Alexandria, where he ſeems to have found a munificent patron in Ptolemy Philadelphus, if we may judge from the panegyric which he compoſed on that prince (the 17th Idyllium). It has been ſaid that Theocritus was ſtrangled by Hiero, but we have not found evidence of this.

The compoſitions of this poet are diſtinguiſhed, among the ancients, by the name of *Idylliums*, in order to expreſs the ſmallneſs and variety of their natures: they would now be called *Miſcellanies*, or *Poems on ſeveral Occaſions*. The firſt nine and the eleventh are confeſſed to be true paſtorals, and hence Theocritus has uſually paſſed for nothing more than a paſtoral poet; yet he is manifeſtly robbed of a great part of his fame, if his other poems have not their proper laurels. For though the greater part of his Idylliums cannot be called the ſongs of ſhepherds, yet they have certainly their reſpective merits. His paſtorals ought to be conſidered as the foundation of his credit; upon this claim he will be admitted for the finiſher as well as the inventor of his art, and will be acknowledged to have excelled all his imitators as much as originals uſually do their copies.

The

Theocritus || Theodore.

The works of this poet were firſt publiſhed in folio by Aldus Manutius at Venice in 1495. A more elegant and correct edition was printed by Henry Stephens at Paris in 1566. An edition was publiſhed at Leipſic in 1765, with valuable notes by the learned Reiſke. But what will moſt highly gratify the admirers of paſtoral poetry, is an edition publiſhed in 1770, 2 vols 4to, by Mr Thomas Wharton. It is accompanied by the ſcholia of the beſt editors, and the different readings of 15 MSS.

THEODOLITE, a mathematical inſtrument for meaſuring heights and diſtances. See MENSURATION and SURVEYING.

THEODORE, king of Corſica, Baron Nieuhoff in the county of La Marc in Weſtphalia. He had his education in the French ſervice, and afterwards went to Spain, where he received ſome marks of regard from the duke of Riperda and Cardinal Alberoni; but being of an unſettled diſpoſition, he quitted Spain, and travelled into Italy, England, and Holland, in ſearch of new adventures. He at laſt fixed his attention on Corſica, and formed the ſcheme of rendering himſelf ſovereign of that iſland. He was a man of abilities and addreſs; and having fully informed himſelf of every thing relating to Corſica, went to Tunis, where he fell upon means to procure ſome money and arms; and then went to Leghorn, from whence he wrote a letter to the Corſican chiefs Giafferi and Paoli, offering conſiderable aſſiſtance to the nation if they would elect him as their ſovereign. This letter was conſigned to Count Domenico Rivarola, who acted as Corſican plenipotentiary in Tuſcany, and he gave for anſwer, that if Theodore brought the aſſiſtance he promiſed to the Corſicans, they would very willingly make him king.

Upon this he, without loſs of time, ſet ſail, and landed at Tavagna in the ſpring of the year 1736. He was a man of a very ſtately appearance, and the Turkiſh dreſs he wore added to the dignity of his mien. He had a few attendants with him; and his manners were ſo engaging, and his offers ſo plauſible, that he was proclaimed king of Corſica before Count Rivarola's diſpatches arrived to inform the chiefs of the terms upon which he had agreed. He brought with him about 1000 zequins of Tunis, beſides ſome arms and ammunition, and made magnificent promiſes of foreign aſſiſtance; whence the Corſicans, who were glad of any ſupport, willingly gave into his ſchemes. Theodore inſtantly aſſumed every mark of royal dignity. He had his guards and his officers of ſtate; he conferred titles of honour, and ſtruck money both of ſilver and copper. The ſilver pieces were few in number, and can now hardly be met with; the copper coins have on one ſide T. R. that is, "Theodorus Rex," with a double branch croſſed, and round it this inſcription, PRO BONO PUBLICO RE. CO. that is, "For the public good of the kingdom of Corſica:" on the other ſide is the value of the piece; *Cinque ſolidi*, or five ſous.

The Genoeſe were not a little confounded with this unexpected adventurer. They publiſhed a violent manifeſto againſt Theodore, treating him with great contempt; but at the ſame time ſhowing they were alarmed at his appearance. Theodore replied, in a manifeſto, with all the calmneſs and dignity of a monarch; but after being about eight months in Corſica, perceiving that the people began to cool in their affections towards him, he aſſembled his chiefs, and declared he would keep them no longer in a ſtate of uncertainty, being determined to ſeek in perſon the ſupport he ſo long expected. He ſettled an adminiſtration during his abſence, recommended unity in the ſtrongeſt terms, and left the iſland with reciprocal aſſurances of fidelity and affection. He went to Holland, where he was ſo ſucceſsful as to obtain credit from ſeveral rich merchants, particularly Jews, who truſted him with cannon and other warlike ſtores to a great value, under the charge of a ſupercargo. With theſe he returned to Corſica in 1739; but by this time the French, as auxiliaries to the Genoeſe, had become ſo powerful in the iſland, that though Theodore threw in his ſupply of warlike ſtores, he did not incline to venture his perſon, the Genoeſe having ſet a high price on his head. He therefore again departed; and after many unavailing attempts to recover his crown, at length choſe for retirement a country where he might enjoy the participation of that liberty which he had ſo vainly endeavoured to give his Corſicans; but his ſituation in England by degrees grew wretched, and he was reduced ſo low as to be ſeveral years before his death a priſoner for debt in the King's Bench. At length, to the honour of ſome gentlemen of rank, a charitable contribution was ſet on foot for him in the year 1753. Mr Boſwell obſerves, that Mr Horace Walpole generouſly exerted himſelf for the unhappy Theodore, and wrote a paper in *The World* with great elegance and humour, ſoliciting a contribution for the unhappy monarch in diſtreſs, to be paid to Mr Robert Dodſley bookſeller, as lord high treaſurer. This brought him a very handſome ſum, and he was ſet at liberty. That gentleman adds, that Mr Walpole has the original deed, by which Theodore made over the kingdom of Corſica in ſecurity to his creditors, and that he has alſo the great ſeal of the kingdom. Theodore died in 1756, and was buried in St Ann's churchyard, Weſtminſter; where, in 1757, a ſimple unadorned monument of marble was erected to his memory by a gentleman, with an inſcription, which, after mentioning ſome of the above particulars, concludes with the following lines:

Theo. || Theo.

> The grave, great teacher, to a level brings
> Heroes and beggars, galley-ſlaves and kings:
> But Theodore this moral learn'd ere dead,
> Fate pour'd its leſſon on his living head,
> Beſtow'd a kingdom and deny'd him bread.

THEODORET, biſhop of St Cyricus in Syria, in the 4th century, and one of the moſt learned fathers of the church, was born in the year 386, and was the diſciple of Theodorus Mopſueſtia and St John Chryſoſtom. Having received holy orders, he was with difficulty perſuaded to accept of the biſhopric of St Cyricus, about the year 420. He diſcovered great frugality in the expences of his table, dreſs, and furniture, but ſpent conſiderable ſums in improving and adorning the city of Cyricus. He erected two large bridges, public baths, fountains, and aqueducts, and laboured with great zeal and ſucceſs in his dioceſe. Yet his zeal was not confined to his own church: he went to preach at Antioch and the neighbouring towns; where he became admired for his eloquence and learning, and had the happineſs to convert multitudes of people. He wrote in favour of John of Antioch and the Neſtorians, againſt Cyril's Twelve Anathemas: he afterwards attacked the opinions of Neſtorius, and was depoſed in the ſynod held by the Eutychians,

ret, Eutychians at Epheſus; but was again reſtored by the general council of Chalcedon, in which he was preſent, in 451. It is thought that he died ſoon after; though others ſay that he lived till the year 457. There are ſtill extant Theodoret's excellent Commentary on St Paul's Epiſtles, and on ſeveral other books of the Holy Scriptures. 2. His Eccleſiaſtical Hiſtory from the time of Arius to Theodoſius the Younger. 3. The Hiſtory of the famous Anchorites of his time. 4. Epiſtles. 5. Diſcourſes on Providence. And, 6. An excellent treatiſe againſt the Pagans, entitled, *De Curandis Græcorum Affectibus;* and other works. The beſt edition of all which is that of Father Sirmond in Greek and Latin, in 4 vols folio.

THEODOSIUS I. called the *Great*, was a native of Spain. The valour he had ſhown, and the great ſervices he had done to the empire, made Gratian, when attacked by the Goths and Germans, to admit him as a partner in the government. He received the purple in 379, aged 43. See CONSTANTINOPLE, N° 77—88. Theodoſius II.

THEOGONY, from Θεος, *God*, and γονη, "ſeed, offſpring," that branch of the heathen theology which taught the genealogy of their gods. Theognis.

Heſiod gives us the ancient theogony in a poem under that title. Among the moſt ancient writers, Dr Burne obſerves that theogony and coſmogony ſignified the ſame thing. In effect, the generation of the gods of the ancient Perſians, fire, water, and earth, is apparently no other than that of the primary elements.

THEOGNIS, an ancient Greek poet of Megara in Achaia, flouriſhed about the 59th Olympiad, 144 B. C. We have a moral work of his extant, containing a ſummary of precepts and reflections, uſually found in the collections of the Greek minor poets.

THEOLOGY

Definition. IS a Greek word (θεολογια), and ſignifies that ſcience which treats of the being and attributes of God, his relations to us, the diſpenſations of his providence, his will with reſpect to our actions, and his purpoſes with reſpect to our end. The word was firſt uſed to denote the fables of thoſe poets and philoſophers who wrote of the genealogy and exploits of the gods of Greece. It was afterwards adopted by the earlieſt writers of the Chriſtian church, who ſtyled the author of the Apocalypſe, by way of eminence, ὁ θεολογος, *the Divine*.

Although every pagan nation of antiquity had ſome tutelary deities peculiar to itſelf, they may yet be conſidered as having all had the ſame theology, ſince an intercommunity of gods was univerſally admitted, and the heavenly bodies were adored as the *dii majorum gentium* over the whole earth. This being the caſe, we are happily relieved from treating, in the ſame article, of the truths of Chriſtianity and the fictions of paganiſm, as we have elſewhere traced idolatry from its ſource, and ſhewn by what means "the fooliſh hearts of men became ſo darkened that they changed the glory of the incorruptible God into an image made like to corruptible man, and to birds, and four-footed beaſts, and creeping things." See POLYTHEISM.

The abſurdities and inconſiſtency of the pretended revelation of the Arabian impoſtor have been ſufficiently expoſed under the words ALCORAN and MAHOMETANISM; ſo that the only theology of which we have to treat at preſent is the *Chriſtian* theology, which comprehends that which is commonly called *natural*, and that which is *revealed* in the ſcriptures of the Old and New Teſtaments. Theſe taken together compoſe a body of ſcience ſo important, that in compariſon with it all other ſciences ſink into inſignificance; for without a competent knowledge of the attributes of God, of the ſeveral relations in which he ſtands to us, and of the ends for which we were created, it is obvious that we muſt wander through life like men groping in the dark, ſtrangers to the road on which we are travelling, as well as to the fate awaiting us at the end of our journey.

But if this knowledge be neceſſary to all Chriſtians, it is doubly ſo to thoſe who are appointed to feed the flock of Chriſt, and to teach the ignorant what they are to believe, and what to do, in order to work out their own ſalvation. The wiſdom and piety of our anceſtors have accordingly founded profeſſorſhips of theology in all our univerſities, where the principles of our religion are taught in a ſyſtematic and ſcientific manner; and the church has ordained, that no man ſhall be admitted to the office of a preacher of the goſpel who has not attended a regular courſe of ſuch theological lectures. 3 To be ſtudied carefully by thoſe intended for the ſervice of the church.

It muſt not, however, be ſuppoſed, that, by merely liſtening to a courſe of lectures however able, any man will become an accompliſhed divine. The principles of this ſcience are to be found only in the word and works of God; and he who would extract them pure and unſophiſticated, muſt dig for them himſelf in that exhauſtleſs mine. To fit a man for this important inveſtigation, much previous knowledge is requiſite. He muſt ſtudy the works of God ſcientifically before he can perceive the full force of that teſtimony which they bear to the power, the wiſdom, and the goodneſs of their author. Hence the neceſſity of a general acquaintance with the phyſical and mathematical ſciences before a man enter on the proper ſtudy of theology, for he will not otherwiſe obtain juſt and enlarged conceptions of the God of the univerſe. See PHYSICS, N° 115. 4 Previous knowledge requiſite for the proſecution of this ſtudy.

But an acquaintance with the phyſical and mathematical ſciences is not alone a ſufficient preparation for the ſtudy of theology. Indeed it is poſſible for a man to devote himſelf ſo wholly to any of theſe ſciences, as to make it counteract the only purpoſes for which it can be valuable to the divine; for he who is conſtantly immerſed in matter, is apt to ſuſpect that there is no other ſubſtance; and he who is habituated to the routine of geometrical demonſtration, becomes in time incapable of reaſoning at large, and eſtimating the force of the various degrees of moral evidence. To avert theſe diſagreeable conſequences, every man, before he enter on the ſtudy of that ſcience which is the ſubject of the preſent article, ſhould make himſelf acquainted with the principles of logic, the ſeveral powers of the human mind, and the different ſources of evidence; in doing which he will find the greateſt aſſiſtance from Bacon's *Novum Organum*,

Introduction.

ganum, Locke's *Eſſay on the Human Underſtanding*, Reid's *Eſſays on the Intellectual and Active Powers of Man*, and Tatham's *Chart and Scale of Truth*. Theſe works will teach him to think juſtly, and guard him againſt a thouſand errors, which thoſe who have not laid ſuch a foundation are apt to embrace as the truths of God.

The man who propoſes to ſtudy theology ought to have it in view as the ultimate end of his labours, to impart to others that knowledge which he may procure for himſelf. "Amongſt the many marks which diſtinguiſh the *Chriſtian* philoſopher from the *Pagan*, this (ſays a learned writer *) is one of the moſt ſtriking—the *Pagan* ſought knowledge in a ſelfiſh way, to ſecrete it for his own uſe; the *Chriſtian* ſeeks it with the generous purpoſe (firſt in view, though laſt in execution) to impart it to others. The Pagan philoſopher, therefore, having cultivated the *art of thinking*, proceeds to that of *ſpeaking*, in order to diſplay his vanity in the dexterous uſe of deceit. On the other hand, the *Chriſtian philoſopher* cultivates the *art of ſpeaking*, for the ſole purpoſe of diſſeminating the truth in his office of preacher of the goſpel."

* *Warburton.*

As every man, before he enters on the proper ſtudy of theology, receives, at leaſt in this country, the rudiments of a liberal education, it may perhaps be ſuperfluous to mention here any books as peculiarly proper to teach him the art of ſpeaking: we cannot however forbear to recommend to our ſtudent the attentive peruſal of Quintilian's *Inſtitutions*, and Dr Blair's *Lectures on Rhetoric and the Belles Lettres*. A familiar acquaintance with theſe works will enable him, if he be endowed by nature with talents fit for the office in which he propoſes to engage, to expreſs his thoughts with correctneſs and elegance; "without which, it has been well obſerved, that ſcience, eſpecially in a clergyman, is but learned lumber, a burden to the owner, and a nuiſance to every body elſe."

No man can proceed thus far in the purſuits of general ſcience without having been at leaſt initiated in the learned languages; but he who intends to make theology his profeſſion ſhould devote himſelf more particularly to the ſtudy of Greek and Hebrew, becauſe in theſe tongues the original ſcriptures are written. He who is incapable of conſulting the original ſcriptures, muſt reſt his faith, not on the ſure foundation of the word of God, but on the credit of fallible tranſlators; and if he be at any time called on to vindicate revelation againſt the ſcoffs of infidelity, he will have to ſtruggle with many difficulties which are eaſily ſolved by him who is maſter of the original tongues.

5 Cautions to be obſerved in attending the lectures of a profeſſor.

The ſtudent having laid in this ſtock of preparatory knowledge, is now qualified to attend with advantage the theological lectures of a learned profeſſor; but in doing this, he ſhould be very careful neither to admit nor reject any thing on the bare authority of his maſter. Right principles in theology are of the utmoſt importance, and can reſt on no authority inferior to that of the word of God. On this account we have long been of opinion, that a profeſſor cannot render his pupils ſo much ſervice by a ſyſtematical courſe of lectures, as by directing their ſtudies, and pointing out the road in which they may themſelves arrive in the ſhorteſt time at the genuine ſenſe of the ſacred ſcriptures. In this opinion we have the honour to agree with the ableſt lecturer * in theology that we have ever heard. The authors of all ſyſtems are more or leſs prejudiced in behalf of ſome particular and artificial mode of faith. He, therefore, who begins with the ſtudy of them, and afterwards proceeds to the ſacred volume, ſees with a jaundiced eye every text ſupporting the peculiar tenets of his firſt maſter, and acts as abſurd a part as he who tries not the gold by the copel, but the copel by the gold. Before our young divine, therefore, ſit down to the ſerious peruſal of any one of thoſe *inſtitutes* or *bodies of theology* which abound in all languages, and even before he read that which the nature of our work compels us to lay before him, we beg leave to recommend to his conſideration the following

Introduction

* *The Dr Cam bell of berdeen.*

Preliminary Directions for the Study of Theology.

6 Chriſtian theology divided to two great parts.

Christian theology is divided into two great parts, *natural* and *revealed*; the former comprehending that which may be known of God from the creation of the world, even his eternal power and Godhead; the latter, that which is diſcovered to man nowhere but in the ſacred volume of the Old and New Teſtaments.

7 Firſt principles of theology communicated

Concerning the extent of natural theology many opinions have been formed, whilſt ſome have contended that there is no ſuch thing. Into theſe diſputes we mean not at preſent to enter. We believe that one of them could have had no exiſtence among ſober and enlightened men, had the contending parties been at due pains to define with accuracy the terms which they uſed. Whatever be the origin of religion, which we have endeavoured to aſcertain elſewhere (ſee Religion, N° 6—17.), it is obvious, that no man can receive a written book as the word of God till he be convinced by ſome other means that God exiſts, and that he is a Being of power, wiſdom, and goodneſs, who watches over the conduct of his creature man. If the progenitor of the human race was inſtructed in the principles of religion by the Author of his being (a fact of which it is difficult to conceive how a conſiſtent theiſt can entertain a doubt), he might communicate to his children, by natural means, much of that knowledge which he himſelf could not have diſcovered had he not been ſupernaturally enlightened. Between illuſtrating or proving a truth which is already talked of, and making a diſcovery of what is wholly unknown, every one perceives that there is an immenſe difference (A).

To beings whoſe natural knowledge originates wholly from

(A) The diſcriminating powers of Ariſtotle will not be queſtioned; and in the following extract made by Cicero from ſome of his works which are now loſt, he expreſſes our ſentiments on this important ſubject with his uſual preciſion:——"Præclare ergo Ariſtoteles, SI ESSENT, inquit, qui ſub terra ſemper habitaviſſent, bonis, et illuſtribus domiciliis, quæ eſſent ornata ſignis atque picturis, inſtructaque rebus iis omnibus, quibus abundant ii, qui beati putantur, nec tamen exiſſent unquam ſupra terram; ACCEPISSENT AUTEM FAMA ET AUDITIONE, ESSE QUODDAM NUMEN,

Preliminary Directions.

from ſenſation, and whoſe minds cannot, but by much diſcipline, advance from ſenſe to ſcience, a long ſeries of revelations might be neceſſary to give them at firſt juſt notions of God and his attributes, and to enable them to perceive the relation between the effect and its cauſe, ſo as to infer by the powers of their own reaſon the exiſtence of the Creator from the preſence of his creatures. Such revelations, however, could be ſatisfactory only to thoſe who immediately received them. Whenever the Deity has been pleaſed by ſupernatural means to communicate any information to man, we may be ſure that he has taken effectual care to ſatisfy the perſon ſo highly favoured that his underſtanding was not under the influence of any illuſion; but ſuch a perſon could not communicate to another the knowledge which he had thus received by any other means than an addreſs to his rational faculties. No man can be required to believe, no man indeed can believe, without proof, that another, who has no more faculties either of ſenſation or intellect than himſelf, has obtained information from a ſource to which he has no poſſible acceſs. An appeal to miracles would in this caſe ſerve no purpoſe; for we muſt believe in the exiſtence, power, wiſdom, and juſtice of God, before a miracle can be admitted as evidence of any thing but the power of him by whom it is performed. See MIRACLE.

It is therefore undeniable that there are ſome principles of theology which may be called *natural*; for though it is in the higheſt degree probable that the parents of mankind received all their theological knowledge by *ſupernatural* means, it is yet obvious that ſome parts of that knowledge muſt have been capable of a proof purely rational, otherwiſe not a ſingle religious truth could have been conveyed through the ſucceeding generations of the human race but by the immediate inſpiration of each individual. We indeed admit many propoſitions as certainly true, upon the ſole authority of the Jewiſh and Chriſtian ſcriptures, and we receive theſe ſcriptures with gratitude as the lively oracles of God; but it is ſelf-evident that we could not do either the one or the other, were we not convinced by natural means that God exiſts, that he is a Being of goodneſs, juſtice, and power, and that he inſpired with divine wiſdom the penmen of theſe ſacred volumes. Now, though it is very poſſible that no man or body of men, left to themſelves from infancy in a deſert world, would ever have made a theological diſcovery; yet whatever propoſitions relating to the being and attributes of the firſt cauſe and the duty of man, can be demonſtrated by human reaſon, independent of written revelation, may be called *natural theology*, and are of the utmoſt importance, as being to us the firſt principles of all religion. Natural theology, in this ſenſe of the word, is the foundation of the Chriſtian revelation; for without a previous knowledge of it, we could have no evidence that the ſcriptures of the Old and New Teſtaments are indeed the word of God.

10 Natural theology to be ſtudied before the doctrines of revelation.

Our young divine, therefore, in the regular order of his ſtudies ought to make himſelf maſter of *natural theology* before he enter upon the important taſk of ſearching the ſcriptures. On this ſubject many books have been publiſhed in our own and other languages; but perhaps there is none more worthy of attention than the Religion of Nature delineated by Mr Wollaſton (B). It is a work of great merit, and bears ample teſtimony to its author's learning and acuteneſs: yet we think it ought to be read with caution. Mr Wollaſton's theory of moral obligation is fanciful and groundleſs; and whilſt we readily acknowledge that he demonſtrates many truths with elegance and perſpicuity, we cannot deny that he attempts a proof of others, for which we believe no other evidence can be brought than the declarations of Chriſt and his apoſtles in the holy ſcriptures. To ſupply the defects of his theory of morals, we would recommend to the ſtudent an attentive peruſal of Cumberland on the Law of Nature, and Paley's Elements of Moral Philoſophy. A learned author * affirms of Cumberland, that "he excels all men in fixing

11 Books recommended.

* *Warburton.*

NUMEN, ET VIM DEORUM; deinde aliquo tempore, patefactis terræ faucibus, ex illis abditis ſedibus evadere in hæc loca, quæ nos incolimus, atque exire potuiſſent: cum repente terram, et maria, cœlumque vidiſſent: nubium magnitudinem, ventorumque vim cognoviſſent, adſpexiſſentque ſolem, ejuſque tum magnitudinem, pulchritudinemque, tum etiam efficientiam cognoviſſent, quod is diem efficeret, toto cœlo luce diffuſa: cum autem terras nox opacaſſet, tum cœlum totum cernerent aſtris diſtinctum et ornatum, lunæque luminum varietatem tum creſcentis, tum ſeneſcentis, eorumque omnium ortus et occaſus, atque in omni æternitate ratos, immutabileſque curſus: hæc cum viderent, PROFECTO ET ESSE DEOS, et HÆC TANTA OPERA DEORUM ESSE arbitrarentur." *De Nat. Deorum*, lib. ii. § 37.

From this paſſage it is evident, that the Stagyrite, though he conſidered the motions of the heavenly bodies, the ebbing and flowing of the ſea, and the other phenomena of nature, as affording a complete *proof* of the being and providence of God, did not however ſuppoſe that from theſe phenomena an untaught barbarian would *diſcover* this fundamental principle of religion. On the contrary, he expreſsly affirms, that before a man can feel the force of the evidence which they give of this important truth, he muſt have HEARD of the exiſtence and power of God.

(B) It may not be improper to inform the reader, that Mr Wollaſton, the author of the Religion of Nature, was a different man from Mr Woolſton, who blaſphemed the miracles of our Saviour. The former was a clergyman of great piety, and of ſuch moderate ambition as to refuſe one of the higheſt preferments in the church of England when it was offered to him; the latter was a clergyman likewiſe, but remarkable only for gloomy infidelity, and a perverſe deſire to deprive the wretched of every ſource of comfort. In the mind of the former, philoſophy and devotion were happily united; in the mind of the latter, there was neither devotion nor ſcience. Yet theſe writers have been frequently confounded; ſometimes through inadvertence from the ſimilarity of their name; and ſometimes, we are afraid, deſignedly, from a weak and bigotted abhorrence of every ſyſtem of religion that pretends to have its foundation in reaſon and in the nature of things.

Preliminary Directions.

the true grounds of moral obligation, out of which natural law and natural religion both arife;" and we have ourfelves never read a work in which the various duties which a man owes to his Maker, himfelf, and his fellow-creatures, are more accurately ftated or placed on a furer bafis than in the moral treatife of the archdeacon of Carliſle.

As Wollaſton demonſtrates with great perſpicuity, the being and many of the attributes of God, it may perhaps appear ſuperfluous to recommend any other book on that ſubject. The preſent age, however, having among other wonderful phenomena, witneſſed a revival of *Atheiſm*, we would adviſe our ſtudent to read with much attention Cudworth's Intellectual Syſtem, and to read it rather in Moſheim's Latin tranſlation than in the author's original Engliſh. It is well known that Cudworth wrote his incomparable work in confutation of Hobbes's philoſophy; but inſtead of confining himſelf to the whimſies of his antagoniſt, which were in a little time to ſink into oblivion, he took a much wider range, and traced atheiſm through all the mazes of antiquity, expoſing the weakneſs of every argument by which ſuch an abſurdity had ever been maintained. In exhauſting the metaphyſical queſtions agitated among the Greeks concerning the being and perfections of God, he has not only given us a complete hiſtory of ancient learning, as far as it relates to theſe inquiries, but has in fact anticipated moſt of the ſophiſms of our modern atheiſts, who are by no means ſuch diſcoverers as they are ſuppoſed to be by their illiterate admirers.

The ſtudent having made himſelf maſter of natural theology, and carefully endeavoured to aſcertain its limits, is now prepared to enter on the important taſk of ſearching the ſcriptures. In doing this, he ought to diveſt himſelf as much as poſſible of the prejudices of education in behalf of a particular ſyſtem of faith, and ſit down to the ſtudy of the ſacred volume as of a work to which he is an entire ſtranger. He ought firſt to read it as a moral hiſtory of facts and doctrines, beginning with the books of Moſes, and proceeding through the reſt, not in the order in which they are commonly publiſhed, but in that in which there is reaſon to believe they were written (ſee SCRIPTURES). If he be maſter of the Hebrew and Greek languages, he will doubtleſs prefer the original text to any verſion; and in this peruſal we would adviſe him to conſult no commentator, becauſe his object at preſent is not to ſtudy the doctrines contained in the bible, but merely to diſcover what are the ſubjects of which it treats. Many hiſtories of the bible have been written; and were we acquainted with a good one, we ſhould recommend it as a clue to direct the young divine's progreſs through the various books which compoſe the ſacred volume. Stackhouſe's hiſtory has been much applauded by ſome, and as much cenſured by others. It is not a work of which we can expreſs any high degree of approbation; but if read with attention, it may no doubt be uſeful as a guide to the ſeries of facts recorded in the ſcriptures. Between the Old and New Teſtaments there is a great chaſm in the hiſtory of the Jewiſh nation; but it is ſupplied in a very able and ſatisfactory manner by Dr Prideaux, whoſe *Old and New Teſtament connected* is one of the moſt valuable hiſtorical works in our own or any other language. Shuckford's *Sacred and Profane Hiſtory of the World connected* is likewiſe a work of merit, and may be read with advantage as throwing light on many paſſages of the Old Teſtament: but this author is not intitled to the ſame confidence with Prideaux, as his learning was not ſo great, and his partialities ſeem to have been greater.

Preliminary Directions.

12 How the ſcriptures are to be ſtudied.

In thus making himſelf maſter of the hiſtory of the Old and New Teſtaments, the ſtudent will unavoidably acquire ſome general notion of the various doctrines which they contain. Theſe it will now be his buſineſs to ſtudy more particularly, to aſcertain the preciſe meaning of each, and to diſtinguiſh ſuch as relate to the whole human race, from thoſe in which Abraham and his poſterity were alone intereſted. He muſt therefore travel over the ſacred volume a ſecond time; and ſtill we would adviſe him to travel without a guide. From Walton's *Polyglot bible*, and the large collection called *Critici ſacri*, he may indeed derive much aſſiſtance in his endeavours to aſcertain the ſenſe of a difficult text; but we think he will do well to make little uſe of commentators and expoſitors, and ſtill leſs of ſyſtem-builders, till he has formed ſome opinions of his own reſpecting the leading doctrines of the Jewiſh and Chriſtian religions.

"Impreſſed (ſays an able writer) with an awful ſenſe of the importance of the ſacred volume, the philoſophical divine will ſhake off the bias of prejudices however formed, of opinions however ſanctioned, and of paſſions however conſtitutional, and bring to the ſtudy of it the advantage of a pure and impartial mind. Inſtead of waſting all his labour upon a number of minute and leſs ſignificant particulars, and of refining away plain and obvious ſenſe by the ſubtleties of a narrow and corroſive mind, his firſt object will be to inſtitute a theological inquiry into the general deſign of the written word, and from principles fully contained and fairly underſtood, to illuſtrate the true *nature* and *genius of the religious diſpenſation* in all its parts. He will mark the difference between the firſt and ſecond covenants, and obſerve the connection that ſubſiſts between them. He will trace the temporary economy of the *Old Teſtament*, and weigh the nature and intent of the *partial covenant* with the Jews; obſerving with aſtoniſhment how it was made introductory of better things to come: and he will follow it through the *law* and the *prophets* in its wonderful evolutions, till he ſee this vaſt and preparatory machine of providence crowned and completed in the eternal goſpel. This *New Teſtament*, the laſt and beſt part of the religious diſpenſation, he will purſue through the ſacred pages of that goſpel with redoubled attention; contemplating the divine foundation on which it claims to be built, the ſupernatural *means* by which it was executed, and the immortal end which it has in view *." * *Tatham's Chart and Scale of Truth.*

In the courſe of this inquiry into the import of the ſacred volume, the ſtudent will pay particular attention to the circumſtances of the age and country in which its various writers reſpectively lived, and to the nature of the different *ſtyles*, *analogical* and *parabolical*, in which it is written. He will likewiſe keep in mind that God, whom it claims for its author, is the parent of truth, and that all his actions and diſpenſations muſt be conſiſtent with one another. He will therefore compare the different paſſages of the Old and New Teſtaments which relate to the ſame doctrine, or to the ſame event, reaſonably concluding that the bible muſt be the beſt interpreter of itſelf; and though the opinions which he thus forms

Preliminary Directions.

inary tions.

forms may often be erroneous, they will ſeldom be dangerous errors, and may eaſily be corrected by mature reflection, or by conſulting approved authors who have treated before him of the various points which have been the ſubject of his ſtudies. Of this mode of proceeding one good conſequence will be, that, having from the ſacred ſcriptures formed a ſyſtem of theology for himſelf, he will afterwards ſtudy the ſyſtems of other men without any violent prejudices for or againſt them; he will be ſo much attached to his own opinions as not to relinquiſh them in obedience to mere human authority, at the ſame time that he will be ready to give them up when convinced that they are not well founded; and if he have read the ſcriptures attentively, he will have acquired ſuch a love of truth as to embrace her wherever ſhe may be found.

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As we have ſuppoſed that every man, after having formed a theological ſyſtem of his own, will conſult the ſyſtems of others, it may perhaps be expected that we ſhould here recommend thoſe which, in our opinion, are moſt worthy of his attention. To do this, however, would, we apprehend, be an interference with the rights of private judgment. But leſt we ſhould be ſuſpected of wiſhing to bias the mind of the young ſtudent toward the ſhort ſyſtem which we are obliged to give, we ſhall juſt obſerve, that by the divines of what is called the *Arminian ſchool*, Epiſcopius's *Theologiæ Inſtitutiones*, Limborch's *Theologia Chriſtiana*, and Locke's *Reaſonableneſs of Chriſtianity*, have long been held in the higheſt eſteem; whilſt the followers of Calvin have preferred the *Inſtitutiones* of their maſter, Turretine's *Inſtitutio Theologiæ Elencticæ*, and Gill's *Body of Divinity*. This laſt work has many merits and many defects. Its ſtyle is coarſe and tedious; and the author embraces every opportunity of introducing the diſcriminating tenets of his ſect: but his book is fraught with profound learning, breathes the ſpirit of piety, and may be read with advantage by every divine who has previouſly formed the outlines of a ſyſtem for himſelf.

Boo re- con end- ed the Mo c diſ- per ion.

As the Jewiſh and Chriſtian diſpenſations are cloſely linked together, being only parts of one great whole, it is impoſſible to have an adequate notion of the latter without underſtanding the deſign of the former. Now, though the Moſaic religion is nowhere to be learned but in the Old Teſtament, it may be convenient for our ſtudent, after he has formed his own opinions of it from that ſacred ſource, to know what has been written on the ſubject by others. For illuſtrating the ritual law, a learned prelate warmly recommends the *Ductor Dubitantium* of Maimonides, and Spencer's book entitled *De Legibus Hebræorum Ritualibus*. Both works have undoubtedly great merit; but our young divine will do well to read along with them *Hermanni Witſii Ægyptiaca*, and Dr Woodward's Diſcourſe on the Worſhip of the Ancient Egyptians, where ſome of Spencer's notions are ſhortly and ably refuted. On the other parts of this diſpenſation, ſuch as the nature of its civil government; the rewards and puniſhments peculiar to it (c); its extraordinary adminiſtration by appointed agents, endowed with ſupernatural powers, and with the gifts of miracles and prophecy; the *double ſenſe* in which the latter is ſometimes involved; and the language conſequent on its nature and uſe—the reader will find much erudition and ingenuity diſplayed in the ſecond part of Warburton's *Divine Legation of Moſes demonſtrated*. That work is entitled to a ſerious peruſal; for it diſplays great learning and genius, and, we believe, the heavieſt cenſures have fallen on it from thoſe by whom it was never read.

15 Inquiry to be made into the reality of revelation.

Having proceeded thus far in the courſe, the ſtudent's next buſineſs ſhould be to inquire ſeriouſly what evidence there is that the doctrines which he has ſo carefully ſtudied were indeed revealed in times paſt by God. He muſt already have perceived, in the nature and tendency of the doctrines themſelves, ſtrong marks of their origin being more than human; but he muſt likewiſe have met with many difficulties, and he muſt prepare himſelf to repel the attacks of unbelievers. Here he will find opportunities of exerting the utmoſt powers of his reaſoning faculties, and of employing in the ſervice of religion all the ſtores he may have amaſſed of human learning. The ſcriptures pretend to have been written by ſeveral men who lived in different ages of the world; but the lateſt of them in an age very remote from the preſent. His firſt buſineſs therefore muſt be to prove the authenticity of theſe books, by tracing them up by hiſtorical evidence to the ſeveral writers whoſe names they bear. But it is not enough to prove them authentic. They profeſs to have been written by men divinely inſpired, and of courſe infallible in what they wrote. He muſt therefore inquire into the truth of this inſpiration. The Bible contains a number of truths doctrinal and moral, which are called *myſteries*, and aſſerted to be the immediate dictates of God himſelf. To evince this great point to man, a number of ſupernatural *teſts* and *evidences* are inſeparably connected with thoſe myſteries; ſo that if the former be true, the latter muſt be ſo likewiſe. He muſt therefore examine theſe teſts and evidences, to eſtabliſh the divinity of the Holy Scriptures; and in this part of his courſe he will find much aſſiſtance from many writers whoſe defences of the truth and divinity of the Chriſtian religion do honour to human nature.

16 Books recommended on that ſubject.

The firſt ſtep towards the embracing of any truth is, to get fairly rid of the objections which are made to it; and the general objections made by deiſtical writers to the Chriſtian revelation are by no writer more completely removed than by Biſhop Butler, in his celebrated work entitled *The Analogy of Religion natural and revealed to the Conſtitution and Courſe of Nature*. This book therefore the ſtudent ſhould read with attention, and meditate on with patience; but as it does not furniſh a *poſitive proof* of the divinity of our religion, he ſhould paſs from it to *Grotius de Veritate Religionis Chriſtianæ*, and Stillingfleet's *Origines Sacræ*. Both theſe works are excellent; and the latter, which may be conſidered

(c) On this ſubject the reader will find many excellent obſervations in Biſhop Bull's *Harmonia Apoſtolica*, with its ſeveral defences, and in a ſmall book of Dr Wells's, entitled A Help for the Right Underſtanding of the ſeveral Divine Laws and Covenants, whereby man has been obliged through the ſeveral ages of the world to guide himſelf in order to ſalvation.

Preliminary Directions.

considered as an improvement of the former, is perhaps the fulleſt and ableſt defence of revelation in general that is to be found in any language. In this part of the united kingdom it is now indeed ſcarcely mentioned, or mentioned with indifference; but half a century ago the Engliſh divines thought it a ſubject of triumph, and ſtyled its author their *incomparable Stillingfleet*. Other works, however, may be read with great advantage, and none with greater than Paley's *Evidences of the Chriſtian Religion*, and Leſlie's *Short Method with the Deiſts*; which laſt work, in the compaſs of a very few pages, contains proofs of the divinity of the Jewiſh and Chriſtian revelations, to which the celebrated Dr Middleton confeſſed (D), that for 20 years he had laboured in vain to fabricate a ſpecious anſwer (E).

17 Jewiſh controverſy to be ſtudied,

Having ſatisfied himſelf of the truth of revelation in general, it may be worth the young divine's while to provide a defence of the Chriſtian religion againſt the objections of modern Judaiſm. In this part of his ſtudies he will need no other inſtruction than what he may reap from Limborch's work entitled *De Veritate Religionis Chriſtianæ amica collatio cum erudito Judæo*. "In that diſputation, which was held with Orobio, he will find all that the ſtretch of human parts on the one hand, or ſcience on the other, can produce to varniſh error or unravel ſophiſtry. All the papers of Orobio in defence of Judaiſm, as oppoſed to Chriſtianity, are printed at large, with Limborch's anſwers, ſection by ſection; and the ſubtileſt ſophiſms of a very ſuperior genius are ably and ſatisfactorily detected and expoſed by the ſtrong, profound, and clear reaſoning, of this renowned remonſtrant *." See OROBIO and LIMBORCH.

* *Warburton's Directions for the Study of Theology.*

18 and the various controverſies among Chriſtians themſelves.

The various controverſies ſubſiſting between the ſeveral denominations of Chriſtians, about points which ſeparate them into different churches, ought next to be ſtudied in the order of the courſe; for nothing is unimportant which divides the followers of that Maſter whoſe favourite precept was *love*. It has indeed been long faſhionable to decry polemical divinity as an uſeleſs, if not a pernicious, ſtudy; but it is not impoſſible that this faſhion has had its origin in ignorance, and that it tends to perpetuate thoſe ſchiſms which it profeſſes to lament. We are, however, far from recommending to the young divine a peruſal of the works of the ſeveral combatants on each ſide of a diſputed queſtion, till he has fitted himſelf for judging between them by a long courſe of preparatory ſtudy; and the only preparation which can fit him for this purpoſe is an impartial ſtudy of eccleſiaſtical hiſtory. He who has with accuracy traced the progreſs of our holy religion from the days of the apoſtles to the preſent time, and marked the introduction of new doctrines, and the riſe of the various ſects into which the Chriſtian world is divided, is furniſhed with a criterion within himſelf by which to judge of the importance and truth of the many conteſted doctrines; whilſt he who, without this preparation, ſhall read a multitude of books on any religious controverſy, will be in danger of becoming a convert to his laſt author, if that author poſſeſs any tolerable ſhare of art and ingenuity.

Prelim. Direc.

19 Import. of eccl. tical hi ry, and books r comme ed.

There are many hiſtories of the Chriſtian church which poſſeſs great merit, but we are acquainted with none which appears to us wholly impartial. Moſheim's is perhaps the moſt perfect compend (F); and one of its greateſt excellencies is, that on every ſubject the beſt writers are referred to for fuller information. Theſe indeed ſhould often be conſulted, not only to ſupply the defects neceſſarily reſulting from the narrowneſs of the limits which the author, with great propriety, preſcribed to himſelf; but alſo to correct his partial obliquities; for with all his merits, and they were many and great, he is certainly not free from the influence of prejudice. Indeed there is no coming at the true hiſtory of the primitive church, but by ſtudying the works of the primitive writers; and the principal works of the firſt four centuries will amply reward the labour of peruſing them (G). The riſe and progreſs of the reformation in general, the moſt important period of church-hiſtory, may be beſt learned from Sleidan's book *De Statu Religionis et Reipublicæ, Carolo V. Cæſare, Commentarii*; the Hiſtory of the Reformation of the Church of Scotland from Knox and Spotiſwood; and that of the Church of England from the much applauded work of Biſhop Burnet.

After this courſe of eccleſiaſtical hiſtory, the young divine may read with advantage the moſt important controverſies which have agitated the Chriſtian world. To enumerate theſe controverſies, and to point out the ableſt authors who have written on each, would be a tedious, and perhaps not a very profitable taſk. On one controverſy, however, we are induced to recommend a very maſterly work, which is Chillingworth's book againſt Knott, entitled *The Religion of Proteſtants a ſafe way to Salvation*; in which the ſchool jargon of that Jeſuit is admirably expoſed, and the long diſpute between

(D) This piece of information we had from the late Dr Berkeley, prebendary of Canterbury, who had it from Archbiſhop Secker, to whom the confeſſion was made.

(E) To theſe defences of revelation we might have added the collection of ſermons preached at Boyle's lecture from 1691 to 1732, publiſhed in three volumes folio, 1739; the works of Leland; Biſhop Newton's Diſſertations on Prophecy; and above all, Lardner's Credibility of the Goſpel Hiſtory, with the Supplement to it. But there would be no end of recommending eminent writers on this ſubject. We have mentioned ſuch as we moſt approve among thoſe with whom we are beſt acquainted; but we muſt, once for all, caution the reader againſt ſuppoſing that we approve of *every* thing to be found in any work except the ſacred Scriptures.

(F) The biſhop of Landaff, in the catalogue of books publiſhed at the end of his Theological Tracts, recommends ſeveral other eccleſiaſtical hiſtories as works of great merit; ſuch as Dupin's, Echard's, Gregory's and Formey's, together with *Paul Erneſti Jablonſki Inſtitutiones Hiſtoriæ Chriſtianæ*, publiſhed at Frankfort in three volumes, 1754-67.

(G) For a proof of this poſition, and for a juſt eſtimate of the value of the *Fathers*, as they are called, ſee the introduction to Warburton's Julian, and Kett's Sermons at Bampton's Lectures.

tween the Popiſh and Reformed churches placed on its proper ground, the Holy Scriptures. Preliminary Directions.

One of the moſt plauſible objections to the ſtudy of polemical divinity, is its tendency to give a rigid turn to the ſentiments of thoſe long engaged in it; whilſt we know, from higher authority that "the end of the commandment is charity." But for preſerving charity in the minds of Chriſtians, there are better means than abſolute ignorance or indifference to truth. Charity is violated only when a church unreaſonably reſtrains the inquiries of its own members, or exerciſes intolerance towards thoſe who have renounced its juriſdiction. The injuſtice of the firſt ſpecies of eccleſiaſtical tyranny is expoſed in a very maſterly manner by Jeremy Taylor in his *Liberty of Prophecying*, and by Stillingfleet in his *Irenicum;* the injuſtice of the ſecond, by Locke in his celebrated Letters on Toleration. The man who ſhall peruſe theſe three works, and impartially weigh the force of their arguments, will be in little danger of thinking uncharitably of thoſe from whoſe principles the love of truth may compel him to diſſent.

In theſe directions for the ſtudy of theology, we might have enumerated many more books on each branch of the ſubject well deſerving of the moſt attentive peruſal; but he who ſhall have gone through the courſe here recommended, will have laid a foundation on which he may raiſe ſuch a ſuperſtructure as will entitle him to the character of an accompliſhed divine. His diligence muſt indeed be continued through life; for when a man ceaſes to make acquiſitions in any department of learning, he ſoon begins to loſe thoſe which he has already made; and a more contemptible character is nowhere to be found than that of a clergyman unacquainted with the learning of his profeſſion. This learning, however, is not to be acquired, and indeed is ſcarcely to be preſerved, by ſtudying *bodies* or *inſtitutes* of *theology;* and though we have mentioned a few generally approved by two rival ſects of Chriſtians, and muſt, in conformity with the plan of our work, give another ourſelves, we do not heſitate to declare, that the man who has carefully gone through the courſe of ſtudy which we have recommended, though it be little more than the outlines on which he is to work, may, with no great loſs to himſelf, neglect ours and all other ſyſtems. For as an excellent writer *, whom we have often quoted, well obſerves, "to judge of the *fact* whether ſuch a revelation containing ſuch a principle, with its myſteries and credentials, was actually ſent from God, and received by man, by examining the *evidences* and *circumſtances* which accompanied it—the *time* when, the *place* where, the *manner* how, it was delivered—the *form* in which it deſcends to us—and in what it is *contained*—together with the particular *ſubſtance* and *burden* of it—and how every part is to be rightly *underſtood:* theſe are the various and extenſive ſubjects which conſtitute the ſublime office of THEOLOGIC REASONING and the PROPER STUDY OF DIVINITY." On this account we ſhall paſs over ſlightly, many things which every clergyman ought thoroughly to underſtand, and confine ourſelves, in the ſhort compend which we are to give, to the chief articles of Chriſtian theology. In doing this, we ſhall endeavour to diveſt ourſelves of party prejudices; but as we are far from thinking that this endeavour will be completely ſucceſsful (for we believe there is no man totally free from prejudice), we cannot conclude this part of the article more properly than with the following ſolemn CHARGE, with which a very learned divine † always prefaced his Theological Lectures.

† *Dr Taylor of Norwich.*

21
A charge to ſtudents of theology.

I. "I do ſolemly charge you, in the name of the God of Truth, and of our Lord Jeſus Chriſt, who is the Way, the Truth, and the Life, and before whoſe judgement-ſeat you muſt in no long time appear, that in all your ſtudies and inquiries of a religious nature, preſent or future, you do conſtantly, carefully, impartially, and conſcientiouſly, attend to evidence, as it lies in the Holy Scriptures, or in the nature of things, and the dictates of reaſon; cautiouſly guarding againſt the ſallies of imagination, and the fallacy of ill-grounded conjecture.

II. "That you admit, embrace, or aſſent to no principle or ſentiment by me taught or advanced, but only ſo far as it ſhall appear to you to be ſupported and juſtified by proper evidence from revelation or the reaſon of things.

III. "That if, at any time hereafter, any principle or ſentiment by me taught or advanced, or by you admitted or embraced, ſhall, upon impartial and faithful examination, appear to you to be dubious or falſe, you either ſuſpect or totally reject ſuch principle or ſentiment.

IV. "That you keep your mind always open to evidence: That you labour to baniſh from your breaſt all prejudice, prepoſſeſſion, and party-zeal: That you ſtudy to live in peace and love with all your fellow Chriſtians; and that you ſteadily aſſert for yourſelf, and freely allow to others, the unalienable rights of judgment and conſcience."

PART I. OF NATURAL THEOLOGY.

SECT. I. *Of the Being and Attributes of* GOD.

HE who cometh to God, ſays an ancient divine *, deeply read in the philoſophy of his age, muſt believe that he is, and that he is a rewarder of them who diligently ſeek him. This is a truth as undeniable as that a man cannot concern himſelf about a nonentity. The exiſtence of God is indeed the foundation of all religion, and the firſt principle of the ſcience which is the ſubject of this article. It is likewiſe a principle which muſt command the aſſent of every man who has any notion of the relation between effects and their cauſes, and whoſe curioſity has ever been excited by the phenomena of nature. This great and important truth we have elſewhere endeavoured to demonſtrate (ſee METAPHYSICS, Part III. Chap. vi.); but it may be proved by arguments leſs abſtracted than the nature of that article required us to uſe. Of theſe we ſhall give one or two, which we hope will be level to every ordinary capacity; while, at the ſame time, we earneſtly recommend to the young divine a diligent ſtudy of thoſe books on the

Being and Attributes of God.

the ſubject which we have mentioned in the preceding directions.

We ſee that the human race, and every other ſpecies of animals, is at preſent propagated by the co-operation of two parents; but has this proceſs continued from eternity? A moment's reflection will convince us that it has not. Let us take any one man alive, and let us ſuppoſe his father and mother dead, and himſelf the only perſon at preſent exiſting: how came he into the world? It will be ſaid he was produced mechanically or chemically by the conjunction of his parents, and that his parents were produced in the ſame manner by theirs. Let this then be ſuppoſed; it muſt ſurely be granted, that when this man was born, an addition was made to the ſeries of the human race. But a ſeries which can be enlarged may likewiſe be diminiſhed; and by tracing it backwards, we muſt at ſome period, however remote, reach its beginning. There muſt therefore have been a firſt pair of the human race, who were not propagated by the conjunction of parents. How did theſe come into the world?

23 propagation of animals

* See *Bentley's Boyle's Lectures.*

Anaximander tells us*, that the firſt men and all animals were bred in warm moiſture, incloſed in cruſtaceous ſkins like crab-fiſh or lobſters; and that when they arrived at a proper age, their ſhelly priſons growing dry, broke, and made way for their liberty. Empedocles informs us, that mother Earth at firſt brought forth vaſt numbers of legs, and arms, and heads, &c. which approaching each other, arranging themſelves properly, and being cemented together, ſtarted up at once full grown men.

Surely thoſe ſages, or their followers, ſhould have been able to tell us why the earth has not in any climate this power of putting forth vegetable men or the parts of men at preſent. If this univerſal parent be eternal and ſelf-exiſtent, it muſt be incapable of decay or the ſmalleſt change in any of its qualities; if it be not eternal, we ſhall be obliged to find a cauſe for its exiſtence, or at leaſt for its form and all its powers. But ſuch a cauſe may have produced the firſt human pair, and undoubtedly did produce them, without making them ſpring as plants from the ſoil. Indeed the growth of plants themſelves clearly evinces a cauſe ſuperior to any vegetative power which can be ſuppoſed inherent in the earth. No plant can be propagated but from ſeed or ſlips from the parent ſtock; but when one contemplates the regular proceſs of vegetation, the exiſtence of every plant implies the prior exiſtence of a parent ſeed, and the exiſtence of every ſeed the prior exiſtence of a parent plant. Which then of theſe, the oak or the acorn, was the firſt, and whence was its exiſtence derived? Not from the earth: for we have the evidence of univerſal experience that the earth never produces a tree but from ſeed, nor ſeed but from a tree. There muſt therefore be ſome ſuperior power which formed the firſt ſeed or the firſt tree, planted it in the earth, and gave to it thoſe powers of vegetation by which the ſpecies has been propagated to this day.

24 and vegetables,

Thus clearly do the proceſſes of generation and vegetation indicate a power ſuperior to thoſe which are uſually called the *powers of nature*. The ſame thing appears no leſs evident from the laws of attraction and repulſion, which plainly prevail through the whole ſyſtem of matter, and hold together the ſtupendous ſtructure. Experiment ſhows that very few particles of the moſt ſolid body are in actual contact with each other (ſee OPTICS, N° 63—68. PHYSICS, N° 23.); and that there are conſiderable interſtices between the particles of every elaſtic fluid, is obvious to the ſmalleſt reflection. Yet the particles of ſolid bodies ſtrongly cohere, whilſt thoſe of elaſtic fluids repel each other. How are theſe phenomena accounted for? To ſay that the former is the effect of attraction and the latter of repulſion, is only to ſay that two individual phenomena are ſubject to thoſe laws which prevail through the whole of the claſſes under which they are reſpectively arranged; whilſt the queſtion at iſſue is concerning the ORIGIN OF THE LAWS THEMSELVES, the *power* which makes the particles of gold cohere, and thoſe of air repel each other. Power without ſubſtance is inconceivable; and by a law of human thought, no man can believe a being to operate but where it is in ſome manner or other actually preſent: but the particles of gold adhere, and the particles of air keep at a diſtance from each other, by powers exerted where no matter is preſent. There muſt therefore be ſome ſubſtance endowed with power which is not material.

25 and from the laws of attraction and repulſion, &c.

Of this ſubſtance or being the power is evidently immenſe. The earth and other planets are carried round the ſun with a velocity which human imagination can ſcarcely conceive. That this motion is not produced by the agency of theſe vaſt bodies on one another, or by the interpoſition of any material fluid, has been ſhown elſewhere (ſee METAPHYSICS, N° 196—200. and OPTICS, N° 67.); and ſince it is a law of our beſt philoſophy, *that we are not to multiply ſubſtances without neceſſity*, we muſt infer that the ſame Being which formed the firſt animals and vegetables, endowing them with powers to propagate their reſpective kinds, is likewiſe the cauſe of all the phenomena of nature, ſuch as *coheſion*, *repulſion*, *elaſticity*, and *motion*, even the motions of the heavenly bodies themſelves.

If this powerful Being be ſelf-exiſtent, intelligent, and independent in his actions and volitions, he is an original or firſt cauſe, and that Being whom we denominate GOD. If he be not ſelf-exiſtent and independent, there muſt be a cauſe in the order of nature prior and ſuperior to Him, which is either itſelf the firſt cauſe, or a link in that ſeries of cauſes and effects, which, however vaſt we ſuppoſe it, muſt be traced ultimately to ſome one Being, who is ſelf-exiſtent, and has in himſelf the power of beginning motion, independent of every thing but his own intelligence and volition. In vain have Atheiſts alleged, that the ſeries may aſcend infinitely, and for that reaſon have no firſt mover or cauſe. An infinite ſeries of ſucceſſive beings involves an abſurdity and contradiction (ſee METAPHYSICS, N° 288.): but not to inſiſt on this at preſent, we ſhall only begin to leave to conſider ſuch a ſeries as a whole, and ſee what conſequences will flow from the ſuppoſition. That we may with logical propriety conſider it in this light, is incontrovertible; for the birth of each individual of the human race ſhows that it is made up of parts; but parts imply a whole as neceſſarily as an attribute implies its ſubject. As in this ſuppoſed ſeries there is no cauſe which is not likewiſe an effect, nor any body moving another which was not itſelf moved by a third, the whole is undeniably equivalent to an infinite effect, or an infinite body moved: but if a finite effect muſt neceſſarily have proceeded from a cauſe, and a finite body

26 Abſurdity of an infinite ſeries of effects.

in

and in motion must have been put into that state by a mover, is there a human mind which can conceive an infinite effect to have proceeded from *no* cause, or an infinite body in motion to have been moved by *nothing?* No, surely! An infinite effect, were such a thing possible, would compel us to admit an infinite cause, and an infinite body in motion a mover of infinite power. Being and Attributes of God.

This great cause is GOD, whose wisdom, power, and goodness, all nature loudly proclaims. That the phenomena which we daily see evince the existence of *one* such Being, has just been shown; and that we have no reason to infer the existence of *more* than one, is very evident. For, not to lay more stress than it will bear on that rule of Newton's, which forbids us to multiply substances without necessity, such a harmony prevails through the whole visible universe, as plainly shows it to be under the government of one intelligence. That on this globe the several elements serve for nourishment to plants, plants to the inferior animals, and animals to man; that the other planets of our system are probably inhabited, and their inhabitants nourished in the same or a similar manner; that the sun is so placed as to give light and heat to all, and by the law of gravitation to bind the whole planets into one system with itself—are truths so obvious and so universally acknowledged, as to supersede the necessity of establishing them by proof. The fair inference therefore is, that the solar system and all its parts are under the government of *one intelligence*, which directs all its motions and all the changes which take place among its parts for some wise purposes. To suppose it under the government of two or more intelligences would be highly unreasonable; for if these intelligences had equal power, equal wisdom, and the same designs, one of them would evidently be superfluous; and if they had equal power and contrary designs, they could not be the parents of that harmony which we clearly perceive to prevail in the system.

But the Being capable of regulating the movements of so vast a machine, may well be supposed to possess infinite power, and to be capable of superintending the motions of the universe. That the widely extended system of nature is but one system, of which the several parts are united by many bonds of mutual connection, has been shown elsewhere (see PHYSICS), and appears daily more and more evident from our progress in physical discoveries; and therefore it is in the highest degree unreasonable to suppose that it has more than one author, or one supreme governor.

As the unity of design apparent in the works of creation plainly proves the unity of their Author, so do the immensity of the whole, and the admirable adjustment of the several parts to one another, demonstrate His power and His wisdom. On this subject the following beautiful reflections by Mr Wollaston are deserving of the most serious attention.

"In order (says that able writer *) to prove to any one the grandness of this fabric of the world, one needs only to bid him consider the *sun*, with that insupportable glory and lustre that surrounds it; to demonstrate its vast distance, magnitude, and heat; to represent to him the chorus of planets moving periodically, by uniform laws, in their several orbits about it; guarded some of them by secondary planets, and as it were emulating the state of the sun, and probably all possessed by proper inhabitants; to remind him of those surprising visits which the *comets* make to us, and the large trains of uncommon splendour which attend them, the far country from which they come, and the curiosity and horror which they excite not only among us, but in the inhabitants of other planets, who may also be up to see the entry and progress of these ministers of fate; to direct his eye and contemplation through those azure fields and vast regions above him up to the *fixed stars*, that radiant numberless host of heaven; and to make him understand how unlikely a thing it is that they should be placed there only to adorn and bespangle a canopy over our heads; to convince him that they are rather so many *other suns*, with their several systems of planets about them; to show him by the help of glasses still more and more of these fixed lights, and to beget in him an apprehension of their inconceivable numbers, and those immense spaces that lie beyond our reach and even our imagination: One needs but to do this (continues our author), and explain to him such things as are now known almost to every body; and by it to show, that if the world be not infinite, it is *infinito similis*, and undoubtedly the work of an INFINITE ARCHITECT. Being and Attributes of God.

"But if we would take a view of all the *particulars* contained within that astonishing compass which we have thus hastily run over, how would wonders multiply upon us? Every corner, every part of the world, is as it were made up of *other* worlds. If we look upon this our earth, what scope does it furnish for admiration? The great variety of mountains, hills, valleys, plains, rivers, seas, trees, and plants! The many tribes of different animals with which it is stocked; the multifarious inventions and works of one of these, i. e. of us men; with the wonderful instincts of others, guiding them uniformly to what is best for themselves, in situations where neither sense nor reason could direct them. And yet when all these (heaven and earth) are surveyed as nicely as they can be by the help of our unassisted senses and of telescopes, we may discover by the assistance of good microscopes, in very small parts of matter, as many *new* wonders as those already discovered, new kingdoms of animals, with new and curious architecture. So that as our senses and even conception fainted before in the vast journeys we took in considering the expanse of the universe, they here again fail us in our researches into the principles and minute parts of which it is composed. Both the *beginnings* and the *ends* of things, the *least* and the *greatest*, all conspire to baffle us; and which way soever we prosecute our inquiries, we still meet with fresh subjects of amazement, and fresh reasons to believe that there are indefinitely more and more behind, that will forever escape our eagerest pursuits and deepest penetration.

"In this vast assemblage, and amidst all the multifarious motions by which the several processes of generation and corruption, and the other phenomena of nature, are carried on, we cannot but observe that there are stated methods, as so many forms of proceeding, to which things punctually and religiously adhere. The same *causes* circumstanced in the same manner produce always the same *effects*; all the *species* of animals among us are made according to one general *idea*; and so are those of *plants* also, and even of *minerals*. No new species are brought forth or have arisen anywhere; and the old are preserved and continued by the *old ways*.

"It appears, lastly, beyond dispute, that in the part

Being and Attributes of God.

and model of the world there is a contrivance for accompliſhing certain ends. The ſun is placed near the centre of our ſyſtem, for the more convenient diſpenſing of his benign influences to the planets moving about him; the place of the earth's *equator* interſects that of her *orbit*, and makes a proper angle with it, in order to diverſify the *year*, and create an uſeful variety of *ſeaſons*; and many other things of this kind will be always obſerved, and though a thouſand times repeated, be meditated upon with pleaſure by good men and true philoſophers. Who can obſerve the vapours to aſcend, eſpecially from the ſea, meet above in clouds, and fall again after condenſation, without being convinced that this is a kind of *diſtillation*, in order to clear the water of its groſſer ſalts, and then by rains and dews to ſupply the fountains and rivers with freſh and wholeſome liquor; to nouriſh the vegetables below by ſhowers, which deſcend in drops as from a *watering-pot* upon a garden? Who can view the *ſtructure* of a plant or animal, the indefinite number of its fibres and fine veſſels, the formation of larger veſſels, and the ſeveral members out of them, with the apt diſpoſition of all theſe; the means contrived for the reception and diſtribution of *nutriment*; the *effect* this nutriment has in extending the veſſels, bringing the vegetable or animal to its full growth and expanſion, continuing the *motion* of the ſeveral fluids, repairing the decays of the body, and preſerving *life*? Who can take notice of the ſeveral *faculties* of animals, their arts of ſaving and providing for themſelves, or the ways in which they are provided for; the uſes of plants to animals, and of ſome animals to others, particularly to mankind; the care taken that the ſeveral ſpecies ſhould be propagated, without confuſion, from their proper ſeeds; the ſtrong inclination planted in animals for that purpoſe, their love of their young and the like.—Who (ſays our author) can obſerve all this, and not ſee a *deſign* in ſuch *regular* pieces, ſo nicely wrought and ſo admirably preſerved? If there were but one animal in exiſtence, and it could not be doubted but that his eyes were formed that he might ſee with them, his ears that he might hear with them, and his feet to be inſtruments by which he might remove himſelf from place to place; if *deſign* and *contrivance* can be much leſs doubted, when the ſame things are repeated in the individuals of all the tribes of animals; if the like obſervations be made with reſpect to vegetables and other things; and if all theſe *claſſes* of things, and much more the *individuals* comprehended under them, be inconceivably numerous, as moſt unqueſtionably they are—one cannot but be convinced, from what ſo plainly runs through the nobler parts of the viſible world, that not only *they*, but other things, even thoſe that ſeem to be *leſs noble*, have their ends likewiſe, though not always perceived by capacities limited like ours. And ſince we cannot, with the Epicureans of old, ſuppoſe the parts of matter to have *contrived* among themſelves this wonderful form of a world, to have taken by agreement each its reſpective *poſt*, and then to have purſued in conjunction conſtant *ends* by certain methods and meaſures *concerted*, there muſt be ſome other Being, whoſe wiſdom and power are equal to ſuch a mighty work as is the *ſtructure* and *preſervation* of the world. There muſt be ſome Almighty MIND who modelled and preſerves it; lays the cauſes of things ſo deep; preſcribes them ſuch uniform and ſteady laws; deſtines and adapts them to certain purpoſes; and makes one thing to fit and anſwer another ſo as to produce one harmonious whole. Yes,

Being and Attributes of God.

> Theſe are thy glorious works, Parent of good!
> Almighty, thine this univerſal frame,
> Thus wondrous fair; THYSELF how wondrous then!
> How wondrous in wiſdom and in power!"

29 goodneſs

But the GOODNESS of God is not leſs conſpicuous in his works than His power or His wiſdom. Contrivance proves deſign, and the predominant tendency of the contrivances indicates the diſpoſition of the deſigner. "The world (ſays an elegant and judicious writer*) abounds with contrivances, and all the contrivances in it with which we are acquainted are directed to beneficial purpoſes. Evil no doubt exiſts; but it is never that we can perceive the object of contrivance. Teeth are contrived to eat, not to ache; their aching now and then is incidental to the contrivance, perhaps inſeparable from it; but it is not its object. This is a diſtinction which well deſerves to be attended to. In deſcribing implements of huſbandry, one would hardly ſay of a ſickle that it is made to cut the reaper's fingers, though from the conſtruction of the inſtrument, and the manner of uſing it, this miſchief often happens. But if he had occaſion to deſcribe inſtruments of torture or execution, this, he would ſay, is to extend the ſinews; this to diſlocate the joints; this to break the bones; this to ſcorch the ſoles of the feet. Here pain and miſery are the very objects of the contrivance. Now nothing of this ſort is to be found in the works of nature. We never diſcover a train of contrivance to bring about an evil purpoſe. No anatomiſt ever diſcovered a ſyſtem of organization calculated to produce pain and diſeaſe; or, in explaining the parts of the human body, ever ſaid, this is to irritate, this to inflame, this duct is to convey the gravel to the kidneys, this gland to ſecrete the humour which forms the gout. If by chance he came to a part of which he knows not the uſe, the moſt that he can ſay is, that to him it appears to be uſeleſs: no one ever ſuſpects that it is put there to incommode, to annoy, or to torment. If God had wiſhed our miſery, he might have made ſure of his purpoſe, by forming our ſenſes to be as many ſores and pains to us as they are now inſtruments of gratification and enjoyment; or, by placing us among objects ſo ill ſuited to our perceptions as to have continually offended us, inſtead of miniſtering to our refreſhment and delight. He might have made, for inſtance, every thing we taſted bitter, every thing we ſaw loathſome, every thing we touched a ſting, every ſmell a ſtench, and every ſound a diſcord."

* Dr Pa

Inſtead of this, all our ſenſations, except ſuch as are excited by what is dangerous to our health, are pleaſures to us: The view of a landſcape is pleaſant; the taſte of nouriſhing food is pleaſant; ſounds not too loud are agreeable, while muſical ſounds are exquiſite; and ſcarcely any ſmells, except ſuch are excited by effluvia obviouſly pernicious to the brain, are diſagreeable; while ſome of them, if not too long indulged, are delightful. Our lives are preſerved and the ſpecies is continued by obeying the impulſe of appetites; of which the gratification is exquiſite when not repeated too frequently, to anſwer the purpoſes of the Author of our being. Since, then, God has called forth his conſummate

Being and Attributes of God.

mate wiſdom to contrive and provide for our happineſs, and has made thoſe things which are neceſſary to our exiſtence and the continuance of the race ſources of our greateſt ſenſual pleaſures, who can doubt but that benevolence is one of his attributes; and that, if it were not impious to draw a compariſon between them, it is the attribute in which he himſelf moſt delighteth?

But it is not from ſenſation only that we may infer the benevolence of the Deity: He has formed us with minds capable of intellectual improvement, and he has implanted in the breaſt of every man a very ſtrong deſire of adding to his knowledge. This addition, it is true, cannot be made without labour; and at firſt the requiſite labour is to moſt people irkſome: but a very ſhort progreſs in any ſtudy converts what was irkſome into a pleaſure of the moſt exalted kind; and he who by ſtudy, however intenſe, enlarges his ideas, experiences a complacency, which, though not ſo poignant perhaps as the pleaſures of the ſenſualiſt, is ſuch as endears him to himſelf, and is what he would not exchange for any thing elſe which this world has to beſtow, except the ſtill ſweeter complacency ariſing from the conſciouſneſs of having diſcharged his duty.

That the practice of virtue is attended with a peculiar pleaſure of the pureſt kind, is a fact which no man has ever queſtioned, though the immediate ſource of that pleaſure has been the ſubject of many diſputes. He who attributes it to a moral ſenſe, which inſtinctively points out to every man his duty, and on the performance of it rewards him with a ſentiment of ſelf-approbation, muſt of neceſſity acknowledge benevolence to be one of the attributes of that Being who has ſo conſtituted the human mind. That to protect the innocent, relieve the diſtreſſed, and do to others as we would in like circumſtances wiſh to be done by, fills the breaſt, previous to all reflection, with a holy joy, as the commiſſion of any crime tears it with remorſe, cannot indeed be controverted. Many, however, contend, that this joy and this remorſe ſpring not from any moral inſtinct implanted in the mind, but are the conſequence of early and deep-rooted aſſociations of the practice of virtue with the hope of future happineſs, and of vice with the dread of future miſery. On the reſpective merits of theſe two theories we ſhall not now decide, but only obſerve, that they both lead with equal certainty to the benevolence of the Deity, who made us capable of forming aſſociations, and ſubjected thoſe aſſociations to fixed laws. This being the caſe, the moral ſenſe, with all its inſtantaneous effects, affords not a more convincing proof of his goodneſs, than that principle in our nature by which remote circumſtances become ſo linked together, that the one circumſtance never occurs without bringing the other alſo into view. It is thus that the pleaſing complacency, which was perhaps firſt excited by the hopes of future happineſs, comes in time to be ſo aſſociated with the conſciouſneſs of virtuous conduct, the only thing entitled to reward, that a man never performs a meritorious action without experiencing the moſt exquiſite joy diffuſed through his mind, though his attention at that inſtant may not be directed either to heaven or futurity. Were we obliged, before we could experience this joy, to eſtimate by reaſon the merit of every individual action, and trace its connection to heaven and future happineſs through a long train of intermediate reaſoning, we ſhould be in a great meaſure deprived of the preſent reward of virtue; and therefore this aſſociating principle contributes much to our happineſs. But the benevolence of a Being, who ſeems thus anxious to furniſh us with both ſenſual and intellectual enjoyments, and who has made our duty our greateſt pleaſure, cannot be queſtioned; and therefore we muſt infer, that the Author of Nature wiſhes the happineſs of the whole ſenſible and intelligent creation.

30 Objections.

To ſuch reaſoning as this in ſupport of the Divine Benevolence many objections have been made. Some of them appear at firſt ſight plauſible, and are apt to ſtagger the faith of him who has beſtowed no time on the ſtudy of that branch of general ſcience which is called *phyſics* (ſee PHYSICS). To omit theſe altogether in ſuch an article as this might be conſtrued into neglect; while it is certain that there is in them nothing worthy the attention of that man who is qualified either to eſtimate their force, or to underſtand the arguments by which they have often been repelled.

31 anſwered.

It has been aſked, Why, if the Author of Nature be a benevolent Being, are we neceſſarily ſubject to pain, diſeaſes, and death? The ſcientific phyſiologiſt replies, Becauſe from theſe evils Omnipotence itſelf could not in our preſent ſtate exempt us, but by a conſtant ſeries of miracles. He who admits miracles, knows likewiſe that mankind were originally in a ſtate in which they were not ſubject to death; and that they fell under its dominion through the fault of their common progenitors. But the fall and reſtoration of man is the great ſubject of revealed religion; and at preſent we are diſcuſſing the queſtion like philoſophers who have no other data on which to proceed than the phenomena of nature. Now we know, that as all matter is diviſible, every ſyſtem compoſed of it muſt neceſſarily be liable to decay and diſſolution; and our material ſyſtem would decay and be diſſolved long before it could ſerve the purpoſes of nature, were there not methods contrived with admirable wiſdom for repairing the waſte occaſioned by perpetual friction. The body is furniſhed with different fluids, which continually circulate through it in proper channels, and leave in their way what is neceſſary to repair the ſolids. Theſe again are ſupplied by food *ab extra;* and to the whole proceſſes of digeſtion, circulation, and nutrition, the air we breathe is abſolutely neceſſary. But as the air is a very heterogeneous fluid, and ſubject to violent and ſudden changes, it is obvious that theſe changes muſt affect the blood, and by conſequence the whole frame of the human body. The air indeed in proceſs of time conſumes even marble itſelf; and therefore we cannot wonder that as it is in one ſtate the parent of health, it ſhould in another be the ſource of diſeaſe to ſuch creatures as man and other terreſtrial animals. Nor could theſe conſequences be avoided without introducing others much more deplorable. The world is governed by general laws, without which there could be among men neither arts nor ſciences; and though laws different from thoſe by which the ſyſtem is at preſent governed might perhaps have been eſtabliſhed, there is not the ſmalleſt reaſon to imagine that they could on the whole have been better, or attended with fewer inconveniences. As long as we have material and ſolid bodies capable of motion, liable to reſiſtance from other ſolid bodies, ſupported by food,

Being and Attributes of God.

subject to the agency of the air, and divisible, they must necessarily be liable to pain, disease, corruption, and death, and that too by the very influence of those laws which preserve the order and harmony of the universe. Thus gravitation is a general law so good and so necessary, that were it for a moment suspended, the world would instantly fall to pieces; and yet by means of this law the man must inevitably be crushed to death on whom a tower shall chance to tumble. Again, the attraction of cohesion is a general law, without which it does not appear that any corporeal system could possibly exist: it is by this law too, or a modification of it, that the glands and lacteals of the human body extract from the blood such particles as are necessary to nourish the solids; and yet it is by means of the very same modification of the very same law that a man is liable to be poisoned.

32 Sickness, pain, and the dread of death serve good purposes.

Although the human body could not have been preserved from dangers and dissolution but by introducing evils greater on the whole than those to which it is now liable, why, it has sometimes been asked, is every disorder to which it is subject attended with sickness or with pain? and why is such a horror of death implanted in our breasts, seeing that by the laws of nature death is inevitable? We answer, That sickness, pain, and the dread of death, serve the very best purposes. Could a man be put to death, or have his limbs broken without feeling pain, the human race had long ago been extinct. Felt we no uneasiness in a fever, we should be insensible of the disease, and die before we suspected our health to be impaired. The horror which generally accompanies our reflections on death tends to make us more careful of life, and prevents us from quitting this world rashly when our affairs prosper not according to our wishes. It is likewise an indication that our existence does not terminate in this world; for our dread is seldom excited by the prospect of the pain which we may suffer when dying, but by our anxiety concerning what we may be doomed to suffer or enjoy in the next stage of our existence; and this anxiety tends more perhaps than any thing else to make us live while we are here in such a manner as to ensure our happiness hereafter.

Thus from every view that we can take of the works and laws of God, and even from considering the objections which have sometimes been made to them, we are compelled to acknowledge the benevolence of their Author. We must not, however, suppose the Divine benevolence to be a fond affection like that which is called benevolence among men. All human affections and passions originate in our dependence and wants; and it has been doubted whether any of them be at first disinterested (see PASSION): but he to whom existence is essential cannot be dependent; he who is the Author of every thing can feel no want. The Divine benevolence therefore must be wholly disinterested, and of course free from those partialities originating in self-love, which are alloys in the most sublime of human virtues. The most benevolent man on earth, though he wishes the happiness of every fellow-creature, has still, from the ties of blood, the endearments of friendship, or, perhaps from a regard to his own interest, some particular favourites whom, on a competition with others, he would certainly prefer. But the equal Lord of all can have no particular favourites. His benevolence is therefore coincident with justice; or, that which is called *divine justice*, is only benevolence exerting itself in a particular manner for the propagation of general felicity. When God prescribes laws for regulating the conduct of his intelligent creatures, it is not because he can reap any benefit from their obedience to those laws, but because such obedience is necessary to their own happiness; and when he punishes the transgressor, it is not because in his nature there is any disposition to which the prospect of such punishment can afford gratification, but because in the government of free agents punishment is necessary to reform the criminal, and to intimidate others from committing the like crimes.

33 The divine benevolence coincident with justice.

Being and Attributes of God.

The essence of this self-existent, all-powerful, infinitely wise, and perfectly good Being, is to us wholly incomprehensible. That it is not matter, is shown by the process of argumentation by which we have proved it to exist: but what it is we know not, and it would be impious presumption to inquire. It is sufficient for all the purposes of religion to know that God is somehow or other present to every part of his works; that existence and every possible perfection is essential to him; and that he wishes the happiness of all his creatures. From these truths we might proceed to illustrate the perpetual superintendance of his providence, both general and particular, over every the minutest part of the universe: but that subject has been discussed in a separate article; to which, therefore, we refer the reader. (See PROVIDENCE). We shall only observe at present, that the manner in which animals are propagated affords as complete a proof of the constant superintendance of divine power and wisdom, as it does of the immediate exertion of these faculties in the formation of the parent pair of each species. For were propagation carried on by *necessary* and mechanical laws, it is obvious, that in every age there would be generated, in each species of animals, the very same proportion of males to females that there was in the age preceding. On the other hand, did generation depend on *fortuitous* mechanism, it is not conceivable but that, since the beginning of the world, several species of animals should in *some age* have generated nothing but *males*, and others nothing but *females*; and that of course many species would have been long since extinct. As neither of these cases has ever happened, the preservation of the various species of animals, by keeping up constantly in the world a due, though not always the same, proportion between the sexes of male and female, is a complete proof of the superintendance of Divine providence, and of that saying of the apostle, that it is "in God we live, move, and have our being."

34 God incomprehensible;

35 but constantly present to his works.

SECT. II. *Of the Duties and Sanctions of Natural Religion.*

36 Reverence and gratitude due to God.

FROM the short view that we have taken of the divine perfections, it is evidently our duty to reverence in our minds the self-existent Being to whom they belong. This is indeed not only a duty, but a duty of which no man who contemplates these perfections, and believes them to be real, can possibly avoid the performance. He who thinks irreverently of the Author of nature, can never have considered seriously the power, the wisdom, and the goodness, displayed in his works; for whoever has a tolerable notion of these must be convinced, that he who performed them has no imperfection;

tion; that his power can accompliſh every thing which involves not a contradiction; that his knowledge is intuitive, and free from the poſſibility of error; and that his goodneſs extends to all without partiality and without any alloy of ſelfiſh deſign. This conviction muſt make every man on whoſe mind it is impreſſed ready to proſtrate himſelf in the duſt before the Author of his being; who, though infinitely exalted above him, is the ſource of all his enjoyments, conſtantly watches over him with paternal care, and protects him from numberleſs dangers. The ſenſe of ſo many benefits muſt excite in his mind a ſentiment of the livelieſt gratitude to him from whom they are received, and an ardent wiſh for their continuance.

While ſilent gratitude and devotion thus glow in the breaſt of the contemplative man, he will be careful not to form even a mental image of that all-perfect Being to whom they are directed. He knows that God is not material; that he exiſts in a manner altogether incomprehenſible; that to frame an image of him would be to aſſign limits to what is infinite; and that to attempt to form a poſitive conception of him would be impiouſly to compare himſelf with his Maker.

The man who has any tolerable notion of the perfections of the Supreme Being will never ſpeak lightly of him, or make uſe of his name at all but on great and ſolemn occaſions. He knows that the terms of all languages are inadequate and improper, when applied directly to him who has no equal, and to whom nothing can be compared; and therefore he will employ theſe terms with caution. When he ſpeaks of his mercy and compaſſion, he will not conſider them as feelings wringing the heart like the mercy and compaſſion experienced by man, but as rays of pure and diſintereſted benevolence. When he thinks of the ſtupendous ſyſtem of nature, and hears it, perhaps, ſaid that God formed it for his own glory, he will reflect that God is ſo infinitely exalted above all his creatures, and ſo perfect in himſelf, that he can neither take pleaſure in their applauſe, nor receive any acceſſion of any kind from the exiſtence of ten thouſand worlds. The immenſe fabric of nature therefore only diſplays the glory or perfections of its Author to *us* and to other *creatures* who have not faculties to comprehend him in himſelf.

When the contemplative man talks of *ſerving* God, he does not dream that his ſervices can increaſe the divine felicity; but means only that it is his duty to obey the divine laws. Even the pronoun *He*, when it refers to God, cannot be of the ſame import as when it refers to man; and by the philoſophical divine it will ſeldom be uſed but with a mental alluſion to this obvious diſtinction.

As the man who duly venerates the Author of his being will not ſpeak of him on trivial occaſions, ſo will he be ſtill further from calling upon him to witneſs impertinences and falſehood (ſee OATH). He will never mention his name but with a *pauſe*, that he may have time to reflect in ſilence on his numberleſs perfections, and on the immenſe diſtance between himſelf and the Being of whom he is ſpeaking. The ſlighteſt reflection will convince him that the world with all that it contains depends every moment on that God who formed it; and this conviction will compel him to wiſh for the divine protection of himſelf and his friends from all dangers and misfortunes. Such a wiſh is in effect a prayer, and will always be accompanied with adoration, confeſſion, and thankſgiving (ſee PRAYER). But adoration, confeſſions, ſupplication, and thankſgiving, conſtitute what is called *worſhip*, and therefore the worſhip of God is a natural duty. It is the addreſſing of ourſelves as his dependants to him as the ſupreme cauſe and governor of the world, with acknowledgements of what we enjoy, and petitions for what we really want, or he knows to be convenient for us. As if, ex. gr. I ſhould in ſome humble and compoſed manner (ſays Mr Wollaſton) pray to that "Almighty Being, upon whom depends the exiſtence of the world, and by whoſe providence I have been preſerved to this moment, and enjoyed many undeſerved advantages, that he would graciouſly accept my grateful ſenſe and acknowledgements of all his beneficence towards me; that he would deliver me from the evil conſequences of all my tranſgreſſions and follies; that he would endue me with ſuch diſpoſitions and powers as may carry me innocently and ſafely through all future trials, and may enable me on all occaſions to behave myſelf conformably to the laws of reaſon piouſly and wiſely; that He would ſuffer no being to injure me, no misfortunes to befal me, nor me to hurt myſelf by any error or miſconduct of my own: that he would vouchſafe me clear and diſtinct perceptions of things; with ſo much health and proſperity as may be good for me; that I may at leaſt paſs my time in peace, with contentment and tranquillity of mind; and that having faithfully diſcharged my duty to my family and friends, and endeavoured to improve myſelf in virtuous habits and uſeful knowledge, I may at laſt make a decent and happy exit, and find myſelf in ſome better ſtate."

Duties and Sanctions of Natural Religion.

40 Divine worſhip a natural duty.

That an untaught ſavage would be prompted by *inſtinct* to addreſs the Supreme Being in ſuch terms as this, we are ſo far from thinking, that to us it appears not probable that ſuch a ſavage, in a ſtate of ſolitude, would be led by inſtinct to ſuppoſe the exiſtence of that Being. But as ſoon as the being and attributes of God were, by whatever means, made known to man, every ſentiment expreſſed in this prayer muſt neceſſarily have been generated in his mind; for not to be ſenſible that we derive our exiſtence and all our enjoyments from God, is in effect to deny his being or his providence; and not to feel a wiſh that he would give us what we want, is to deny either his goodneſs or his power.

The worſhip of God therefore is a natural duty reſulting from the contemplation of his attributes and a ſenſe of our own dependence. But the reaſoning which has led us to this concluſion reſpects only *private* devotion; for it is a queſtion of much greater difficulty, and far enough from being yet determined, whether *public* worſhip be a duty of that religion which can with any propriety be termed *natural*. Mr Wollaſton indeed poſitively affirms that it is, and endeavours to prove his poſition by the following arguments.

41 Whether or not is public worſhip a duty of natural religion?

"A man (ſays he) may be conſidered as a member of ſome ſociety; and as *ſuch* he ought to worſhip God if he has the opportunity of doing it, if there be proper prayers uſed publicly to which he may reſort, and if his health, &c. permit. Or the ſociety may be conſidered as *one body*, that has common intereſts and concerns, and *as ſuch* is obliged to worſhip the Deity, and offer one prayer. Beſides, there are many who know not of themſelves

42 Arguments for it,

Duties and Sanctions of Natural Religion.

themſelves how to pray; perhaps cannot ſo much as read. Theſe muſt be taken *as they are;* and conſequently ſome time and place *appointed* where they may have ſuitable prayers read to them, and be guided in their devotions. And further, towards the keeping mankind in order, it is *neceſſary* there ſhould be ſome religion profeſſed, and even eſtabliſhed, which cannot be without public worſhip. And were it not for that ſenſe of virtue which is *principally* preſerved (ſo far as it is preſerved) by national *forms* and *habits* of religion, men would ſoon loſe it *all*, run wild, prey upon one another, and do what elſe the worſt of ſavages do."

Theſe are in themſelves juſt obſervations, and would come with great force and propriety from the tongue or pen of a Chriſtian preacher, who is taught by revelation that the Maſter whom he ſerves has commanded his followers "not to forſake the aſſembling of themſelves together," and has promiſed, "that if two of them ſhall agree on earth as touching any thing that they ſhall aſk, it ſhall be done for them of his Father who is in heaven." As urged by ſuch a man, and on ſuch grounds, they would ſerve to ſhow the fitneſs of the divine command, and to point out the benefits which a religious obedience to it might give us reaſon to expect. But the author is here profeſſing to treat of *natural* religion, and to ſtate the duties which reſult from the mere relation which ſubſiſts between man as a creature and God as his creator and conſtant preſerver. Now, though we readily admit the benefits of public worſhip as experienced under the Chriſtian diſpenſation, we do not perceive any thing in this reaſoning which could lead a pious theiſt to expect the ſame benefit previous to all experience. When the author thought of *national forms* and *eſtabliſhments of religion*, he certainly loſt ſight of his proper ſubject, and, as ſuch writers are too apt to do, comprehended under the religion of nature what belongs only to that which is revealed. Natural religion, in the proper ſenſe of the words, admits of no particular *forms*, and of no *legal eſtabliſhment*. Private devotion is obviouſly one of its duties, becauſe ſentiments of adoration, confeſſion, ſupplication, and thankſgiving, neceſſarily ſpring up in the breaſt of every man who has juſt notions of God and of himſelf: but it is not ſo obvious that ſuch notions would induce any body of men to meet at *ſtated times* for the purpoſe of expreſſing their devotional ſentiments in public. Mankind are indeed ſocial beings, and naturally communicate their ſentiments to each other; but we cannot conceive what ſhould at firſt have led them to think that public worſhip at ſtated times would be acceptable to the ſelf-exiſtent Author of the univerſe. In caſe of a famine, or any other calamity in which the whole tribe was equally involved, they might ſpeak of it to each other, inquire into its cauſe, and in the extremity of their diſtreſs join perhaps in one fervent petition, that God would remove it. In the ſame manner they might be prompted to pour forth occaſional ejaculations of public gratitude for public mercies; but it does not follow from theſe incidental occurrences that they would be led to inſtitute times and places and forms of national worſhip, as if they believed the omniſcient Deity more ready to hear them in public than in private. That the appointment of ſuch times and forms and places is beneficial to ſociety, experience teaches us; and therefore it is the duty, and has been the practice, of the ſupreme magiſtrate, in every age and in every civilized country, to provide for the maintenance of the national worſhip. But this practice has taken its riſe, not from the deductions of reaſon, but either from direct revelation, as among the Jews and Chriſtians; or from tradition, which had its origin in ſome early revelations, as among the more enlightened Pagans of ancient and modern times.

43 borrowed from revelation.

We hope none of our readers will imagine that we mean, in any degree, to call in queſtion the fitneſs or the duty of public worſhip. This is far from our intention; but while we are convinced of the importance and neceſſity of this duty, we do not apprehend that we leſſen its dignity, or detract from the weight of almoſt univerſal practice, by endeavouring to derive that practice from its true ſource, which appears to us to be not human reaſon, but divine revelation.

44 The practice of virtue a duty of natural religion.

But whatever doubts may be entertained with reſpect to the origin of public worſhip, there can be none as to the foundation of moral virtue. Reaſon clearly perceives it to be the will of our Maker, that each individual of the human race ſhould treat every other individual as, in ſimilar circumſtances, he would expect to be treated himſelf. It is thus only that the greateſt ſum of human happineſs can be produced (ſee MORAL PHILOSOPHY, N° 17. and 135.); for were all men temperate, ſober, juſt in their dealings, faithful to their promiſes, charitable to the poor, &c. it is obvious that no miſeries would be felt on earth, but the few which, by the laws of corporeal nature, unavoidably reſult from the union of our minds with ſyſtems of matter. But the deſign of God in forming ſentient beings was to communicate to them ſome portion, or rather ſome reſemblance, of that felicity which is eſſential to himſelf; and therefore every action which in its natural tendency co-operates with this deſign muſt be agreeable to him, as every action of a contrary tendency muſt be diſagreeable.

From this reaſoning it follows, that we are obliged not only to be juſt and beneficent to one another, but alſo to abſtain from all unneceſſary cruelty to inferior animals. That we have a right to tame cattle, and employ them for the purpoſes of agriculture and other arts where ſtrength is required, is a poſition which we believe has ſeldom been controverted. But if it is the intention of God to communicate a portion of happineſs to all his creatures endowed with ſenſe, it is obvious that we ſin againſt him when we ſubject even the horſe or the aſs to greater labour than he is able to perform; and this ſin is aggravated when from avarice we give not the animal a ſufficient quantity of food to ſupport him under the exertions which we compel him to make. That it is our duty to defend ourſelves and our property from the ravages of beaſt of prey, and that we may even exterminate ſuch beaſts from the country in which we live, are truths which cannot be queſtioned; but it has been the opinion of men, eminent for wiſdom and learning, that we have no right to kill an ox or a ſheep for *food*, but in conſequence of the divine permiſſion to Noah recorded in the ninth chapter of the book of Geneſis. Whether this opinion be well or ill founded we ſhall not poſitively determine, though the arguments on which it reſts are of ſuch a nature as the reaſoners of the preſent day would perhaps find it no eaſy taſk to anſwer; but it cannot admit of a doubt, that, in killing ſuch animals, we are, in duty to *their* Creator and *ours*, bound to put them to the leaſt poſſible pain. If this be granted, it is ſtill more

45 Cruelty to the inferior animals a ſin.

evident

and evident that we act contrary to the divine will when we torture and put to death such animals as are confessedly not injurious to ourselves, or to any thing on which the comforts of life are known to depend. We are indeed far from being convinced with the poet, that insects and reptiles "in mortal sufferance feel as when a giant dies:" but their feelings on that occasion are certainly such, as that, when we wantonly inflict them, we thwart, as far as in our power, the benevolent purpose of the Creator in giving them life and sense. Let it be observed too, that the man who practises needless cruelty to the brute creation is training up his mind for exercising cruelty towards his fellow-creatures, to his slaves if he have any, and to his servants; and, by a very quick progress, to all who may be placed beneath him in the scale of society.

Such are the plain duties of natural religion; and if they were universally practised, it is evident that they would be productive of the greatest happiness which mankind could enjoy in this world, and that piety and virtue would be their own reward. They are however far from being universally practised; and the consequence is, that men are frequently raised to affluence and power by vice, and sometimes sunk into poverty by a rigid adherence to the rules of virtue.

This being the case, there can be no question of greater importance, while there are few more difficult to be answered, than "What are the sanctions by which natural religion enforces obedience to her own laws?" It is not to be supposed that the great body of mankind should, without the prospect of an ample reward, practise virtue in those instances in which such practice would be obviously attended with injury to themselves; nor does it appear reasonable in any man to forego present enjoyment, without the well-grounded hope of thereby securing to himself a greater or more permanent enjoyment in reversion. Natural religion therefore, as a system of doctrines influencing the conduct, is exceedingly defective, unless it affords sufficient evidence, intelligible to every ordinary capacity, of the immortality of the soul, or at least of a future state of rewards and punishments. That it *does* afford this evidence, is strenuously maintained by some deists, and by many philosophers of a different description, who, though they profess Christianity, seem to have some unaccountable dread of being deceived by their bibles in every doctrine which cannot be supported by philosophical reasoning.

One great argument made use of to prove that the immortality of the soul is among the doctrines of natural religion, is the universal belief of all ages and nations that men continue to live in some other state after death has separated their souls from their bodies. "Quod si *omnium consensus naturæ vox est:* omnesque, qui ubique sunt, consentiunt esse aliquid, quod ad eos pertineat, qui vita cesserint: nobis quoque idem existimandum est: et si, quorum aut ingenio, aut virtute animus excellit, eos arbitramur, quia natura optima sunt, cernere naturæ vim maxime: verisimile est, *cum optimus quisque maxime posteritati serviat*, esse aliquid, cujus is post mortem sensum sit habiturus. Sed ut deos esse natura opinamur, qualesque sint, ratione cognoscimus, sic permanere animos arbitramur *consensu nationum omnium* *."

That this is a good argument for the truth of the doctrine, through whatever channel men may have received it, we readily acknowledge; but it appears not to us to be any proof of that doctrine's being the deduction of human reasoning. The popular belief of Paganism, both ancient and modern, is so fantastic and absurd, that it could never have been rationally inferred from what nature teaches of God and the soul. In the Elysium of the Greek and Roman poets, departed spirits were visible to mortal eyes; and must therefore have been clothed with some material vehicle of sufficient density to reflect the rays of light, though not to resist the human touch. In the mythology of the northern nations, as deceased heroes are represented as eating and drinking, they could not be considered as entirely divested of matter; and in every popular creed of idolatry, future rewards were supposed to be conferred, not for private virtue, but for public violence, on heroes and conquerors and the destroyers of nations. Surely no admirer of what is now called natural religion will pretend that these are part of its doctrines; they are evidently the remains of some primeval tradition obscured and corrupted in its long progress through ages and nations.

Duties and Sanctions of Natural Religion.

48 not the offspring of nature.

49 Opinions of the philosophers respecting a future state.

The philosophers of Greece and Rome employed much time and great talents in disquisitions concerning the human soul and the probability of a future state; and if the genuine conclusions of natural religion on this subject are anywhere to be found, one would naturally look for them in the writings of those men whose genius and virtues did honour to human nature. Yet it is a fact, that the philosophers held such notions concerning the substance of the soul and its state after death as could afford no rational support to suffering virtue, (see METAPHYSICS, Part III. chap. 4.). Socrates is indeed an exception. Confining himself to the study of ethics, that excellent person inferred by the common moral arguments (see MORAL PHILOSOPHY, N°232—246.), that the reality of a future state of rewards and punishments is in the highest degree probable. He was not, however, at all times absolutely *convinced* of this important truth; for a little before his death he said to some who were about him, "I am now about to leave this world, and ye are still to continue in it; which of us have the better part allotted us, God only knows *." And again, at the end of his most admired discourse concerning the immortality of the soul, delivered at a time when he must have been serious, he said to his friends who came to pay their last visit, "I would have you to know that I have great hopes that I am now going into the company of good men; yet I would not be too peremptory and confident concerning it †."

* *Plato in Apolog. Soc.*

† *Plato in Phæd.*

Next to Socrates, Cicero was perhaps the most respectable of all the philosophers of antiquity; and he seems to have studied this great question with uncommon care: yet what were his conclusions? After retailing the opinions of various sages of Greece, and showing that some held the soul to be the *heart;* others, the *blood* in the heart; some the *brain;* others, the *breath;* one, that it was *harmony;* another, that it was *number;* one, that it was *nothing* at all; and another, that it was a certain *quinteſſence* without a name, but which might properly be called ἐντελεχια—he gravely adds, "Harum sententiarum quæ vera sit, Deus aliquis viderit: quæ verisimillima, magna quæstio est ‡." He then proceeds to give his own opinion; which was, that the soul was part of God.

‡ *Tusc. Quæst.* lib. i. § 9, 10, 11.

To us who know by other evidence that the soul is immortal, and that there will be a future state in which all

Duties and Sanctions of Natural Religion.

all the obliquities of the preſent ſhall be made ſtraight, the argument drawn from the moral attributes of God, and the unequal diſtribution of the good things of this life, appears to have the force of demonſtration. Yet none of us will ſurely pretend to ſay that his powers of reaſoning are greater than were thoſe of Socrates and Cicero: and therefore the probability is, that had we been like them deſtitute of the light of revelation, we ſhould have been diſturbed by the ſame doubts, and have ſaid with the latter, on reading the arguments of the former as detailed by Plato. "Neſcio quomodo, dum lego, aſſentior: cum poſui librum, et mecum ipſe de immortalitate animorum cœpi cogitare, aſſenſio illa elabitur *."

* *Ibid.*

50 Without the light of revelation we ſhould have doubted like them.

No one, we hope, will ſuſpect us of an impious attempt to weaken the evidence of a future ſtate. God forbid! The expectation of that ſtate is the only ſupport of virtue and religion; and we think the arguments we have ſtated elſewhere, and referred to on the preſent occaſion, make the reality of it ſo highly probable, that, though there were no other evidence, he would act a very fooliſh part who ſhould confine his attention wholly to the preſent life. But we do not apprehend that we can injure the cauſe either of virtue or of religion, by confeſſing, that thoſe arguments which left doubts in the minds of Socrates and Cicero appear not to us to have the force of *complete demonſtration* of that life and immortality which our Saviour brought to light through the goſpel.

51 Natural religion has no means of certainly reconciling the Deity to ſinners.

Were the caſe, however, otherwiſe; were the arguments which the light of nature affords for the immortality of the human ſoul as convincing as any geometrical demonſtration—natural religion would ſtill be defective; becauſe it points out no method by which ſuch as have offended God may be reſtored to his favour and to the hopes of happineſs which by their ſin they had loſt. That he who knows whereof we are made would ſhow himſelf placable to ſinners, and that he would find ſome way to be reconciled, might perhaps be reaſonably inferred from the conſideration of his benevolence diſplayed in his works. But when we come to inquire more particularly *how* we are to be reconciled, and whether a *propitiation* will be required, *nature* ſtops ſhort, and expects with impatience the aid of ſome particular revelation. That God will receive returning ſinners, and accept of repentance inſtead of perfect obedience, cannot be certainly known by thoſe to whom he has not *declared* that he will. For though repentance be the moſt probable, and indeed the only means of reconciliation which nature ſuggeſts; yet whether he, who is of purer eyes than to behold iniquity, will not require ſomething further before he reſtores ſinners to the privileges which they have forfeited, mere human reaſon has no way of diſcovering. From nature therefore ariſes no ſufficient comfort to ſinners, but anxious and endleſs ſolicitude about the means of appeaſing the Deity. Hence thoſe different ways of ſacrificing, and thoſe numberleſs ſuperſtitions which overſpread the heathen world, but which were ſo little ſatisfactory to the wiſer part of mankind, that, even in thoſe days of darkneſs, the philoſophers frequently declared that, in their opinion, thoſe rites and oblations could avail nothing towards appeaſing the wrath of an offended God, or making their prayers acceptable to him. Hence Socrates and one of his diſciples are repreſented by Plato† as expecting a perſon divinely commiſſioned to inform them whether ſacrifices be acceptable to the deity, and as reſolving to offer no more till that perſon's arrival, which they piouſly hoped might be at no great diſtance.

† *In Alcibiades.*

52 Theſe doubts removed by the Scriptures.

This darkneſs of the pagan world is to us who live under the ſunſhine of the goſpel happily removed by the various revelations contained in the ſcriptures of the Old and New Teſtaments. Theſe taken together exhibit ſuch a diſplay of providence, ſuch a ſyſtem of doctrines, and ſuch precepts of practical wiſdom, as the ingenuity of man could never have diſcovered. The Chriſtian, with the ſcriptures in his hands, can regulate his conduct by an infallible guide, and reſt his hopes on the ſureſt foundation. Theſe ſcriptures it is now our buſineſs to examine.

PART II. OF REVEALED THEOLOGY.

53 Many pretences to revelation,

IN every civilized country the popular ſyſtem of theology has claimed its origin from divine revelation. The Pagans of antiquity had their augurs and oracles; the Chineſe have their inſpired teachers Confucius and Fohi: the Hindoos have their ſacred books derived from Brahama; the followers of Mahomet have their Koran dictated by an angel; and the Jews and Chriſtians have the Scriptures of the Old and New Teſtaments, which they believe to have been written by holy men of old, who ſpake and wrote as they were moved by the Holy Ghoſt.

That the claims of ancient Paganiſm to a theology derived from heaven, as well as the ſimilar claims of the Chineſe, Hindoos, and Mahometans, are ill founded, has been ſhown in various articles of this work, (ſee CHINA, HINDOSTAN, MAHOMETANISM, MYTHOLOGY, and POLYTHEISM); whilſt under the words RELIGION, REVELATION, and SCRIPTURE, we have ſufficiently proved the divine inſpiration of the Jewiſh and Chriſtian ſcriptures, and of courſe the divine origin of Jewiſh and Chriſtian theology. Theſe indeed are not two ſyſtems of theology, but parts of one ſyſtem which was gradually revealed as men were able to receive it; and therefore both ſcriptures muſt be ſtudied by the Chriſtian divine.

54 though the Jewiſh and Chriſtian revelation are alone true.

There is nothing in the ſacred volume which it is not of importance to underſtand; for the whole proceeds from the fountain of truth: but ſome of its doctrines are much more important than others, as relating immediately to man's everlaſting happineſs; and theſe it has been cuſtomary to arrange and digeſt into regular ſyſtems, called *bodies* or *inſtitutes* of *Chriſtian theology*. Could theſe artificial ſyſtems be formed with perfect impartiality, they would undoubtedly be uſeful, for the bible contains many hiſtorical details, but remotely related to ſalvation; and even of its moſt important truths, it requires more time and attention than the majority of Chriſtians have to beſtow, to diſcover the mutual connection and dependence.

55 Common diviſions of revealed theology.

Artificial ſyſtems of theology are commonly divided into two great parts, the *theoretic* and the *practical*; and

and theſe again are ſubdivided into many inferior branches. Under the theoretic part are ſometimes claſſed,

1. *Dogmatic* theology; which comprehends an entire ſyſtem of all the dogmas or tenets which a Chriſtian is bound to believe and profeſs. The truth of theſe the divine muſt clearly perceive, and be able to enforce on his audience: and hence the neceſſity of ſtudying what is called,

2. The *exegeſis*, or the art of attaining the true ſenſe of the holy ſcriptures; and,

3. *Hermeneutic* theology, or the art of interpreting and explaining the ſcriptures to others; an art of which no man can be ignorant who knows how to attain the true ſenſe of them himſelf.

4. *Polemical* theology, or controverſy; and,

5. *Moral* theology, which is diſtinguiſhed from moral philoſophy, or the ſimple doctrine of ethics, by teaching a much higher degree of moral perfection than the mere light of reaſon could ever have diſcovered, and adding new motives to the practice of virtue.

The practical ſciences of the divine are,

1. *Homiletic* or *paſtoral* theology; which teaches him to adapt his diſcourſes from the pulpit to the capacity of his hearers, and to purſue the beſt methods of guiding them by his doctrine and example in the way of ſalvation.

2. *Catechetic* theology, or the art of teaching youth and ignorant perſons the principal points of evangelical doctrine, as well with regard to belief as to practice.

3. *Caſuiſtic* theology, or the ſcience which decides on doubtful caſes of moral theology, and that calms the ſcruples of conſcience which ariſe in the Chriſtian's ſoul during his journey through the preſent world.

We have mentioned theſe diviſions and ſubdiviſions of the ſcience of theology, not becauſe we think them important, but merely that our readers may be at no loſs to underſtand the terms when they meet with them in other works. Of ſuch terms we ſhall ourſelves make no uſe, for the greater part of them indicate diſtinctions where there is no difference, and tend only to perplex the ſtudent. As the truths of Chriſtianity are all contained in the ſcriptures of the Old and New Teſtaments, it is obvious that dogmatic theology muſt comprehend the ſpeculative part of that which is called moral, as well as every doctrine about which controverſy can be of importance. But no man can extract a ſingle dogma from the bible but by the practice of what is here called the *exegeſis*; ſo that all the ſubdiviſions of this arrangement of theoretical theology muſt be ſtudied together as they neceſſarily coaleſce into one. The ſame thing is true of the three branches into which practical theology is here divided. He who has acquired the art of adapting his homilies to the various capacities of a mixed audience, will need no new ſtudy to fit him for inſtructing children, and the moſt ignorant perſons who are capable of inſtruction; and the complete maſter of moral theology will find it no very difficult taſk to reſolve all the caſes of conſcience which he can have reaſon to ſuppoſe will ever be ſubmitted to his judgment. For theſe reaſons we ſhall not trouble our readers with the various diviſions and ſubdiviſions of theology. Our preliminary directions will ſhow them how we think the ſcience ſhould be ſtudied; and all that we have to do as ſyſtem-*builders* is to lay before them the view which the ſcriptures preſent to us of the being and perfections of God, his various diſpenſations to man, and the duties thence incumbent on Chriſtians. In doing this, we ſhall follow the order of the divine diſpenſations as we find them recorded in the Old and New Teſtaments, dwelling longeſt on thoſe which appear to us of moſt general importance. But as we take it for granted that every reader of this article will have previouſly read the whole ſacred volume, we ſhall not ſcruple to illuſtrate dogmas contained in the Old Teſtament by texts taken from the New, or to illuſtrate doctrines peculiar to the Chriſtian religion by the teſtimony of Jewiſh prophets.

God and his Attributes.

Sect. I. *Of God and his Attributes.*

57 The firſt revelation ſuppoſes the being of God to be a known truth.

In every ſyſtem of theology the firſt truths to be believed are thoſe which relate to the being and attributes of God. The Jewiſh lawgiver, therefore, who records the earlieſt revelations that were made to man, begins his hiſtory with a diſplay of the power and wiſdom of God in the creation of the world. He does not inform his countrymen, and expect them to believe, on the authority of his divine commiſſion, that God *exiſts*; for he well knew that the being of God muſt be admitted, and juſt notions entertained of his attributes, before man can be required to pay any regard to miracles which afford the only evidence of a primary revelation. "In the beginning (ſays he) God created the heavens and the earth." Here the being of God is aſſumed as a truth univerſally received; but the ſentence, ſhort as it is, reveals another, which, as we ſhall afterwards ſhew, human reaſon could never have diſcovered.

There is nothing which the ſcriptures more frequently or more earneſtly inculcate than the unity of the divine nature. The texts aſſerting this great and fundamental truth are almoſt numberleſs. "Unto thee (ſays Moſes to his countrymen*) it was ſhewed, that thou mighteſt know that the Lord is God; there is *none elſe beſides him*. Know therefore that the Lord *he is God* in *heaven above* and upon the *earth beneath: there is none elſe*." And again, "Hear, O Iſrael, the Lord our God is *one Lord*," or, as it is expreſſed in the original, "Jehovah our God is one Jehovah," one Being to whom exiſtence is eſſential, who could not have a beginning and cannot have an end. In the prophecies of Iſaiah, God is introduced as repeatedly declaring†, "I am Jehovah, and there is *none elſe*; there is *no God beſides me*; that they may know from the riſing of the ſun and from the weſt, that there is *none beſides me*: I am *Jehovah*, and there is *none elſe*: Is there a God beſides me? Yea there is *no God*; I know not any." In perfect harmony with theſe declarations of Moſes and the prophets, our Saviour, addreſſing himſelf to his Father, ſays ‡, "This is life eternal, that they might know *Thee, the only true God*, and Jeſus Chriſt whom Thou haſt ſent;" and St Paul, who derived his doctrine from his divine Maſter, affirms §, that "an idol is nothing in the world; and that there is *none other God but one*."

* Deut. iv. 35. and 39. vi. 4.

† Iſaiah xiv. 5, 6, 18, xliv. 8.

‡ John xvii. 3.

§ 1 Cor. viii. 4.

The unity of the divine nature, which, from the order and harmony of the world, appears probable to human reaſon, theſe texts of revelation put beyond a doubt. Hence the firſt precept of the Jewiſh law, and, according to their own writers, the foundation of their whole religion, was, "Thou ſhalt have none other gods before Me."

God and his Attributes.

Me." Hence, too, the reason of that strict command to Jews and Christians to give divine worship to none but God: "Thou shalt worship the Lord thy God, and him only shalt thou serve;" because he is *God alone*. Him only must we fear, because he alone hath infinite power; in him alone must we trust, because "he only is our rock and our salvation;" and to him alone must we direct our devotions, because "he only knoweth the hearts of the children of men."

58 Denotes a plurality of persons in the Godhead.

The word אלהים does not indicate a plurality of gods. In the opinion, however, of many eminent divines, it denotes, by its junction with the singular verb, a plurality of persons in the one Godhead; and some few have contended, that by means of this peculiar construction, the Christian doctrine of the Trinity may be proved from the first chapter of the book of Genesis. To this latter opinion we can by no means give our assent. That there are three distinct persons in the one divine nature may be inferred with sufficient evidence from a multitude of passages in the Old and New Testaments diligently compared together; but it would perhaps be rash to rest the proof of so sublime a mystery on any single text of holy scripture, and would certainly be so to rest it on the text in question. That Moses was acquainted with this doctrine, we may reasonably conclude from his so frequently making a plural name of God to agree with a verb in the singular number; but had we not possessed the brighter light of the New Testament to guide us, we should never have thought of drawing such an inference. For supposing the word אלהים to denote clearly a plurality of persons, how could we have known that the number is neither more or less than three, had it not been ascertained to us by subsequent revelations?

There are indeed various passages in the Old Testament, of the phraseology of which no rational account can be given, but that they indicate more than one person in the Godhead. Such are those texts already noticed; "and the Lord God said, let US make man in OUR image, after OUR likeness;" and "the Lord God said, behold the man is become like ONE of US." To these may be added the following, which are to us perfectly unintelligible on any other supposition; "and the Lord God said, let US go down, and there confound their language *." "If I be a *Master* (in the Hebrew *adonim*, MASTERS), where is my fear† ?" "The fear of the Lord (JEHOVAH) is the beginning of wisdom, and the knowledge of the Holy (in the Hebrew HOLY ONES) is understanding ‡." "Remember thy Creator (Hebrew, thy CREATORS) in the days of thy youth §." "And now the LORD GOD and his SPIRIT hath sent me ||." "Seek ye out of the book of the LORD and read; for MY mouth it hath commanded, and his SPIRIT it hath gathered them *."

That these texts imply a plurality of divine persons, seems to us incontrovertible. When Moses represents God as saying, let us make man, the majesty of the plural number had not been adopted by earthly sovereigns; and it is obvious that the Supreme Being could not, as has been supposed, call on angels to make man; for in different places of scripture † creation is attributed to God alone. Hence it is that Solomon speaks of Creators in the *plural number*, though he means only the one Supreme Being, and exhorts men to remember them in the days of their youth. In the passage first quoted from Isaiah, there is a distinction made between the *Lord God* and his *Spirit*; and in the other, three divine persons are introduced, viz. the *Speaker*, the *Lord*, and the *Spirit* of the Lord. It does not, however, appear evident from these passages, or from any other that we recollect in the Old Testament, that the persons in Deity are three and no more: but no sober Christian will harbour a doubt but that the precise number was by some means or other made known to the ancient Hebrews; for inquiries leading to it would be naturally suggested by the form in which the high priest was commanded to bless the people. "The LORD bless thee and keep thee. The LORD make his face to shine upon thee, and be gracious unto thee. The LORD lift up his countenance upon thee, and give thee peace *."

God and his Attributes.

59 A Trinity in unity the doctrine of scripture.

The form of Christian baptism establishes the truth of the doctrine of the Trinity beyond all reasonable ground of dispute. "Go (says our blessed Saviour) and teach all nations, baptizing them in the name of the Father, and of the Son, and of the Holy Ghost." What was it the apostles were to teach all nations? Was it not to turn from their vanities to the living God; to renounce their idols and false gods, and so to be baptized in the name of the Father, and of the Son, and of the Holy Ghost? What now must occur to the Gentile nations on this occasion, but that, instead of all their deities, to whom they had before bowed down, they were in future to serve, worship and adore, Father, Son, and Holy Ghost, as the only true and living God? To suppose that GOD and TWO CREATURES are here joined together in the solemn rite by which men were to be admitted into a new religion, which directly condemns all *creature-worship*, would be so unreasonable, that we are persuaded such a supposition never was made by any converted Polytheist of antiquity. The nations were to be baptized in the name of three persons, in the *same manner*, and therefore, doubtless, in the *same sense*. It is not said in the name of GOD and his two faithful *servants;* nor in the name of GOD, and CHRIST, and the HOLY GHOST, which might have suggested a thought that *one* only of the three is God; but in the name of the FATHER, and of the SON, and of the HOLY GHOST. Whatever honour, reverence, or regard, is paid to the first person in this solemn rite, the same is paid to all three. Is he acknowledged as the object of worship? So are the other two likewise. Is he God and Lord over us? So are they. Are we enrolled as subjects, servants, and soldiers, under him? So are we equally under all. Are we hereby regenerated and made the temple of the Father? So are we likewise of the Son and Holy Ghost. "We will come (says our Saviour †) and make our abode with him."

If those who believe the inspiration of the scriptures could require any further proof that the Godhead comprehends a trinity of persons in one nature, we might urge the apostolical form of benediction; "The grace of our LORD JESUS CHRIST, and the love of GOD, and the communion of the HOLY GHOST, be with you all ‡." Would St Paul, or any other man of common sense, have in the same sentence, and in the most solemn manner, recommended his Corinthian converts to the love of God, and to the grace and communion of two creatures? We should think it very absurd to recommend a man at once to the favour of a king and a beggar;

* Gen. xi. 6, 7.
† Mal. i. 6.
‡ Prov. ix. 10.
§ Eccl. xii. 1.
|| Isaiah xlviii. 16.
* Isaiah xxxiv. 16.
† Job ix. 8. Isa. xlv. *passim.*
* Numb. vi. 24, 25, 26.
† John xiv. 23.
‡ 2 Cor. xiii. 14.

gar; but how infinitely ſmall is the diſtance between the greateſt earthly potentate and the meaneſt beggar, when compared with that which muſt for ever ſubſiſt between the Almighty Creator of heaven and the moſt elevated creature?

God and his Attributes.

But how, it will be aſked, can three divine perſons be but one and the ſame God? This is a queſtion which has been often put, but which, we believe, no created being can fully anſwer. The divine nature and its manner of exiſtence is, to us, wholly incomprehenſible; and we might with greater reaſon attempt to weigh the mountains in ſcales, than by our limited faculties to fathom the depths of infinity. The Supreme Being is preſent in power to every portion of ſpace, and yet it is demonſtrable, that in his eſſence he is not extended (ſee METAPHYSICS, N° 309, 310). Both theſe truths, his inextenſion and omnipreſence, are fundamental principles in what is called *natural religion;* and when taken together they form, in the opinion of moſt people, a myſtery as incomprehenſible as that of the Trinity in unity. Indeed there is nothing of which it is more difficult to form a diſtinct notion than *unity* ſimple, and abſolutely indiviſible. Though the Trinity in unity, therefore, were no Chriſtian doctrine, myſteries muſt ſtill be believed; for they are as inſeparable from the religion of nature as from that of revelation; and atheiſm involves the moſt incomprehenſible of all myſteries, even the beginning of exiſtence without a cauſe. We muſt indeed form the beſt notions that we can of this and all other myſteries; for if we have no notions whatever of a Trinity in unity, we can neither believe nor diſbelieve that doctrine. It is however to be remembered, that all our notions of God are more or leſs analogical; that they muſt be expreſſed in words which, literally interpreted, are applicable only to man; and that propoſitions underſtood in this literal ſenſe may involve an apparent contradiction, from which the truth meant to be expreſſed by them would be ſeen to be free, had we direct and adequate conceptions of the divine nature. On this account it is to be wiſhed that men treating of the myſtery of the Holy Trinity, had always expreſſed themſelves in ſcripture language, and never aimed at being wiſe above what is written; but ſince they have acted otherwiſe, we muſt, in juſtice to our readers, animadvert on one or two ſtatements of this doctrine, which we have reaſon to believe are earneſtly contended for by ſome who conſider themſelves as the only orthodox.

In the ſcriptures, the three perſons are denominated by the terms FATHER, SON, and HOLY GHOST, or by GOD, the WORD, who is alſo declared to be God, and the SPIRIT OF GOD. If each be truly God, it is obvious that they muſt all have the ſame divine nature, juſt as every man has the ſame human nature with every other man; and if there be but ONE GOD, it is equally obvious that they muſt be of the ſame individual ſubſtance or eſſence, which no three men can poſſibly be. In this there is a difficulty; but, as will be ſeen by and by, there is no contradiction. The very terms FATHER and SON imply ſuch a relation between the two perſons ſo denominated, as that though they are of the ſame ſubſtance, poſſeſſed of the ſame attributes, and equally God, juſt as a human father and his ſon are equally men, yet the ſecond muſt be perſonally ſubordinate to the firſt. In like manner, the HOLY GHOST, who is called the Spirit of God, and is ſaid to *proceed from* the *Father*, and to be *ſent* by the *Son*, muſt be conceived as ſubordinate to both, much in the ſame way as a ſon is ſubordinate to his parents, though poſſeſſed of equal or even of ſuperior powers. That this is the true doctrine, appears to us undeniable from the words of our Saviour himſelf, who, in a prayer addreſſed to his Father, ſtyles him * by way of pre-eminence, "the only true God," as being the fountain or origin of the Godhead from which the Son and the Holy Ghoſt derive their true divinity. In like manner, St Paul, when oppoſing the polytheiſm of the Greeks, ſays expreſsly †, that "to us there is but one God, THE FATHER, OF whom are all things, and we in, or for, him; and one LORD JESUS CHRIST, BY whom are all things, and we by him."

* John xvii. 3.

† 1 Cor. viii. 6.

That the primitive fathers of the Chriſtian church maintained this ſubordination of the ſecond and third perſons of the bleſſed Trinity to the firſt, has been evinced with complete evidence by Biſhop Bull. We ſhall tranſcribe two quotations from him, and refer the reader for fuller ſatisfaction to *ſect.* 4. of his *Defenſio fidei Nicenæ.* The firſt ſhall be a paſſage cited from *Novatian*, in which the learned prelate aſſures us the ſenſe of all the ancients is expreſſed. "Quia quid eſt Filius, non ex ſe eſt, quia nec innatus eſt; ſed ex patre eſt, quia genitus eſt: ſive dum verbum eſt, ſive dum virtus eſt, ſive dum ſapientia eſt, ſive dum lux eſt, ſive dum Filius eſt, et quicquid horum eſt, non aliunde eſt quam ex Patre, Patri ſuo originem ſuam debens." The next is from Athanaſius, who has never been accuſed of holding low opinions reſpecting the ſecond perſon of the holy Trinity. This father, in his fifth diſcourſe againſt the Arians, ſays, καλα γαρ τον Ιωαννην εν ταυτη τη αρχη ην ὁ λογος και ὁ λογος, ην προς τον θεον. Θεος γαρ εστιν ἡ αρχη, και επειδαν εξ αυτης ἡ, διο τουτο και θεος ην ὁ λογος; *according to John, the Word was in this firſt principle, and the Word was God. For God is the principle; and becauſe the Word is from the principle, therefore the Word is God.* Agreeably to this doctrine, the Nicene fathers, in the creed which they publiſhed for the uſe of the univerſal church, ſtyle the only begotten Son, GOD OF GOD, θεος εκ θεου.

62 Denied by ſome modern divines, but

Regardleſs however of antiquity, and of the plain ſenſe of ſcripture, ſome modern divines of great learning contend, that the three perſons in Deity are all *conſubſtantial, co-eternal, co-ordinate*, without *derivation, ſubordination*, or *dependence*, of *any ſort*, as to nature or eſſence; while others affirm, that the ſecond and third perſons derive from the firſt their perſonality, but not their nature. We ſhall conſider theſe opinions as different, though, from the obſcurity of the language in which we have always ſeen them expreſſed, we cannot be certain but they may be one and the ſame. The maintainers of the former opinion hold, that the three perſons called *Elohim* in the Old Teſtament, naturally independent on each other, entered into an agreement before the creation of the world, that one of them ſhould in the fulneſs of time aſſume human nature, for the purpoſe of redeeming mankind from that miſery into which it was foreſeen that they would fall. This antemundane agreement, they add, conſtitutes the whole of that paternal and filial relation which ſubſiſts between the firſt and ſecond perſons whom we denominate Father and Son; and they hold, that the Son is ſaid to be begotten before all worlds, to indicate that *He* who was before all worlds was *begotten*, or to *be* begotten, into the office

God and his Attributes.

of redeemer; or, more deciſively, to ſignify that he undertook that office before the creation, and *aſſumed* to himſelf ſome appearance or figure of the reality in which he was to execute it; and he is called μονογενης, or the only begotten, becauſe he *alone* was begotten into the office of redeemer *.

* See *Ridgeley's Body of Divinity.*

63 The expreſs doctrine of ſcripture.

To many of our readers we doubt not but this will appear a very extraordinary doctrine, and not eaſy to be reconciled with the unity of God. It is however ſufficiently overturned by two ſentences of holy ſcripture, about the meaning of which there can be no diſpute.

† John iv. 9. "In this (ſays St John †) was manifeſted the love of God towards us, becauſe that God ſent his only begotten Son into the world, that we might live through him." Taking the word *ſon* in its uſual acceptation, this was certainly a wonderful degree of love in the Father of mercies to ſend into the world on our account a perſon ſo nearly related to him as an only ſon; but if we ſubſtitute this novel interpretation of the words *only begotten ſon* in their ſtead, the apoſtle's reaſoning will loſe all its force. St John will then be made to ſay, "In this was manifeſted the love of God toward us, becauſe that God ſent a divine perſon equal to himſelf, and no way related to him, but who had before the creation covenanted to come into the world, that we might live through him." Is this a proof of the love of the perſon here called God? Again, the inſpired author of the epiſtle to the Hebrews, treating of our Saviour's prieſthood, ſays, among other things expreſſive of his humiliation, that "though he was a SON, yet learned

‡ Heb. v. 8. he obedience by the things which he ſuffered ‡." If the word *ſon* be here underſtood in its proper ſenſe, this verſe diſplays in a very ſtriking manner the condeſcenſion of our divine Redeemer, who, though he was no leſs a perſon than the proper Son of God by nature, yet vouchſafed to learn obedience by the things which he ſuffered; but if we ſubſtitute this metaphorical ſonſhip in place of the natural, the reaſoning of the author will be very extraordinary. "Though this divine perſonage agreed before all worlds to ſuffer death for the redemption of man, yet learned he obedience by the things which he ſuffered." What ſenſe is there in this argument? Is it a proof of condeſcenſion to fulfil one's engagement? Surely, if the meaning of the word *ſon*, when applied to the ſecond perſon of the bleſſed Trinity, were what is here ſuppoſed, the inſpired writer's argument would have been more to the purpoſe for which it is brought had it run thus: "Though he was *not* a ſon, i. e. though he had made no previous agreement, yet condeſcended he to learn," &c.

The other opinion, which ſuppoſes the Son and the Holy Ghoſt to derive from the Father their perſonality, but not their nature, is to us wholly unintelligible; for perſonality cannot exiſt, or be conceived in a ſtate of ſeparation from all natures, any more than a quality can exiſt in a ſtate of ſeparation from all ſubſtances. The former of theſe opinions we are unable to reconcile with the unity of God; the latter is clothed in words that have no meaning. Both, as far as we can underſtand them, are palpable polytheiſm; more palpable indeed than that of the Grecian philoſophers, who though they worſhipped gods many, and lords many, yet all held one God ſupreme over the reſt. See POLYTHEISM, N° 32.

But if the Son and the Holy Ghoſt derive their nature as well as their perſonality from the Father, will it not follow that they muſt be poſterior to him in time, ſince every effect is poſterior to its cauſe? No; this conſequence ſeems to follow only by reaſoning too cloſely from one nature to another, when there is between the two but a very diſtant analogy. It is indeed true, that among men, every father muſt be prior in time as well as in the order of nature to his ſon; but were it eſſential to a man to be a father, ſo as that he could not exiſt otherwiſe than in that relation, it is obvious that his ſon would be coeval with himſelf, though ſtill as proceeding from him, he would be poſterior in the order of nature. This is the caſe with all neceſſary cauſes and effects. The viſible ſun is the immediate and neceſſary cauſe of light and heat, either as emitting the rays from his own ſubſtance, or as exciting the agency of a fluid diffuſed for that purpoſe through the whole ſyſtem. Light and heat, therefore, muſt be as old as the ſun; and had he exiſted from eternity, they would have exiſted from eternity with him, though ſtill, as his effects, they would have been behind him in the order of nature. Hence it is, that as we muſt ſpeak analogically of the Divine nature, and when treating of mind, even the Supreme mind, make uſe of words literally applicable only to the modifications of matter, the Nicene fathers illuſtrate the eternal generation of the ſecond perſon of the bleſſed Trinity by this proceſſion of light from the corporeal ſun, calling him *God* OF *God*, *light* OF *light*.

God and his Attributes.

64 The ſecond and third perſons poſterior to the firſt.

Another compariſon has been made uſe of to enable us to form ſome notion, however inadequate, how three Divine perſons can ſubſiſt in the ſame ſubſtance, and thereby conſtitute but one God. Moſes informs us, that man was made after the image of God. That this relates to the ſoul more than to the body of man, has been granted by all but a few groſs anthropomorphites; but it has been well obſerved *, that the ſoul, though in itſelf one indiviſible and unextended ſubſtance, is conceived as conſiſting of three principal faculties, the *underſtanding*, the *memory*, and the *will*. Of theſe, though they are all coeval in time, and equally eſſential to a rational ſoul, the underſtanding is in the order of nature obviouſly the firſt, and the memory the ſecond; for things muſt be perceived before they can be remembered; and they muſt be remembered and compared together before they can excite volitions, from being ſome agreeable, and others diſagreeable. The memory therefore may be ſaid to ſpring from the underſtanding, and the will from both; and as theſe three faculties are conceived to conſtitute one ſoul, ſo may three Divine perſons partaking of the ſame individual nature or eſſence conſtitute one God.

* *Leſlie's Socinian Controverſy.*

65 No contradiction in the Catholic doctrine of the Trinity.

Theſe parallels or analogies are by no means brought forward as proofs of the Trinity, of which the evidence is to be gathered wholly from the word of God; but they ſerve perhaps to help our labouring minds to form the juſteſt notions of that myſtery which it is poſſible for us to form in the preſent ſtate of our exiſtence; and they ſeem to reſcue the doctrine ſufficiently from the charge of contradiction, which has been ſo often urged againſt it by Unitarian writers. To the laſt analogy we are aware it has often been objected, that the ſoul may as well be ſaid to conſiſt of ten or twenty faculties as of three, ſince the paſſions are equally eſſential to it with the underſtanding, the memory, and the will, and are as different from one another as theſe three faculties are.

This,

God and his Attributes.

This, however, is probably a miſtake; for the beſt philoſophy ſeems to teach us, that the paſſions are not innate; that a man might exiſt through a long life a ſtranger to many of them; and that there are probably no two minds in which are generated *all* the paſſions (ſee PASSION); but underſtanding, memory, and will, are abſolutely and equally neceſſary to every rational being. But whatever be in this, if the human mind can be *conceived* to be one indiviſible ſubſtance, conſiſting of different faculties, whether many or few, why ſhould it be thought an impoſſibility for the infinite and eternal nature of God to be communicated to three perſons acting different parts in the creation and government of the world, and in the great ſcheme of man's redemption.

Objections.

To the doctrine of the Trinity many objections have been made, as it implies the divinity of the Son and the Holy Ghoſt; of whom the former aſſumed our nature, and in it died for the redemption of man. Theſe we ſhall notice when we come to examine the revelations more peculiarly Chriſtian; but there is one objection which, as it reſpects the doctrine in general, may be properly noticed here. It is ſaid that the firſt Chriſtians borrowed the notion of a Triune God from the later Platoniſts; and that we hear not of a Trinity in the church till converts were made from the ſchool of Alexandria. But if this be the caſe, we may properly aſk, whence had thoſe Platoniſts the doctrine themſelves? It is not ſurely ſo ſimple or ſo obvious as to be likely to have occurred to the reaſoning mind of a Pagan philoſopher; or if it be, why do Unitarians ſuppoſe it to involve a contradiction? Plato indeed taught a doctrine in ſome reſpects ſimilar to that of the Chriſtian Trinity, and ſo did Pythagoras, with many other philoſophers of Greece and the Eaſt (ſee PLATONISM, POLYTHEISM, and PYTHAGORAS); but though theſe ſages appear to have been on ſome occaſions extremely credulous, and on others to have indulged themſelves in the moſt myſterious ſpeculations, there is no room to ſuppoſe that they were *naturally weaker men* than ourſelves, or that they were capable of inculcating as truths what they *perceived* to involve a *contradiction*. The Platonic and Pythagorean trinities never could have occurred to the mind of him who merely from the works of creation endeavoured to diſcover the being and attributes of the Creator; and therefore as thoſe philoſophers travelled into Egypt and the Eaſt in queſt of knowledge, it appears to us in the higheſt degree probable, that they picked up this myſterious and ſublime doctrine in thoſe regions where it had been handed down as a dogma from the remoteſt ages, and where we know that ſcience was not taught ſyſtematically, but detailed in collections of ſententious maxims and traditionary opinions. If this be ſo, we cannot doubt but that the Pagan trinities had their origin in ſome primæval revelation. Nothing elſe indeed can account for the general prevalence of a doctrine ſo remote from human imagination, and of which we find veſtiges in the ſacred books of almoſt every civilized people of antiquity. The corrupt ſtate in which it is viewed in the writings of Plato and others, is the natural conſequence of its deſcent through a long courſe of oral tradition; and then falling into the hands of men who bent every opinion as much as poſſible to a conformity with their own ſpeculations. The trinity of Platoniſm therefore, inſtead of being an objection, lends, in our opinion, no feeble ſupport to the Chriſtian doctrine, ſince it affords almoſt a complete proof of that doctrine's having made part of the firſt revelations communicated to man.

Having thus diſcovered that the one God comprehends three perſons, let us now inquire what this triune God exerted when he created the heaven and the earth. That by the heaven and the earth is here meant the whole univerſe, viſible and inviſible, is known to every perſon acquainted with the phraſeology of Scripture; and we need inform no man converſant with Engliſh writers, that by *creation*, in its proper ſenſe, is meant bringing into *being* or making that to *exiſt* which exiſted not *before*. It muſt, however, be acknowledged, that the Hebrew word ברא does not always imply the production of ſubſtance, but very often the forming of particular organized bodies out of pre-exiſting matter. Thus when it is ſaid * that "God *created* great whales, and every living creature that moveth, which the waters brought forth abundantly after their kind," and again, "that he *created* man male and female;" though the word ברא is uſed on both occaſions, we are not to conceive that the bodies of the firſt human pair, and of theſe animals, were brought into being from nonentity, but only that they were formed by a proper organization being given to pre-exiſtent matter. But when Moſes ſays, "In the beginning God *created* the heaven and the earth," he cannot be ſuppoſed to mean, that "in the beginning God only gave form to matter already exiſting of itſelf;" for in the very next verſe we are aſſured that after this act of creation was over, "the earth was ſtill *without form* and void," or, in other words, in a chaotic ſtate.

* Gen. i. 21, 27.

68 Creation taught by Moſes.

That the Jews, before the coming of our Saviour, underſtood their lawgiver to teach a proper creation, is plain from that paſſage in the ſecond book of the Maccabees, in which a mother, to perſuade her ſon to ſuffer the cruelleſt tortures rather than forſake the law of his God, uſes the following argument: "I beſeech thee, my ſon, look upon the heaven and the earth, and all that is therein, and conſider that God made them of things that were not." To the ſame purpoſe the inſpired author of the epiſtle to the Hebrews, when magnifying the excellence of faith, ſays, "Through faith we underſtand that the worlds were framed by the word of God, ſo that things which are ſeen were not made of things which do appear;" where, as Biſhop Pearſon has ably proved †, the phraſe μη εκφαινομενων is equivalent to ουκ εξ οντων, in the quotation from the Maccabees.

† *Expoſition of the Creed.*

The very firſt verſe, therefore, of the book of Geneſis informs us of a moſt important truth, which all the uninſpired wiſdom of antiquity could not diſcover. It aſſures us, that as nothing exiſts by chance, ſo nothing is neceſſarily exiſting but the three divine perſons in the one Godhead. Every thing elſe, whether material or immaterial, derives its ſubſtance, as well as its form or qualities, from the fiat of that ſelf-exiſtent Being, "who was, and is, and is to come."

69 The whole univerſe not created at once.

It does not, however, follow from this verſe, or from any other paſſage in the ſacred Scriptures, that the whole univerſe was called into exiſtence at the ſame inſtant; neither is it by any means evident that the chaos of our world was brought into being on the firſt of thoſe ſix days during which it was gradually reduced into form. From a paſſage ‡ in the book of Job, in which we are told by God himſelf, that when the "foundation of the earth

‡ xxxviii. 7.

God and his Attributes.

earth was laid the morning ſtars ſang together, and all the ſons of God ſhouted for joy," it appears extremely probable that worlds had been created, formed, and inhabited, long before our earth had any exiſtence. Nor is this opinion at all contrary to what Moſes ſays of the creation of the ſtars; for though they are mentioned in the ſame verſe with the ſun and moon, yet the manner in which, according to the original, they are introduced, by no means indicates that all the ſtars were formed at the ſame time with the luminaries of our ſyſtem. Moſt of them have been created long before, and ſome of them ſince, our world was brought into being; for that clauſe (verſe 16.) "he made the ſtars alſo," is in the Hebrew no more than "and the ſtars;" the words *he made* being inſerted by the tranſlators. The word verſe therefore ought to be rendered thus, "and God made two great lights; the greater light to rule the day, and the leſſer light with the ſtars to rule the night; where nothing is intimated with reſpect to the *time* when the ſtars were formed, any more than in that verſe of the Pſalms *, which exhorts us to give thanks to God who made the moon and ſtars to rule by night; for his mercy endureth "for ever." The firſt verſe of the book of Geneſis informs us that all things ſpiritual and corporeal derive their exiſtence from God; but it is nowhere ſaid that all matter was created at the ſame time.

* Pſalm cxxxvi. 9.

That the whole corporeal univerſe *may have been* created at once muſt be granted; but if ſo, we have reaſon to believe that this earth, with the ſun and all the planets of the ſyſtem, were ſuffered to remain for ages in a ſtate of chaos, "without form and void;" becauſe it appears from other ſcriptures, that worlds of intelligent creatures exiſted, and even that ſome angels had fallen from a ſtate of happineſs prior to the era of the Moſaic coſmogony. That the ſun and the other planets revolving round him were formed at the ſame time with the earth, cannot indeed be queſtioned; for it is not only probable in itſelf from the known laws of nature, but is expreſsly affirmed by the ſacred hiſtorian, who relates the formation of the ſun and moon in the order in which it took place; but there is one difficulty which has furniſhed ignorance with ſomething like an objection to the divine legation of the Hebrew lawgiver, and which we ſhall notice.

70 The ſolar ſyſtem created at once.

71 A difficulty ſolved.

Moſes informs us, that on the *firſt day* after the production of the chaos, the *element of light* was created; and yet within a few ſentences he declares, that the ſun, the fountain of light, was not made till the *fourth day*. How are theſe two paſſages to be reconciled? We anſwer, That they may be reconciled many ways. Moſes wrote for the uſe of a whole people, and not for the amuſement or inſtruction of a few aſtronomers; and in this view his language is ſufficiently proper, even though we ſuppoſe the formation of the ſun and the other planets to have been carried on at the ſame time, and in the ſame progreſſive manner, with the formation of this earth. The voice which called light into exiſtence would ſeparate the fiery and luminous particles of the chaos from thoſe which were opake, and, on this hypotheſis, conſolidate them in one globe, diffuſing an obſcure light through the planetary ſyſtem; but if the earth's atmoſphere continued till the fourth day loaded with vapours, as from the narrative of Moſes it appears to have done, the ſun could not till *that day* have been *ſeen* from the earth, and may therefore, in popular language, be ſaid with ſufficient propriety to have been *formed* on the fourth day, as it was then made to *appear*. (See CREATION, N° 13.). But though this ſolution of the difficulty ſerves to remove the objection, and to ſecure the credit of the ſacred hiſtorian, candour compels us to confeſs that it appears not to be the true ſolution.

God and his Attributes.

The difficulty itſelf ariſes entirely from ſuppoſing the ſun to be the ſole fountain of light; but the truth of this opinion is not ſelf-evident, nor has it ever been eſtabliſhed by ſatisfactory proof. It is indeed to a mind diveſted of undue deference to great names, and conſidering the matter with impartiality, an opinion extremely improbable. The light of a candle placed on an eminence may in a dark night be ſeen in every direction at the diſtance of at leaſt three miles. But if this ſmall body be rendered viſible by means of rays emitted from itſelf, the flame of a candle, which cannot be ſuppoſed more than an inch in diameter, muſt, during every inſtant that it continues to burn, throw from its own ſubſtance luminous matter ſufficient to fill a ſpherical ſpace of ſix miles in diameter. This phenomenon, if real, is certainly ſurpriſing; but if we purſue the reflection a little farther, our wonder will be greatly increaſed. The matter which, when converted into flame, is an inch in diameter, is not, when of the conſiſtence of cotton and tallow, of the dimenſions of the 20th part of an inch; and therefore, on the common hypotheſis, the 20th part of an inch of tallow may be ſo rarefied as to fill a ſpace of 113.0976 cubic miles! a rarefaction which to us appears altogether incredible. We have indeed heard much of the diviſibility of matter *ad infinitum*, and think we underſtand what are uſually called *demonſtrations* of the truth of that propoſition; but theſe demonſtrations prove not the actual diviſibility of real ſolid ſubſtances, but only that on trial we ſhall find no end of the ideal proceſs of dividing and ſubdividing imaginary extenſion.

On the whole, therefore, we are much more inclined to believe that the matter of light is an extremely ſubtile fluid, diffuſed through the corporeal univerſe, and only excited to agency by the ſun and other fiery bodies, than that it conſiſts of ſtreams continually iſſuing from the ſubſtance of theſe bodies. It is indeed an opinion pretty generally received, and certainly not improbable in itſelf, that light and electricity are one and the ſame ſubſtance (ſee *ELECTRICITY-Index*); but we know that the electrical fluid, though pervading the whole of corporeal nature, and, as experiments ſhow, capable of acting with great violence, yet lies dormant and unperceived till its agency be excited by ſome foreign cauſe. Juſt ſo it may be with the matter of light. That ſubſtance may be "diffuſed from one end of the creation * to the other. It may traverſe the whole univerſe, form a communication between the moſt remote ſpheres, penetrate into the inmoſt receſſes of the earth, and only wait to be put in a proper motion to communicate viſible ſenſations to the eye. Light is to the organ of ſight what the air is to the organ of hearing. Air is the medium which, vibrating on the ear, cauſes the ſenſation of ſound; but it equally exiſts round us at all times, though there be no ſonorous body to put it in motion. In like manner, light may be equally extended at all times, by night as well as by day, from the moſt diſtant fixed ſtars to this earth, though it then only ſtrikes our eyes ſo as to excite viſible ſenſations when impelled by the ſun or ſome other maſs

* *Nature diſplayed.*

of

of fire." Nor let any one imagine that this hypotheſis interferes with any of the known laws of optics; for if the rays of light be impelled in ſtraight lines, and in the ſame direction in which they are ſuppoſed to be emitted, the phenomena of viſion muſt neceſſarily be the ſame.

Moſes therefore was probably a more accurate philoſopher than he is ſometimes ſuppoſed to be. The element of light was doubtleſs created, as he informs us, on the firſt day; but whether it was then put in that ſtate in which it is the medium of viſion, we cannot know, and we need not inquire, ſince there was neither man nor inferior animal with organs fitted to receive its impreſſions. For the firſt three days it may have been uſed only as a powerful inſtrument to reduce into order the jarring chaos. Or if it was from the beginning capable of communicating viſible ſenſations, and dividing the day from the night, its agency muſt have been immediately excited by the Divine power till the fourth day, when the ſun was formed, and endowed with proper qualities for inſtrumentally diſcharging that office. This was indeed miraculous, as being contrary to the preſent laws of nature: but the whole creation was miraculous; and we ſurely need not heſitate to admit a leſs miracle where we are under the neceſſity of admitting a greater. The power which called light and all other things into exiſtence, could give them their proper motions by ten thouſand different means; and to attempt to ſolve the difficulties of creation by philoſophic theories reſpecting the laws of nature, is to trifle with the common ſenſe of mankind: it is to conſider as ſubſervient to a law that very power by whoſe continued exertion the law is eſtabliſhed.

Having thus proved that the univerſe derives its being, as well as the form and adjuſtment of its ſeveral parts, from the one ſupreme and ſelf-exiſtent God, let us here pauſe, and reflect on the ſublime conceptions which ſuch aſtoniſhing works are fitted to give us of the divine perfections.

And, in the firſt place, how ſtrongly do the works of creation impreſs on our minds a conviction of the infinite power of their Author? He ſpoke, and the univerſe ſtarted into being; he commanded, and it ſtood faſt. How mighty is the arm which "ſtretched out the heavens and laid the foundations of the earth; which removeth the mountains and they know it not; which overturneth them in his anger; which ſhaketh the earth out of her place, and the pillars thereof tremble! How powerful the word which commandeth the ſun, and it riſeth not; and which ſealeth up the ſtars;" which ſuſtaineth numberleſs worlds of amazing bulk ſuſpended in the regions of empty ſpace, and directs their various and inconceivably rapid motions with the utmoſt regularity! "Lift up your eyes on high, and behold, who hath created all theſe things? By the word of the Lord were the heavens made, and all the hoſt of them by the breath of his mouth. Hell is naked before him, and deſtruction hath no covering. He ſtretcheth out the North over the empty place, and hangeth the earth upon nothing. He has meaſured the waters in the hollow of his hand, and meted out the heavens with a ſpan; and comprehended the duſt of the earth in a meaſure; and weighed the mountains in ſcales, and the hills in a balance. Behold! the nations are as a drop of the bucket, and are counted as the ſmall duſt of the balance; behold, he taketh up the iſles as a very little thing. All nations before him are as nothing, and they are counted to him leſs than nothing, and vanity. To whom then will ye liken God, or what likeneſs will ye compare unto him*?"

God and his Attributes.

* Pſ. xxxiii. 6, 9; Job ix. 4, &c. xxvi. 6; Iſa. xi. 12.

As the works of creation are the effects of God's power, they likewiſe in the moſt eminent manner diſplay his wiſdom. This was ſo apparent to Cicero, even from the partial knowledge in aſtronomy which his time afforded, that he declared† thoſe who could aſſert the contrary void of all underſtanding. But if that great maſter of reaſon had been acquainted with the modern diſcoveries in aſtronomy, which exhibit numberleſs worlds ſcattered through ſpace, and each of immenſe magnitude; had he known that the ſun is placed in the centre of our ſyſtem, and that to diverſify the ſeaſons the planets move round him with exquiſite regularity; could he have conceived that the diſtinction between light and darkneſs is produced by the diurnal rotation of the earth on its own axis, inſtead of that diſproportionate whirling of the whole heavens which the ancient aſtronomers were forced to ſuppoſe; had he known of the wonderful motions of the comets, and conſidered how ſuch eccentric bodies have been preſerved from falling upon ſome of the planets in the ſame ſyſtem, and the ſeveral ſyſtems from falling upon each other; had he taken into the account that there are yet greater things than theſe, and "that we have ſeen but a few of God's works;"—that virtuous Pagan would have been ready to exclaim in the words of the Pſalmiſt, "O Lord, how manifold are thy works! In wiſdom haſt thou made them all; the earth is full of thy riches."

74 His wiſdom,

† *De Nat. Deorum*, lib. ii.

75 and goodneſs.

That creation is the offſpring of unmixed goodneſs, has been already ſhown with ſufficient evidence (ſee METAPHYSICS, N° 312. and N° 29. of this article); and from the vaſt number of creatures on our earth endowed with life and ſenſe, and a capability of happineſs, and the infinitely greater number which probably inhabit the planets of this and other ſyſtems, we may infer that the goodneſs of God is as boundleſs as his power, and that "as is his majeſty, ſo is his mercy." Out of his own fulneſs hath he brought into being numberleſs worlds, repleniſhed with myriads of myriads of creatures, furniſhed with various powers and organs, capacities and inſtincts; and out of his own fulneſs he continually and plentifully ſupplies them all with every thing neceſſary to make their exiſtence comfortable. "The eyes of all wait upon him, and he giveth them their meat in due ſeaſon. He openeth his hand and ſatisfies the deſires of every living thing; he loveth righteouſneſs and judgment; the earth is full of the goodneſs of the Lord. He watereth the ridges thereof abundantly; he ſettleth the furrows thereof; he maketh it ſoft with ſhowers, and bleſſeth the ſpringing thereof. He crowneth the year with his goodneſs; and his paths drop fatneſs. They drop upon the paſtures of the wilderneſs; and the little hills rejoice on every ſide. The paſtures are clothed with flocks; the valleys alſo are covered with corn; they ſhout with joy, they alſo ſing‡." Survey the whole of what may be ſeen on and about this terraqueous globe, and ſay, if our Maker hath a ſparing hand. Surely the Author of ſo much happineſs muſt be eſſential goodneſs; and we muſt conclude with St John, that "God is love."

‡ Pſ. cxlv. 15, 16. xxiii. 5. lv. 10, &c.

Theſe attributes of power, wiſdom, and goodneſs, ſo conſpicuouſly

God and his Attributes.

conſpicuouſly diſplayed in the works of creation, belong in the ſame ſupreme degree to each perſon in the bleſſed Trinity; for Moſes declares that the heaven and the earth were created, not by *one* perſon, but by the *Elohim*. The λογος indeed, or ſecond perſon, appears to have been the *immediate* Creator; for St John aſſures us *, that "all things were made by him, and that without him was not any thing made that was made." Some Arian writers of great learning (and we believe the late Dr Price was of the number) have aſſerted, that a being who was created himſelf may be endowed by the Omnipotent God with the power of creating other beings; and as they hold the λογος or *word*, to be a creature, they contend that he was employed by the Supreme Deity to create, not the whole univerſe, but only this earth, or at the utmoſt the ſolar ſyſtem. "The old argument (ſays one of them), that no being inferior to the great Omnipotent can create a world, is ſo childiſh as to deſerve no anſwer. Why may not God communicate the power of making worlds to any being whom he may chooſe to honour with ſo glorious a prerogative? I have no doubt but ſuch a power may be communicated to many good men during the progreſs of their exiſtence; and to ſay that it may *not*, is not only to limit the power of God, but to contradict acknowledged analogies."

76 The ſecond perſon in the Trinity the immediate Creator.

* Ch. i. 3.

77 Creation peculiar to God.

We are far from being inclined to limit the power of God. He can certainly do whatever involves not a direct contradiction; and therefore, though we know nothing *analogous* to the power of *creating worlds*, yet as we perceive not any contradiction implied in the notion of that power being communicated, we ſhall admit that ſuch a communication may be *poſſible*, though we think it in the higheſt degree *improbable*. But ſurely no man will contend that the *whole univerſe* was brought into exiſtence by *any creature;* becauſe that creature himſelf, however highly exalted, is neceſſarily comprehended in the notion of the univerſe. Now St Paul expreſsly affirms †, that, by the ſecond perſon in the bleſſed Trinity, "were ALL *things* created that are in heaven, and that are in earth, *viſible* and *inviſible*, whether they be THRONES, or DOMINIONS, or PRINCIPALITIES, or POWERS; all things were created by him and for him; and he is before all things, and by him all things conſiſt." Indeed the Hebrew Scriptures in more places than one ‡ expreſsly declare that this earth, and of courſe the whole ſolar ſyſtem, was *formed*, as well as *created*, not by an inferior being, but by the *true* God, even *Jehovah* alone; and in the New Teſtament §, the Gentiles are ſaid to be without excuſe for not glorifying him as God, "becauſe his eternal power and Godhead are clearly ſeen from the creation of the world." But if it were natural to ſuppoſe that the power of creating worlds has been, or ever will be, communicated to beings inferior to the great Omnipotent, this reaſoning of the apoſtle's would be founded on falſe principles, and the ſentence which he paſſed on the Heathen would be contrary to juſtice.

† Coloſ. iv. 17.

‡ Iſa. xl. 12. xliv. 24. Jerem. x. 10—13.

§ Rom. i. 18—22.

But though it be thus evident that the λογος was the immediate Creator of the univerſe, we are not to ſuppoſe that it was without the concurrence of the other two perſons. The Father, who may be ſaid to be the fountain of the Divinity itſelf, was certainly concerned in the creation of the world, and is therefore in the apoſtle's creed denominated the "Father Almighty Maker of heaven and earth;" and that the Holy Ghoſt or third perſon is likewiſe a Creator, we have the expreſs teſtimony of two inſpired writers: "By the word of the Lord (ſays the Pſalmiſt) were the heavens made, and all the hoſt of them by the breath (Hebrew, SPIRIT) of his mouth." And Job declares, that the "SPIRIT of God made him, and that the breath of the Almighty gave him life." Indeed theſe three divine perſons are ſo intimately united, that what is done by one muſt be done by all, as they have but one and the ſame will. This is the reaſon aſſigned by Origen * for our paying divine worſhip to each; θρησκευομεν ουν τον πατερα της αληθειας και τον υιον την αληθειαν, ονλα δνο τη υποστασει πραγματα, εν δε τη ομονοια, και τη συμφωνια και τη ταυτοτητι της βουλησεως, "we worſhip the Father of truth, and the Son the truth itſelf, being two things as to hypoſtaſis, but one in agreement, conſent, and ſameneſs of will." Nor is their union a mere agreement in will only; it is a phyſical or eſſential union: ſo that what is done by one muſt neceſſarily be done by the others alſo, according to that of our Saviour, "I am in the Father and the Father in me: The Father who dwelleth in me, he doth the works."

God and his Attributes.

* Cont. Celſ. p.

SECT. II. *Of the Original State of Man, and the firſt Covenant of Eternal Life which God vouchſafed to make with him.*

78 Peculia of the preſſion which is ſaid make n

IN the Moſaic account of the creation, every attentive reader muſt be ſtruck with the manner in which the ſupreme Being is repreſented as making man: "And God ſaid, let US make man in our image, after our likeneſs; and let *them* have dominion over the fiſh of the ſea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth. So God created man in his own image; in the image of God created he him; male and female created he THEM. And God bleſſed them; and God ſaid unto them, be fruitful, and multiply, and repleniſh the earth, and ſubdue it; and have dominion over the fiſh of the ſea, and over the fowl of the air, and over every living thing that moveth upon the earth. And God ſaid, behold, I have given you every herb bearing ſeed, which is upon the face of all the earth; and every tree, in the which is the fruit of a tree yielding ſeed: to you it ſhall be for meat. And God ſaw every thing that he had made, and, behold, it was very good. And the evening and the morning were the ſixth day. Thus the heavens and the earth were finiſhed, and all the hoſt of them. And on the ſeventh day God ended his work which he had made; and he reſted on the ſeventh day from all his works which he had made. And God bleſſed the ſeventh day and ſanctified it: becauſe that in it he had reſted from all his work which God created and made *." Gen. 26, &c.

This is a very remarkable paſſage, and contains much important information. It indicates a plurality of perſons in the Godhead, deſcribes the nature of man as he came at firſt from the hands of his Creator, and furniſhes data from which we may infer what were the duties required of him in that primeval ſtate, and what were the rewards to which obedience would entitle him. 1, 2, 3.

79 In his o image.

Of the plurality of Divine perſons, and their eſſential union, we have treated in the preceding ſection, and proceed now to inquire into the ſpecific nature of the firſt man. This muſt be implied in the *image of God*, in

in which he is said to have been created; for it is by that phrase alone that he is characterized, and his pre-eminence marked over the other animals. Now this image or likeness must have been found either in his body alone, his soul alone, or in both united. That it could not be in his body alone, is obvious; for the infinite and omnipotent God is allowed by all men to be without body, parts, or passions, and therefore to be such as nothing corporeal can possibly resemble.

If this likeness is to be found in the human soul, it comes to be a question in what faculty or power of the soul it consists. Some have contended, that man is the only creature on this earth who is animated by a principle essentially different from matter; and hence they have inferred, that he is said to have been formed in the Divine image, on account of the immateriality of that vital principle which was infused into his body when the "Lord God breathed into his nostrils the breath of life, and man became a living soul *." That this account of the animation of the body of man indicates a superiority of the human soul to the vital principle of all other animals, cannot, we think, be questioned; but it does not therefore follow, that the human soul is the only immaterial principle of life which animates any terrestrial creature. It has been shown elsewhere (see METAPHYSICS, N° 235.), that the power of sensation, attended with individual consciousness, as it appears to be in all the higher species of animals, cannot result from any organical structure, or be the quality of a compound extended being. The vital principle in such animals therefore must be immaterial as well as the human soul; but as the word *immaterial* denotes only a negative notion, the souls of men and brutes, though both immaterial, may yet be substances essentially different. This being the case, it is plain that the Divine image in which man was formed, and by which he is distinguished from the brute creation, cannot consist in the mere circumstance of his mind being a substance different from matter, but in some positive quality which distinguishes him from every other creature on this globe.

About this characteristic quality various opinions have been formed. Some have supposed † "that the image of God in Adam appeared in that rectitude, righteousness, and holiness, in which he was made; for God made man upright (Eccles. vii. 2.), a holy and righteous creature; which holiness and righteousness were in their kind perfect; his understanding was free from all error and mistakes; his will biassed to that which is good; his affections flowed in a right channel towards their proper objects; there were no sinful motions and evil thoughts in his heart, nor any propensity or inclination to that which is evil; and the whole of his conduct and behaviour was according to the will of God. And this righteousness (say they) was *natural*, and not personal and acquired. It was not obtained by the exercise of his free-will, but was created with him, and belonged to his mind, as a natural faculty or instinct." They therefore call it *original righteousness*, and suppose that it was lost in the fall.

To this doctrine many objections have been made. It has been said that righteousness consisting in right actions proceeding from proper principles, could not be created with Adam and make a part of his nature; because nothing which is produced in a man without his knowledge and consent can be in him either virtue or vice. Adam, it is added, was unquestionably placed in a state of trial, which proves that he had righteous habits to *acquire*; whereas the doctrine under consideration, affirming his original righteousness to have been perfect, and therefore incapable of improvement, is inconsistent with a state of trial. That his understanding was free from all errors and mistakes, has been thought a blasphemous position, as it attributes to man one of the incommunicable perfections of the Deity. It is likewise believed to be contrary to fact; for either his understanding was bewildered in error, or his affections flowed towards an improper object, when he suffered himself at the persuasion of his wife to transgress the express law of his Creator. The objector expresses his wonder at its having ever been supposed that the *whole* of Adam's conduct and behaviour was according to the will of God, when it is so notorious that he yielded to the first temptation with which, as far as we know, he was assailed in paradise.

Original State of Man.

Convinced by these and other arguments, that the image of God in which man was created could not consist in original righteousness, or in exemption from all possibility of error, many learned men, and Bishop Bull * among others, have supposed, that by the image of God is to be understood certain gifts and powers supernaturally infused by the Holy Spirit into the minds of our first parents, to guide them in the ways of piety and virtue. This opinion they rest chiefly upon the authority of Tatian, Irenæus, Tertullian, Cyprian, Athanasius, and other fathers of the primitive church; but they think, at the same time, that it is countenanced by several passages in the New Testament. Thus when St Paul says †, "and so it is written, The first man Adam was made a living soul, the last Adam was made a quickening Spirit;" they understand the whole passage as relating to the creation of man, and not as drawing a comparison between Adam and Christ, to show the great superiority of the latter over the former. In support of this interpretation they observe, that the apostle immediately adds, "howbeit, that was not first which is spiritual, but that which is natural, and afterwards that which is spiritual;" an addition which they think was altogether needless, if by the quickening Spirit he had referred to the incarnation of Christ, which had happened in the very age in which he was writing. They are therefore of opinion, that the body of Adam, after being formed of the dust of the ground, was first animated by a vital principle endowed with the faculties of reason and sensation, which entitled the whole man to the appellation of a living soul. After this they suppose certain graces of the Holy Spirit to have been infused into him, by which he was made a quickening spirit, or formed in the image of God; and that it was in consequence of this succession of powers communicated to the same person, that the apostle said, "Howbeit, that was not first which is spiritual, but that which is natural."

* See his *English Works*, vol. iii.

83 Opinion of Bishop Bull and some of the ancient fathers

† 1 Cor. xv. 45, 46.

We need hardly observe, that with respect to a question of this kind the authority of *Tatian* and the other fathers quoted is nothing. Those men had no better means of discovering the true sense of the scriptures of the Old Testament than we have; and their ignorance of the language in which these scriptures are written, added to some metaphysical notions respecting the soul,

Original State of Man.

which too many of them had derived from the school of Plato, rendered them very ill qualified to interpret the writings of Moses. Were authority to be admitted, we should consider that of Bishop Bull and his modern followers as of greater weight than the authority of all the ancients to whom they appeal. But authority cannot be admitted; and the reasoning of this learned and excellent man from the text of St Paul is surely very inconclusive. It makes two persons of Adam; a first, when he was a natural man composed of a body and a reasonable soul; a second, when he was endowed with the gifts of the Holy Spirit, and by them formed in the image of God! In the verse following too, the apostle expressly calls the second man, of whom he had been speaking, "the Lord from heaven;" but this appellation we apprehend to be too high for Adam in the state of greatest perfection in which he ever existed. That our first parents were endowed with the gifts of the Holy Ghost, we are strongly inclined to believe for reasons which shall be given by and by; but as these gifts were adventitious to their nature, they could not be that image in which God *made* man.

84 ill-founded.

85 Other opinions.

Since man was *made* in the image of God, that phrase, whatever be its precise import, must denote something *peculiar* and at the same time essential to human nature; but the only two qualities at once natural and peculiar to man are his shape and his reason. As none but an anthropomorphite will say that it was Adam's shape which reflected this image of his Creator, it has been concluded that it was the faculty of reason which made the resemblance. To give strength to this argument it is observed †, that when God says, "let us make man in our image," he immediately adds, "and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth;" but as many of the cattle have much greater bodily strength than man, this dominion could not be maintained but by the faculty of reason bestowed upon him and withheld from them.

† *Warburton's Divine Leg.* book ix.

If the image of God was impressed only on the mind of man, this reason seems to be conclusive; but it has been well observed ‡ that it was the whole man, and not the *soul alone*, or the *body* alone, that is said to have been formed in the divine image; even as the whole man, soul and body, is the seat of the new and spiritual image of God in regeneration and sanctification. "The very God of peace (says the apostle) sanctify you wholly; and may your whole *spirit*, *soul* and *body*, be preserved blameless to the coming of our Lord Jesus Christ." It is worthy of notice, too, that the reason assigned for the prohibition of murder to Noah and his sons after the deluge, is, that man was made in the image of God. "Whoso sheddeth man's blood, by man shall his blood be shed; for in the image of God made he man." These texts seem to indicate, that whatever be meant by the image of God, it was stamped equally on the soul and on the body. In vain is it said that man cannot resemble God in shape. This is true, but it is little to the purpose; for man does not resemble God in his reasoning faculty more than in his form. It would be idolatry to suppose the supreme majesty of heaven and earth to have a body or a shape; and it would be little short of idolatry to imagine that he is obliged to compare ideas and notions together; to advance from particular truths to general propositions; and to acquire knowledge, as we do, by the tedious processes of inductive and syllogistic reasoning. There can therefore be no direct image of God either in the soul or in the body of man; and the phrase really seems to import nothing more than those powers or qualities by which man was fitted to exercise dominion over the inferior creation; as if it had been said, "Let us make man in our image, after our likeness, that *they may have* dominion, &c." But the erect form of man contributes in some degree, as well as his rational powers, to enable him to maintain his authority over the brute creation; for it has been observed by travellers, that the fiercest beast of prey, unless ready to perish by hunger, shrinks back from a steady look of the human face divine.

‡ *Gill's Body of Divinity*, book iii. chap. 3.

Original State of Man.

86 True import of the phrase.

By some *, however, who have admitted the probability of this interpretation, another has been devised for its being said that man was formed in the image of God. All the members of Christ's body, say they, were written and delineated in the book of God's purposes and decrees, and had an ideal existence from eternity in the divine mind; and therefore the body of Adam might be said to be formed after the image of God, because it was made according to that idea. But to this reasoning objections may be urged, which we know not how to answer. All things that ever were or ever shall be, the bodies of us who live at present as well as the bodies of those who lived 5000 years ago, have from eternity had an ideal existence in the Divine mind; nor in this sense can one be said to be prior to another. It could not therefore be after the idea of the identical body of Christ that the body of Adam was formed; for in the Divine mind ideas of both bodies were present together from eternity, and each body was formed after the ideal archetype of itself. It may be added likewise, that the body of Christ was not God, nor the idea of that body the idea of God. Adam therefore could not with propriety be said to have been formed in the image of God, if by that phrase nothing more were intended than the resemblance between his body and the body of Christ. These objections to this interpretation appear to us unanswerable; but we mean not to dictate to our readers. Every man will adopt that opinion which he thinks supported by the best arguments; but it is obvious, that whatever more may be meant by the image of God in which man was made, the phrase undoubtedly comprehends all those powers and qualities by which he is enabled to maintain his authority over the inferior creation. Among these the faculty of reason is confessedly the most important; for it is by it that man is capable of being made acquainted with the Author of his being, the relation which subsists between them, and the duties implied in that relation from the creature to the Creator.

* *Gill*, &c.

87 Religious instruction communicated to Adam.

That the first man, however, was not left to discover these things by the mere efforts of his own unassisted reason, we have endeavoured to show in another place; (see RELIGION, N° 5—10.); and the conclusion to which we were there led, is confirmed by the portion of revelation before us. The inspired historian says, that "God blessed the seventh day and *sanctified* it, because that in it he had rested from all his works, which he created and made;" but Adam could not have understood what was meant by the *sanctification* of a particular day, or of any thing else, unless he had previously received

received some religious instruction. There cannot therefore be a doubt, but that as soon as man was made, his Creator communicated to him the truths of what is called natural religion, which we have endeavoured to explain and establish in Part I. of this article; and to these were added the precept to keep holy the Sabbath-day, and set it apart for the purposes of contemplation and worship.

Original State of Man.

This was a very wise institution, as all the divine institutions must be. "The great end for which we are brought into life, is to attain the knowledge and be confirmed in the love of God. This includes obedience to his will in thought, word, and deed, or that course of conduct which can alone make us happy here, and fit us for everlasting glory hereafter. But of these things we cannot retain a proper sense without close and repeated application of thought; and the unavoidable cares and concerns of the present life occupying much of our attention, it is, in the nature of things, necessary that some certain portion of time should be appropriated to the purposes of religious instruction and the public adoration of our Creator, in whom we all live, and move, and have our being." Hence a very learned divine † has inferred, that though the particular time is a matter of positive appointment, the observation of a sabbath in general is a duty of natural religion, as having its foundation in the reason of things. See SABBATH.

† *Taylor of Norwich*.

Man therefore in his *natural* and original state was a rational and religious being, bound to do "justice, to love mercy, to walk humbly with his God, and to keep holy the Sabbath-day." These seem to be all the duties which in that state were required of him; for as soon as he was introduced into the terrestrial paradise and admitted into covenant with his Maker, he was placed in a *supernatural* state, when other duties were of course enjoined.

That our first parents were both made on the fifth day, Moses expressly affirms when he says ‡, that "God created them male and female, and blessed them, and called *their* name *Adam* (K), in the day when they were created:" but that they were introduced into the garden of Eden on that day, is an opinion which, however generally it may be received, seems not to be reconcileable with the plain narrative of the sacred penman. After telling us that on the fifth day God finished all his works, which he saw to be very good, and rested on the seventh day, he briefly recapitulates the history of the generations of the heavens and of the earth, gives us a more particular account of the formation of the first man, informing us that the "Lord God formed him out of the dust of the ground, and breathed into his nostrils the breath of life, when man became a living soul;" and then proceeds to say ||, that the "Lord God planted a garden eastward in Eden, where he put the man whom he HAD *formed*." From this short history of the first pair it appears beyond dispute evident, that neither the man nor the woman was formed *in* the garden; and that from their creation some time elapsed before the garden was prepared for their reception, is likewise evident from a comparison of Gen. i. 29. with Gen. ii. 16, 17. In the first of these passages God gives to man, immediately after his creation, "every herb bearing seed which was upon the face of all the earth, and *every tree*, without exception, in which was the fruit of a tree bearing seed: to him he said it should be for meat." In the second, "he commanded the man saying, of every tree of the garden thou mayest freely eat; but of the tree of knowledge of good and evil, thou shalt not eat of it; for in the day thou eatest thereof thou shalt surely die." When the first grant of food was given, Adam and his wife must have been where no tree of knowledge grew, and they must have been intended to live at least so long in that state as that they should have occasion for food, otherwise the formal grant of it would have been not only superfluous, but apt to mislead them with respect to the subsequent restriction.

90 before he was placed in the garden of Eden.

In this original state man was under the discipline of what we have called *natural religion*, entitled to happiness while he should perform the duties required of him, and liable to punishment when he should neglect those duties, or transgress the law of his nature as a rational and moral agent. This being the case, it is a matter of some importance, to ascertain, if we can, what the rewards and punishments are which natural religion holds out to her votaries.

That under every dispensation of religion the pious and virtuous man shall enjoy more happiness than misery; and that the incorrigibly wicked shall have a greater portion of misery than happiness, are truths which cannot be controverted by any one who admits, that the Almighty governor of the universe is a Being of wisdom, goodness, and justice. But respecting the rewards of virtue and the punishment of vice, more than these general truths seems not to be taught by natural religion. Many divines, however, of great learning and worth, have thought otherwise, and have contended, that from the nature of things the rewards bestowed by an infinite God upon piety and virtue must be eternal like their author. These men indeed appear willing enough to allow that the punishments with which natural religion is armed against vice must be only of a temporary duration, because reason, say they, is ready to revolt at the thought of *everlasting* punishment.

91 did not when performed, entitle him to eternal life.

This opinion, which confounds natural with revealed religion, giving to the former an important truth which belongs exclusively to the latter, has been so ably confuted by a learned writer, that we shall submit his arguments to our readers in preference to any thing which we can give ourselves.

"If reason doth, on the one hand, seem to revolt at *everlasting punishment*, we must confess that FANCY, on the other, (even when full plumed by *vanity*), hath scarcely force enough to rise to the idea of *infinite rewards*. How the heart of man came to consider this as no more than an adequate retribution for his right conduct during the short trial of his virtue here, would

(K) The woman was some time afterwards distinguished by the name of Eve, חוה, because she was to be the mother of all living, and particularly of that blessed seed which was to bruise the head of the serpent. See *Parkhurst's Lexicon* on the word.

Original State of Man.

be hard to tell, did we not know what monſters PRIDE begot of old upon *Pagan philoſophy;* and how much greater ſtill theſe latter ages have diſcloſed, *by the long* incubation of *ſchool-divinity* upon *folly*. What hath been urged from natural reaſon, in ſupport of this extravagant preſumption, is ſo very ſlender, that it recoils as you enforce it. Firſt, you ſay, "that the ſoul, the ſubject of theſe eternal rewards, being *immaterial*, and ſo therefore unaffected by the cauſes which bring material things to an end, is, by its nature, fitted for eternal rewards.—This is an argument *ad ignorantiam*, and holds no farther.—Becauſe an *immaterial* being is not ſubject to that mode of diſſolution which affects *material* ſubſtances, you conclude it to be eternal. This is going too faſt. There may be, and probably are, many natural cauſes (unknown indeed to us), whereby immaterial beings come to an end. But if the nature of things cannot, yet God certainly can, put a final period to ſuch a being when it hath ſerved the purpoſe of its creation. Doth ANNIHILATION impeach that wiſdom and goodneſs which was diſplayed when God brought it *out of nothing?* Other immaterial beings there are, viz. the ſouls of brutes, which have the ſame natural ſecurity with man for their exiſtence, of whoſe *eternity* we never dream. But pride, as the poet obſerves, *calls God unjuſt*,

92 Arguments to prove that they did inconcluſive.

> If man alone engroſs not heaven's high care;
> Alone made *perfect* here, IMMORTAL there.

However, let us (for argument's ſake) allow the human ſoul to be unperiſhable by nature, and ſecured in its exiſtence by the unchangeable will of God, and ſee what will follow from thence—An *infinite* reward for virtue during one moment of its exiſtence, becauſe reaſon diſcovers that, by the law of nature, *ſome* reward is due? By no means. When God hath amply repaid us for the performance of our duty, will he be at a loſs how to diſpoſe of us for the long remainder of *eternity?* May he not find new and endleſs employment for reaſonable creatures, to which, when properly diſcharged, new rewards and in endleſs ſucceſſion will be aſſigned? Modeſt reaſon ſeems to dictate this to the followers of the *law of nature*. The flattering expedient of ETERNAL REWARDS for virtue here was invented in the ſimplicity of early ſpeculation, after it had fairly brought men to conclude that the ſoul is immaterial.

"Another argument urged for the eternity of the rewards held out by natural religion to the practice of piety and virtue is partly phyſical and partly moral. The merit of ſervice (ſay the admirers of that religion) increaſes in proportion to the excellence of that Being to whom our ſervice is directed and becomes acceptable. An infinite being, therefore, can diſpenſe no rewards but what are infinite. And thus the virtuous man becomes entitled to immortality.

"The misfortune is, that this reaſoning holds equally on the ſide of the unmerciful doctors, as they are called, who doom the wicked to EVERLASTING PUNISHMENT. Indeed were this the only diſcredit under which it labours, the mercileſs doctors would hold themſelves little concerned. But the truth is, that the argument from *infinity* proves juſt nothing. To make it of any force, both the parties ſhould be *infinite*. This inferior emanation of God's *image*, MAN, ſhould either be ſupremely good or ſupremely bad, a kind of deity or a kind of devil. But theſe reaſoners, in their attention to the *divinity*, overlook the *humanity*, which makes the decreaſe keep pace with the accumulation, till the rule of logic, that the *concluſion follows the weaker* part, comes in to end the diſpute *."

* Warburton's Divine Legation, b. ix.

Theſe arguments ſeem to prove unanſwerably that immortality is not eſſential to any part of the compound being man, and that it cannot be claimed as a reward due to his virtue. It is not indeed eſſential to any created being, for what has not exiſtence of itſelf, cannot of itſelf have perpetuity of exiſtence (ſee METAPHYSICS, N° 272, &c.); and as neither man nor angel can be profitable to God, they cannot claim from him any thing as a debt. Both, indeed, as moral agents, have duties preſcribed them; and while they faithfully perform theſe duties, they have all the ſecurity which can ariſe from the perfect benevolence of him who brought them into exiſtence, that they ſhall enjoy a ſufficient portion of happineſs to make that exiſtence preferable to non-exiſtence; but reaſon and philoſophy furniſh no data from which it can be inferred that they ſhall exiſt for ever. Man is compoſed in part of periſhable materials. However perfect Adam may be thought to have been when he came firſt from the hands of his Creator, his body, as formed of the duſt of the ground, muſt have been naturally liable to decay and diſſolution. His ſoul, indeed, was of a more durable ſubſtance; but as it was formed to animate his body, and had no prior conſcious exiſtence, it is not eaſy to conceive what ſhould have led him, under an equal providence, where rewards and puniſhments were exactly diſtributed, to ſuppoſe that one part of him ſhould ſurvive the other. In his natural and original ſtate, before the covenant made with him in paradiſe, he was unqueſtionably a mortal creature. How long he continued in that ſtate, it ſeems not poſſible to form a plauſible conjecture. Biſhop Warburton ſuppoſes him to have lived ſeveral years under no other diſpenſation than that of natural religion; during which he was as liable to death as his fallen poſterity are at preſent.

93 Adam before his introduction into paradiſe liable to death.

"We muſt needs conclude (ſays this learned writer *), that God having tried Adam in *the ſtate of nature*, and approved of the good uſe he made of his free-will under the direction of that light, advanced him to a ſuperior ſtation in *Paradiſe*. How long, before this remove, man had continued ſubject to *natural religion* alone, we can only gueſs: but of this we may be aſſured, that it was ſome conſiderable time before the garden of Eden could naturally be made fit for his reception. Since Moſes, when he had concluded his hiſtory of the creation, and of God's *reſt* on, and *ſanctification* of, the ſeventh day, proceeds to ſpeak of the condition of this new world in the following terms: "*And God made every plant of the field before it was in the earth, and every herb of the field before it grew; for the Lord God had not cauſed it to rain upon the earth* †." Which ſeems plainly to intimate, that when the ſeeds of vegetables had been created on the third day, they were left to nature, in its ordinary operations, to mature by ſun and ſhowers. So that when in courſe of time Paradiſe was become capable of accommodating its inhabitants, they were tranſplanted thither."

* Divine Legation, book ix. chap i.

94 How long he continued in that ſtate,

† Gen. ii. 4, 5.

This reaſoning is not without a portion of that ingenuity which was apparent in every thing that fell from the pen of Warburton; but it was completely confut-

ed almoſt as ſoon as it was given to the public, and ſhown to be deduced from premiſes which could be employed againſt the author's ſyſtem. If only the *ſeeds* of vegetables were created on the third day, and then left to nature, in its ordinary operations, to mature by ſun and ſhowers, the firſt pair muſt have periſhed before a ſingle vegetable could be fit to furniſh them with food; and we may ſuppoſe that it was to prevent this diſaſter that the garden of Eden was miraculouſly ſtored at once with full grown trees and fruit in perfect maturity, whilſt the reſt of the earth was left under the ordinary laws of vegetation. There is, however, no evidence that they were only the *ſeeds* of vegetables that God created. On the contrary, Moſes ſays expreſsly *, that God made the earth on the third day bring forth the herb *yielding* ſeed after his kind, and the tree *yielding fruit* whoſe *ſeed* was in itſelf after his kind;" and when he recapitulates the hiſtory of the creation, he ſays, that God made, not every ſeed, but every *plant* of the field *before* it was in the earth, and every *herb* of the field *before* it grew. From the proceſs of vegetation, therefore, nothing can be inferred with reſpect to the time of Adam's introduction into paradiſe, or to aſcertain the duration of his original ſtate of nature. If angels were created during the ſix days of which the Hebrew lawgiver writes the hiſtory, an hypotheſis very generally received (ſee ANGEL), though in the opinion of the preſent writer not very probable, there can be no doubt but our firſt parents lived a conſiderable time under the law of nature before they were raiſed to a ſuperior ſtation in the garden of Eden; for it ſeems very evident that the period of their continuance *in* that ſtation was not long. Of this, however, nothing can be ſaid with certainty. They may have lived for years, or only a few days in their original ſtate; but it is very neceſſary to diſtinguiſh between that ſtate in which they were under no other diſpenſation than what is commonly called *natural religion*, entitled, upon their obedience, to the indefinite rewards of piety and virtue, and their ſtate in Paradiſe when they were put under a new law, and by the free grace of God promiſed, if they ſhould be obedient, a ſupernatural and eternal reward. Into that ſtate we muſt now attend them, and aſcertain, if we can, the preciſe terms of the firſt covenant.

Moſes, who in this inveſtigation is our only guide, tells us, that the Lord God, after he had formed the firſt pair, "planted a garden eaſtward in Eden, and took the man and put him into the garden to dreſs it and to keep it. And the Lord God (continues he) commanded the man, ſaying, of every tree of the garden thou mayeſt freely eat; but of the tree of the knowledge of good and evil thou ſhalt not eat of it; for in the day that thou eateſt thereof, thou ſhalt ſurely die†." Here is no mention made of the laws of piety and moral virtue reſulting from the relation in which the various individuals of the human race ſtand to each other, and in which all as creatures ſtand to God their Almighty and beneficent Creator. With theſe laws Adam was already well acquainted; and he muſt have been ſenſible, that as they were founded in his nature no ſubſequent law could diſpenſe with their obligation. They have been equally binding on all men in every ſtate and under every diſpenſation; and they will continue to be ſo as long as the general practice of juſtice, mercy, and piety, ſhall contribute to the ſum of human happineſs. The new law peculiar to his paradiſaical ſtate was the command not to eat of the fruit of the tree of the knowledge of good and evil. This was a poſitive precept, not founded in the nature of man, but very proper to be the teſt of his obedience to the will of his Creator. The laws of piety and virtue are ſanctioned by nature, or by that general ſyſtem of rules according to which God governs the phyſical and moral worlds, and by which he has ſecured, in ſome ſtate or other, happineſs to the pious and virtuous man, and miſery to ſuch as ſhall prove incorrigibly wicked. The law reſpecting the forbidden fruit was ſanctioned by the penalty of *death* denounced againſt diſobedience; and by the ſubjects of that law the nature of this penalty muſt have been perfectly underſtood: but Chriſtian divines, as we ſhall afterwards ſee, have differed widely in opinion reſpecting the full import of the Hebrew words which our tranſlators have rendered by the phraſe *thou ſhalt ſurely die*. All, however, agree that they threatened death, in the common acceptation of the word, or the ſeparation of the ſoul and body as one part of the puniſhment to be incurred by eating the forbidden fruit; and hence we muſt infer, that had the forbidden fruit not been eaten, our firſt parents would never have died, becauſe the penalty of death was denounced againſt no other tranſgreſſion. What therefore is ſaid reſpecting the fruit of the tree of knowledge, implies not only a law but alſo a covenant (L), promiſing to man, upon the obſervance of one poſitive precept, immortality or eternal life; which is not eſſential to the nature of any created being, and cannot be claimed as the merited reward of the greateſt virtue or the moſt fervent piety.

Original State of Man.

* Gen. i. 11.

† Gen. ii. 8. 15, 16, 17.

96 The covenant of eternal life made with Adam in paradiſe.

This obvious truth will enable us to diſpoſe of the objections which have been ſometimes brought by free-thinking divines againſt the wiſdom and juſtice of puniſhing ſo ſeverely as by death the breach of a mere poſitive precept; which, conſidered in itſelf, appears to be a precept of very little importance. We have only to reply, that as an exemption from death is not due either

(L) It does not appear that any tranſaction between God and mankind in general was denominated by a word equivalent to the Engliſh word *covenant* till the end of the fourth century, when ſuch phraſeology was introduced into the church by the celebrated Auguſtine, biſhop of Hippo. That the phraſeology is ſtrictly proper, no man can ſuppoſe who reflects on the infinite diſtance between the contracting parties, and the abſolute dominion of the one over the other. To be capable of entering into a *covenant*, in the proper ſenſe of the word, both parties muſt have a right either to agree to the terms propoſed or to reject them; but ſurely Adam had no right to bargain with his Maker, or to refuſe the gift of immortality on the terms on which it was offered to him. The word *diſpenſation* would more accurately denote what is here meant by the word *covenant;* but as this laſt is in general uſe, we have retained it as ſufficient, when thus explained, to diſtinguiſh what man received from God upon certain poſitive conditions, from what he had a claim to by the conſtitution of his nature.

Original State of Man

either to the nature or to the virtue of man, it was wiſe and juſt to make it depend on the obſervance of a poſitive precept, to impreſs on the minds of our firſt parents a conſtant conviction, that they were to be preſerved immortal, not in the ordinary courſe of divine providence, but by the ſpecial grace and favour of God. The ſame conſideration will ſhow us the folly of thoſe men who are for turning all that is ſaid of the trees of knowledge and of life into figure and allegory. But the other trees which Adam and Eve were permitted to eat were certainly real trees, or they muſt have periſhed for want of food. And what rules of interpretation will authoriſe us to interpret *eating* and *trees* literally in one part of the ſentence and figuratively in the other? A garden in a delightful climate is the very habitation, and the fruits produced in that garden the very food, which we ſhould naturally ſuppoſe to have been prepared for the progenitors of the human race; and though in the garden actually fitted up for this purpoſe two trees were remarkably diſtinguiſhed from the reſt, perhaps in ſituation and appearance as well as in uſe, the diſtinction was calculated to ſerve the beſt of purpoſes. The one called the *tree of life*, of which, while they continued innocent, they were permitted to eat, ſerved as a ſacramental pledge or aſſurance on the part of God, that as long as they could obſerve the terms of the covenant their life ſhould be preſerved; the other of which it was death to taſte, was admirably adapted to impreſs on their minds the neceſſity of implicit obedience to the Divine will, in whatever manner it might be made known to them.

A queſtion has been ſtarted of ſome importance, What would have finally become of men if the firſt covenant had not been violated? That they would have been all immortal is certain; but it is by no means clear that they would have lived for ever on this earth. On the contrary, it has been an article of very general belief in all ages of the church †, that the garden of Eden was an emblem or type of heaven, and therefore called *Paradiſe* (ſee PARADISE); and that under the firſt covenant, mankind, after a ſufficient probation here, were to be tranſlated into heaven without taſting death. This doctrine is not indeed explicitly taught in Scripture; but many things conſpire to make it highly probable. The frequent communications between God and man before the fall (M), ſeem to indicate that Adam was training up for ſome higher ſtate than the terreſtrial paradiſe. Had he been intended for nothing but to cultivate the ground and propagate his ſpecies, he might have been left like other animals to the guidance of his own reaſon and inſtincts; which, after the rudiments of knowledge were communicated to him, muſt ſurely have been ſufficient to direct him to every thing neceſſary to the comforts of a life merely ſenſual and rational, otherwiſe he would have been an imperfect animal. It is obvious too, that this earth, however fertile it may have originally been, could not have afforded the means of ſubſiſtence to a race of immortal beings multiplying to infinity. For theſe reaſons, and others which will readily occur to the reader, it ſeems incontrovertible,

† *Bull's State of Man before the Fall.*

97 had it not been violated, entitled him to heaven.

that, under the firſt covenant, either mankind would have been ſucceſſively tranſlated to ſome ſuperior ſtate, or would have ceaſed to propagate their kind as ſoon as the earth ſhould have been repleniſhed with inhabitants. He who reflects on the promiſe, that, after the general reſurrection, there is to be a new heaven and a new earth, will probably embrace the latter part of the alternative; but that part in its conſequences differs not from the former. In the new earth promiſed in the Chriſtian revelation, nothing is to dwell but righteouſneſs. It will therefore be preciſely the ſame with what we conceive to be expreſſed by the word heaven; and if under the firſt covenant this earth was to be converted into a ſimilar place, where, after a certain period, men ſhould never marry nor be given in marriage, but enjoy what divines have called the *beatific viſion*, we may confidently affirm, that, had the firſt covenant been faithfully obſerved, Adam and his poſterity, after a ſufficient probation, would all have been tranſlated to ſome ſuperior ſtate or heaven.

98 and the gifts of divine grace.

To fit them for that ſtate, the gifts of divine grace ſeem to have been abſolutely neceſſary. To them it was a ſtate certainly ſupernatural, otherwiſe a God of infinite wiſdom and perfect goodneſs would not, for a moment, have placed them in an inferior ſtate. But to enable any creature, eſpecially ſuch a creature as man, whom an ancient philoſopher has juſtly ſtyled ζωον μιμηλικον, to riſe above its *nature*, foreign and divine aid is unqueſtionably requiſite: and therefore, though we cannot perſuade ourſelves that the gifts of the Holy Ghoſt conſtituted that image of God in which man was originally made, we agree with Biſhop Bull, that theſe gifts were beſtowed on our firſt parents to enable them to fulfil the terms of the covenant under which they were placed.

On the whole, we think it apparent from the portions of ſcripture which we have examined, that Adam and Eve were endued with ſuch powers of body and mind as fitted them to exerciſe dominion over the other animals; that thoſe powers conſtituted that image of God in which they are ſaid to have been formed; that they received by immediate revelation the firſt principles of all uſeful knowledge, and eſpecially of that ſyſtem which is uſually called *natural religion;* that they lived for ſome time with no other religion, entitled to the natural rewards of piety and virtue, but all the while liable to death; that they were afterwards tranſlated into paradiſe where they were placed under a new law, with the penalty of death threatened to the breach of it, and the promiſe of endleſs life if they ſhould faithfully obſerve it; and that they were endued with the gifts of the Holy Ghoſt, to enable them, if not wanting to themſelves, to fulfil the terms of that covenant, which has been improperly termed the *covenant of works*, ſince it flowed from the mere grace of God, and conferred privileges on man to which the moſt perfect human virtue could lay no juſt claim.

99 It is therefore improperly called the *covenant of works*,

SECT. III. *Of the Fall of Adam, and its Conſequences.*

FROM the preceding account of the primeval ſtate of man,

(M) That there were ſuch frequent communications, has been ſhown to be in the higheſt degree probable by the late Dr Law biſhop of Carliſle. See his *Diſcourſe on the ſeveral Diſpenſations of revealed Religion.*

man, it is evident that his continuance in the terreſtrial paradiſe, together with all the privileges which he there enjoyed, were made to depend on his obſervance of one poſitive precept. Every other duty incumbent on him, whether as reſulting from what is called the law of his nature, or from the expreſs command of his God, was as much his duty before as after he was introduced into the garden of Eden; and though the tranſgreſſion of any law would undoubtedly have been puniſhed, or have been forgiven only in conſequence of ſincere repentance and amendment, it does not appear that a breach of the *moral* law, or of the commandment reſpecting the ſanctification of the *Sabbath-day*, would have been puniſhed with death, whatever may be the import of that word in the place where it is firſt threatened. The puniſhment was denounced only againſt eating the fruit of the tree of the knowledge of good and evil: For "the Lord God commanded the man, ſaying, of every tree of the garden thou mayeſt freely eat, but of the tree of the knowledge of good and evil thou ſhalt not eat of it; for in the day that thou eateſt thereof thou ſhalt ſurely die." To the word *death* in this paſſage divines have affixed many and different meanings. By ſome it is ſuppoſed to import a ſeparation of the ſoul and body, while the latter was to continue in a ſtate of conſcious exiſtence; by others, it is taken to imply annihilation or a ſtate without conſciouſneſs; by ſome, it is imagined to ſignify eternal life in torments; and by others a ſpiritual and moral death, or a ſtate neceſſarily ſubject to ſin. In any one of theſe acceptations it denoted ſomething new to Adam, which he could not underſtand without an explanation of the term; and therefore, as it was threatened as the puniſhment of only one tranſgreſſion, it could not be the divine intention to inflict it on any other.

The abſtaining from a particular fruit in the midſt of a garden abounding with fruits of all kinds, was a precept which at firſt view appears of eaſy obſervation; and the penalty threatened againſt the breach of it was, in every ſenſe, awful. The precept, however, was broken notwithſtanding that penalty; and though we may thence infer that our firſt parents were not beings of ſuch abſolute perfection as by divines they have ſometimes been repreſented, we ſhall yet find, upon due conſideration, that the temptation by which they were ſeduced, when taken with all its circumſtances, was ſuch as no wife and modeſt man will think himſelf able to have reſiſted. The ſhort hiſtory of this important tranſaction, as we have it in the third chapter of the book of Geneſis, is as follows.

"Now the ſerpent was more ſubtile than any beaſt of the field which the Lord God had made; and he ſaid unto the woman, Yea, hath God ſaid, ye ſhall not eat of every tree of the garden? And the woman ſaid unto the ſerpent, We may eat of the fruit of the trees of the garden; but of the fruit of the tree which is in the midſt of the garden, God hath ſaid ye ſhall not eat of it, neither ſhall ye touch it, leſt ye die. And the ſerpent ſaid unto the woman, ye ſhall not ſurely die: For God doth know, that on the day ye eat thereof, then your eyes ſhall be opened, and ye ſhall be as gods, knowing good and evil. And when the woman *ſaw* that the tree was good for food, and that it was pleaſant to the eyes, and a tree to be deſired to make one wiſe, ſhe took of the fruit thereof, and did eat, and gave alſo unto her huſband with her, and he did eat." Fall of Adam, and its conſequences.

To the leſs attentive reader this converſation between the ſerpent and the woman muſt appear to begin abruptly; and indeed it is not poſſible to reconcile it with the natural order of a dialogue, or even with the common rules of grammar, but by ſuppoſing the tempter's queſtion, "Yea, hath God ſaid, ye ſhall not eat of every tree of the garden?" to have been ſuggeſted by ſomething immediately preceding either in words or in ſignificant ſigns. Eve had undoubtedly by ſome means or other informed the ſerpent that ſhe was forbidden to eat of the fruit on which he was probably feaſting; and that information, whether given in words or in actions, muſt have produced the queſtion with which the ſacred hiſtorian begins his relation of this fatal dialogue. We are told that the woman *ſaw* that the tree was *good for food;* that it was pleaſant to the eyes, and a tree to be *deſired to make one wiſe;* but all this ſhe could not have *ſeen*, had not the ſerpent eaten of its fruit in her preſence. In her walks through the garden, it might have often appeared pleaſant to her eyes; but previous to experience ſhe could not know but that its fruit was the moſt deadly poiſon, far leſs could ſhe conceive it capable of conferring wiſdom. But if the ſerpent ate of it before her, and then extolled its virtues in rapturous and intelligible language, ſhe would at once ſee that it was not deſtructive of animal life, and naturally infer that it had very ſingular qualities. At the moment ſhe was drawing this inference, it is probable that he invited her to partake of the delicious fruit, and that her refuſal produced the conference before us. That ſhe yielded to his temptation need excite no wonder; for ſhe knew that the ſerpent was by nature a mute animal, and if he attributed his ſpeech to the virtues of the tree, ſhe might infer, with ſome plauſibility, that what had power to raiſe the brute mind to human, might raiſe the human to divine, and make her and her huſband, according to the promiſe of the tempter, become as gods, knowing good and evil. Milton, who was an eminent divine as well as the prince of poets, makes her reaſon thus with herſelf. 102 In conſequence of a moſt artful temptation,

Great are thy virtues, doubtleſs, beſt of fruits,
Tho' kept from man, and worthy to be admir'd;
Whoſe taſte, too long forborne, at firſt eſſay
Gave elocution to the mute, and taught
The tongue not made for ſpeech to ſpeak thy praiſe.
* * * * *
——For us alone
Was death invented? or to us denied
This intellectual food, for beaſts reſerved?
For beaſts it ſeems: yet that one beaſt which firſt
Hath taſted, envies not, but brings with joy
The good befallen him, author unſuſpect,
Friendly to man, far from deceit or guile.
What fear I then, rather what know to fear
Under this ignorance of good and evil,
Of God or death, of law or penalty?
Here grows the cure of all, this fruit divine,
Fair to the eye, inviting to the taſte,
Of virtue to make wiſe: what hinders then
To reach, and feed at once both body and mind?

Paradiſe Loſt, book ix.

Full

Fall of Adam, and its consequences.

Full of these hopes of raising herself to divinity, and not, as has sometimes been supposed, led headlong by a sensual appetite, she took of the fruit and did eat, and gave to her husband with her, and he did eat. The great poet makes Adam delude himself with the same sophistry that had deluded Eve, and infer, that as the serpent had attained the language and reasoning powers of man, they should attain

> Proportional ascent, which could not be
> But to be gods, or angels, demi-gods.

103 and Adam and Eve turned out of paradise.

Thus was the covenant, which, on the introduction of our first parents into paradise, their Creator was graciously pleased to make with them, broken by their violation of the condition on which they were advanced to that supernatural state; and therefore the historian tells us, that "lest they should put forth their hand and take also of the tree of life and eat, and live for ever, the Lord God sent them forth from the garden of Eden to till the ground from whence they were taken (N)." Had they been so sent forth without any farther intimation respecting their present condition or their future prospects, and if the death under which they had fallen was only a loss of consciousness, they would have been in precisely the same state in which they lived before they were placed in the garden of Eden; only their minds must now have been burdened with the inward sense of guilt, and they must have *known* themselves to be subject to death; of which, though not exempted from it by nature, they had probably no *apprehension* till it was revealed to them in the covenant of life which they had so wantonly broken.

God, however, did not send them forth thus hopeless and forlorn from the paradise of delights which they had so recently forfeited. He determined to punish them for their transgression, and at the same time to give them an opportunity of recovering more than their lost inheritance. Calling therefore the various offenders before him, and inquiring into their different degrees of guilt, he began with pronouncing judgment on the serpent in terms which implied that there was mercy for man. "And the Lord God said unto the serpent, Because thou hast done this, thou art cursed above all cattle, and above every beast of the field: upon thy belly shalt thou go, and dust shalt thou eat all the days of thy life; and I will put enmity between thee and the woman, and between thy seed and her seed: it shall bruise thy head, and thou shalt bruise his heel."

104 The tempter punished.

That this sentence has been fully inflicted on the serpent, no reasoning can be necessary to evince. Every species of that reptile is more hateful to man than any other terrestrial creature; and there is literally a perpetual war between them and the human race. It is remarkable too that the *head* of this animal is the only part which it is safe to bruise. His tail may be bruised, or even cut off, and he will turn with fury and death on his adversary: but the slightest stroke on the head infallibly kills him. That the serpent, or at least the greater part of serpents, go on their belly, every one knows; though it is said *, that in some parts of the east serpents have been seen with wings, and others with feet, and that these species are highly beautiful. If there be any truth in this story, we may suppose that these walking and flying serpents have been suffered to retain their original elegance, that mankind might see what the whole race was before the curse was denounced on the tempter of Eve: but it is certain that most of the species have neither wings nor feet, and that many of the most poisonous of them live in burning deserts, where they have nothing to eat but the dust among which they crawl †.

To this degradation of the serpent, infidels have objected, that it implies the punishment of an animal which was incapable of guilt; but this objection is founded in thoughtlessness and ignorance. The elegant form of any species of inferior animals adds nothing to the happiness of the animals themselves: the ass is probably as happy as the horse, and the serpent that crawls as he that flies. Fine proportions attract indeed the notice of man, and tend to impress upon his mind just notions of the wisdom and goodness of the Creator; but surely the symmetry of the horse or the beauty of the peacock is more properly displayed for this purpose than the elegance of the instrument employed by the enemy of mankind. The degradation of the serpent in the presence of our first parents must have served the best of purposes. If they had so little reflection as not yet to have discovered that he was only the instrument with which a more powerful being had wrought their ruin, they would be convinced, by the execution of this sentence, that the forbidden fruit had no power in itself to improve the nature either of man or of beast. But it is impossible that they could be so stupid as this objection supposes them. They doubtless knew by this time that some great and wicked spirit had actuated the organs of the serpent; and that when enmity was promised to be put between its seed and the seed of the woman, that promise was not meant to be fulfilled by serpents occasionally biting the heels of men, and by men in return bruising the heads of serpents! If such enmity, though it has literally taken place, was all that was meant by this prediction, why was not Adam directed to bruise the head of the identical serpent which had seduced his wife? If he could derive any consolation from the exercise of revenge, surely it would be greater from his revenging himself on his own enemy, than from the knowledge that there should be a perpetual warfare between his descendants and the breed of serpents through all generations.

We are told, that when the foundations of the earth were laid, the morning stars sang together, and all the sons of God shouted for joy; and it is at least probable that there would be similar rejoicing when the six days work of creation was finished. If so, Adam and Eve, who were but a little lower than the angels, might be admitted into the chorus, and thus be made acquainted with the existence of good and evil spirits. At all events, we cannot doubt but their gracious and merciful Creator

* De... Rev... mine... cand...

† Sec... char... Pliny... Serp... with... Bruc... Trav...

(N) The ideas which this language conveys are indeed *allegorical;* but they inform us of this, and nothing but this, that *immortal life was a thing extraneous to our nature*, and not put into our paste or composition when first fashioned by the forming hand of the Creator." *Warburton's Divine Legation*, book ix. chap. i.

Fall of Adam, and its consequences.

Creator would inform them that they had a powerful enemy; that he was a rebellious angel capable of deceiving them in many ways; and that they ought therefore to be constantly on their guard against his wiles. They must have known too that they were themselves animated by something different from matter; and when they found they were deceived by the serpent, they might surely, without any remarkable stretch of sagacity, infer that their malignant enemy had actuated the organs of that creature in a manner somewhat similar to that in which their own souls actuated their own bodies. If this be admitted, the degradation of the serpent would convince them of the weakness of the tempter when compared with their Creator; and confirm their hopes, that since he was not able to preserve unhurt his own instrument of mischief, he should not be able finally to prevail against them; but that though he had bruised their heels, the promised seed of the woman should at last bruise his head, and recover the inheritance which they had lost. See PROPHECY, N° 9, 10.

Having thus punished the original instigator to evil, the Almighty Judge turned to the fallen pair, and said to the woman, "I will greatly multiply thy sorrow and thy conception: in sorrow shalt thou bring forth children; and thy desire shall be to thy husband, and he shall rule over thee. And unto Adam he said, Because thou hast hearkened unto the voice of thy wife, and hast eaten of the tree of which I commanded thee, saying, Thou shalt not eat of it; cursed is the ground for thy sake; in sorrow shalt thou eat of it all the days of thy life. Thorns also and thistles shall it bring forth unto thee, and thou shall eat the herb of the field. In the sweat of thy face shalt thou eat bread till thou return unto the ground; for out of it wast thou taken: for dust thou art, and unto dust shalt thou return."

Here is a terrible denunciation of toil and misery and death upon two creatures; who, being inured to nothing, and formed for nothing but happiness, must have felt infinitely more horror from such a sentence, than we, who are familiar with death, intimate with misery, and "born to sorrow as the sparks fly upward," can form any adequate conception of. The hardship of it, too, seems to be aggravated by its being severer than what was originally threatened against the breach of the covenant of life. It was indeed said, "In the day thou eatest thereof, thou shalt surely die:" but no mention was made of the woman's incurring sorrow in conception, and in the bringing forth of children; of the curse to be inflicted on the ground; of its bringing forth thorns and thistles instead of food for the use of man; and of Adam's eating bread in sorrow and the sweat of his face till he should return to the dust from which he was taken.

These seeming aggravations, however, are in reality instances of divine benevolence. Adam and Eve were now subjected to death; but in the sentence passed on the serpent, an obscure intimation had been given them that they were not to remain for ever under its power. It was therefore their interest, as well as their duty, to reconcile themselves as much as possible to their fate; to wean their affections from this world, in which they were to live only for a time; and to hope, with humble confidence, in the promise of their God, that, upon their departure from it, they should be received into some better state. To enable them to wean their affections from earth, nothing could more contribute than to combine sensual enjoyment with sorrow, and lay them under the necessity of procuring their means of subsistence by labour, hard and often fruitless. This would daily and hourly impress upon their minds a full conviction that the present world is not a place fit to be an everlasting habitation; and they would look forward, with pious resignation, to death, as putting a period to all their woes. Had they indeed been furnished with no ground of hope beyond the grave, we cannot believe that the Righteous Judge of all the earth would have added to the penalty originally threatened. That penalty they would doubtless have incurred the very day on which they fell; but as they were promised a deliverance from the consequences of their fall, it was proper to train them up by severe discipline for the happiness reserved for them in a future state.

After the passing of their sentence, the man and woman were turned out into the world, where they had formerly lived before they were placed in the garden of Eden; and all future access to the garden was for ever denied them. They were not, however, in the same state in which they were originally before their introduction into Paradise: They were now conscious of guilt; doomed to severe labour; liable to sorrow and sickness, disease and death: and all these miseries they had brought, not only on themselves, but also on their unborn posterity to the end of time. It may seem indeed to militate against the moral attributes of God, to inflict misery on children for the sins of their parents; but before any thing can be pronounced concerning the Divine goodness and justice in the present case, we must know precisely how much we suffer in consequence of Adam's transgression, and whether we have ourselves any share in that guilt which is the cause of our sufferings.

107 Doubtful whether men would have been exempted from pain under the first covenant,

That women would have had less sorrow in the bringing forth of children; that we should have been subjected to less toil and exempted from death, had our first parents not fallen from their paradisaical state—are truths incontrovertible by him who believes the inspiration of the Holy Scriptures; but that mankind would in that state have been wholly free from pain and every bodily distress, is a proposition which is not to be found in the Bible, and which therefore no man is bound to believe. The bodies of Adam and Eve consisted of flesh, blood, and bones, as ours do; they were surrounded by material objects as we are; and their limbs were unquestionably capable of being fractured. That their souls should never be separated from their bodies while they abstained from the forbidden fruit, they knew from the infallible promise of him who formed them, and breathed into their nostrils the breath of life; but that not a bone of themselves or of their numerous posterity should ever be broken by the fall of a stone or of a tree, they were not told, and had no reason to expect. Of such fractures, pain would surely have been the consequence; though we have reason to believe that it would have been quickly removed by some infallible remedy, probably by the fruit of the tree of life.

Perhaps it may be said, that if we suppose our first parents or their children to have been liable to accidents of this kind in the garden of Eden, it will be difficult to conceive how they could have been preserved from death,

Fall of Adam, and its conſequences.

as a ſtone might have fallen on their heads as well as on their feet, and have at once deſtroyed the principle of vitality. But this can be ſaid only by him who knows little of the phyſical world, and ſtill leſs of the power of God. There are many animals which are ſuſceptible of pain, and yet not eaſily killed; and man in paradiſe might have reſembled theſe. At any rate, we are ſure that the Omnipotent Creator could and would have preſerved him from death; but we have no reaſon to believe that, by a conſtant miracle, he would have preſerved him from every kind of pain. Indeed, if, under the firſt convenant, mankind were in a ſtate of probation, it is certainly conceivable that ſome one individual of the numerous race might have fallen into ſin, without actually breaking the covenant by eating the fruit of the tree of knowledge; and ſuch a ſinner would undoubtedly have been puniſhed by that God who is of purer eyes than to behold iniquity: but how puniſhment could have been inflicted on a being exempted from all poſſibility of pain as well as of death, we confeſs ourſelves unable to imagine. Remorſe, which is the inſeparable conſequence of guilt, and conſtitutes in our preſent ſtate great part of its puniſhment, flows from the fearful looking for of judgment, which the ſinner knows ſhall, in a future ſtate, devour the adverſaries of the goſpel of Chriſt; but he, who could neither ſuffer pain nor death, had no cauſe to be afraid of future judgement, and was therefore not liable to the tortures of remorſe. We conclude, therefore, that it is a miſtake to ſuppoſe pain to have been introduced into the world by the fall of our firſt parents, or at leaſt that the opinion contrary to ours has no foundation in the word of God.

108 though they would from death.

Death, however, was certainly introduced by their fall; for the inſpired apoſtle aſſures us, that in *Adam all die* *; and again, that *through the offence of ONE many are dead* †. But concerning the full import of the word *death* in this place, and in the ſentence pronounced upon our firſt parents, divines hold opinions extremely different. Many contend, that it includes death *corporal*, *ſpiritual* or *moral*, and *eternal*; and that all mankind are ſubjected to theſe three kinds of death, on account of their ſhare in the guilt of the original tranſgreſſion, which is uſually denominated *original ſin*, and conſidered as the ſource of all moral evil.

* Cor. xv. 22.
† Rom. v. 15.

That all men are ſubjected to death corporal in conſequence of Adam's tranſgreſſion, is univerſally admitted; but that they are in any ſenſe partakers of his guilt, and on that account ſubjected to death ſpiritual and eternal, has been very ſtrenuouſly denied. To diſcover the truth is of great importance; for it is intimately connected with the Chriſtian doctrine of redemption. We ſhall therefore ſtate, with as much impartiality as we can, the arguments commonly urged on each ſide of this much agitated queſtion.

109 Doctrine of original ſin ſtated.

Thoſe who maintain that all men ſinned in Adam, generally ſtate their doctrine thus: "The covenant being made with Adam as a public perſon, not for himſelf only but for his poſterity, all mankind deſcending from him by ordinary generation *ſinned* in him and fell with him in that firſt tranſgreſſion; whereby they are deprived of that original righteouſneſs in which he was created, and are utterly indiſpoſed, diſabled, and made oppoſite to all that is ſpiritually good, and wholly inclined to all evil, and that continually; which is commonly called *original ſin*, and from which do proceed all actual tranſgreſſions, ſo as we are by nature children of wrath, bond-ſlaves to Satan, and juſtly liable to all puniſhments in this world and in that which is to come, even to everlaſting ſeparation from the comfortable preſence of God, and to moſt grievous torments in ſoul and body, without intermiſſion, in hell fire for ever."

Fall of Adam, and its conſequences.

That which in this paſſage we are firſt to examine, is the ſentence which affirms all mankind deſcending from Adam by ordinary generation to have *ſinned* in him and fallen with him in his firſt tranſgreſſion; the truth of which is attempted to be proved by various texts of Holy Scripture. Thus St Paul ſays expreſsly, that "by one man ſin entered into the world, and death by ſin; and ſo death paſſed upon all men, for that *all have ſinned*. But not as the offence, ſo alſo is the free gift. For if, through the *offence* of *one*, *many* be *dead;* much more the grace of God, and the gift by grace, which is by one man, Jeſus Chriſt, hath abounded unto many; and not as it was by one that ſinned, ſo is the gift (for the *judgment* was by *one* unto *condemnation*); but the free gift is of many offences unto juſtification. For if, by one man's offence, death reigned by one; much more they, who receive the abundance of grace and of the gift of righteouſneſs, ſhall reign in life by one, Jeſus Chriſt. Therefore as, by the *offence of one*, *judgment* came upon *all men* to *condemnation;* even ſo, by the righteouſneſs of One, the free gift came upon all men unto juſtification of life. For as by one man's diſobedience *many were made ſinners;* ſo by the obedience of one ſhall many be made righteous *." In this paſſage the apoſtle aſſures us, that all upon whom death hath paſſed have *ſinned;* but death hath paſſed upon infants, who could not commit actual ſin. Infants therefore muſt have ſinned in Adam, ſince death hath paſſed upon them; for death "is the wages only of ſin." He tells us likewiſe, that by the offence of one, judgment came upon all men to condemnation; and therefore ſince the Righteous Judge of heaven and earth never condemns the innocent with the wicked, we muſt conclude, that all men partake of the guilt of that offence for which judgment came upon them to condemnation. Theſe concluſions are confirmed by his ſaying expreſsly, that "by one man's diſobedience many (*i. e.* all mankind) were *made ſinners;*" and elſewhere †, that "there is none righteous, no *not one;*" and that his Epheſian converts "were dead in treſpaſſes and ſins, and were by *nature* children of wrath even as *others*." The ſame doctrine, it is ſaid, we are taught by the inſpired writers of the Old Teſtament. Thus Job, expoſtulating with God for bringing into judgment with him ſuch a creature as man, ſays, "Who can bring a clean thing out of an unclean? Not one." And Eliphaz, reproving the patient patriarch for what he deemed preſumption, aſks ‡, "What is man that he ſhould be clean, or he who is born of a woman that he ſhould be righteous?" From theſe two paſſages it is plain, that Job and his unfeeling friend, though they agreed in little elſe, admitted as a truth unqueſtionable, that man inherits from his parents a ſinful nature, and that it is impoſſible for any thing born of a woman by ordinary generation to be righteous. The pſalmiſt talks the very ſame language; when acknowledging his tranſgreſſions, he ſays ||, "Behold I was ſhapen in iniquity, and in ſin did my mother conceive me."

110 Argument for it.

* Rom. v. 12, 15—21.
† Rom. iii. 10. and Eph. ii. 1. and 3.
‡ Job xiv. 4. and xv. 14.
|| Pſalm li. 5.

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Having thus proved the fact, that all men are made sinners by Adam's disobedience, the divines, who embrace this side of the question, proceed to inquire how they can be partakers in guilt which was incurred so many ages before they were born. It cannot be by imitation; for infants, according to them, are involved in this guilt before they be capable of imitating any thing. Neither do they admit that sin is by the apostle put for the consequences of sin, and many said to be made sinners by one man's disobedience, because by that disobedience they were subjected to death, which is the wages of sin. This, which they call the doctrine of the Arminians, they affirm to be contrary to the whole scope and design of the context; as it confounds together sin and death, which are there represented, the one as the cause, and the other as the effect. It likewise exhibits the apostle reasoning in such a manner as would, in their opinion, disgrace any man of common sense, and much more an inspired writer; for then the sense of these words, "Death hath passed upon all men, for that all have sinned," must be, death hath passed upon all men, because it hath passed upon all men; or, all men are obnoxious to death, because they are obnoxious to it. The only way therefore, continue they, in which Adam's posterity can be made sinners through his disobedience, is by the IMPUTATION of his disobedience to them; and his imputation is not to be considered in a *moral* sense, as the action of a man committed by himself, whether good or bad, is reckoned unto him as his own; but in a *forensic* sense, as when one man's debts are in a legal way placed to the account of another. Of this we have an instance in the apostle Paul, who said to Philemon concerning Onesimus, "If he hath wronged thee, or oweth thee any thing (ελλογει), let it be imputed to me," or placed to and put on my account. And thus the posterity of Adam are made sinners by his disobedience; that being imputed to them and put to their account, as if it had been committed by them personally, though it was not.

Some few divines of this school are indeed of opinion, that the phrase, "By one man's disobedience many were made sinners," means nothing more than that the posterity of Adam, through his sin, derive from him a corrupt nature. But though this be admitted as an undoubted truth, the more zealous abettors of the system contend, that it is not the whole truth. "It is true (say they) that all men are made of one man's blood, and that blood tainted with sin; and so a clean thing cannot be brought out of an unclean. What is born of the flesh is flesh, carnal and corrupt: every man is conceived in sin and shapen in iniquity; but there is a difference between being *made sinners* and *becoming* sinful. The one respects the *guilt*, the other the *pollution* of nature; the one is previous to the other, and the foundation of it. Men receive a corrupt nature from their immediate parents; but they are made sinners, not by any act of their disobedience, but only by the imputation of the sin of Adam."

To illustrate this doctrine of imputed sin, they observe, that the word κατεστάθησαν, used by the apostle, signifies *constituted* in a judicial way, ordered and appointed in the dispensation of things that so it should be; just as Christ was made sin or a sinner by imputation, or by that constitution of God which laid upon him the sins of all his people, and dealt with him as if he had been the guilty person. That this is the sense of the passage, they argue further from the punishment inflicted on men for the sin of Adam. The punishment threatened to that sin was death; which includes death corporal, moral, and eternal. Corporal death, say they, is allowed by all to be suffered on account of the sin of Adam; and if so, there must be guilt, and that guilt made over to the sufferer, which can be done only by *imputation*. A moral death is no other than the loss of the image of God in man, which consisted in righteousness and holiness; and particularly it is the loss of original righteousness, to which succeeded unrighteousness and unholiness. It is both a sin and a punishment for sin; and since it comes on all men as a punishment, it must suppose preceding sin, which can be nothing but Adam's disobedience; the guilt of which is made over to his posterity by *imputation*. This appears still more evident from the posterity of Adam being made liable to eternal death in consequence of his transgression; for the wages of sin is death, even death eternal, which never can be inflicted on guiltless persons. But from the passage before us we learn, that "by the offence of *one* judgment came upon all men to condemnation;" and therefore the guilt of that offence must be reckoned to all men, or they could not be justly condemned for it. That Adam's sin is imputed to his posterity, appears not only from the words, "by one man's disobedience many were made sinners;" but likewise from the opposite clause, "so by the obedience of One shall many be made righteous;" for the many ordained to eternal life, for whom Christ died, are made righteous, or justified, only through the imputation of his righteousness to them; and therefore it follows, that all men are made sinners only through the imputation of Adam's disobedience.

Fall of Adam, and its consequences.

112
The punishment of imputed guilt.

To this doctrine it is said to be no objection that Adam's posterity were not in being when his sin was committed; for though they had not then actual being, they had yet a virtual and representative one. They were in him both *seminally* and *federally*, and sinned in him *; just as Levi was in the loins of Abraham, and paid in him tithes to Melchizedeck †. From Adam they derive a corrupt nature; but it is only from him, as their federal head, that they derive a share of his guilt, and are subjected to his punishment. That he was a federal head to all his posterity, the divines of this school think evident from his being called a figure of Christ ‡; and the first Adam described as natural and earthly, in contradistinction to Christ the second Adam described as spiritual and the Lord from heaven; and from the punishment threatened against his sin being inflicted not on himself only, but on all his succeeding offspring. He could not be a figure of Christ, say they, merely as a man; for all the sons of Adam have been men as well as he, and in that sense were as much figures of Christ as he; yet Adam and Christ are constantly contrasted, as though they had been the only two men that ever existed, because they were the only two heads of their respective offspring. He could not be a figure of Christ on account of his extraordinary production; for though both were produced in ways uncommon, yet each was brought into the world in a way peculiar to himself. The first Adam was formed of the dust of the ground; the second, though not begotten by a man, was born of a woman. They did not therefore resemble each other in the manner of their formation, but in their office as

* Rom. v. 12.
† Heb. vii. 9, 10.

113
Adam a federal head to his posterity.
‡ Rom. v. 14.

Fall of Adam, and its consequences.

covenant-heads; and in that alone the comparison between them is exact.

Nor have any of the posterity of Adam, it is said, reason to complain of such a procedure. Had he stood in his integrity, they would have been, by his standing, partakers of all his happiness; and therefore should not murmur at receiving evil through his fall. If this do not satisfy, let it be considered, that since God, in his infinite wisdom, thought proper that men should have a head and representative, in whose hands their good and happiness should be placed, none could be so fit for this high station as the common parent, made after the image of God, so wise, so holy, just, and good. Lastly, to silence all objections, let it be remembered, that what God gave to Adam as a federal head, relating to himself and his posterity, he gave as the Sovereign of the universe, to whom no created being has right to ask,

114 No cause of complaint in this constitution of things.

* See *Gill's Body of Divinity*.

"What dost thou*?"

Such are the consequences of Adam's fall, and such the doctrine of original sin, as maintained by the more rigid followers of Calvin. That great reformer, however, was not the author of this doctrine. It had been taught so early as in the beginning of the fifth century, by St Augustine, the celebrated bishop of Hippo (see AUGUSTINE); and the authority of that father had made it more or less prevalent in both the Greek and Roman churches long before the Reformation. Calvin was indeed the most eminent modern divine by whom it has been held in all its rigour; and it constitutes one great part of that theological system, which, from being taught by him, is now known by the name of *Calvinism*.

115 St Augustian the author of this doctrine.

116 Objections to it,

But if it was as sovereign of the universe that God gave to Adam what he received in paradise relating to himself and his posterity, Adam could in no sense of the words be a federal head; because, upon this supposition, there was no covenant. The Sovereign of the universe may unquestionably dispense his benefits, or withhold them, as seems expedient to his infinite wisdom; and none of his subjects or creatures can have a right to say to him, What dost thou? But the dispensing or withholding of benefits is a transaction very different from the entering into covenants; and a judgment is to be formed of it on very different principles. Every thing around us proclaims that the Sovereign of the universe is a being of perfect benevolence; but, say the disciples of the school now under consideration, the dispensation given to Adam in paradise was so far from being the offspring of benevolence, that, as it is understood by the followers of Calvin, it cannot possibly be reconciled with the eternal laws of equity. The self-existent and all-sufficient God might or might not have created such a being as man; and in either case there would have been no reason for the question "What dost thou?" But as soon as he determined to create him capable of happiness or misery, he would not have been either benevolent or just, if he had not placed him in a state where, by his own exertions, he might, if he choose, have a greater share of happiness than of misery, and find his existence, upon the whole, a blessing. They readily acknowledge, that the existence of any created being may be of longer or shorter duration, according to the good pleasure of the Creator; and therefore they have no objection to the apostolic doctrine, that "in Adam all die:" for immortality being not a debt, but a *free gift*, may be bestowed on any terms, and with perfect justice withdrawn when these terms are not complied with. Between death, however, as it implies a loss of consciousness, and the extreme misery of eternal life in torments, there is an immense difference. To death all mankind might justly be subjected through the offence of one; because they had originally no claim to be exempted from it, though that one and they too had remained for ever innocent: but eternal life in torments is a punishment which a God of justice and benevolence can never inflict but upon personal guilt of the deepest die. That we can personally have incurred guilt from a crime committed some thousands of years before we were born, is impossible. It is indeed a notion as contrary to Scripture as to reason and common sense: for the apostle expressly informs us*, "that sin is the transgression of some law;" and the sin of Adam was the transgression of a law which it was never in our power either to observe or to break. Another apostle† assures us, that "where no law is, there is no transgression"; but there is now no law, nor has been any these 5000 years, forbidding mankind to eat of a particular fruit; for, according to the Calvinists themselves‡, Adam had no sooner committed his first sin, by which the covenant with him was broken, than he ceased to be a covenant-head. This law given him was no more; the promise of life by it ceased; and its sanction, death, took place. But if this be so, how is it possible that his unborn posterity should be under a law which had no existence, or that they should be in a worse state in consequence of the covenant being broken, and its promise having ceased, than he himself was before the covenant was first made? He was originally a mortal being, and was promised the supernatural gift of immortality on the single condition of his abstaining from the fruit of the tree of knowledge of good and evil. From that fruit he did not abstain; but by eating it fell back into his natural state of mortality. Thus far it is admitted that his posterity fell with him: for they have no claim to a supernatural gift which he had forfeited by his transgression. But we cannot admit, say the divines of this school, that they fell into his guilt; for to render it possible for a man to incur guilt by the transgression of a law, it is necessary not only that he have it in his power to keep the law, but also that he be capable of transgressing it by a *voluntary* deed. But surely no man could be capable of voluntarily eating the forbidden fruit 5000 years before he himself or his volitions existed. The followers of Calvin think it a sufficient objection to the doctrine of transubstantiation, that the same numerical body cannot be in different places at the same instant of time. But this ubiquity of body, say the remonstrants, is not more palpably absurd, than the supposition that a man could exert volitions before he or his will had any existence.

Fall of Adam, and its consequences.

117 As inconsistent with the justice of God,

* 1 John i. 4.

† Rom. iv. 15.

‡ *Gill's Body of Divinity*, b. iii. ch. 10.

118 The scripture, and the nature of things.

119 The word IMPUTATION removes no difficulties.

Nor will the introduction of the word *imputation* into this important question remove a single difficulty. For what is that we mean by saying that the sin of Adam is imputed to his posterity? Is the guilt of that sin transferred from him to them? So surely thought Dr Gill, when he said that it *is made over to them*. But this is the same absurdity as the making over of the sensible qualities of bread and wine to the internal substance of our Saviour's body and blood! This imputation either found the posterity of Adam guilty of his sin, or it made them so. It could not find them guilty for

for the reaſon already aſſigned; as well as becauſe the apoſtle ſays expreſsly, that for the offence of *one* judgement came upon *all* men, which would not be true had *all* offended. It could not make them guilty; for this reaſon, that if there be in phyſics or metaphyſics a ſingle truth ſelf-evident, it is, that the numerical powers, actions, or qualities, of one being cannot poſſibly be transferred to another, and be made its powers, actions, or qualities. Different beings may in diſtant ages have qualities of the ſame kind; but as eaſily may 4 and 3 be made equal to 9, as two beings be made to have the ſame identical quality. In Scripture we nowhere read of the actions of one man being imputed to another. "Abraham (we are told) believed in God, and it was counted to him for righteouſneſs;" but it was his *own* faith, and not the faith of another man, that was ſo counted. "To him that worketh not, but believeth, his faith (not another's) is imputed for righteouſneſs." And of our faith in him that raiſed Chriſt from the dead, it is ſaid, that "it ſhall be imputed, not to our fathers or our children, but to us for righteouſneſs."

Fall of Adam, and its conſequences.

When this phraſe is uſed with a negative, not only is the man's own perſonal ſin ſpoken of, but the non-imputation of that ſin means nothing more but that it brings not upon the ſinner condign puniſhment. Thus when Shemei "ſaid unto David, Let not my lord *impute* iniquity unto me;" it could not be his meaning that the king ſhould not think that he had offended; for with the ſame breath he added, "Neither do thou remember that which thy ſervant *did perverſely*, the day that my lord the king went of Jeruſalem, that the king ſhould take it to his *heart*. For thy ſervant doth *know* that *I have ſinned*." Here he plainly confeſſes his ſin, and declares, that by intreating the king not to *impute it to him*, he wiſhed only that it ſhould not be ſo remembered as that the king ſhould take it to heart, and puniſh him as his perverſeneſs deſerved. When therefore it is ſaid *, that "God was in Chriſt reconciling the world to himſelf, not imputing to them their iniquities, the meaning is only that for Chriſt's ſake he was pleaſed to exempt them from the puniſhment due to their ſins. In like manner, when the prophet, foretelling the ſufferings of the Meſſiah, ſays, that "the Lord laid on him the iniquity of us all," his meaning cannot be, that the Lord by *imputation* made his immaculate Son guilty of all the ſins that men have ever committed; for in that caſe it would not be true that the "juſt ſuffered for the unjuſt," as the apoſtle expreſsly teaches †: but the ſenſe of the verſe muſt be, as Biſhop Coverdale tranſlated it, "through him the Lord pardoneth all our ſins." This interpretation is countenanced by the ancient verſion of the Seventy, και Κυριος παρεδωκεν αυτον ταις αμαρτιαις ημων; words which expreſs a notion very different from that of imputed guilt. The Meſſiah was, without a breach of juſtice, delivered for ſins of which he had voluntarily offered to pay the penalty; and St Paul might have been juſtly charged by Philemon with the debts of Oneſimus, which he had deſired might be placed to his account. Had the apoſtle, however, expreſſed no ſuch deſire, ſurely Philemon could by no deed of his have made him liable for debts contracted by another; far leſs could he by *imputation*, whatever that word may mean, have made him virtually concur in the contracting of thoſe debts. He could not have been juſtly ſubjected to ſuffering without his own conſent; and he could not poſſibly have been made guilty of the ſins of thoſe for whom he ſuffered.

The doctrine of imputed guilt therefore, as underſtood by the Calviniſts, is, in the opinion of their opponents, without foundation in Scripture, and contrary to the nature of things. It is an impious abſurdity (ſay they), to which the mind can never be reconciled by the hypotheſis, that all men were in Adam both ſeminally and federally, and ſinned in him, as Levi paid tithes to Melchizedeck in the loins of Abraham. The apoſtle, when he employs that argument to leſſen in the minds of his countrymen the pride of birth and the lofty opinions entertained of their prieſthood, plainly intimates, that he was uſing a bold figure, and that Levi's paying tithes is not to be underſtood in a ſtrict and literal ſenſe. "Now conſider (ſays he) how great this man was, unto whom even the patriarch Abraham gave the tenth of the ſpoils. And, *as I may ſo ſay*, Levi alſo, who receiveth tithes, paid tithes in Abraham: for he was yet in the loins of his father when Melchizedeck met him." This is a very good argument to prove that the Levitical prieſthood was inferior in dignity to that of Melchizedeck; and by the apoſtle it is employed for no other purpoſe. Levi could not be greater than Abraham, and yet Abraham was inferior to Melchizedeck. This is the whole of St Paul's reaſoning, which lends no ſupport to the doctrine of original ſin, unleſs it can be ſhown that Levi and all his deſcendants contracted from this circumſtance ſuch a ſtrong propenſity to the *paying* of tithes, as made it a matter of extreme difficulty for them, in every ſubſequent generation, to comply with that part of the divine law which conſtituted them *receivers* of tithes. That all men were ſeminally in Adam, is granted; and it is likewiſe granted that they may have derived from him, by ordinary generation, diſeaſed and enfeebled bodies: but it is as impoſſible to believe that moral guilt can be tranſmitted from father to ſon by the phyſical act of generation, as to conceive a ſcarlet colour to be a cube of marble, or the ſound of a trumpet a cannon ball. That Adam was as fit a perſon as any other to be entruſted with the good and happineſs of his poſterity, may be true; but there is no fitneſs whatever, according to the Arminians, in making the everlaſting happineſs or miſery of a whole race depend upon the conduct of any fallible individual. "That any man ſhould ſo repreſent me (ſays Dr Taylor *), that when he is guilty, I am to be reputed guilty; when he tranſgreſſes, I ſhall be accountable and puniſhable for his tranſgreſſion; and this before I am born, and conſequently before I am in any capacity of knowing, helping, or hindering, what he doth: all this every one who uſeth his underſtanding muſt clearly ſee to be falſe, unreaſonable, and altogether inconſiſtent with the truth and goodneſs of God." And that no ſuch appointment ever had place, he endeavours to prove, by ſhowing that the texts of Scripture upon which is built the doctrine of the Calviniſts reſpecting original ſin, will each admit of a very different interpretation.

121 Moral guilt cannot be tranſmitted from father to ſon.

* *Doctrine of Original Sin*, part iii.

One of the ſtrongeſt of theſe texts is Romans v. 19. which we have already quoted, and which our author thus explains. He obſerves, that the apoſtle was a Jew, familiarly acquainted with the Hebrew tongue; that he wrote his epiſtle as well for the uſe of his own countrymen reſiding in Rome, as for the benefit of the Gentile converts; and that though he made uſe of the Greek language,

122 The ſeveral texts on which this doctrine is built capable of a different interpretation.

Fall of Adam, and its conſequences.

language, as moſt generally underſtood, he frequently employed Hebrew idioms. Now it is certain that the Hebrew words חטאה and עון, "ſin and iniquity," are frequently uſed in the Old Teſtament to ſignify *ſuffering*, by a figure of ſpeech which puts the effect for the cauſe; and it is ſurely more probable, that in the verſe under conſideration, the apoſtle uſed the correſponding Greek word ἁμαρτωλοι in the Hebrew ſenſe, than that he meant to contradict what he had ſaid in the former verſe, by teaching that all men were made guilty of an act of diſobedience committed thouſands of years before the majority of them had any being. In the preceding verſe he ſays, "that by the offence of one, judgment came upon all men to condemnation." But this cannot be true, if by that offence all men were made ſinners; for then judgment muſt have come upon each for his own ſhare in the original diſobedience. "Any one may ſee (ſays our author) that there is a vaſt difference between a man's making *himſelf* a ſinner by his *own* wicked act, and his being made a ſinner by the wicked act of *another*. In the latter caſe, he can be a ſinner in no other ſenſe but as he is a ſufferer; juſt as Lot would have been made a ſinner with the Sodomites, had he been conſumed in the iniquity of the city *; and as the ſubjects of Abimelech would have been made ſinners, had he, in the integrity of his heart, committed adultery with Abraham's wife†. That the people of Gerar could have contracted any real guilt from the adultery of their ſovereign, or that he, by lying with a woman whom he had reaſon to believe to be not the wife but the ſiſter of another man, would have incurred all the moral turpitude of that crime, are poſitions which cannot be maintained. Yet he ſays, that Abraham had brought upon him and on his kingdom a *great ſin;* though it appears, from comparing the 6th verſe with the 17th and 18th, that he had not been brought under ſin in any other ſenſe than as he was made to ſuffer for taking Sarah into his houſe. In this ſenſe, "Chriſt, though we are ſure that he knew no ſin, was made ſin for us, and numbered with the tranſgreſſors," becauſe he ſuffered death for us on the croſs; and in this ſenſe it is true, that by the diſobedience of Adam all mankind were made ſinners, becauſe, in conſequence of his offence, they were by the judgment of God made ſubject to death.

* Gen. xix. 15.

† Gen. xx.

But it may be thought that this interpretation of the words *ſin* and *ſinners*, though it might perhaps be admitted in the 19th verſe, cannot be ſuppoſed to give the apoſtle's real meaning, as it would make him employ in the 12th verſe an abſurd argument, which has been already noticed. But it may perhaps be poſſible to get quit of the abſurdity, by examining the original text inſtead of our tranſlation. The words are, και ουτως εις παντας ανθρωπους ὁ θανατος διηλθεν εφ ᾧ παντες ημαρτον. In order to aſcertain the real ſenſe of theſe words, the firſt thing to be done is to diſcover the antecedent to the relative ᾧ. Our tranſlators ſeem to conſider it as uſed abſolutely without any antecedent; but this is inaccurate, as it may be queſtioned whether the relative was ever uſed in any language without an antecedent either expreſſed or underſtood. Accordingly, the Calviniſt critics, and even many Remonſtrants, conſider ενος ανθρωπου in the beginning of the verſe as the antecedent to ᾧ in the end of it, and tranſlate the clauſe under conſideration thus: "And ſo death hath paſſed upon all men, in whom (viz. Adam) all have ſinned." Θανατος, however, ſtands much nearer to ᾧ than ανθρωπου; and being of the ſame gender, ought, we think, to be conſidered as its real antecedent: but if ſo, the clauſe under conſideration ſhould be thus tranſlated: "and ſo death hath paſſed upon all men, unto which (o) all have ſinned, or, as the Arminians explain it, have ſuffered. If this criticiſm be admitted as juſt, εφ ᾧ muſt be conſidered as ſtanding here under a particular emphaſis, denoting the utmoſt length of the conſequences of Adam's ſin (p); as if the apoſtle had ſaid, "ſo far have the conſequences of Adam's ſin extended, and ſpread their influence among mankind, introducing not only a curſe upon the earth, and ſorrow and toil upon its inhabitants, but even DEATH, UNIVERSAL DEATH, in every part, and in all ages of the world." His words (ſay the Remonſtrants) will unqueſtionably bear this ſenſe; and it is ſurely much more probable that it is their true ſenſe, than that an inſpired writer ſhould have taught a doctrine ſubverſive of all our notions of right and wrong, and which, if really embraced, muſt make us incapable of judging when we are innocent and when guilty.

When the apoſtle ſays that there is none righteous, no not one, he gives us plainly to underſtand that he is quoting from the 14th Pſalm; and the queſtion firſt to be anſwered is, In what ſenſe were theſe words uſed by the Pſalmiſt? That they were not meant to include all the men and women then living, far leſs all that have ever lived, is plain from the fifth verſe of the ſame Pſalm, where we are told that thoſe wicked perſons "were in great fear, becauſe God was in the congregation of the *righteous*." There was then, it ſeems, a congregation of righteous perſons, in oppoſition to thoſe called the *children of men*, of whom alone it is ſaid that there was none that did good, no not one. The truth is, that the perſons of whom David generally complains in the book of Pſalms, conſtituted a ſtrong party diſaffected to his perſon and government. That faction he deſcribes as proud and oppreſſive, as deviſing miſchief againſt him, as violent men continually getting together for war. He ſtyles them his *enemies;* and ſometimes characterizes them by the appellation which was given to the apoſtate deſcendants of Cain before the deluge. Thus in the 57th Pſalm, which was compoſed when he fled from Saul to the cave in which he ſpared that tyrant's life, he complains, "I lie among them that are ſet on fire, even the SONS OF MEN, whoſe teeth are ſpears," &c.; and

(o) That επι, when conſtrued with a dative caſe, often ſignifies *to* or *unto*, is known to every Greek ſcholar. Thus επ' ευδοξια ὁδος, *the way to fame*, (Lucian). Κακουργος επι τω θανατω, *a criminal unto death*, (Demoſth.). Επι θανατω συλλαβειν, *to carry to death or execution*, (Iſoc.). Υμεις επ ελευθερια εκληθητε, *ye have been called to liberty*, (Gal. v. 13.). Κτισθεντες εν Χριστω Ιησου επι εργοις αγαθοις, *created in Chriſt Jeſus unto good works*, (Epheſ. ii. 10.). See alſo 1 Theſ. iv. 7.; 2 Tim. ii. 14.; and many other places of the New Teſtament.

(p) Εφ' ᾧ has likewiſe this import, denoting the *terminus ad quem* in Phil. iii. 12. and iv. 10.

Fall of Adam, and its conſequences.

and again, in the 58th Pſalm, he ſays, "Do ye indeed ſpeak righteouſneſs, O congregation? Do ye judge uprightly, O ye ſons of men?" By comparing theſe texts with 1 Sam. xxvi. 19. it will appear evident that by the SONS OF MEN mentioned in them, he meant to characterize thoſe enemies who exaſperated Saul againſt him. Now it is well known, that there was a party adhering to the intereſts of the houſe of Saul, which continued its enmity to David during the 40 years of his reign, and joined with Abſalom in rebellion againſt him only eight years before his death. But it is the opinion of the moſt judicious commentators †, that the 14th Pſalm was compoſed during the rebellion of Abſalom; and therefore it is ſurely much more probable, that by *the children of men*, of whom it is ſaid there is "none that doth good, no not one," the inſpired poet meant to characterize the rebels, than that he ſhould have directly contradicted himſelf in the compaſs of two ſentences ſucceeding each other. Had he indeed known that all the children of men, as deſcending from Adam, "are utterly indiſpoſed, diſabled, and made oppoſite to all that is ſpiritually good, and wholly and continually inclined to all evil," he could not, with the leaſt degree of conſiſtency, have repreſented the Lord as looking down from heaven upon them, to ſee if there were any that did underſtand and ſeek after God;" but if by the children of men was meant only the rebel faction, this ſcenical repreſentation is perfectly conſiſtent, as it was natural to ſuppoſe that there might be in that faction ſome men of good principles miſled by the arts of the rebel chiefs.

† Hammond, &c.

Having thus aſcertained the ſenſe of the words as originally uſed by the Pſalmiſt, the Arminian proceeds to inquire for what purpoſe they were quoted by the apoſtle; and in this inquiry he ſeems to find nothing difficult. The averſion of the Jews from the admiſſion of the Gentiles to the privileges of the goſpel, the high opinion which they entertained of their own worth and ſuperiority to all other nations, and the ſtrong perſuaſion which they had that a ſtrict obedience to their own law was ſufficient to juſtify them before God, are facts univerſally known; but it was the purpoſe of the apoſtle to prove that all men ſtood in need of a Redeemer, that Jews as well as Gentiles had been under the dominion of ſin, and that the one could not in that reſpect claim any ſuperiority over the other. He begins his epiſtle, therefore, with ſhowing the extreme depravity of the Heathen world; and having made good that point, he proceeds to prove, by quotations from the book of Pſalms, Proverbs, and Iſaiah, that the Jews were in nowiſe better than they, that every mouth might be ſtopped, and all the world become guilty, or inſufficient for their own juſtification before God.

The next proof brought by the Calviniſts in ſupport of their opinion, that all men derive guilt from Adam by ordinary generation, is that text in which St Paul ſays that the Epheſians "were by *nature* children of wrath even as others." To this their opponents reply, that the doctrine of original ſin is in this verſe, as in the laſt quoted, countenanced only by our tranſlation, and not by the original Greek as underſtood by the ancient fathers of the Chriſtian church, who were greater maſters of that language than we. The words are και ημεν τεκνα φυσει οργης; in which it is obvious, that τεκνα, though in its original ſenſe it ſignifies the genuine children of parents by natural generation, cannot be ſo underſtood here; becauſe no man was ever begotten by, or born of, the abſtract notion *wrath*. It muſt therefore be uſed figuratively; and in other places of ſcripture it often denotes a cloſe relation to any perſon or thing. Thus we read of the children of *God*, of the *kingdom*, the *reſurrection*, *wiſdom*, *light*, *obedience*, and *peace*; whence it is concluded, that by the children of wrath are meant thoſe who are liable to puniſhment or rejection. And becauſe there were in thoſe days ſome children, in a lower and leſs proper ſenſe, by *adoption*, and others, in a higher and more proper ſenſe, by *natural generation*, of whom the relation of the latter to their parents was much cloſer than that of the former; the apoſtle tells the Epheſians, that they were by *nature* children of wrath, to convince them that they were *really* liable to it by the ſtricteſt and cloſeſt relation poſſible. That the word φυσει here is of the ſame import with *really* or *truly*, and that it does not ſignify what we mean by *nature* in the proper ſenſe of that word, the ancient fathers are generally agreed *; and that the modern Greeks, who ſtill ſpeak a dialect of the noble language of their anceſtors, underſtand the word in the ſame ſenſe, is apparent from their verſion of the text before us. In the moſt correct and elegant edition of the New Teſtament in their vernacular tongue, the words under conſideration are thus rendered; και φυσικα ημασθαν τεκνα οργης ωσαν και οι λοιποι, where it is impoſſible that φυσικα can ſignify *natural*, otherwiſe the apoſtle will be made to ſay, not that we are by nature derived from Adam liable to wrath, but that we were *naturally begotten* by *wrath* in the abſtract! For taking the word φυσει in the ſenſe of *really* or *truly*, both the ancient and modern Greeks appear indeed to have the authority of St Paul himſelf; who, writing to Timothy, calls him γνησιον τεκνον, "his true or genuine ſon;" not to ſignify that he was the child of the apoſtle by natural generation, but that he was cloſely related to him in the faith to which St Paul had converted him. That the words τεκνα φυσει οργης can ſignify nothing but *truly* or *really relations to wrath*, is ſtill farther evident from the ground aſſigned of that relation. It is not the ſin of Adam, or the impurity of natural generation, "but the treſpaſſes and ſins in which the Epheſians in time paſt *walked*, according to the courſe of the world, according to the prince of the power of the air," the ſpirit that at the time of the apoſtle's writing "worked in the children of diſobedience." Surely no man can ſuppoſe that the Epheſians at any paſt time *walked* in Adam's treſpaſs and ſin, or that the prince of the power of the air tempted *them* to eat the forbidden fruit.

* See *Hammond and Whithy on the Text*, and *Suidas* on the word φυσις.

Having thus commented on the principal texts which are cited from the New Teſtament to prove the doctrine of original ſin, the Arminians treat thoſe which are quoted from the Old Teſtament, in ſupport of the ſame doctrine, with much leſs ceremony. Thus, when Job ſays, "who can bring a clean thing out of an unclean? Not one," he is ſpeaking, ſay they, not of the pravity of our nature, but of its frailty and weakneſs, of the ſhortneſs and miſery of human life. The ſentence is proverbial; and as it is uſed only to ſignify, that nothing can be more perfect than its original, it muſt, whenever it occurs, be underſtood according to the ſubject to which it is applied. That in the place under conſideration

Fall of Adam, and its consequences.

tion it refers to our mortality, they think plain from the context; and Dr Taylor adds *, with some plausibility, that if the words refer to the guilt which we are supposed to derive from Adam, they will prove too much to serve the common scheme of original sin. They will prove that our natural and inherent pravity, so far from rendering us fit subjects of wrath, may be urged as a reason why God should not even bring us into judgement; for the patriarch's whole expostulation runs thus, "Dost thou open thine eyes upon such a one, and bringest me into judgment with thee? Who can bring a clean thing out of an unclean?"

* *Scripture Doctrine*, part ii.

The other text, quoted from the same book, they think still less to the purpose; for Eliphaz is evidently contrasting the creature with the Creator; in comparison with whom, he might well say, without alluding to original guilt, "what is man that he should be clean? and he who is born of a woman that he should be righteous? Behold he putteth no trust in his saints; yea the *heavens* are not clean in his sight. How much more abominable and filthy is man, who drinketh iniquity like water?" He does not say, who derives by birth an iniquitous nature; for he knew well, that as we are born, we are the pure workmanship of God, "whose hands have fashioned and formed every one of us;" but "who *drinketh* iniquity like water," who maketh himself iniquitous by running headlong into every vicious practice.

Of the text quoted from the fifty-first psalm in support of the doctrine of original sin, Dr Taylor labours †, by a long and ingenious criticism, to prove that our translators have mistaken the sense. The word which they have rendered *shapen*, he shows to be used once by Isaiah, and twice in the book of Proverbs, to signify *brought forth*; and that which is rendered *conceived me*, is never, he says, employed in scripture to denote human conception. In this last remark, however, he is contradicted by a great authority, no less indeed than that of Mr Parkhurst ‡, who says, that the LXX constantly render it by κισσαω or ηγκισσαω, and the Vulgate generally by *concipio*. Without taking upon us to decide between these two eminent Hebrew scholars, we shall only observe, that upon one occasion ‖ it certainly denotes ideas much grosser than those which the Psalmist must have had of his mother's conception; and that there, at least, Dr Taylor properly translates it, *incalescebant*, adding, "de hoc vero incalescendi genere loqui Davidem nemo sanus existimare potest. Matrem enim incaluisse, aut ipsum calefeciisse eo modo quo incalescerent Jacobi pecudes Regem dicere, prorsus indecorum et absurdum." He contends, however, that the original force of the word is *to be hot*, and that it is applied to *conception*, to *resentment*, to *warmth* by which the body is nourished, to *idolaters* in love with idols, and to the heat of metals. The heat of idolaters, of resentment, and of metals, are evidently foreign to the Psalmist's purpose; and the idea conveyed by the word *incalescere* being set aside for the reasons already assigned, there remains only the warmth by which the body is nourished, and of that warmth our author is confident that David spoke.

† *Ubi supra.*

‡ See his *Lexicon* on *the word* חם.

‖ Gen. xxx. 38, 39, 40. compared with xxxi. 10.

If this criticism be admitted, the whole verse will then run thus: "Behold I was born in iniquity, and in sin did my mother nurse me;" which hath no reference to the original formation of his constitution, but is a periphrasis of his being a *sinner from the womb*, and means nothing more than that he was a *great sinner*, or had contracted *early habits* of sin. He no more designed to signify in this verse, that by ordinary generation he had a nature conveyed to him which was "utterly indisposed, disabled, and opposite to all that is spiritually good, and wholly and continually inclined to evil," than he meant in another * to signify strictly and properly that "the wicked are estranged from the womb, and TELL LIES as soon as they are born;" or that Job meant to signify †, that from the moment he came from his mother's womb he had been a guide to the widow and a succour to the fatherless. All these are hyperbolical forms of expression; which, though they appear strained, and perhaps extravagant, to the phlegmatic inhabitants of Europe, are perfectly suited to the warm imaginations of the orientals, and to the genius of eastern languages. They mean not that Job was *born* with *habits* of *virtue*, that the wicked actually *walked*, and *spoke*, and *spoke lies* from the instant of their *birth*, or that the Psalmist was really *shapen* in *sin* and *conceived in iniquity*. This last sentence, if interpreted literally, would indeed be grossly impious: it would make the inspired penman throw the whole load of his iniquity and sin from off himself upon *him* who shaped, and upon *her* who conceived him; even upon that God "whose hands had made him and fashioned him, and whom he declares that he will praise for having made him fearfully and wonderfully," and upon that parent who conceived him with sorrow, and brought him forth with pain, and to whom the divine law commanded him to render honour and gratitude. "But if, after all (says Dr Taylor ‡), you will adhere to the literal sense of the text for the common doctrine of *original sin*, show me any good reason why you ought not to admit the literal sense of the text, *this is my body*, for *transubstantiation?* If you say, it is absurd to suppose that Christ speaks of his real natural body; I say, it is likewise absurd to suppose that the Psalmist speaks of his being really and properly shapen in iniquity, and conceived in sin. If you say, that the sense of the words *this is my body* may be clearly explained by other texts of scripture where the like forms of speech are used; I say, and have shown, that the Psalmist's sense may as clearly and evidently be made out by parallel texts, where you have the like kind of expression. If you say that transubstantiation is attended with consequences hurtful to piety, I say that the common doctrine of original sin is attended with consequences equally hurtful; for it is a principle apparently leading to all manner of iniquity, to believe that sin is natural to us, that it is interwoven and ingrafted into our very constitution from our conception and formation in the womb."

* Ps. li. 3.

† Job xxxi. 18.

‡ *Script. Doctrine* part ii.

123

Consequences of eating the forbidden fruit, according to the Arminians.

The Arminians having thus, as they think, proved that the posterity of Adam, are not in any sense rendered guilty by his sin, contend, that the death threatened against his eating of the forbidden fruit, and which, in consequence of his transgression, came upon all men, can mean nothing more than the loss of that vital principle which he received when God breathed into his nostrils the breath of life, and he became a living soul. Every thing beyond this is pure conjecture, which has no foundation in the scriptures of truth, and is directly contrary to all the notions of right and wrong which

we

we have been able to acquire from the ſtudy of thoſe very ſcriptures. It is not conceivable from any thing in the hiſtory, that Adam could underſtand it of the loſs of any other life than that which he had lately received, for no other life is ſpoken of to which the threatened death can be oppoſed; and in ſuch circumſtances, it was ſtrange indeed, if by the word *death* he underſtood either eternal life in miſery, or a neceſſity of continuing in ſin. The ſenſe therefore of the threatening, ſay they, is this: "I have formed thee of the duſt of the ground, and breathed into thy noſtrils the breath of life; and thus thou art become a living ſoul. But if thou eateſt of the fruit of the tree of knowledge of good and evil, thou ſhalt ceaſe to be a living ſoul; for I will take from thee the breath of life, and thou ſhalt return to the duſt of which thou waſt formed."

Fall of Adam, and its conſequences.

Thus far the Arminians of the preſent day are agreed in oppoſing the doctrine of the rigid Calviniſts, and in ſtating their own notions of the conſequences of Adam's fall; but from that event their adverſaries deduce one conſequence, which ſome of them admit and others deny. It is ſaid, that though we cannot poſſibly be partakers in Adam's guilt, we yet derive from him a moral taint and infection, by which we have a natural propenſity to ſin; that having loſt the image of God, in which he was created, Adam begat ſons in his own image; and in one word, that the ſenſual appetites of human nature were inflamed, and its moral and intellectual powers greatly weakened by the eating of the forbidden fruit. The heathens themſelves acknowledged and lamented this depravity; though they were ignorant of the ſource from which it ſprung. The ſcriptures aſſert it, affirming that no man can be born pure and clean; that whatever is born of the fleſh, or comes into the world by ordinary generation, is fleſh, carnal and corrupt; that the imagination of the thoughts of man's heart is only evil continually; that the heart is deceitful above all things and deſperately wicked; and that out of it proceeds all that is vile and ſinful *.

This depravity of human nature, thus clearly deducible from ſcripture, and confirmed by the teſtimony of ages, an ingenious writer of the moderate Arminian ſchool undertakes to illuſtrate upon the principles of natural knowledge. "We know (ſays he †), that there are ſeveral fruits in ſeveral parts of the world of ſo noxious a nature as to deſtroy the beſt human conſtitution on earth. We alſo know that there are ſome fruits in the world which inflame the blood into fevers and frenzies; and we are told that the Indians are acquainted with a certain juice, which immediately turns the perſon who drinks it into an idiot, leaving him at the ſame time in the enjoyment of his health and all the powers of his body. Now I aſk Whether it be not poſſible, nay, whether it be not rational, to believe, that the ſame fruit, which, in the preſent infirmity of nature, would utterly deſtroy the human conſtitution, might, in its higheſt perfection, at leaſt diſturb, impair, and diſeaſe it? and whether the ſame fruit, which would now inflame any man living into a fever or frenzy, might not inflame Adam into a turbulence and irregularity of paſſion and appetite; and whether the ſame fluids, which inflame the blood into irregularity of paſſion and appetite, may not naturally produce infection and impair the conſtitution? That the forbidden fruit had the effect to produce irregularity of appetite, appears as from other proofs, ſo I think fully and clearly from the covering which Adam and Eve made uſe of ſoon after their offence; for there is no imaginable reaſon for that covering but one, and that one ſufficiently demonſtrates, that irregularity and violence of appetite, independent of the dominion of reaſon, was the effect of their offence. But the fruit which inflamed the ſenſual appetite might likewiſe debaſe their rational powers; for I aſk, whether the ſame juice, which now affects the brain of an ordinary man ſo as to make him an idiot, might not affect the brain of Adam ſo as to bring his underſtanding down to the preſent ſtandard of ordinary men? And if this be poſſible, and not abſurd to be ſuppoſed, it is evident that the ſubſequent ignorance and corruption of human nature may be clearly accounted for upon theſe ſuppoſitions; nay, I had almoſt ſaid upon any one of them. For it is univerſally known, that the infections and infirmities of the father affect the children yet in his loins; and if the mother be equally infected, muſt, unleſs removed by proper remedies, affect their poſterity to the end of the world, or at leaſt till the race become extinct. Therefore why all mankind might not by their firſt father's ſin be reduced to the ſame condition of infirmity and corruption with himſelf, eſpecially when the mother was equally infirm, and infected, I believe no man anyway ſkilled in the knowledge of nature will ſo much as pretend to ſay."

This account of the corruption of human nature ſeems to be generally adopted by moderate divines, as well among the Calviniſts as among the Arminians; but by the high-fliers in both ſchools it is rejected, on different principles indeed, with great indignation. The zealous Calviniſt contends, that this hereditary corruption is not to be accounted for or explained by any principle of phyſical ſcience, ſince it is part of that puniſhment which was inflicted on the race for their original ſin. If we were not partakers of Adam's guilt, ſay they, we ſhould not have been partakers of his corruption. The one is previous to and the foundation of the other. The depravity of human nature is a puniſhment for ſin? and ſo it was threatened to Adam, and came upon him as ſuch, and ſo to all his poſterity, by the *ordination* and *appointment of God;* for which there can be no other foundation but the imputation of Adam's diſobedience to them, nor can any thing elſe vindicate the righteouſneſs of God. For if the law of nature was ſufficient, why ſhould this *original* taint infect men rather than the ſins of their immediate parents ‡."

The more violent Arminians, on the other hand, deny that we inherit any moral taint whatever from Adam, or that the rational powers of our minds are naturally weaker than his were. Of that wonderful degree of perfection which is uſually attributed to the firſt pair, they find no evidence in ſcripture. All that we learn of them, ſay they, is, that they fell from a ſtate of exquiſite happineſs by yielding to a temptation leſs powerful by far than ſome others which many of their degenerate ſons have ſucceſsfully reſiſted. "I leave you to judge (ſays Dr Taylor §), whether Joſeph, when he reſiſted the ſolicitations of his miſtreſs, and Moſes when he refuſed to be called the ſon of Pharaoh's daughter, chooſing rather to ſuffer affliction with the people of God than to enjoy the pleaſures of ſin for a ſeaſon, eſteeming the reproach of true religion greater riches than the treaſures of Egypt, did not exhibit proofs of

‡ *Gill's Body of Divinity*, book iii. ch. 10, 11, and 13.

126 whilſt others reject the doctrine,

§ *Scripture Doctrine*, &c.

Fall of Adam, and its consequences.

regularity of passions and appetites equal at least to what Adam displayed in the garden of Eden. When the three young men mentioned in the book of Daniel submitted to be burnt alive in a fiery furnace rather than worship Nebuchadnezzar's golden image; when Daniel himself resolved, rather than conceal the worship of God for one month only of his life, to be torn in pieces by hungry lions; and, to come nearer to our own times, when numbers of men and women, during the reign of Mary queen of England, chose rather to be burnt at a stake than renounce the reformed religion and embrace the errors of popery—surely all these persons exhibited a virtue, a faith in God, and a steady adherence to what they believed to be the truth, far superior to what Adam displayed, when his wife gave him of the forbidden fruit, and he did eat." If it be said that these persons were supported under their trials by the grace of God strengthening them, the same will be said of Adam. He was undoubtedly supplied with every aid from the spirit of grace which was necessary to enable him to fulfil his duty; for being designed for more than mere animal life, even for the refined enjoyments of heaven, there is every reason to believe, as we have already observed, that he was put under the guidance of the Holy Ghost, to train him for that supernatural state of felicity. These communications of the spirit would of course be withdrawn when he forfeited his right to those privileges, on account of which they were originally vouchsafed to him; but that any positive malignity or taint was infused into his nature, that his mere rational powers were weakened, or his appetites inflamed by the forbidden fruit, there is no evidence to be found in scripture, or in the known constitution of things. The attributing of this supposed hereditary taint to the noxious qualities of the forbidden fruit, is a whimsical hypothesis, which receives no countenance from any well authenticated fact in natural history. After the numberless falsehoods that have been told of the poison tree of Java, something more would be requisite than the common evidence of a lying voyager to give credit to the qualities of the Indian tree, of which the fruit instantly turns the wisest man into an idiot: and yet for this singular story our ingenious author vouchsafes not even that evidence, slight as it generally is. The inference drawn from the covering used by our first parents is contradicted by every thing that we know of human nature; for surely no man inflamed to the utmost with the fire of animal love, ever turned his eyes from a naked beauty ready and eager to receive him to her embrace. Yet this, it seems, was the behaviour of Adam and Eve in such a state! According to our author, the juice of the forbidden fruit had rendered their carnal appetites violent and independent of reason; according to the scripture, they were both naked; and as they were husband and wife, there was no law prohibiting them from gratifying these inflamed appetites. In such circumstances, how did they conduct themselves? One would naturally imagine that they immediately retired to some shady grove, and pleased themselves in all the soft dalliances of wedded love. Their conduct, however, was very different. We are told, that "they sewed fig-leaves together, and made themselves aprons to cover their nakedness:" And this transaction is brought as a proof of the impetuosity of their carnal appetites. The truth is, that the carnal appetite appears

127 and deem the physical illustration of it whimsical;

not to be naturally more violent than is necessary to answer the end for which it was implanted in the human constitution. Among savages the desires of animal love are generally very moderate; and even in society they have not often, unless inflamed by the luxurious arts of civil life, greater strength than is requisite to make mankind attend to the continuation of their species. In the decline of empires highly polished, where the difference of rank and opulence is great, and where every man is ambitious of emulating the expence of his immediate superiors, early marriages are prevented by the inability of most people to provide for a family in a way suitable to what each is pleased to consider as his proper station; and in that state of things the violence of animal love will indeed frequently produce great irregularities. But for that state of things, as it was not intended by the Author of nature, it is perhaps unreasonable to suppose that provision should be made; and yet we believe it will be found, upon due consideration, that if the desires of animal love were less violent than they are, the general consequences would be more pernicious to society than all the irregularities and vices which these desires now accidentally produce; for there would then be no intercourse between the sexes whatever except in the very highest stations of life. That our constitution is attended with many sensual appetites and passions, is true; and that there is a great danger of their becoming excessive and irregular in a world so full of temptation as ours is, is also true; but there is no evidence that all this is the consequence of Adam's fall, and far less that it amounts to a *natural propensity* to sin. For I presume (says Dr Taylor), that by a natural propensity is meant a necessary inclination to sin, or that we are necessarily sinful from the original bent and bias of our natural powers. But this must be false; for then we should not be sinful at all, because that which is necessary, or which we cannot help, is not sin. That we are weak and liable to temptation, is the will of God holy and good, and for glorious purposes to ourselves; but if we are wicked, it must be through our own fault, and cannot proceed from any constraint, or necessity, or taint in our constitution."

128 maintaining that have no natural propensity to sin.

Thus have we given as full and comprehensive a view as our limits will permit of the different opinions of the Calvinists and Arminians respecting the consequences of Adam's fall. If we have dwelt longer upon the scheme of the latter than of the former, it is because every Arminian argument is built upon criticism, and appeals to the original text; whilst the Calvinists rest their faith upon the plain words of scripture as read in our translation. If we might hazard our own opinion, we should say that the truth lies between them, and that it has been found by the moderate men of both parties, who, while they make use of different language, seem to us to have the same sentiments. That all mankind really sinned in Adam, and are on that account liable to most grievous torments in soul and body, without intermission, in hell fire for ever, is a doctrine which cannot be reconciled to our natural notions of God. On the other hand, if human nature was not somehow debased by the fall of our first parents, it is not easy to account for the numberless phrases in scripture which certainly seem to speak that language, or for the very general opinion of the Pagan philosophers and poets respecting the golden age and the degeneracy of man. Cicero, in a quotation preserved

129 The opinions of moderate men among the Calvinists and Arminians the same, and countenanced by general tradition.

preſerved by St Auguſtine from a work that is now loſt has theſe remarkable words, "Homo non ut a matre ſed ut a noverca natura editus eſt in vitam, corpore nudo, et fragili, et infirmo; animo autem anxio ad moleſtias, humili ad timores, molli ad labores, prono ad libidines; in *quo tamen ineſt tanquam obrutus quidam divinus ignis ingenii et mentis* *." Nor do we readily perceive what ſhould induce the more zealous Arminians to oppoſe ſo vehemently this general opinion of the corruption of human nature. Their deſire to vindicate the juſtice and goodneſs of God does them honour; but the doctrine of inherent corruption militates not againſt theſe attributes; for what we have loſt in the firſt Adam has been amply ſupplied to us in the ſecond; and we know from the higheſt authority that the duties required of us are in proportion to our ability, ſince we are told, that "unto whomſoever much is given, of him ſhall much be required."

Theology from the fall of Adam to the coming of Chriſt.

131 Revelations frequent in the early ages of the world;

Sect. IV. *View of Theology from the fall of Adam to the coming of Chriſt.*

We have dwelt long on the original ſtate of man, his introduction into the terreſtrial paradiſe, the privileges to which he was there admitted, his forfeiture of thoſe privileges, and the ſtate to which he was reduced by tranſgreſſing the law of his Maker; but the importance of theſe events renders them worthy of all the attention that we have paid to them. They paved the way for the coming of Chriſt and the preaching of the goſpel; and unleſs we thoroughly underſtand the origin of the goſpel, we cannot have an adequate conception of its deſign. By contraſting the firſt with the ſecond Adam, St Paul gives us clearly to underſtand, that one purpoſe for which Chriſt came into the world and ſuffered death on the croſs, was to reſtore to mankind that life which they had loſt by the fall of their original progenitor. The preaching of the goſpel therefore commenced with the firſt hint of ſuch a reſtoration; and the promiſe given to Adam and Eve, that "the ſeed of the woman ſhould bruiſe the head of the ſerpent," was as truly evangelical as theſe words of the apoſtle, by which we are taught, that "this is a faithful ſaying and worthy of all acceptation, that Chriſt Jeſus came into the world to ſave ſinners†." The former text taken by itſelf is indeed obſcure, and the latter is explicit; but both belong to the ſame ſyſtem, for the Scriptures contain but two covenants or diſpenſations of God to man, in which the whole race is included.

Chriſtianity therefore is indeed very near as old as the creation; but its principles were at firſt obſcurely revealed, and afterwards gradually developed under different forms as mankind became able to receive them, (ſee Prophecy, N° 5. &c.). All that appears to have been at firſt revealed to Adam and Eve was, that by ſome means or other one of their poſterity ſhould in time redeem the whole race from the curſe of the fall; or if they had a diſtinct view of the means by which that redemption was to be wrought, it was probably communicated to them at the inſtitution of ſacrifices, (ſee Sacrifice). This promiſe of a future deliverer ſerved to comfort them under their heavy ſentence; and the inſtitution of ſacrifices, whilſt it impreſſed upon their minds lively ideas of the puniſhment due to their tranſgreſſion, was admirably calculated to prepare both them and their poſterity for the great atonement which, in due time, was to take away the ſins of the world.

Our firſt parents, after their fall, were ſo far from being left to fabricate a mode of worſhip for themſelves by thoſe innate powers of the human mind of which we daily hear ſo much, and feel ſo little, that God was graciouſly pleaſed to manifeſt himſelf to their *ſenſes*, and viſibly to conduct them by the angel of his preſence in all the rites and duties of religion. This is evident from the different diſcourſes which he held with Cain, as well as from the complaint of that murderer of being hid from his face, and from its being ſaid, that "he went out from the preſence of the Lord and dwelt on the eaſt of Eden." Nor does it appear that God wholly withdrew his viſible preſence, and left mankind to their own inventions, till their wickedneſs became ſo very great that his ſpirit could no longer ſtrive with them. The infant ſtate of the world ſtood in conſtant need of his ſupernatural guidance and protection. The early inhabitants of this globe cannot be ſuppoſed to have been able, with Moſes*, to look up to him who is *inviſible*, and perform a worſhip purely rational and ſpiritual. They were all tillers of the ground, or keepers of cattle; employed in cultivating and repleniſhing this new world; and, through the curſe brought upon it by their forefather, forced, with him, to eat their bread "in the ſweat of their brow." Man in ſuch circumſtances could have little leiſure for ſpeculation; nor has mere ſpeculation, unleſs furniſhed with principles from another ſource, ever generated in the human mind adequate notions of God's nature or providence, or of the means by which he can be acceptably worſhipped. Frequent manifeſtations, therefore, of his preſence would be neceſſary to keep a tolerable ſenſe of religion among them, and ſecure obedience to the divine inſtitutions; and that the Almighty did not exhibit ſuch manifeſtations, cannot be inferred from the ſilence of that very ſhort hiſtory which we have of thoſe early ages. Adam himſelf continued 930 years a living monument of the juſtice and mercy of God; of his extreme hatred and abhorrence of ſin, as well as of his love and long ſuffering towards the ſinner. He was very ſenſible how ſin had entered into the world, and he could not but appriſe his children of its author. He would at the ſame time inform them of the unity of God, and his dominion over the evil one; of the means by which he had appointed himſelf to be worſhipped; and of his promiſe of future deliverance from the curſe of the fall. Such information would produce a tolerable idea of the Divine Being, and afford ſufficient motives to obey his will. The effects of it accordingly were apparent in the righteous family of Seth, who ſoon diſtinguiſhed themſelves from the poſterity of Cain, and for their eminent piety were honoured with the appellation of *the ſons of God*. Of this family ſprang a perſon ſo remarkable for virtue and devotion, as to be exempted from Adam's ſentence and the common lot of his ſons; for after he had walked with God 300 years, and propheſied to his brethren, he was tranſlated that he ſhould not ſee death. Of this miraculous event there can be no doubt but that his contemporaries had ſome viſible demonſtration; and as the fate of Abel was an argument to their reaſon, ſo the tranſlation of Enoch was a proof to their ſenſes of another ſtate of life after the preſent. To Adam himſelf,

* Heb. xi. 13.

† Tim. i. 15

Theology from the fall of Adam to the coming of Chriſt.

if he was then alive (s), it muſt have been a lively and affecting inſtance of what he might have enjoyed, had he kept his innocence; it muſt have been a comfortable earneſt of the promiſed victory over the evil one; and have confirmed his hope, that when the head of the ſerpent ſhould be completely bruiſed, he and his poſterity would be reſtored to the favour of their Maker, and behold his preſence in bliſs and immortality.

132 yet vice, and probably idolatry, ſoon became prevalent.

Notwithſtanding this watchful care of God over his fallen creature man, vice, and probably idolatry, ſpread through the world with a rapid pace. The family of Seth married into that of Cain, and adopted the manners of their new relations. Rapine and violence, unbounded luſt and impurity of every kind, prevailed univerſally; and when thoſe giants in wickedneſs had filled the earth with tyranny, injuſtice and oppreſſion; when the whole race was become entirely carnal—God, after raiſing up another prophet to give them frequent warnings of their fate for the ſpace of 120 years, was at length obliged, in mercy to themſelves as well as to the ſucceeding generations of men, to cut them off by a general deluge. See DELUGE.

133 Pure religion for ſome time after the flood;

Thus did God, by the ſpirit of prophecy, by frequent manifeſtations of his own preſence, and by uninterrupted tradition, make ample proviſion for the inſtruction and improvement of the world for the firſt 1600 years. After the deluge he was pleaſed to converſe again with Noah, and make in his perſon a new and extenſive covenant with mankind, (ſee PROPHECY, N° 11.). Of his power, juſtice, and goodneſs; of his ſupreme dominion over the earth and the heavens; of his abhorrence of ſin, and his determination not to let it go unpuniſhed—that patriarch and his family had been moſt awfully convinced: nor could they or their children, for ſome time, want any other argument to enforce obedience, fear, and worſhip. The ſons of Noah were an hundred years old when the deluge overwhelmed the earth. They had long converſed with their anceſtors of the old world, had frequented the religious aſſemblies, obſerved every Sabbath day, and had been inſtructed by thoſe who had ſeen Adam. It is therefore impoſſible that they could be ignorant of the creation of the world, of the fall of man, or of the promiſe of future deliverance from the conſequences of that fall; or that they could offer their ſacrifices, and perform the other rites of the inſtituted worſhip, without looking forward with the eye of faith to that deliverance ſeen, perhaps obſcurely, through their typical oblations.

134 Idolatry, however, the cauſe of the diſperſion from Babel.

In this ſtate of things religion might for ſome time be ſafely propagated by tradition. But when by degrees mankind corrupted that tradition in its moſt eſſential parts; when, inſtead of the one Supreme God, they ſet up ſeveral orders of inferior deities, and worſhipped all the hoſt of heaven; when, at the ſame time they were uniting under one head, and forming a univerſal empire under the patronage of the Sun their chief divinity (ſee BABEL)—God ſaw it neceſſary to diſperſe them into diſtinct colonies, by cauſing ſuch diſcord among them as rendered it impoſſible for any one ſpecies of idolatry to be at once univerſally eſtabliſhed.

After this diſperſion, there is reaſon to believe that particular revelations were vouchſafed wherever men were diſpoſed to regard them. Peleg had his name prophetically given him from the diſperſion which was to happen in his days; and not only his father Eber, but all the heads of families mentioned from Noah to Abraham, are with much plauſibility ſuppoſed to have had the ſpirit of prophecy on many occaſions. Noah was undoubtedly both prieſt and prophet; and living till within two years of the birth of Abraham, or, according to others, till that patriarch was near 60 years old, he would ſurely be able to keep up a tolerable ſenſe of true religion among ſuch of his deſcendants as ſojourned within the influence of his doctrine and example. His religious ſon Shem, who lived till after the birth of Iſaac, could not but preſerve in tolerable purity the faith and worſhip of the true God among ſuch of his own deſcendants as lived in his neighbourhood.

Theology from the fall of Adam to the coming of Chriſt.

But though the remains of true religion were thus preſerved among a few righteous men, idolatry had in a ſhort time prevailed ſo far among the ſons of Noah, that God ſaw it expedient not only to ſhorten the lives of men, but alſo to withdraw his preſence from the generality, who had thus rendered themſelves unworthy of ſuch communications; and to ſelect a particular family, in which his worſhip might be preſerved pure amidſt the various corruptions that were overſpreading the world.

135 The call of Abraham was

With this view Abraham was called, and, after many remarkable trials of his faith and conſtancy, admitted to a particular intimacy and friendſhip with his Maker. God entered into a peculiar covenant with him, engaging to be his preſent guide, protector, and defender; to beſtow all temporal bleſſings upon him and his ſeed; and to make ſome of thoſe ſeed the inſtruments of conveying bleſſings of a higher kind to all the nations of the earth.

136 to prevent the univerſal ſpreading of idolatry.

It was doubtleſs for his ſingular piety that Abraham was fixed upon to be the parent of that people, who ſhould preſerve the knowledge of the unity of God in the midſt of an idolatrous and polytheiſtic world; but we are not to imagine that it was for his ſake only that all this was done, or that his leſs worthy deſcendants were by the equal Lord of all treated with partial fondneſs for the virtues of their anceſtor; it was for the benefit of mankind in general that he was called from his country, and from his father's houſe, that he might preſerve the doctrine of the divine unity in his own family, and be an inſtrument in the hand of Providence (and a fit one he was) to convey the ſame faith to the nations around him. Accordingly, we find him diſtinguiſhed among the neighbouring princes, and kings reproved for his ſake; who being made acquainted with his prophetic character, deſired his interceſſion with God. Hiſtory tells us of his converſing on the ſubject of religion with the moſt learned Egyptians, who appear to have derived from him or ſome of his deſcendants the rite of circumciſion, and to have been for a while ſtopt in their progreſs towards the laſt ſtage of that degrading idolatry which afterwards rendered their national worſhip the opprobrium of the whole earth, (ſee POLYTHEISM, N° 28). We are informed that his name was held in the greateſt veneration all over the Eaſt; that the Magians, Sabians, Perſians,

(s) According to the Samaritan chronology, he was alive; according to the Hebrew, he had been dead 57 years.

Theology from the fall of Adam to the coming of Christ.

Persians, and Indians, all glory in him as the greatest reformer of their respective religions: and to us it appears extremely probable, that not only the Brachmans, but likewise the Hindoo god Brahma *, derive their names from the father of the faithful. As he was let into the various counsels of the Almighty, and taught to reason and reflect upon them; as he was fully apprised of the overthrow of Sodom and Gomorrah, with the particular circumstances of that miraculous event; and as he had frequent revelations of the promised Redeemer, whose day he longed earnestly to see, and seeing it was glad—there can be no doubt but that he and his family took care to propagate these important doctrines in every nation which they visited; for the only reason which we can conceive for his being made to wander from place to place was, that different people might be induced to inquire after his profession, his religion, and his hopes.

But though the Supreme Being was pleased to manifest himself in a more frequent and familiar manner to Abraham, he by no means left the rest of the world without sufficient light. Lot professed the true religion in the midst of Sodom. In Canaan we meet with Melchizedeck, king and priest of the most high God, who blessed Abraham, and to whom that patriarch himself did homage. Abimelech king of Gerar receiving an admonition from the Lord, immediately paid a due regard to it; and the same sense of religion and virtue descended to his son. Laban and Bethuel acknowledged the Lord, and the former of them was even favoured with a vision. In Arabia, we find Job and his three friends, all men of high rank, entering into the deepest disquisitions in theology; agreeing about the unity, omnipotence, and spirituality of God; the justice of his providence, with other fundamental articles of true religion; and mentioning divine inspiration or revelation as a thing not uncommon in their age and country * (U). Balaam appears to have been a true prophet; and as he was unquestionably a man of bad morals, the natural inference is, that the gift of prophecy was then, as afterwards, bestowed on individuals, not for their own sakes, but for the sake of the public; and that, as in "every nation, he who feareth God and worketh righteousness is accepted of him;" so in those early ages of the world, when mankind were but children in religious knowledge, they were blessed with the light of divine revelation wherever they were disposed to make a proper use of it.

Very few, however, appear to have had this disposition; and therefore God was pleased to adopt Abraham and part of his posterity as the race from which the great Redeemer was to spring, to train them up by degrees in suitable notions of their Creator, and gradually to open up to them, as they were able to receive it, the nature of that dispensation under which "all the nations of the earth were to be blessed in the patriarch's seed, (see PROPHECY N° 13.). For this purpose, he held frequent correspondence with them; and to strengthen and confirm their faith, to fix and preserve their dependence on the one God of heaven and earth, he daily gave them new promises, each more magnificent than that which preceded it. He blessed Isaac, miraculously increased his substance, and soon made him the envy of the neighbouring princes. He foretold the condition of his two sons, renewed the promise made to Abraham, and blessed the adopted son Jacob, with whom he condescended to converse as he had conversed with Abraham and Isaac; renewing to him the great promise; bestowing upon him all kinds of riches; and impressing such terror upon all the cities which were round about him as prevented them from hurting either him or his family.

All this was indeed little enough to keep alive even in the mind of Jacob a tolerable sense of duty and dependence on his Creator. After the first vision he is surprised, and hesitates, seemingly inclined to make a kind of stipulation with his Maker. "If (says he) God will be with me, and will keep me in this way that I go, and will give me bread to eat, and raiment to put on, so that I come again to my father's house in peace, *then* shall the Lord be my God †." It appears not to have been till after many such revelations, blessings, and deliverances, and being reminded of the vow which on this occasion he had vowed, that he set himself in good earnest to reform the religion of his own family, and to drive out from it all strange gods *. So little able, in that age, were the boasted powers of the human mind to preserve in the world just notions of the unity of the Godhead, that we see there was a necessity for very frequent revelations, to prevent even the best men from running headlong into polytheism and idolatry.

† Gen. xxviii. 20, 21.

* Gen. xxxv. 2.

Thus was God obliged to treat even with the patriarchs themselves, by way of positive covenant and express compact; to promise to be their God if they would be his people; to give them a portion of temporal blessings as introductory to future and spiritual ones; and to engage them in his service by immediate rewards, till they could be led on to higher views, and prepared by the bringing in of a better hope to worship him in spirit and in truth. With regard to what may be called the *theory* of religion, mankind were yet scarcely got out of their childhood. Some extraordinary persons indeed occasionally appeared in different countries, such as Enoch, Noah, Abraham, and Job, with many others, who had a more enlarged prospect of things, and entertained more worthy sentiments of the divine dispensations and of the ultimate end of man; but these were far superior to the times in which they lived, and appear to have been providentially raised up to prevent the savage state and savage idolatry from becoming universal among men. See SAVAGE.

139 The patriarchal worship of those early ages performed in faith.

The worship which was practised by those holy men appears to have consisted principally of the three kinds of sacrifice mentioned elsewhere (see SACRIFICE); to which were doubtless added prayers and praises, with

(U) There are great disputes among the learned respecting the antiquity and the author of the *book* of Job, and whether it be a history of events, or a poem which has its foundation in history. All sober men, however, are agreed, that there really was such a *person* as Job, eminent for patience under uncommon sufferings; and that he was of very remote antiquity. The LXX give us the names of his father and mother, and say that he was the fifth from Abraham.

Theology from the fall of Adam to the coming of Christ.

the more valuable oblation of pure hands and devout hearts. Such of them as looked forward to a future redemption, and had any tolerable notion of the means by which it was to be effected, as Abraham certainly had, must have been sensible that the blood of bulls and of goats could never take away sin, and that their sacrifices were therefore valuable only when they were offered in faith of that great promise, "which they, having seen it afar off, were persuaded of, and embraced: and confessed that they were strangers and pilgrims upon earth."

That such persons looked for "a better country, even a heavenly one," in a future state, cannot be questioned; for they knew well how sin and death had entered into the world, and they must have understood the promise made to their original progenitor, and repeatedly renewed to themselves, to include in it a deliverance at some period from every consequence of the first transgression. They were to all intents and purposes Christians as well as we. They indeed placed their confidence in a Redeemer, who in the fulness of time was to appear upon earth, while we place ours in a Redeemer that has been already manifested; they expressed that confidence by one mode of worship, we express it by another; but the patriarchal worship had the same end in view with the Christian—the attainment of everlasting life in heaven.

140 of a future Redeemer.

141 Such faith, however, not general.

The generality of men, however, appear not, in the early age of which we now write, to have extended their views beyond the present life. From the confused remains of ancient tradition, they acknowledged indeed some superior power or powers, to whom they frequently applied for direction in their affairs; but in all probability it was only for direction in temporal affairs, such as the cultivation of the ground, or their transactions with each other. In the then state of things, when no part of the world was overstocked with inhabitants, and when luxury with its consequences was everywhere unknown, virtue and vice must have produced their natural effects; and the good man being happy here, and the wicked man miserable, reason had no data from which to infer the reality of a future state of rewards and punishments. Those who were blessed with the light of revelation undoubtedly looked forward to that state with a holy joy; but the rest worshipped superior powers from worldly motives. How many of those powers there might be, or how far their influence might reach, they knew not. Uncertain whether there be one Supreme Governor of the whole world, or many co-ordinate powers presiding each over a particular country, climate, or place—gods of the hills and of the valleys, as they were afterwards distinguished—they thought that the more of these they could engage in their interest the better. Like the Samaritans therefore, in after times, they sought, wherever they came, the "the manners of the god of the land," and served him, together with their own gods.

142 The purpose for which the Israelites were made to sojourn in Egypt.

Thus was the world ready to lose all knowledge of the true God and his worship, had not he been graciously pleased to interpose, and take effectual care to preserve that knowledge in one nation, from which it might be conveyed to the rest of mankind at different times, and in greater or less degrees, as they should be capable of receiving it. To this purpose he made way for the removal of Jacob and his family to one of the most improved and polished countries of the world; and introduced them into it in a manner so advantageous, as to give them an opportunity of imparting much religious knowledge to the natives. The natives, however, were gross idolaters; and that his chosen people might be as far as possible from the contagion of their example, he placed them upon the borders of Egypt, where, though they multiplied exceedingly, they were by their very occupation † still kept a separate people, and must have been rendered, by a long and severe oppression, in a great degree averse to the manners and religion of their neighbours. This aversion, however, seems to have gradually becomes less and less; and before they were miraculously redeemed from their house of bondage, they had certainly lost all correct notions of the unity of God, and the nature of his worship, and had adopted the greater part of the superstitions of their task-masters. Of this we need no other proof than what is implied in the words of Moses ‡, when he said unto God, "Behold, when I come unto the children of Israel, and say unto them, the God of your fathers hath sent me unto you; and they shall say unto me, WHAT IS HIS NAME? what shall I say unto them?" Had not the destined lawgiver of the Hebrews been aware that his countrymen had adopted a plurality of gods, this difficulty could not have occurred to him; for *names* are never thought of but to distinguish from each other beings of the same kind; and he must have remembered, that in Egypt, where the multitude of gods was marshalled into various classes, the knowledge of their names was deemed of great importance. This we learn likewise from Herodotus, who informs us *, that the Pelasgi, after settling in Greece, thought it necessary to consult the oracle of Dodona, whether it would be proper to give to their own gods the names of the Egyptian divinities? and that the oracle, as might have been supposed, assured them that it would. Indeed the Hebrews during their residence in Egypt had acquired such an attachment to the idolatrous worship of the country, that it appears never to have left them entirely till many ages afterwards, when they were carried captive into Babylon, and severely punished for their repeated apostasies; and so completely were they infatuated by these superstitions at the era of their exodus, that, as the prophet Ezekiel informs us §, they rebelled against God, and would not cast away their abominations, or forsake the idols of Egypt, even in the *very day* that the hand of Omnipotence was lifted up to bring them forth of that land in which they had been so long and so cruelly oppressed. In such a state of things, to have suffered them to remain longer in Egypt, could have served no good purpose; and therefore to fulfil the promise which he had given to Abraham, God determined to deliver them out of the hands of the Egyptians by means which should convince both them and their offspring of his own supremacy over heaven and earth.

† Gen. xv. 13, 14.

‡ Exod. iii. 13.

143 Consequences of it.

* Lib. ii. cap. 52, 53.

§ Ch. xx.

144 Moses appointed to bring them out of Egypt.

As Moses was the person appointed to deliver God's message to Pharaoh, and to demand of him leave for the Israelites to go three days journey into the wilderness to serve the God of their fathers, it was necessary that he should be endowed with the power of working miracles to evince the reality of his divine mission. Without a conviction that his claims were well founded, neither Pharaoh nor his own countrymen could reasonably have been expected to listen to the proposals of a man who, though blessed in his youth with a princely education, had come directly on his embassy from the humble employment

ployment of a shepherd, which he had for many years exercised in the country of Midian. To prove that he was really sent by God, any visible and undoubted controul of the laws of nature would have been abundantly sufficient; but he was to prove not only this truth, but also the unity of the Divine nature; and the miracles which he was directed to work were executions of judgement against the very gods of Egypt†.

Theology from the fall of Adam to the coming of Christ.

† Exod. xii.

When Pharaoh first turned a deaf ear to his request, though enforced by the conversion of a rod into a serpent, at the command of Jehovah he smote with the same rod upon the waters in the river, which were instantly converted into blood, and occasioned the death of all the fishes that swam in them. To any people this miracle would have been a proof of Divine agency: but it was in a particular manner calculated to open the eyes of the blind and infatuated Egyptians, who considered the Nile as one of their greatest gods, and all the fishes that it contained as subordinate divinities. They called that noble river sometimes *Sirius*, sometimes *Osiris*, sometimes *Canobus* (see CANOBUS), and not unfrequently Ωκεανος (x); and adored it as the parent of all their deities. What then must the people have thought when they found their most revered god, at the command of a servant of Jehovah, converted into blood, and all his sacred offspring into stinking carcases? To conceive their consternation, if it can be conceived, the reader must remember, that the Egyptian priests held blood in the utmost abhorrence, as a thing of which the very touch would deeply pollute them, and require immediate and solemn expiation. The same sacred river was a second time polluted, when it sent forth frogs, which covered all the land of Egypt, and died in the houses, in the villages, and in the fields; thus rendering it impossible for the people to avoid the touch of dead bodies, though from every such contact they believed themselves to contract an impurity, which, in the case before us, must have been the more grievous, that in the whole country there was not left a pool of uninfected water to wash away the stain.

The third plague inflicted on the Egyptians was, the converting of the dust of the land into lice, upon man and upon beast, throughout the whole kingdom. To see the propriety of this miracle as a judgment upon their idolatry, we must recollect their utter abhorrence of all kinds of vermin, and their extreme attention to external purity above every other people perhaps that has hitherto existed on the face of the earth. On this head they were more particularly solicitous when about to enter the temples of their gods; for Herodotus informs us, that their priests wore linen raiment only, and shaved off every hair from their heads and bodies, that there might be no *louse* or other detestable object upon them when performing their duty to the gods. This plague therefore, while it lasted, made it impossible for them to perform their idolatrous worship, without giving such offence to their deities as they imagined could never be forgiven. Hence we find, that on the production of the lice, the priests and magicians perceived immediately from what hand the miracle had come, and exclaimed, "This is the finger of God!" The fourth plague seems to have been likewise acknowledged to be the finger of God, if not by the magicians, at least by Pharaoh; for in a fit of terror he agreed that the Israelites should go and serve the Lord. That he was terrified at the swarms of flies which infested the whole country, except the land of Goshen, will excite no wonder, when it is known that the worship of the fly originated in Egypt; whence it was carried by the Caphtorim to Palestine; by the Phœnicians to Sidon, Tyre, and Babylon; and from these regions to other parts of the world. The denunciation of this plague was delivered to Pharaoh early in the morning, when he was on the banks of the Nile, probably paying his accustomed devotion to his greatest god; and when he found himself and his people tormented by a swarm of subordinate divinities, who executed the judgment of Jehovah in defiance of the power of the supreme *numen* of Egypt, he must have been convinced, had any candour remained in his mind, that the whole system of his superstition was a mass of absurdities, and that his gods were only humble instruments at the disposal of a Superior Power. He was not, however, convinced; he was only alarmed, and quickly relapsed into his wonted obstinacy. The fifth plague therefore, the murrain among the cattle, brought death and destruction on his most revered gods themselves. Neither Osiris, nor Isis, nor Ammon, nor Pan, had power to save his brute representatives. The sacred bull, and heifer, and ram, and goat, were carried off by the same malady which swept away all the other herds of deities, these *dii stercorei*, who lived on grass and hay. The impression of this punishment must have been awful on the minds of the Egyptians, but perhaps not equal to that which succeeded it.

In Egypt there were several altars on which human sacrifices were offered; and from the description of the persons qualified to be victims, it appears that those unhappy beings must have been foreigners, as they were required to have bright hair and a particular complexion. The hair of the Israelites was much brighter than that of the Egyptians, and their complexions fairer; and therefore there can be little doubt but that, during their residence in Egypt, they were made to furnish the victims demanded by the bloody gods. These victims being burnt alive on a high altar, and thus sacrificed for the good of the nation, their ashes were gathered together by the priests, and scattered upwards in the air, that a blessing might be entailed on every place to which an atom of this dust should be wafted. Moses too, by the direction of the true God, took ashes of the furnace, probably of one of those very furnaces in which some of his countrymen had been burnt, and sprinkling them towards heaven in the sight of Pharaoh, brought boils and blains upon all the people, of so malignant a nature, that the magicians and the other ministers of the medical gods, with which Egypt abounded beyond all other countries, could not themselves escape the infection.

The powers of darkness were thus foiled; but the heart of the monarch was still hardened. Destruction was therefore next brought on him and his country by the elements, which were among the earliest idol deities not

(x) Whence came the Greek word ωκεανος, *the ocean*.

Theology from the fall of Adam to the coming of Chriſt.

not only of the Egyptians, but of every other polytheiſtic nation. "The Lord rained hail on the land of Egypt; ſo that there was hail, and fire mingled with the hail, ſuch as there was none like it in all the land of Egypt ſince it became a nation. And the hail ſmote throughout all the land of Egypt all that was in the field, both man and beaſt; and the hail ſmote every herb of the field, and broke every tree of the field." This was a dreadful calamity in itſelf; and the horror which it excited in the minds of the people muſt have been greatly aggravated by the well-known fact, that Egypt is bleſſed with a ſky uncommonly ſerene; that in the greateſt part of it rain has never been ſeen at any other time ſince the creation of the world; and that a ſlight and tranſient ſhower is the utmoſt that in the ordinary courſe of nature falls anywhere throughout the country. The ſmall quantity of vegetables which was left undeſtroyed by the fire and the hail was afterwards devoured by locuſts, which by a ſtrong eaſt wind were brought in ſuch numbers from Arabia, where they abounded at all times, that they covered the whole face of the earth, and did eat every herb of the land, and all the fruit of the trees, ſo that there remained not any green thing in the trees or in the herbs of the field through all the land of Egypt.

The ninth plague which the obſtinacy of Pharaoh brought upon his country, whilſt it ſeverely puniſhed the Egyptians for their cruelty to the Hebrews, ſtruck at the very foundation of all idolatry. We have elſewhere ſhown, that the firſt objects of idolatrous worſhip were the contending powers of light and darkneſs (ſee POLYTHEISM); and that the benevolent principle, or the power of light, was everywhere believed to maintain a conſtant ſuperiority over the power of darkneſs. Such was the faith of the ancient Perſians; and ſuch, as a very learned writer has lately proved, was likewiſe the faith of the earlier Egyptians. It was therefore with wiſdom truly divine, that God, to ſhow the vanity of their imaginations, brought upon thoſe votaries of light, who fancied themſelves the offſpring of the ſun, a preternatural darkneſs, which, for three days, all the powers of their ſupreme deity, and his ſubordinate agents, could not diſpel.

The tenth and laſt plague brought on this idolatrous people was more univerſally and ſeverely felt than any which had preceded it. It was likewiſe, in ſome ſenſe, an inſtance of the *lex talionis*, which requires an eye for an eye, and a tooth for a tooth, &c. Moſes was commanded, at his firſt interview with Pharaoh, to ſay, "Thus ſaith the Lord, Iſrael is my ſon, even my firſt-born. Let my ſon go that he may ſerve me: and if thou refuſe to let him go, behold, I will ſlay thy ſon, even thy firſt-born." Before this threat was put in execution, every attempt was made to ſoften the hardened heart of the obſtinate tyrant. The waters of his ſacred river were turned into blood, and all the fiſhes that it contained ſlain; frogs were brought over all the land to pollute the people; the miniſters of religion were rendered ſo impure by vermin, that they could not diſcharge their wonted offices; the animals moſt revered as gods, or emblems of gods, were cut off by a murrain; the elements, that were everywhere worſhipped as divinities, carried through the land a devaſtation, which was completed by ſwarms of locuſts; the aſhes from the ſacred furnace, which were thought to convey bleſſings whitherſoever they were wafted, were made to communicate incurable diſeaſes; a thick and preternatural darkneſs was ſpread over the kingdom, in defiance of the power of the great Oſiris; and when the hearts of the people and their ſovereign continued ſtill obdurate, the eldeſt ſon in each family was ſlain, becauſe they refuſed to let go Iſrael, God's firſt-born. From this univerſal peſtilence the Iſraelites were preſerved by ſprinkling the door-poſts of their houſes with the blood of one of the animals adored in Egypt; a fact which, as it could not be unknown to Pharaoh or his ſubjects, ought to have convinced that people of the extreme abſurdity of their impious ſuperſtitions. This effect it ſeems not to have had; but the death of the firſt-born produced the deliverance of the Hebrews; for when it was found that there was not a houſe where there was not one dead, "Pharaoh called for Moſes and Aaron by night, and ſaid, Riſe up, and get you forth from among my people, both you and the children of Iſrael; and bleſs me alſo. And the Egyptians were urgent upon the people, that they might ſend them out of the land in haſte; for they ſaid, We be all dead men (Y)." The wonted obſtinacy of the monarch indeed very ſoon returned; and his ſubjects, forgetting the loſs of their children, joined with him in a vain attempt to bring back to bondage the very people whom they had been thus urgent to ſend out of the land; but their attempt was defeated by Jehovah, and all who engaged in it drowned in the Red ſea.

The God of Iſrael having thus magnified himſelf over the Egyptians and their gods, and reſcued his people from bondage by ſuch means as muſt not only have ſtruck terror and aſtoniſhment into the whole land, but alſo have ſpread his name through all the countries which had any communication with that far-famed nation, proceeded to inſtruct and exerciſe the Hebrews for many years in the wilderneſs. He inculcated upon them the unity of the Godhead; gave them ſtatutes and judgments more righteous than thoſe of any other nation; and by every method conſiſtent with the freedom of moral agency guarded them againſt the contagion of idolatry and polytheiſm. He ſent his angel before them to keep them in the way, took upon himſelf the office of their ſupreme civil governor, and by his preſence directed them in all their undertakings. He led them with repeated ſigns and wonders through the neighbouring nations, continued to try and diſcipline them

147 Reaſon detaining the Iſraelites ſo long in the wilderneſs.

(Y) For this account of the plagues of Egypt, we are indebted to the very valuable *Obſervations* on the ſubject publiſhed by *Mr Bryant*. We have not quoted the authorities by which the learned and pious author ſupports his opinions; becauſe it is to be hoped, that for a fuller account of theſe important tranſactions the reader will have recourſe to his work, of which we have given only a very brief abſtract. For much of the preceding parts of this ſection, we acknowledge our obligations to Biſhop Law's admirable diſcourſe on the *Several Diſpenſations of Revealed Religion*.

them till they were tolerably attached to his government and eſtabliſhed in his worſhip, and introduced them into the Promiſed Land when its inhabitants were ripe for deſtruction. At their entrance into it, he gave them a ſummary repetition of their former laws, with more ſuch ordinances, both of a ceremonial and moral kind, as were both ſuited to their temper and circumſtances, as well as to prefigure, and by degrees to prepare them for, a more perfect diſpenſation under the Meſſiah.

Theology from the fall of Adam to the coming of Chriſt.

The Jewiſh law had two great objects in view; of which the firſt was to preſerve among them the knowledge of the true God, a rational worſhip ſpringing from that knowledge, and the regular practice of moral virtue: and the ſecond was to fit them for receiving the accompliſhment of the great promiſe made to their anceſtors, by means analogous to thoſe which a ſchoolmaſter employs to fit his pupils for diſcharging the duties of maturer years. Every thing in that law peculiar to itſelf, its various ceremonies, modes of ſacrificing, the ſanctions by which it was enforced, and the theocratic government by which it was adminiſtered, had a direct tendency to promote one or other of theſe ends; and keeping theſe ends in view, even the minuteſt laws, at which impious ignorance has affected to make itſelf merry, will be diſcovered by thoſe who ſhall ſtudy the whole ſyſtem, and are at the ſame time acquainted with the genius of ancient polytheiſm, to have been enacted with the moſt conſummate wiſdom.

It is not eaſy for us, who have been long bleſſed with the light of revelation, to conceive the propenſity of all nations, in that early age of the world, to the worſhip of falſe gods, of which they were daily adding to the number. It is indeed probable, from many paſſages of Scripture, as well as from profane authors of the greateſt antiquity, that one ſupreme *numen* was everywhere acknowledged: but he was conſidered as an extramundane being, too highly exalted to concern himſelf with the affairs of this world, the government of which, it was believed, he had delegated to various orders of ſubordinate deities. Of thoſe deities, ſome were ſuppoſed to have the charge of one nation and ſome of another. Hence it is, that we read of the gods of Egypt, the gods of the Amorites, and the gods of the different nations around Paleſtine. None of thoſe nations denied the exiſtence of their neighbour's gods; but all agreed, that while the Egyptians were the peculiar care of Oſiris and Iſis, the Amorites might be the favourites of Moloch, the Phœnicians of Cronus, and the Philiſtines of Dagon; and they had no objection occaſionally to join with each other in the worſhip of their reſpective tutelary deities. Nay, it was thought impiety in foreigners, while they ſojourned in a ſtrange country, not to ſacrifice to the gods of the place. Thus Sophocles makes Antigone ſay to her father, that a ſtranger ſhould both venerate and abhor thoſe things which are venerated and abhorred in the city where he reſides; and another author *, who, though comparatively late, drew much of his information from ancient writings which are now loſt, aſſures us, that this complaiſance proceeded from the belief that the "ſeveral parts of the world were from the beginning diſtributed to ſeveral powers, of which each had his peculiar allotment and reſidence."

* *Celſus apud Aug.*

From this notion of local divinities, whoſe power or partial fondneſs was confined to one people, the Iſraelites, on their departure from Egypt, appear not to have been free (z). Hence it is, that when the true God firſt tells them, by their leader Moſes †, that if they would obey his voice indeed and keep his covenant, then they ſhould be a PECULIAR TREASURE to him above all people: to prevent them from ſuppoſing that he ſhared the earth with the idols of the heathen, and had from partial fondneſs choſen them for his *portion*, he immediately adds, for ALL THE EARTH IS MINE. By this addition he gave them plainly to underſtand that they were choſen to be his peculiar treaſure for ſome purpoſe of general importance; and the very firſt article of the covenant which they were to keep was, that they ſhould have no other gods but him. So inveterate, however, was the principle which led to an intercommunity of the objects of worſhip, that they could not have kept this article of the covenant but in a ſtate of ſeparation from the reſt of mankind ‡; and that ſeparation could neither have been effected nor continued without the viſible providence of the Almighty watching over them as his peculiar treaſure. This we learn from Moſes himſelf, who, when interceding for the people after their idolatrous worſhip of the golden calf, and intreating that the preſence of God would ſtill accompany them, adds theſe words §: "For wherein ſhall it be known here that I and thy people have found grace in thy ſight? Is it not in that THOU GOEST WITH US? So ſhall we be SEPARATED, I and thy people, from all the people that are on the face of the earth." On this ſeparation every thing depended; and therefore to render it the more ſecure, Jehovah was graciouſly pleaſed to become likewiſe their ſupreme Magiſtrate, making them a "kingdom of prieſts and a holy nation," and delivering to them a digeſt as well of their civil as of their religious laws.

† Exod. xix. 5.

149 Purpoſe of their ſeparation from other people,

‡ 1 Sam. xxvi. 19.

§ Exod. xxxiii. 16.

The Almighty thus becoming their King, the government of the Iſraelites was properly a THEOCRACY, in which the two ſocieties, civil and religious, were of courſe incorporated. They had indeed after their ſettlement in the Promiſed Land, at firſt, temporary *judges* occaſionally raiſed up; and afterwards permanent magiſtrates called *kings*, to lead their armies in war, and to give vigour to the adminiſtration of juſtice in peace: but neither thoſe judges nor thoſe kings could abrogate a ſingle law of the original code, or make the ſmalleſt addition to it but by the ſpirit of prophecy. They can-

150 of their theocratic government,

(z) It is not indeed evident that they had got entirely quit of this abſurd opinion at a much later period. Jephtha, one of their judges, who, though half paganized (as Warburton obſerves) by a bad education, had probably as correct notions of religion as an ordinary Iſraelite, certainly talked to the king of Ammon as if he had believed the different nations of the earth to be under the immediate protection of different deities: "Wilt not thou (ſays he) poſſeſs that which Chemoſh THY GOD giveth thee to poſſeſs! So whomſoever the Lord OUR GOD ſhall drive out from before us, them will we poſſeſs." (Judges xi. 24.).

Theology from the fall of Adam to the coming of Chriſt.

not therefore be conſidered as ſupreme magiſtrates, by whatever title they may have been known; for they were to go out and come in at the word of the prieſts, who were to aſk counſel for them of the Lord, and with whom they were even aſſociated in all judicial proceedings, as well of a civil as of a ſpiritual nature *. Under any other than a theocratic government, the Hebrews could not have been kept ſeparate from the nations around them; or if they could, that ſeparation would not have anſwered the great purpoſe for which it was eſtabliſhed. "The people, on their leaving Egypt, were ſunk into the loweſt practices of idolatry. To recover them by the diſcipline of a ſeparation, it was neceſſary that the idea of God and his attributes ſhould be impreſſed upon them in the moſt *ſenſible* manner. But this could not be commodiouſly done under his character of God of the univerſe: under his character of King of Iſrael, it well might. Hence it is, that we find him in the Old Teſtament ſo frequently repreſented with affections analogous to human paſſions. The civil relation in which he ſtood to the Iſraelites made ſuch a repreſentation natural; the groſſneſs of their conceptions made the repreſentation neceſſary; and the guarded manner in which it was always qualified prevented it from being miſchievous †." Hence too it is, that under the Moſaic diſpenſation, idolatry was a crime of ſtate, puniſhable by the civil magiſtrate. It was indeed high treaſon, againſt which laws were enacted on the juſteſt principles, and carried into effect without danger of error. Nothing leſs indeed than penal laws of the ſevereſt kind could have reſtrained the violent propenſity of that headſtrong people to worſhip, together with their own God, the gods of the Heathen. But penal laws enacted by human authority for errors in religion are manifeſtly unjuſt; and therefore a theocratic government ſeems to have been abſolutely neceſſary to obtain the end for which the Iſraelites were ſeparated from the ſurrounding nations.

* Num. xxvii. 21. and Deut. xvii. 8—13.

† *Warburton's Div. Leg.* book v. ſect. 2.

151 and of the ritual law,

It was for the ſame purpoſe that the ritual law was given, after their preſumptuous rebellions in the wilderneſs. Before the buſineſs of the golden calf, and their frequent attempts to return into Egypt, it ſeems not to have been the Divine intention to lay on them a yoke of ordinances; but to make his covenant depend entirely on their duly practiſing the rite of circumciſion; obſerving the feſtivals inſtituted in commemoration of their deliverance from bondage, and other ſignal ſervices vouchſafed them; and keeping inviolate all the precepts of the decalogue (A), which, if they had done, they ſhould have even lived in them ‡. But after their repeated apoſtaſies, and impious wiſhes to mix with the ſurrounding nations, it was neceſſary to ſubject them to a multifarious ritual, of which the ceremonial parts were ſolemn and ſplendid, fitted to engage and fix the attention of a people whoſe hearts were groſs; to inſpire them with reverence, and to withdraw their affections from the pageantry of thoſe idle ſuperſtitions which they had ſo long witneſſed in the land of Egypt.

‡ *Divine Leg.* book iv. ſect. 6.

To keep them warmly attached to their public worſhip, that worſhip was loaded with operoſe and magnificent rites, and ſo completely incorporated with their civil polity as to make the ſame things at once duties of religion and acts of ſtate. The ſervice of God was indeed ſo ordered as to be the conſtant buſineſs as well as entertainment of their lives, ſupplying the place of all other entertainments; and the ſacrifices which they were commanded to offer on the moſt ſolemn occaſions, were of ſuch animals as the Egyptians and other Heathens deemed ſacred.

Theology from the fall of Adam to the coming of Chriſt.

152 inſtanced in their ſacrifices,

Thus a heifer without blemiſh was in Egypt held ſacred to the goddeſs Iſis, and worſhipped as the repreſentative of that divinity; but the ſame kind of heifer was by the ritual law of the Hebrews commanded to be burnt without the camp, as the vileſt animal, and the water of ſeparation to be prepared from her aſhes *. The goat was by the Egyptians held in great veneration as emblematical of their ancient god Pan, and ſacrifices of the moſt abominable kind were offered to the impure animal (ſee PAN); but God, by his ſervant Moſes, enjoined the Iſraelites to offer goats themſelves as ſacrifices for ſin, and on one occaſion to diſmiſs the live animal loaded with maledictions into the wilderneſs †. The Egyptians, with ſingular zeal, worſhipped a calf without blemiſh as the ſymbol of Apis, or the god of fertility; and it appears from the book of Exodus, that the Iſraelites themſelves had been infected with that ſuperſtition. They were, however, ſo far from being permitted by their Divine lawgiver to conſider that animal as ſacred, that their prieſts were commanded to offer for themſelves a young calf as a ſin-offering ‡. No animal was in Egypt held in greater veneration than the ram, the ſymbol of their god Ammon, one of the conſtellations. It was therefore with wiſdom truly divine, that Jehovah, at the inſtitution of the paſſover, ordered his people to kill and eat a young ram on the very day that the Egyptians began their annual ſolemnities § in honour of that animal as one of their greateſt gods; and that he enjoined the blood of this divinity to be ſprinkled as a ſign on the two ſide-poſts and upper door-poſt of the houſe in which he was eaten. Surely it is not in the power of imagination to conceive a ritual better calculated to cure the Iſraelites of their propenſity to idol worſhip, or to keep them ſeparate from the people who had firſt given them that propenſity, than one which enjoined them to offer in ſacrifice the very creatures which their ſuperſtitious maſters had worſhipped as gods. "Shall we (ſaid Moſes) ſacrifice the abominations of the Egyptians before their eyes, and will they not ſtone us?"

* Num. xix.

† Levit. xv.

‡ Levit. ix.

§ *Spencer de Legibus Heb. Rit.* lib. ii. cap. iv.

But it was not againſt Egyptian idolatry only that the ritual law was framed: the nations of Syria, in the midſt of whom the Iſraelites were to dwell, were addicted to many cruel and abſurd ſuperſtitions, againſt which it was as neceſſary to guard the people of God as againſt the brute-worſhip of Egypt. We need not inform any reader of the book of Moſes that thoſe nations worſhipped

(A) Of theſe precepts we think it not neceſſary, in an abſtract ſo ſhort as this, to waſte the reader's time with a formal and laboured defence. To the decalogue no objection can be made by any man who admits the obligations of natural religion; for, except the obſervation of the Sabbath-day, it enjoins not a ſingle duty which does not by the confeſſion of all men reſult from our relations to God, ourſelves, and our fellow-creatures.

ped the sun and moon and all the host of heaven; or that it was part of their religion to propitiate their offended gods by occasionally sacrificing their sons and their daughters. From such worship and sacrifices the Israelites were prohibited under the severest penalties; but we cannot consider that prohibition as making part of the *ritual* law, since it relates to practices impious and immoral in themselves, and therefore declared to be abominations to the Lord. The Phœnicians, however, and the Canaanites, entertained an opinion that every child came into the world with a *polluted nature*, and that this pollution could be removed only by a *lustral fire*. Hence they took their new-born infants, and with particular ceremonies made them pass through the flame of a pile sacred to Baal or Moloch, the symbols of their great god the sun. Sometimes this purgation was delayed till the children had arrived at their tenth or twelfth year, when they were made either to leap through the flame, or run several times backwards and forwards between two contiguous sacred fires; and this lustration was supposed to free them from every natural pollution, and to make them through life the peculiar care of the deity in whose honour it was performed *. The true God, however, who would have no fellowship with idols, forbade all such purgations among his people, whether done by fires consecrated to himself or to the bloody deities of the Syrian nations. "There shall not be found (says he) among you any one that maketh his son or his daughter to pass through the fire †."

There are, in the Jewish law, few precepts more frequently repeated than that which prohibits the seething of a kid in its mother's milk ‡; and there being no moral fitness in this precept when considered absolutely and without regard to the circumstances under which it was given, infidel ignorance has frequently thought fit to make it the subject of profane ridicule. But the ridicule will be forborne by those who know that, among the nations round Judea, the feasting on a kid boiled in its mother's milk was an essential part of the impious and magical ceremonies celebrated in honour of one of their gods, who was supposed to have been suckled by a she-goat. Hence, in the Samaritan Pentateuch, the text runs thus: "Thou shalt not seeth a kid in its mother's milk; for whoever does so, is as one who sacrifices an abominable thing, which offends the God of Jacob §." Another precept, apparently of very little importance, is given in these words: "Ye shall not round the corners of your heads, neither shalt thou mar the corners of thy beard ||." But its wisdom is seen at once, when we know that at funerals it was the practice of many of the heathens, in that early period, to round the corners of their heads, and mar their beards, that by throwing the hairs they had cut off on the dead body, or the funeral pile, they might propitiate the shade of the departed hero; and that in other nations, particularly in Phœnicia, it was customary to cut off all the hair of their heads except what grew on the crown, which, with great solemnity, was consecrated either to the sun or to Saturn *. The unlearned Christian, if he be a man of reflection, must read with some degree of wonder such laws as these: "Thou shalt not sow thy vineyard with divers seeds, lest the fruit of thy seed which thou hast sown and the fruits of thy vineyard be defiled. Thou shalt not plough with an ox and an ass together. Thou shalt not wear a garment of divers sorts, or of woollen and linen together †." But his wonder will cease when he knows that all these were practices from which the Sabian idolaters of the east expected the greatest advantages. Their belief in magic and judicial astrology led them to imagine, that by sowing different kinds of corn among their vines they should propitiate the gods which were afterwards known in Rome by the names of Bacchus and Ceres; that, by yoking animals so heterogeneous as the ox and the ass in the same plough, they should by a charm secure the favour of the deities who presided over the affairs of husbandry; and that a garment composed of linen and woollen, worn under certain conjunctions of the stars, would protect its owner, his flocks, his herds, and his field, from all malign influences, and render him in the highest degree prosperous through the whole course of his life ‡. But magical ceremonies were always performed in order to render propitious good or evil demons (see MAGIC); and therefore such ceremonies, however unimportant in themselves, were in that age most wisely prohibited in the Mosaic law, as they naturally led those who were addicted to them to the worship of idols and impure spirits.

Theology from the fall of Adam to the coming of Christ.

† Deut. xxii. 9, 10, 11.

‡ *Spencer*, lib. ii. cap. 30, 31, 33.

If the whole ritual of the Jewish economy be examined in this manner, every precept in it will be found to be directed against some idolatrous practice of the age in which it was given. It was therefore admirably calculated to keep the Israelites a separate people, and to prevent too close an intercourse between them and their Gentile neighbours. The distinction made by their law between clean and unclean animals (see SLAVERY, N° 33.) rendered it impossible for them, without a breach of that law, to eat and drink with their idolatrous neighbours; their sacred and civil ceremonies being directly levelled against the Egyptian, Zabian, and Canaanitish superstitions, had a tendency to generate in their minds a contempt of those superstitions; and that contempt must have been greatly increased by their yearly, monthly, and daily sacrifices, of the very animals which their Egyptian masters had worshipped as gods.

154 The Mosaic laws enforced by temporal sanctions.

That these laws might have the fuller effect on minds gross and carnal, they were all enforced by temporal sanctions. Hence it is that Moses assured them, that if they would hearken to God's judgments, and keep them, and do them, they should be blessed above all people; threatening them at the same time with utter destruction if they should at all walk after other gods, and serve them, and worship them §. Nor were these temporal rewards and punishments held out only to the nation as a collective body; they were promised and threatened to every individual in his private capacity as the certain consequences of his obedience or disobedience. Every particular Hebrew was commanded to honour his father and mother, that it might go well with him, and that his days might be prolonged; whilst he who cursed his father or his mother was surely to be put to death. Against every idolater, and even against the wilful transgressor of the ceremonial law, God repeatedly declared that he would set his face, and would cut off that man from among his people: and that individuals, as well as the nation, were in this life actually rewarded and punished according to their deserts, has been proved by Bishop Warburton ||. Indeed the Mo-

§ Deut. *passim*.

|| *Div. Leg.* book v. sect. 4.

Theology from the fall of Adam to the coming of Christ.

saic law, taken in its literal sense, holds out no other prospects to the Israelites than temporal happiness; such as health, long life, peace, plenty, and dominion, if they should keep the covenant; and temporal misery, viz. diseases, immature death, war, famine, want, subjection, and captivity, if they should break it. "See (says Moses), I have set before thee this day life and good, death and evil; in that I command thee this day to love the Lord thy God, to walk in his ways, and to keep his commandments, and his statutes, and his judgements, that thou mayest live and multiply; and the Lord thy God shall bless thee in the land whither thou goest to possess it. But if thine heart turn away, so that thou wilt not hear, but shalt be drawn away, and worship other gods, and serve them; I denounce unto you this day, that ye shall surely perish, and that ye shall not prolong your days upon the land whither thou passest over Jordan to possess it." And elsewhere, having informed them that, upon their apostasy, their land should be rendered like Sodom and Gomorrah, he adds, that all men should know the reason of such barrenness being brought upon it, and should say, "Because they have forsaken the covenant of the Lord God of their fathers, which he made with them when he brought them forth out of the land of Egypt, the anger of the Lord was kindled against this land, to bring upon it all the curses that are written in this book *."

* Deut. xxx. 15—19. xxxix. 25.

155 Whence it has been rashly inferred that the ancient Hebrews had no hope beyond the grave.

From this fact, which scarcely any man of letters will venture to deny, some divines have concluded, that the ancient Israelites had no hope whatever beyond the grave; and that in the whole Old Testament there is not a single intimation of a future state. That many of the lower classes, who could neither read nor write, were in this state of darkness, may be true; but it is impossible that those who understood the book of Genesis could be ignorant that death came into the world by the transgression of their first parents, and that God had repeatedly promised to redeem mankind from every consequence of that transgression. They must likewise have known that, before the deluge, Enoch was translated into heaven without tasting death; that afterwards Elijah had the same exemption from the common lot of humanity; and that, as God is no respecter of persons, every one who served him with the zeal and fidelity of these two prophets would, by some means or other, be made capable of enjoying the same rewards. The God of Abraham, Isaac, and Jacob, was not the God of the dead, but of the living.

In the earliest periods of their commonwealth, the Israelites could, indeed, only *infer*, from different passages of their sacred books, that there would be a general resurrection of the dead, and a future state of rewards and punishments; but from the writings of the prophets it appears, that before the Babylonish captivity that doctrine must have been very generally received. In the Psalms, and in the prophecies of Isaiah, Daniel, and Ezekiel, there are several texts which seem to us to prove incontrovertibly, that, at the time when these inspired books were written, every Israelite who could read the scriptures must have had some hopes of a resurrection from the dead. We shall consider two of these texts, because they have been quoted by a very learned and valuable writer in support of an opinion the reverse of ours.

In a sublime song, composed with a view to incite the people to confidence in God, the prophet Isaiah has these remarkable words; "Thy dead men shall live; together with my dead body shall they arise. Awake and sing, ye that dwell in the dust; for thy dew is as the dew of herbs, and the earth shall cast out the dead *." We agree with Bishop Warburton that these words are figurative, and that they were uttered to give the Israelites consolation in very disastrous times. The purpose of the prophet was to assure them, that though their community should, in Babylon, be as completely dissolved as a dead body reduced to dust, yet God would restore them to their own land, and raise that community again to life. This was indeed a prophecy only of a temporal deliverance; but as it is expressed in terms relating to the death and resurrection of man, the doctrine of a resurrection must then have been well known, and generally received, or such language would have been altogether unintelligible.

Theology from the fall of Adam to the coming of Christ.

156 This opinion confuted.

* Chap. xxvi. 19.

The prophet Ezekiel, when the state of things was most desperate, is carried by the Spirit into a valley full of dry bones, and asked this question; "Son of man, can these bones live?" To which he answers; "O Lord God, thou knowest †." He was not asked if *all* the dead would rise at the last day; but only if the particular bones *then* presented to him could live at *that time*, and while other bones were mouldering in corruption: and to such a question we cannot conceive any answer that a man brought up in the belief of a general resurrection could have given, but—"O Lord God, thou knowest." Had Ezekiel been a stranger to the doctrine of a general resurrection, or had he not believed that doctrine, he would doubtless have answered the question that was put to him in the negative; but convinced that *all* men are at *some* period to rise from the dead, "that every one may receive the things done in his body, according to that he hath done, whether it be good or bad," he very naturally said, that God alone knew whether the bones then exhibited to him in the valley would rise before the general resurrection.

† Chap. xxxvii. 3.

157 The hope of the Hebrews, however, not from their own law, ‡ Heb. xi. 3, &c.

But though the more intelligent and righteous Israelites certainly "all died in faith, and not having received the promises, but having seen them afar off, were persuaded of them and embraced them, confessing that they were strangers and pilgrims on earth, who desired a better country, that is, a heavenly one ‡," we are not to suppose that this heavenly desire arose from any thing taught in the law of Moses. That law, when taken by itself, as unconnected with prior and subsequent revelations, makes no mention whatever of a heavenly inheritance, which St Paul assures us § was given 430 years before to Abraham by a promise which may be traced back to the first ray of comfort vouchsafed to fallen man in the sentence passed on the original deceiver. "Wherefore then served the law? It was added (says the apostle), because of transgressions, till the seed should come to whom the promise was made." The transgressions here alluded to were polytheism and idolatry, which, with a train of cruel and detestable vices, had overspread the whole world; and the primary intention of the law was to stem the torrent of these corruptions, for which we have seen it was admirably calculated; and, like a schoolmaster, to instruct the Israelites in the unity and worship of Jehovah, and thus by degrees bring them to Christ.

§ Gal. iii. 16—19.

But though it is apparent that a future ſtate of rewards and puniſhments made no part of the Moſaic diſpenſation, yet the law had certainly a ſpiritual meaning to be underſtood when the fulneſs of time ſhould come. Every Chriſtian ſees a ſtriking reſemblance between the ſacrifice of the paſchal lamb, which delivered the Iſraelites from the deſtroying angel in Egypt, and the ſacrifice of the Lamb of God, which taketh away the ſin of the world. Indeed the whole ritual of ſacrifice muſt have led the more intelligent of them to faith in a future ſacrifice; by which, while the heel of the ſeed of the woman ſhould be bruiſed, the head of the ſerpent ſhould be completely cruſhed (ſee SACRIFICE); and as prophets were raiſed up from time to time, to prepare them for the coming of the Meſſiah, and to foretel the nature of his kingdom, there can be no doubt but that thoſe inſpired teachers would lay open to them, as far as was expedient, the temporary duration of the Moſaic law, and convince them that it was only the ſhadow of better things to come. From the nature of their ritual, and the different prophecies vouchſafed them, which became more and more explicit as the time approached for their accompliſhment, they muſt ſurely have been led to expect redemption from the curſe of the fall by the ſufferings of their Meſſiah; but that any one of them knew preciſely the *manner* in which they were to be redeemed, and the nature of that religion which was to ſuperſede their own, is wholly incredible. Such knowledge would have made them impatient under the yoke of ordinances to which they were ſubjected; for after the Chriſtian faith came into full ſplendour, mankind could be no longer under the tuition of ſuch a ſchoolmaſter as the law, which "had only a *ſhadow* of good things; and ſo far from their reality, not even the very *image* of them *." Through theſe ſhadows, however, the Jews, aided by the clearer light of prophecy, though it too ſhone in a dark place, might have ſeen enough of God's plan of redemption to make them acknowledge Jeſus of Nazareth, when he came among them working miracles of mercy, for the Meſſiah ſo long promiſed to their forefathers, and in whom it was repeatedly ſaid, that all the nations of the earth ſhould be bleſſed.

While ſuch care was taken to prepare the deſcendants of Abraham for the coming of the Prince of Peace, we muſt not ſuppoſe that God was a reſpecter of perſons, and that the reſt of the world was totally neglected. The diſperſion of the ten tribes certainly contributed to ſpread the knowledge of the true God among the eaſtern nations. The ſubſequent captivity of the tribes of Judah and Benjamin muſt have confirmed that knowledge in the great empires of Babylon and Perſia; and that particular providence of God which afterwards led Ptolemy Philadelphus to have the Jewiſh ſcriptures tranſlated into the Greek language, laid the divine oracles open to the ſtudy of every accompliſhed ſcholar. At laſt, when the arms of Rome had conquered the civilized world, and rendered Judea a province of the empire; when Auguſtus had given peace to that empire, and men were at leiſure to cultivate the arts and ſciences; when the different ſects of philoſophers had by their diſputations whetted each others underſtandings, ſo that none of them was diſpoſed to ſubmit to an impoſture; and when the police of the Roman government was ſuch that intelligence of every thing important was quickly tranſmitted from the moſt diſtant provinces to the capital of the empire; "when that fulneſs of time was come, God ſent forth his Son made of a woman, made under the law, to redeem them that were under the law, that we might receive the adoption of ſons," and be reſtored to that inheritance of which the forfeiture introduced the ſeveral diſpenſations of revealed religion into the world.

Theology from the fall of Adam to the coming of Chriſt.

SECT. V. *View of Theology more peculiarly Chriſtian.*

MANKIND being trained by various diſpenſations of providence for the reception of Jeſus Chriſt, and the time fixed by the prophets for his coming being arrived, "a meſſenger was ſent before his face to prepare his way before him by preaching the baptiſm of repentance for the remiſſion of ſins." This meſſenger was John the Baptiſt, a very extraordinary man, and the greateſt of all the prophets. His birth was miraculous, the ſcene of his miniſtry the wilderneſs, his manners auſtere, and his preaching upright, without reſpect of perſons. He frankly told his audience that he was not the Meſſiah, that the Meſſiah would ſoon appear among them, that "he was mightier than himſelf, and that he would baptiſe them with the Holy Ghoſt and with fire."

160 Chriſt the divine word incarnate.

Mightier indeed he was; for though born of a woman the Meſſiah was not the ſon of a human father; and though living for the firſt thirty years of his life in obſcurity and poverty, he was the lineal deſcendant of David, and heir to the throne of Iſrael. But the dignity of his human deſcent, great as it was, vaniſhes from conſideration when compared with the glory which he had with his Father before the world was. The Jewiſh diſpenſation was given by the miniſtry of Moſes, and illuſtrated by ſubſequent revelations vouchſafed to the prophets; the immediate author of the Chriſtian religion is the λογος or the ſecond perſon of the bleſſed Trinity, of whom St John declares, that "he was in the beginning with God, and was God; that all things were made by him; and that without him was not any thing made that was made." We have already proved that in the one Godhead there is a Trinity of perſons; and that the λογος is one of the three, is apparent from theſe words of the apoſtle, and from many other paſſages of ſacred ſcripture. Thus he is called *the Lord of hoſts himſelf; the firſt and the laſt, beſides whom there is no God; the moſt high God; God bleſſed for ever; the mighty God, the everlaſting Father, Jehovah our righteouſneſs;* and *the only wiſe God our Saviour* (B). This great Being, as the ſame apoſtle aſſures us, was made fleſh, and dwelt among men; not that the divine nature was or could be changed into humanity, for God is immutable, the ſame almighty and incomprehenſible Spirit,

(B) Iſaiah viii. 13, 14. compared with 1 Peter ii. 7, 8.; Iſaiah vi. 5. compared with John xii. 41.; Iſaiah xliv. 6. compared with Revelation xxii. 13.; Pſalm lxxviii. 56. compared with 1 Corinthians x. 9. Romans ix. 5. Iſaiah ix. 6. Jeremiah xxiii. 6. Jude.

Theology more peculiarly Christian.

Spirit yesterday, to-day, and forever; but the Word or second person in the godhead, assuming a human soul and body into a personal union with himself, dwelt upon earth as a man, veiling his divinity under mortal flesh. Hence he is said elsewhere to have been "manifested in the flesh," and "to have taken upon him the nature of man;" phrases of the same import with that which asserts "the WORD to have been made flesh."

161 Objections to the incarnation of the Word.

This incarnation of the Son of God is perhaps the greatest mystery of the Christian faith, and that to which ancient and modern heretics have urged the most plausible objections. The doctrine of the Trinity is indeed equally incomprehensible; but the nature of God and the mode of his subsistence, as revealed in scripture, no man, who thinks, can be surprised that he does not comprehend; for a revelation which should teach nothing mysterious on such a subject would be as incredible and as useless as another which contained nothing but *mystery*. The difficulty respecting the incarnation, which forces itself on the mind, is not how two natures so different as the divine and human can be so intimately united as to become one person; for this union in itself is not more inconceivable than that of the soul and body in one man; but that which at first is apt to stagger the faith of the reflecting Christian is the infinite distance between the two natures in Christ, and the comparatively small importance of the object, for the attainment of which the eternal Son of God is said to have taken on him our nature.

162 Obviated.

Upon mature reflection, however, much of this difficulty will vanish to him who considers the ways of Providence, and attends to the meaning of the words in which this mystery is taught. The importance of the object for which the WORD condescended to be made flesh, we cannot adequately know. The oracles of truth indeed inform us, that Christ Jesus came into the world to save sinners; but there are passages scattered through the New Testament * which indicate, not obscurely, that the influence of his sufferings extends to other worlds besides this: and if so, who can take on him to say, that the quantity of good which they may have produced was not of sufficient importance to move even to this condescension a Being who is emphatically styled LOVE?

* Eph. i. 10. Col. i. 19, 20.

But let us suppose that every thing which he did and taught and suffered was intended only for the benefit of man, we shall, in the daily administration of providence, find other instances of the divine condescension; which, though they cannot be compared with the incarnation of the second person in the blessed Trinity, are yet sufficient to reconcile our understandings to that mystery when revealed to us by the Spirit of God. That in Christ there should have dwelt on earth "all the fulness of the Godhead bodily †," is indeed a truth by which the devout mind is overwhelmed with astonishment; but it is little less astonishing that the omnipotent Creator should be intimately present at every instant of time to the meanest of his creatures, "upholding all things, the vilest reptile as well as the most glorious angel, by the word of his power ‡." Yet it is a truth self-evident, that without this constant presence of the Creator, nothing which had a beginning could continue one moment in being; that the visible universe would not only crumble into chaos, but vanish into nothing; and that the souls of men, and even the most exalted spirits of creation, would instantly lose that existence, which, as it was not of itself, and is not necessary, must depend wholly on the will of Him from whom it was originally derived. See METAPHYSICS, N° 272—276, and PROVIDENCE, N° 3.

† Col. ii.

‡ Heb. i. 3.

Theology more peculiarly Christian.

In what particular way God is present to his works, we cannot know. He is not diffused through the universe like the *anima mundi* of the ancient Platonists, or that modern idol termed the *substratum of space* (METAPHYSICS, N° 309, 310); but that he is in power as intimately present now to every atom of matter as when he first brought it into existence, is equally the dictate of sound philosophy and of divine revelation; for "in him we live and move and have our being;" and power without substance is inconceivable. If then the divine nature be not debased, if it cannot be debased by being constantly present with the vilest reptile on which we tread, why should our minds recoil from the idea of a still closer union between the second person of the ever blessed Trinity and the body and soul of Jesus Christ? The one union is indeed different from the other, but we are in truth equally ignorant of the nature of both. Reason and revelation assure us that God must be present to his works to preserve them in existence; and revelation informs us farther, that one of the persons in the Godhead assumed human nature into a personal union with himself, to redeem myriads of rational creatures from the miserable consequences of their own folly and wickedness. The importance of this object is such, that, for the attainment of it, we may easily conceive that he who condescends to be potentially present with the worms of the earth and the grass of the field, would condescend still farther to be personally present with the spotless soul and body of a man. Jesus Christ lived indeed a life of poverty and suffering upon earth, but his divine nature was not affected by his sufferings. At the very time when, as a man, he had not a place where to lay his head; as God, he was in heaven as well as upon earth *, dwelling in light inaccessible; and while, as a man, he was increasing in wisdom and stature, his divinity was the fulness of him who filleth all in all, and from whom nothing can be hid.

* John iii. 13.

Perhaps the very improper appellation of *mother of God*, which at an early period of the church was given to the Virgin Mary, may have been one cause of the reluctance with which the incarnation has been admitted; for as we have elsewhere observed (see NESTORIUS), such language, in the proper sense of the words, implies what those, by whom it is used, cannot possibly believe to be true; but it is not the language of scripture. We are there taught, that "Christ being in the form of God, thought it no robbery to be equal with God; but made himself of no reputation, and took upon him the form of a servant, and was made in the likeness of man †;" that "God sent forth his Son made of a woman, made under the law, to redeem them that were under the law, that we might receive the adoption of sons ‡;" and that "the WORD who was in the beginning with God, and was God, by whom all things were made, was made flesh, and dwelt among men (who beheld his glory, the glory as of the only begotten of the Father), full of grace and truth §:" but we are nowhere taught that, as God, he had a mother! It was indeed the doctrine of the primitive church ||, that the very principle of personality and individual existence in Mary's

† Philip. ii. 6, 7.

‡ Gal. iv. 4, 5.

§ John i.

|| *Horsley's Sermon on the incarnation.*

Mary's son, was union with the uncreated Word; and this doctrine is thought to imply the miraculous conception, which is recorded in the plainest terms by two of the evangelists; for he was conceived by the Holy Ghost and born of a virgin *; but, as God, he had been begotten from all eternity of the Father, and in order of nature was prior to the Holy Ghost. This is evident from the appellation of ὁ λογος given to him by St John; for the term being used in that age, both by the Jewish rabbies and the heathen philosophers, to denote the second divine subsistence, which they considered as an eternal and necessary emanation from the first, sometimes called τ'αγαθον and sometimes το ἑν; and the apostle giving no intimation of his using the word in any uncommon sense, we must necessarily conclude, that he meant to inform us that the divinity of Christ is of eternal generation. That the term λογος was used in this sense by the later Platonists, and in all probability by Plato himself, we have sufficiently shewn in another place (see PLATONISM); and that a similar mode of expression prevailed among the Jews in the time of St John, is apparent from the Chaldee paraphrase; which, in the 110th psalm, instead of the words "the Lord said unto my Lord," has, "the Lord said unto his WORD." Again, where we are told in the Hebrew that Jehovah said to Abraham †, "I am thy shield and thy exceeding great reward," we read in the Chaldee, "my WORD is thy shield, and thy exceeding great reward." Where it is said, "your new moons and your appointed feasts my soul hateth ‡," the paraphrast hath it, "my WORD hateth;" and where it is said, that "Israel shall be saved in the Lord with an everlasting salvation §," in the same paraphrase it is, "Israel shall be saved by the WORD of the Lord with everlasting salvation." But there is a passage in the Jerusalem Targum which puts it beyond a doubt, that by the λογος the Jews understood a divine person begotten of his Father before all worlds; for commenting on Genesis iii. 22. the authors of that work thus express themselves: "The WORD of the Lord said, behold Adam, whom I created, is the only begotten upon earth, as I AM THE ONLY BEGOTTEN IN HEAVEN:" in conformity with which, Philo introduces || the Logos speaking thus of himself; Και γαρ ουτε αγεννητος ως θεος ων, ουτε γεννητος ως υμεις. *I am neither unbegotten, as God, nor begotten after the same manner as you are.*

From these quotations we may justly conclude, that the Nicene fathers expressed themselves properly when they declared that the only begotten Son of God was begotten of his Father before all worlds, and is God of God; for if St John had believed the λογος or WORD to be unbegotten, contrary to the belief of all who made use of the phrase at the time when he wrote, he would surely have expressed his dissent from the generally received opinion. This however he is so far from doing, that he gives the amplest confirmation of that opinion, by declaring, that "he beheld the glory of the WORD incarnate as the glory of the only begotten of the Father;" for this declaration is true only of the divinity of Christ, his human nature not being begotten of the Father, but conceived by the Holy Ghost of the Virgin Mary. Hence our blessed Lord assures us, that "as the Father HATH life in HIMSELF, so hath he GIVEN the Son to have life in himself;" that "the Son can do nothing of *himself*, but what he seeth the Father do *;" and that "he knew the Father, because he was from him and sent by him †." We must therefore agree with Bishop Pearson (c), that "though the Father and Son are both truly God, and therefore equal in respect of nature, yet the one is greater than the other, as being the fountain of the Godhead. The Father is God, but *not of God;* Light, but *not of Light.* Christ is God, but *of* God; Light, but *of* Light. There is no difference or inequality in the nature or essence, because the same in both; but the Father of our Lord Jesus Christ hath that essence of himself, from none; Christ hath the same essence, not of himself, but from him."

Theology more peculiarly Christian.

* St John v. 26. 19.

† John vii. 29.

The great purpose for which this divine person was sent into the world, was to bruise the head of the serpent, and restore mankind to the inheritance which had been forfeited by Adam's transgression. Every dispensation of Providence from the fall had been preparatory to this restoration. Prophets had been raised from time to time to preserve in the early ages of the world the knowledge and worship of the true God: the children of Abraham had been separated from the surrounding nations for the same purpose; and by the dispersion of the ten tribes, the captivity of the other two in Babylon, and the translation of the Hebrew scriptures into the Greek language, much of the knowledge which had been revealed to the Israelites was gradually diffused over the eastern world.

Purpose for which Christ was sent into the world.

But while the Jews were thus rendered the instruments of enlightening the heathen nations of antiquity, their intercourse with those nations made them almost unavoidably acquainted with the philosophy which was cultivated among the Chaldeans, the Persians, and the Egyptian Greeks; and ingrafting many of the opinions derived from those schools upon the doctrines of Moses and the prophets, they corrupted their own religion while

(c) We beg leave to recommend to our readers this author's excellent exposition of the apostle's creed, as a work which will render them great assistance in acquiring just notions of the fundamental articles of the Christian faith. They will find it, we think, a complete antidote against the poison of modern Unitarians and modern Tritheists; of whom the former teach that Jesus Christ was a mere man, the son of Joseph as well as of Mary; while the latter, running to the other extreme, maintain, that, with respect to his divinity, he is in no sense subordinate to the Father, but might have been the Father, the Son, or the Holy Ghost, according to the good pleasure of the eternal three. We have been at some pains to prove his divinity, and likewise his eternal generation; but in such a short compend as we must give, it seems not to be worth while to prove his miraculous conception. That miracle is plainly asserted in the New Testament in words void of all ambiguity; and as it is surely as easy for God to make a man of the substance of a woman as of the dust of the earth, we cannot conceive what should have induced any person professing Christianity to call it in question. The natural generation of Christ is a groundless fancy, which can serve no purpose whatever, even to the Unitarians.

Theology more peculiarly Chriſtian.

while they improved that of their neighbours. Hence, by the time that Chriſt came among them, they had made the word of God of none effect through a number of idle fancies which they inculcated on the people as the traditions of the elders; and as they had attached themſelves to different maſters in philoſophy, their unauthoriſed opinions were of courſe different according to the different ſources whence they were drawn. The peculiar tenets of the ESSENES ſeem to have been a ſpecies of myſtic Platoniſm. The PHARISEES are thought to have derived their origin from a Jewiſh philoſopher of the Peripatetic ſchool; and the reſemblance between the doctrines of the SADDUCEES and the philoſophy of Epicurus has eſcaped no man's obſervation.

166 Corruption of the Jews at the time of his coming.

Though theſe ſects maintained mutual communion in public worſhip, they abhorred each other's diſtinguiſhing tenets; and their wranglings had nearly baniſhed from them every ſentiment of true religion. They agreed, however, in the general expectation of the Meſſiah promiſed to their fathers; but, unhappily for themſelves, expected him as a great and temporal prince. To this miſtake ſeveral circumſtances contributed: ſome of their prophets had foretold his coming in lofty terms, borrowed from the ritual law, and the ſplendour of earthly monarchs. The neceſſity of caſting this veil over thoſe living oracles we have ſhewn in another place (ſee PROPHECY, N° 17.). At the time when the predictions were made, the Moſaic ſyſtem had not run out half its courſe, and was therefore not to be expoſed to popular contempt by an information that it was only the harſh rudiment of one more eaſy and perfect. To prevent, however, all miſtakes in the candid and impartial, when the Meſſiah ſhould arrive with the credentials of miraculous powers, other prophets had deſcribed him in the cleareſt terms as having no form nor comelineſs, as a ſheep dumb before his ſhearers, and as a lamb brought to the ſlaughter; but the Jews had ſuffered ſo much from the Chaldeans, the Greeks, and other nations by whom they had been conquered, and were then ſuffering ſo much from their maſters the Romans, that they could think of no deliverance greater than that which ſhould reſcue their nation from every foreign yoke.

What men earneſtly wiſh to be true, they readily believe. Hence that people, loſing ſight of the yoke under which they and the whole human race were brought by the fall of Adam, miſtaking the ſenſe of the bleſſing promiſed to all nations through the ſeed of Abraham, and devoting their whole attention to the moſt magnificent deſcriptions of the Meſſiah's kingdom, expected in him a prince who ſhould conquer the Romans, and eſtabliſh on earth a univerſal monarchy, of which Jeruſalem was to be the metropolis.

167 The objects of his preaching.

As our Saviour came for a very different purpoſe, the firſt object of his miſſion was to rectify the notions of his erring countrymen, in order to fit them for the deliverance which they were to obtain through him. Accordingly, when he entered on his office as a preacher of righteouſneſs, he embraced every opportunity of inveighing againſt the falſe doctrines taught as traditions of the elders; and by his knowledge of the ſecrets of all hearts, he expoſed the vile hypocriſy of thoſe who made a gain of godlineſs. The Jews had been led, by their ſeparation from the reſt of the world, to conſider themſelves as the peculiar favourites of Jehovah; and the conſequence was, that, contrary to the ſpirit of their own law, and the explicit doctrines of ſome of their prophets, they looked on all other nations with abhorrence, as on people phyſically impure. Theſe prejudices the bleſſed Jeſus laboured to eradicate. Having deſired a lawyer, by whom he was tempted, to read that part of the law of Moſes which commanded the Iſraelites to love their neighbours as themſelves, he compelled him, by means of a parabolical account of a compaſſionate Samaritan, to acknowledge, that under the denomination of neighbour the divine lawgiver had comprehended all mankind as the objects of love *. The importance in which Moſes held the ritual law, and to which, as the means of preſerving its votaries from the contagion of idolatry, it was juſtly intitled, had led the Jews to conſider every ceremony of it as of intrinſic value and perpetual obligation: but Jeſus brought to their recollection God's declared preference of mercy to ſacrifice; ſhewed them that the weightier matters of the law, judgment, mercy, and faith, claimed their regard in the firſt place, and its ceremonial obſervances only in the ſecond; and taught them, in conformity with the predictions of their own prophets †, that the hour was about to come when the worſhip of God ſhould not be confined to Jeruſalem, but that "true worſhippers ſhould everywhere worſhip the Father in ſpirit and in truth ‡."

Theology more peculiarly Chriſtian.

* St Luke x. 25—38

† Jeremiah xxxi. 31. &c.

‡ John iv. 25—27.

It being the deſign of Chriſt's coming into the world to break down the middle wall of partition between the Jews and Gentiles, and to introduce a new diſpenſation of religion which ſhould unite all mankind as brethren in the worſhip of the true God, and fit them for the enjoyment of heaven; he did not content himſelf with merely reſtoring the moral part of the Moſaic law to its primitive purity, diſencumbered of the corrupt gloſſes of the Scribes and Phariſees, but added to it many ſpiritual precepts, which, till they were taught by him, had never occurred either to Jew or Gentile. The Hebrew lawgiver had prohibited murder under the penalty of death; but Chriſt extended the prohibition to cauſeleſs anger, and to contemptuous treatment of our brethren, commanding his followers, as they valued their everlaſting ſalvation, to forgive their enemies, and to love all mankind. Adultery was forbidden by the law of Moſes as a crime of the deepeſt dye; but Jeſus ſaid to his diſciples, "that whoſoever looketh on a woman to luſt after her, hath committed adultery with her already in his heart," and is of courſe liable to the Divine vengeance. The *lex talionis* was in force among the Jews, ſo that the man who had deprived his neighbour of an eye or a tooth, was to ſuffer the loſs of an eye or a tooth himſelf; but this mode of puniſhment, which inflicted *blemiſh* for *blemiſh*, though ſuited to the hardneſs of Jewiſh hearts, being inconſiſtent with the mild ſpirit of Chriſtianity, was aboliſhed by our bleſſed Lord, who ſeverely prohibited the indulgence of revenge, and commanded his followers to love even their enemies. Perjury has in every civilized nation been juſtly conſidered as a crime of the higheſt atrocity, and the Moſaic law doomed the falſe witneſs to bear the puniſhment, whatever it might be, which he intended by ſwearing falſely to bring on his brother; but the Author of the Chriſtian religion forbade not only falſe ſwearing, but ſwearing at all, except on ſolemn occaſions, and when an oath ſhould be required by legal authority. See OATH.

By thus reſtoring the law to its original purity, and in

ogy in many cases extending its sense, the blessed Jesus executed the office of a PROPHET to the lost sheep of the house of Israel; but had he not been more than an ordinary prophet, he could not have abrogated the most trivial ceremony of it, nor even extended the sense of any of its moral precepts; for their great lawgiver had told them, that "the Lord their God would raise up unto them but one Prophet, like unto him, to whom they should hearken *." That Prophet was by themselves understood to be the Messiah, whom they expected to tell them all things. It was necessary therefore that Jesus, as he taught some new doctrines, and plainly indicated that greater changes would soon be introduced, should vindicate his claim to that exalted character which alone could authorise him to propose innovations. This he did in the amplest manner, by fulfilling prophecies and working miracles (See MIRACLE and PROPHECY); so that the unprejudiced part of the people readily acknowledged him to be of a truth "that prophet which should come into the world—the Son of God, and the King of Israel." He did not, however, make any change in the national worship, or assume to himself the smallest civil authority. He had submitted to the rite of circumcision, and strictly performed every duty, ceremonial as well as moral, which that covenant made incumbent on other Jews; thus fulfilling all righteousness. Though the religion which he came to propagate was in many respects contrary to the ritual law, it could not be established, or that law abrogated, but in consequence of his death, which the system of sacrifices was appointed to prefigure; and as his kingdom, which was not of this world, could not commence till after his resurrection, he yielded during the whole course of his life a cheerful obedience to the civil magistrate, and wrought a miracle to obtain money to pay the tribute that was exacted of him. Being thus circumstanced, he chose from the lowest and least corrupted of the people certain followers, whom he treated with the most endearing familiarity for three years, and commissioned at his departure to promulgate such doctrines as, consistently with the order of the divine dispensations, he could not personally preach himself. With these men, during the course of his ministry on earth, he went about continually doing good, healing the sick, casting out devils, raising the dead, reproving vice, preaching righteousness, and instructing his countrymen, by the most perfect example which was ever exhibited in the world, of whatsoever things are true, or honest, or just, or pure, or lovely, or of good report. The Scribes and Pharisees, however, finding him not that conqueror whom they vainly expected, becoming envious of his reputation among the people, and being filled with rancour against him for detecting their hypocritical arts, delivered him up to the Roman governor, who, though convinced of his innocence, yielded to the popular clamour, and crucified him between two thieves, as an enemy to Cæsar.

Just before he expired, he said, It is finished, intimating that the purpose was now fulfilled for which he had come into the world, and which, as he had formerly told his disciples, "was not to be ministered unto, but to minister, and to give his life a ransom for many †." For his blood, as he assured them at the institution of the Eucharist, "was to be shed for the remission of sins." That Christ died voluntarily for us, the just for the unjust, and that "there is none other name under heaven given among men whereby we must be saved," is the uniform doctrine of the prophets who foretold his coming, of John the Baptist who was his immediate harbinger, and of the apostles and evangelists who preached the gospel after his ascension into heaven. Thus Isaiah says of the Messiah *, that "he was wounded for our transgressions, and bruised for our iniquities; that the chastisement of our peace was upon him, and that with his stripes we are healed; that we had all like sheep gone astray, turning every one to his own way, and that the Lord laid on him the iniquity of us all; that he was cut off out of the land of the living, and stricken for the transgression of God's people; that his soul or life was made an offering for sin; and that he bore the sin of many, and made intercession for the transgressors." The Baptist, "when he saw Jesus coming unto him, said to the people, Behold the Lamb of God, which taketh away the sin of the world;" plainly intimating that his death was to be a sacrifice, since it was only as a sacrifice that the Jews could form any conception of a lamb taking away sin. The epistles of St Paul are so full of the doctrine of Christ's satisfaction, that it is needless to quote particular texts in proof of it. He tells the Romans, that Jesus Christ was set forth to be a propitiation through faith in his blood; he was delivered for our offences, and "raised again for our justification; that he died for the ungodly; and that God commendeth his love towards us, in that while we were yet sinners Christ died for us." He assures the Corinthians that Christ died for all; that "they who live should not henceforth live unto themselves, but to him who died for them and rose again; and that God made him to be sin for us, who knew no sin, that we might be made the righteousness of God in him." He informs the Galatians, that Christ "gave himself for our sins, that he might deliver us from this present evil world, according to the will of God and our Father; and that he redeemed us from the curse of the law, being made a curse for us." St Peter and St John speak the very same language; the former teaching us, that "Christ suffered for us, and bare our sins in his own body on the tree †; the latter, that the blood of Jesus Christ cleanseth us from all sin, and that he is the propitiation for our sins; and not for our sins only, but also for the sins of the whole world ‡." That he came into the world for the purpose of suffering, appears from his own words: for "no man (said he §) taketh my life from me, but I lay it down of myself: I have power to lay it down, and I have power to take it again. This commandment have I received from my Father." And that he voluntarily laid it down for mankind, is evident from his calling himself the Good Shepherd, and adding, that "the Good Shepherd giveth his life for the sheep ‖."

Theology more peculiarly Christian.

170 He voluntarily died for us.

* Chap. liii.

† 1 Peter ii. 21, and 24.

‡ 1 John i. 7. ii. 2.

§ 1 John x. 18.

‖ *Ibid.* ver. 11.

171 That Christ died for the benefit of the human race, is a truth so apparent from these texts, that no man professing Christianity has hitherto called it in question. Very different opinions have been formed indeed concerning the nature and extent of that benefit, and the means by which it is applied; but that the passion and death of the blessed Jesus were essential parts of his ministry on earth, has seldom been controverted. That on the cross he made satisfaction to his Father for the sins of the world, is the general belief of Christians; but presumptuous men, aiming at being wise beyond what is written, have started a thousand idle questions concerning the necessity

Different opinions respecting the nature and extent of the benefit reaped from his death.

Theology more peculiarly Chriſtian.

of ſuch ſatisfaction, and the manner in which it was made. Some limiting the power and mercy of the Omnipotent, have dared to affirm that God *could not* have pardoned man without receiving full ſatisfaction for his offences; that nothing but the ſhedding of the blood of Chriſt could make that ſatisfaction; that his death was indeed ſufficient to atone for a thouſand worlds; that, however, he did not die for all mankind, but only for a choſen few, ordained to eternal life by a ſecret decree before the foundation of the world; and that the reſt of the race are paſſed by, and doomed to eternal perdition, for the glory of God's juſtice. Others, convinced by every thing around them that the Creator and Governor of the univerſe is a being of infinite benevolence, whoſe only end in giving life muſt have been to communicate happineſs, have contended, that no atonement whatever could be neceſſary to obtain from him the forgiveneſs of ſin on ſincere repentance; that it is contrary to all our notions of juſtice to puniſh the innocent for the guilty; and that therefore the death of Chriſt, though the eſſential part of his miniſtry, could not be neceſſary, but at the moſt expedient.

We enter not into theſe debates. The Scriptures have nowhere ſaid what God could or could not do; and on this ſubject we can know nothing but what they have taught us. That "we are reconciled to God by the death of his Son," is the principal doctrine of the New Teſtament; and without preſuming to limit the power, the mercy, or the wiſdom, of him who created and ſuſtains the univerſe, we ſhall endeavour to ſhow that it is a doctrine worthy of all acceptation. In doing this, we ſhall ſtate impartially the opinions which pious men have held reſpecting the form or manner in which Chriſt by his death made ſatisfaction to God for the ſins of the world; and we hope that our readers will embrace that opinion which ſhall appear to them moſt conſonant to the general ſenſe of ſacred Scripture.

172 Opinions of the Calviniſts.

The ſtricteſt adherents to the theological ſyſtem of Calvin, interpreting literally ſuch texts of Scripture as ſpeak of his being *made ſin* for us, of his *bearing our ſins in his own body on the tree*, and of the Lord's *laying on him the iniquity of us all*, contend, that the ſins of the elect were lifted off from them and laid on Chriſt by *imputation*, much in the ſame way as they think the ſin of Adam is imputed to his poſterity. "By bearing the ſins of his people (ſays Dr Gill *) he took them off from them, and took them upon himſelf, bearing or carrying them, as a man bears or carries a burden on his ſhoulders. There was no ſin *in* him inherently, for if there had, he would not have been a fit perſon to make ſatisfaction for it; but ſin was *put* upon him by his Divine Father, as the ſins of the Iſraelites were put upon the ſcape-goat by Aaron. No creature (continues he) could have done this; but the LORD hath laid on him, or made to meet on him, the iniquity of us all, not a ſingle iniquity, but a whole maſs and lump of ſins collected together; and laid as a common burden upon him; even the ſins of all the elect of God. This phraſe of laying ſin on Chriſt is expreſſive of the *imputation* of it to him; for it was the will of God not to impute the tranſgreſſions of his elect to themſelves, but to Chriſt, which was done by an act of his own; for he hath made him to be ſin for us: that is, by *imputation*, in which way we are made the righteouſneſs of God in him; that being imputed to us by him as our ſins were to Chriſt. The ſenſe (ſays our author) is, a charge of ſin was brought againſt him as the ſurety of his people. He was numbered with the tranſgreſſors; for bearing the ſins of many, he was reckoned as if he had been a ſinner himſelf, ſin being *imputed* to him; and he was dealt with as ſuch. Sin being found upon him by *imputation*, a demand of ſatisfaction for ſin was made, and he anſwered it to the full. All this was with his own conſent. He *agreed* to have ſin laid upon him, and *imputed* to him, and a charge of it brought againſt him, to which he engaged to be reſponſible; yea, he himſelf took the ſins of his people upon him; ſo the evangeliſt Matthew has it, 'He himſelf took our infirmities, and bore our ſickneſſes †.' As he took the nature of men, ſo he took their ſins, which made his fleſh to have *the likeneſs of ſinful fleſh*, though it really was not ſinful. What Chriſt bore being laid upon him, and imputed to him, were *ſins* of all ſorts, original and actual; ſins of every kind, open and ſecret, of heart, lip, and life; all acts of ſin committed by his people, for he has redeemed them from all their iniquities; and God, for Chriſt's ſake, forgives all treſpaſſes, his blood cleanſes from all ſin, and his righteouſneſs juſtifies from all; all being imputed to him as that is to them. Bearing ſin ſuppoſes it to be a burden; and indeed it is a burden too heavy to bear by a ſenſible ſinner (E). When ſin is charged home upon the conſcience, and a ſaint groans, being burdened with it, what muſt that burden be, and how heavy the load which Chriſt bore, conſiſting of all the ſins of all the elect from the beginning of the world to the end of it; and yet he ſunk not, but ſtood up under it; failed not, nor was he diſcouraged, being the mighty God, and the Man of God's right hand, made ſtrong for himſelf."

Theology more peculiarly Chriſtian.

† Chap. viii. 17.

173 Objected to.

To the Arminians or Remonſtrants, this doctrine of the imputation of the ſins of men to the Son of God appears as abſurd as the ſimilar doctrine of the imputation of the ſin of Adam to his unborn poſterity; and it is certainly attended with conſequences which have alarmed ſerious Chriſtians of other denominations.

Were it poſſible in the nature of things, ſays the Arminian, to transfer the guilt of one perſon to another, and to lay it upon him as a burden, it could not be done without violating thoſe laws of equity which are eſtabliſhed in the ſcripture and engraven on the human heart. But this is not poſſible. To talk of lifting lumps of ſin, or transferring them like burdens from the guilty to the innocent, is to utter jargon, ſays he, which has no meaning; and we might with as much propriety ſpeak of lifting a ſcarlet colour from a piece of cloth and laying it on the ſound of a trumpet, as of literally lifting the ſins of the elect from them and laying them on Chriſt. Guilt is ſeated in the mind; and no man can become a ſinner but by an act of volition. If Chriſt therefore *really* took upon him the ſins of his people, he muſt have deliberately formed a wiſh to have actually committed

* *Body of Divinity*, vol. ii. book iii. chap. v. § 4.

(E) By the phraſe *a ſenſible ſinner*, the learned author means a ſinner who is not paſt feeling, but has a conſcience alive to the ſenſe of remorſe.

logy *committed* all these sins; but such a wish, though it would have made him inherently guilty, and therefore incapable of satisfying for sin, could not have cancelled deeds that were done before he was born, or have made those innocent who really had been sinners. A deed once done cannot be undone; a volition which has been formed cannot be annihilated. By sincere repentance, the habitual dispositions are indeed changed, and those who have been sinners become objects of mercy; but no power can recal the hours that are past, or make those actions which have been performed to have been not performed. To remove guilt from the sinner and lay it on the innocent may therefore be safely pronounced impossible even for Omnipotence itself, for it implies that a thing may be and not be at the same instant of time; and the doctrine which teaches that this removal was made from the elect to Christ, is an imagination of yesterday, which has no countenance from scripture, and is contrary to the established constitution of things. Those who imagine that guilt may be propagated from father to son, have something like an argument to urge for the imputation of Adam's sin to his numberless posterity; for all the men and women who have by ordinary generation been introduced into the world, have undoubtedly derived their nature from the primeval pair. But Christ did not derive his nature from the *elect*, that their sins should be communicated to him; nor, as he was miraculously conceived by the Holy Ghost, can we attribute to him any degree of that *taint* which is supposed to have been conveyed from Adam to all the other generations of men.

Theology more peculiarly Christian.

Nothing more, therefore, can be meant by "Christ's being made sin for us," and "bearing our sins in his own body on the tree," or by God's "laying upon him the iniquity of us all," than that by his sufferings we are freed from the punishment of our sins: it being in scripture a common figure of speech, as even Dr Gill has somewhere acknowledged, to denote by the word *sin* the *consequences* of sin. That this figure is used in those texts from which he infers that Christ took the sins of the elect on himself, is evident from the verse which he quotes from the gospel of St Matthew; in which it is said, that "himself took our infirmities and bore our sicknesses." The sicknesses and infirmities there alluded to are the leprosy, the palsy, the fever, and demoniacal possessions: but when our blessed Lord cured these diseases, surely he did not by his omnipotent word lift them off from the patients and take them on himself, so as actually to become a leper, a paralytic, and a dæmonic, or even to be reckoned as such either by the multitude, or by the priests, whose duty it was to take cognizance of every illegal uncleanness *. And if his inveterate enemies did not *impute* to him the leprosy when he removed that plague from others, why should it be supposed that his own Father, to whom he was at all times well-pleasing, imputed to him the sins of which, by his sufferings, he removed the punishment from those who were guilty? To impute to a person any action, whether virtuous or vicious, which he did not perform, can proceed only from ignorance or malice, or partiality; but God is no respecter of persons, and from ignorance and malice he is removed to an infinite distance. It is indeed an undoubted truth, that "the Lord Jesus, by his perfect obedience and sacrifice of himself, which he through the eternal spirit once offered up unto God, hath fully satisfied the justice of his Father; and purchased not only reconciliation, but an everlasting inheritance in the kingdom of heaven for all those whom the Father hath given him †;" but that he actually took on himself the sins of mankind, or that those sins were imputed to him by God, who punished him as a person whom he considered as guilty, is a doctrine equally injurious to the justice of the Father and to the immaculate purity of the Son.

† *Confession of Faith*, chap. viii. § v.

175 They have probably contributed to make Socinus deny the doctrine of redemption.

The earnestness with which this doctrine was inculcated by some of the earliest reformers, and the impossibility of admitting it, which every reflecting and unprejudiced mind must feel, was probably one of the causes which drove Socinus and his followers to the other extreme of denying Christ's satisfaction altogether, and considering his death as nothing more than that of an ordinary martyr, permitted for the purpose of attesting the truth of his doctrine, and paving the way for his resurrection, to confirm the great promise of immortality. According to these men, forgiveness is freely dispensed to those who repent, by the essential goodness of God, without regard to the merit or sufferings of any other being; and the gospel is said to save from sin, because it is the most perfect lesson of righteousness. The great objection of *Crellius* to the doctrine of the satisfaction is, that it is a hinderance to piety; for if Christ has paid the whole debt, he thinks that he must have nothing to do, as nothing more can be required of us. And if it were indeed true that our sins are imputed to Christ, and his righteousness imputed to us, this objection would be insurmountable; for God could not justly exact a double punishment for the same sin, or inflict misery on those to whom he imputes perfect righteousness. But as to this imaginary transferring of virtues and vices from one person to another, the scriptures give no countenance; so they nowhere call the death of Christ a *satisfaction* for the sins of men. The term has indeed been long in use among divines, and when properly explained it may be retained without any danger; but in treating of this subject, it would perhaps be more prudent to restrict ourselves to the use of scripture language, as the word *satisfaction* carries in it the ideas of a debt paid and accepted; whereas it is said by St Paul, that "eternal life is the *gift* of God through Jesus Christ our Lord; and that we are justified *freely by his grace* through the redemption that is in Jesus Christ, whom God hath set forth to be a propitiation through faith in his blood."

176 The death of Christ restored to mankind what they had lost.

To clear up this matter, and attain adequate notions of redemption and justification, it will be necessary to look back to the fall of our first parents; for the great purpose for which Christ was promised, and for which he came into the world, was, by bruising the head of the serpent, to restore mankind to the inheritance which they had lost through the transgression of Adam. This is apparent not only from the original promise made to the woman, but also from different passages in the epistles of St Paul, who expressly calls Christ the second Adam, and says, that, "as by the offence of one, judgement came upon all men to condemnation; even so by the righteousness of one, the free gift came upon all men unto justification of life;" that "as by one man's disobedience many were made sinners, so by the obedience of one shall many be made righteous;" and that, "as in Adam all die, even so in Christ shall all be made alive."

Theology more peculiarly Christian.

alive." Hence it was that John the Baptiſt, when he ſaw Jeſus coming to him, ſaid to his diſciples †, "Behold the Lamb of God which taketh away, not the *ſins*, but the *ſin* of the world," evidently alluding to Adam's ſin and its conſequences, ſince no other ſin was ever committed of which the conſequences extend to the whole world.

† Ch. i. ver. 23.

This being the caſe, it is undeniable, that whatever we loſt in the firſt Adam is reſtored to us by the ſecond; and therefore they who believe that the puniſhment denounced againſt eating the forbidden fruit was death *corporal*, *ſpiritual*, and *eternal*, muſt believe that we are redeemed from all theſe by Chriſt; who having "appeared once in the end of the world to put away ſin by the ſacrifice of himſelf, died for us, that whether we wake or ſleep, we ſhould live together with him *." If the image of God in which man was created was loſt by the breach of the firſt covenant, it is more than reſtored to us "by the Mediator of a better covenant, which is eſtabliſhed upon better promiſes;" if by the ſin of Adam we were utterly indiſpoſed, diſabled, and made oppoſite to all that is ſpiritually good, and wholly inclined to all evil, and that continually, we are freed from that dreadful curſe by "our Saviour Jeſus Chriſt, who gave himſelf for us, that he might redeem us from all iniquity, and purify to himſelf a peculiar people zealous of good works †;" and if for our ſhare in the firſt tranſgreſſion we be juſtly liable to all puniſhments in this world and in that which is to come, the apoſtle aſſures us, that "when we were enemies we were reconciled to God by the death of his Son, becauſe that God was in Chriſt reconciling the world to himſelf, not imputing their treſpaſſes unto them ‡." As Jeſus is "the Lamb ſlain in the divine decree from the foundation of the world," theſe beneficial conſequences of his death have been extended by a retroſpective view to all in every age whoſe names are written in the book of life, though it is abſurd to ſuppoſe that he literally took their ſins upon him, and impious to imagine that he ſuffered under the imputation of ſin.

* Heb. ix. 26. 1 Theſſ. v. 10.

† Titus ii. 14.

‡ Rom. v. 10. 2 Cor. v. 19.

177 Moderate Calviniſts and Remonſtrants of the ſame opinion.

Such is the general doctrine of redemption, as it is taught by the more moderate Calviniſts and more moderate Remonſtrants; for moderate Chriſtians of all denominations, though they expreſs themſelves differently, have nearly the ſame views of the fundamental articles of their common faith. It muſt not, however, be concealed, that many divines of great learning and piety contend ſtrenuouſly againſt the doctrine of vicarious atonement for actual tranſgreſſions of the moral law. Theſe are the more zealous Arminians, who deny that we inherit any mortal taint or intellectual weakneſs from our firſt parents, whom they believe never to have been in a ſtate of greater perfection than many of their poſterity who are called *degenerate*. According to them, we loſt nothing by the fall of Adam but our title to eternal life or perpetual exiſtence, together with thoſe graces of the Holy Spirit which were beſtowed under the firſt covenant to train mankind for the ſociety of heaven; and as eternal life and ſupernatural grace conſtituted one free gift, not due to the nature of man, or indeed of any created being, they might, when forfeited, be reſtored by any means or on any condition which ſhould ſeem expedient to the all-wiſe Donor. Theſe means, and that condition, human reaſon cannot indeed diſcover; but it ſeems very fit that they ſhould be different

178 Doctrine of the more zealous Arminians.

from the means by which moral agents under the law of nature can ſecure to themſelves the favour of their Creator, or recover it when occaſionally loſt. The former depends on arbitrary will and pleaſure, or at leaſt on no other principles diſcoverable by us; while the latter ariſeth out of the eſtabliſhed and well-known conſtitution of things. Thus moral virtue, comprehending piety, was the condition of that favour and protection which man, in his original ſtate, could claim from his Maker; but obedience to a poſitive command was the condition of the free gift of immortality conferred on Adam on his introduction into paradiſe. The claim ariſing from the relation between the creature and the Creator is indiſſoluble, becauſe that relation cannot be diſſolved: ſo that the man who, by a tranſgreſſion of the moral law has forfeited the favour of God, may reaſonably hope to recover it by ſincere repentance and a return to his duty; and nothing but ſuch repentance and reformation can recover it; becauſe, in a moral agent, nothing can be agreeable to God but moral diſpoſitions, which cannot be transferred from one perſon to another, and for the want of which nothing can atone. Our virtues are not required nor our vices prohibited, as if the one could profit and the other injure him who created us; for "is it any *pleaſure* to the Almighty that we are righteous? or is it *gain* to him that we make our ways perfect? Will he reprove us for *fear* of us?" No? He commands us to be virtuous, and forbids us to be vicious, only becauſe virtue is neceſſary to our own happineſs, and vice productive of everlaſting miſery.

Were an immoral man to be introduced into the ſociety of angels and juſt men made perfect, he would not experience in that ſociety what we are taught to expect from the joys of heaven; becauſe to ſuch joys his acquired diſpoſitions would be wholly repugnant. Nor could the ſufferings of any perſon whatever, or the *imputation* of any extrinſic righteouſneſs, make that mind which had long been immerſed in the groſſeſt ſenſuality reliſh the intellectual and refined enjoyments of heaven; or the man who had been the habitual ſlave of envy, malice, and duplicity, a fit inhabitant of that place where all are actuated by mutual love. On the other hand, ſay the divines whoſe doctrine we are now detailing, it is impoſſible to ſuppoſe that the Father of mercies, who knows whereof we are made, ſhould have doomed to eternal miſery any moral agent who had laboured through life to ſerve him in ſincerity and in truth; or that any atonement could be neceſſary to redeem from the pains of hell the man whoſe pious and virtuous diſpoſitions have through penitence and prayer become ſuited to the ſociety of heaven. Unſinning perfection never was nor ever could be expected in man. He is brought into the world free indeed from vice, but equally deſtitute of virtue; and the great buſineſs of his life is to guard his mind from being polluted by the former, and to acquire diſpoſitions habitually leading to the practice of the latter. Till theſe habits be fairly formed, it ſeems impoſſible that he ſhould not ſometimes deviate from the paths of rectitude, and thereby incur a temporary forfeiture of the divine favour; but the very conſtitution of his mind, and the purpoſe for which he is placed in a ſtate of probation, ſhow that the divine favour thus forfeited can be recovered only by repentance and reformation.

Widely

Theology more peculiarly Christian.

Widely different, however, is the case with respect to the forfeiture and recovery of a free gift, to which man has no natural claim. When the condition is broken on which such a gift was bestowed, repentance can be of no avail; it must be either irrecoverably lost, or restored by the mere good pleasure of the giver. Immortality or perpetual existence is a gift which upon certain terms was freely bestowed upon the human race, and forfeited by the transgression of their first parent violating those terms. It was restored by the free grace of God, who was pleased to ordain, that "since by man came death, by man should also come the resurrection of the dead; for as in Adam all die, even so in Christ shall all be made alive. "Hence the apostle, writing to the Romans of the benefits of being the children of God, and joint-heirs with Christ, summeth up those benefits with resurrection from the dead." For the creature, i. e. mankind, was made subject (says he *) to vanity or death, not willingly, but by reason of him who hath subjected the same in hope: because the creature itself also shall be delivered from the bondage of corruption into the glorious liberty of the children of God. For we know that the whole creation groaneth, and travaileth in pain together until now: and not only *they*, but *ourselves* also, who have the first fruits of the spirit, even we ourselves groan within ourselves, waiting for the adoption, viz. *the redemption of our body* (F). That this the redemption of our body is the consequence of the sacrifice of Christ, is taught in the most explicit terms in the epistle to the Hebrews; of which the inspired author informs us, that "forasmuch as the children are partakers of flesh and blood, he also himself likewise took part of the same; that through *death* he might destroy him that had the power of death, that is the devil; and deliver them, who through fear of death were all their lifetime subject to bondage *." A vicarious atonement made with this view, the divines, whose theory we are now considering, acknowledge to be perfectly rational and consistent with the strictest justice. "The law of nature (say they †) allows not of vicarious atonements; but ordains that the man who transgresseth shall himself bear the punishment of his iniquity; a punishment which no man deserves for the faults of another, unless he be partaker of the guilt by joining in the transgression." And in proof of this their opinion, they appeal to the words of God himself, declaring to Moses,—"Whosoever hath sinned against me, him will I blot out of my book ‡." But when the free gift of immortality was lost, it was with great wisdom, say they, that God restored it through a Mediator who should make atonement by his blood for the breach of the first covenant; since such a mediation implies that the gift restored is merely of grace, to the attainment of which man could no further co-operate than by his hopes and wishes.

* Rom. viii. 20. 24.

† Warburton's Div. Leg. b. ix. Law's Considerations on the Theory of Religion, p. iii. cod. Exod. xxxi. 33.

182 The death of Christ an atonement only indirectly for actual sin.

To this view of redemption, and indeed to every view of it which we have yet taken, an objection forces itself upon the mind. Throughout the New Testament LIFE AND IMMORTALITY are considered as a *FREE gift*, and called so in express words by St Paul*. To the scheme under consideration it is essential to consider them as such; and yet we know that a large price was paid for them, as St Paul likewise acknowledges, when he twice tells the Corinthians that they were bought with a price †.

* Rom. v. 15.

† Cor. vi. 20. vii. 23.

181 Obviated.

"To clear up this matter (says Bishop Warburton), and to reconcile the apostle to himself, who certainly was not defective either in natural sense or artificial logic, let us once again remind the reader, that life and immortality bestowed on Adam in paradise was a *FREE gift*, as appears from the history of his creation. As a *free gift*, it was taken back by the Donor when Adam fell; to which resumption our original natural rights are not subject, since natural religion teacheth, that sincere repentance alone will reinstate us in the possession of those rights which our crimes had suspended. So that when this free gift, forfeited by the *first* Adam, was recovered by the *second*, its nature continuing the same, it must still remain a *free gift*—a gift to which man, by and at his creation had no claim; a gift which natural religion did not bestow. But if misled by measuring this *revealed mystery* of human redemption by the scant idea of human transactions, where a *free gift* and *purchased benefit* are commonly opposed to one another, yet even here we may be able to set ourselves right, since, with regard to man, the character of a *free gift* remains to *immortality restored*. For the price paid by forfeited man was not paid by him, but by a Redeemer of divine extraction, who was pleased, by participating of man's nature, to stand in his stead. Hence the sacred writers seeing, in this case, the perfect agreement between a *FREE GIFT* and a *PURCHASED POSSESSION*, call it sometimes by the one and sometimes by the other name ‡."

‡ Div. Leg. book 9. ch. 2.

182

A restoration to life and immortality from that state of unconsciousness or extinction, to which all mankind were doomed in consequence of the fall, is that great salvation which we have obtained through the blood of our Redeemer; and according to the theologians whose theory we are now considering, it was the only thing in the divine intention when the promise was given to the first mother that the seed of the woman should bruise the head of the serpent. But though they contend that the death of Christ does not operate *directly* as an atonement for the *actual* sins of men, they admit that it does so *indirectly* and by necessary consequence, since it gives opportunities for repentance and newness of life, which under the first covenant they did not enjoy. Had a man under that covenant transgressed any moral precept, he would have forfeited the favour of his God, and either been subjected to punishment or to a long course of repentance; but supposing the efficacy of repentance under

(F) That by the words *creature* and *creation* the apostle here means all mankind, and by *vanity* and *corruption*, death, the reader will find proved by Dr Whitby, in his note on the place, with a strength of argument which cannot be shaken; and that the whole creation, the Gentiles as well as the Jews, groaned and travailed in pain together under the apprehension of death, is apparent from the writings of Cicero, who always seems doubtful whether death be a good or an evil; and from the lamentation of Hezekiah, when desired by the prophet to set his house in order because he should die and not live.

Theology more peculiarly Christian.

der the law of nature to be what they suppose it to be, he might before it was perfected have lost his existence by the eating of the forbidden fruit; and thus his penitence or punishment have ended in everlasting death. This can never be the issue of things under the new covenant, which, by the death of Christ, secures immortality to man, and gives to him opportunities, as long as he shall be in a state of probation, of recovering the divine favour when forfeited, whether by a moral transgression or a temporary violation of the peculiar condition of the covenant. Hence they admit the truth of the apostle's doctrine, that we are gainers by the fall of Adam and the redemption wrought by Christ; which will appear when we come to consider their notions of justification. In the mean time it may be proper to observe, that they consider it as no small confirmation of their opinion, that it tends to put an end to the long agitated disputes concerning the *extent* of redemption, and to reconcile passages of scripture which, on the commonly received theories both of Calvinists and Arminians, seem to be at variance with each other.

183 According to the Calvinists Christ died only for the elect.

It is well known to be one of the fundamental doctrines of the Calvinistic school, that "none are *redeemed* by Christ, effectually called, justified, adopted, sanctified, and saved, but the elect only *;" and if the notions of redemption, which, in the end of the 17th century, were very generally embraced, be admitted as just, it will not be easy to overturn the arguments by which that doctrine is supported. Such of them as are connected with the great question of election and reprobation, and enter into the decision of it, we have stated in another place (see PREDESTINATION, N° 14.); but it is farther argued †, that the doctrine of *universal* redemption reflects on the wisdom, the justice, and the power of God, and robs him of his glory.

* *Confession of Faith of the Church of Scotland*, ch. iii. § 6.

† *Gill's Body of Divinity*, vol. ii. book 3. ch. 3.

The scriptures assure us that all men shall not be saved; but how can this be, if Christ died for all, and the scheme of salvation by his death was formed by infinite wisdom? The Arminians indeed say, that those who fail of salvation, fail through their own fault in not performing the conditions required of them; but God either *knew* or knew *not* that such men would not perform those conditions. If he knew it not, his knowledge is limited; if he did know it, where was his wisdom in providing a scheme of redemption for men to whom he was aware that it would be of no benefit? "God, we are told, is righteous in all his ways, and holy in all his works;" but there is no righteousness in making Christ bear the sins of *all* men, and suffer the punishment due to them, if any one of those men shall be afterwards punished everlastingly. If Christ has already paid the debts of the whole world, it cannot be just to cast a single inhabitant of the whole world into the prison of hell, there to be detained till he shall again have paid the uttermost farthing. "The Lord's hand is not shortened that it cannot save;" for he is and always will be the same Almighty power that he was from eternity; but if by the divine decree Christ died for all men, and yet all men shall not be saved, it would appear that man is mightier than his Maker! The ultimate end of God in the redemption of man is admitted to have been his own glory; but if any individual of the human race, who was redeemed by Christ, shall not be saved, God will so far lose his end, and be deprived of his glory. For, if this were the case, where would be the glory of God the Father in forming a scheme which, with respect to multitudes, does not succeed? and where would be the glory of the Son of God, the Redeemer, in working out the redemption of men who are yet not to be saved by him? and where would be the glory of the spirit of God, if redemption were not by him effectually applied to every individual for whom it was wrought? By such arguments as these do the Calvinists oppose the scheme of universal redemption, and contend that Christ died only for the *elect*, or such as shall be placed on his right hand at the day of judgment. This notion of a limited redemption, as they think it more worthy of the sovereignty of God, they believe to be taught by our Saviour himself, when he saith *, "All that the Father *giveth* me shall come to me; and him that cometh to me, I will in nowise cast out. For I came down from heaven, not to do mine own will, but the will of him that sent me. And this is the Father's will who hath sent me, that of all which he hath *given* me I should lose nothing, but should raise it up again at the last day."

Theology more peculiarly Christian.

* John vi. 37—40.

184 According to the Arminians he died for all men.

The Arminians, on the other hand, contend, that it is impious to limit the effects of Christ's death to a chosen few, since it appears from scripture, that by the decree and intention of his Father he tasted death for every man, that all, without exception, might through him obtain remission of their sins. Thus our Lord himself told Nicodemus †, that "as Moses lifted up the serpent in the wilderness, even so must the Son of Man be lifted up; that *whosoever* believeth in him, should not perish, but have everlasting life. For God so loved the *world*, that he gave his only begotten Son, that whosoever believeth in him should not perish, but have everlasting life. For God sent not his Son into the world to condemn the world, but that the *world* through him might be saved." In perfect conformity with the doctrine of his divine Master, St Paul teaches ‡, that "Christ died for *all;* that God was in Christ reconciling the *world* to himself, not imputing their trespasses unto them;" that "he will have *all* men to be saved, and to come unto the knowledge of the truth;" that "Christ gave himself a ransom for *all;*" and that "Jesus was made a little lower than the angels, that by the grace of God he should taste death for *every man.*" The very same thing is taught by St Peter and St John, when the former says §, that "the Lord is not willing that *any* should perish, but that *all* should come to repentance;" and the latter ||, that "Jesus Christ the righteous is the propitiation for our sins; and not for our's only, but for *the whole world.*"

† John iii. 14—18.

‡ 2 Cor. v. 14—20. 1 Tim. ii. 4—7. Heb. ii. 9.

§ 2 Peter iii. 9.

|| 1 John ii. 2.

On these texts, without any commentary, the Arminians are willing to rest their doctrine of universal redemption; though they think that a very strong additional argument for its truth arises from the numberless absurdities which flow from the contrary opinion. Thus, say they *, the apostles were commanded by our Saviour † to "go into *all* the world and preach the gospel to *every creature*," and all who hear it preached are required to believe it: but no man, as the Calvinists themselves confess, can believe the gospel as a Christian, without believing that Christ *died for him;* and therefore, if it be true that Christ died only for the *elect*, a great part of mankind are required to believe a lie, and a falsity is made the object of divine faith! Again, if Christ did not die for *all*, then no man can be sure that he

* *Limborch's Theologia Christiana*, Eng. Trans. book 4. ch. 3.

† St Mark xvi. 15, 16.

ogy he is bound to believe in Christ when preached to him: ecu- nor can any man be justly condemned for infidelity: hri- which is not only absurd in itself, but directly contrary to what we are taught by our blessed Lord, who assures us *, that unbelief is the cause of condemnation. Lastly, if Christ died not for *all*, then is it certain that he cannot claim dominion *over all* in *consequence* of his *death* and *resurrection*; but St Paul says expressly †, that "to *this end* Christ both *died*, and *rose*, and *revived*, that he might be the Lord of the *dead* and *living*." The Arminians acknowledge, that though Christ died for all, there are many who will not be saved; for, say they ‡, the death of Christ did not literally pay the debts incurred by sinners, but only obtained for them the gracious covenant of the gospel, by which all who believe in him, and sincerely endeavour to work out their own salvation with fear and trembling, are entitled to forgiveness of sins and eternal life.

Such is the state of this controversy as it was agitated between the Calvinists and Arminians of the 17th century; but the present leaders of this latter school are of opinion, that it never could have been started, had not both parties mistaken the purpose for which Christ died. It is not conceivable, say they, that any thing for which the eternal Son of God took upon him human nature, and in that nature suffered a cruel and ignominious death, shall not be fully accomplished; and therefore, if in the divine intention he died to make atonement for the sins of man actual as well as original, we must of necessity conclude, that those for whom he died shall certainly be saved. Yet we learn from scripture that many shall go away into everlasting punishment, though the same scripture repeatedly assures us that Christ gave his life a ransom for *all*, and that he is the propitiation for *the whole world*. To reconcile these different passages of scripture is impossible, if we suppose that he laid down his life to atone for the *actual* transgressions of men; but if the direct purpose of the Godhead in forming this stupendous plan of redemption was, that the death of Christ should be the ransom of all from the grave or utter extinction, every difficulty is removed; for we know that all, the wicked as well as the righteous, shall through him be raised to life at the last day. That this was the purpose for which he died, they think apparent from the very words quoted by the Calvinists to prove that redemption was not universal; for he declares that it was his Father's will, "that of all which had been given him he should lose nothing," *not* that he should save it all from *future punishment*, but only that he "should raise it up at the last day." When St John calls him a propitiation for our sins, which, as we have seen, the divines whose doctrine we are now stating hold him to be indirectly, he does not add, as in our translation, for the *sins* of the whole world, but περι ὁλου του κοσμου, for the whole world, which, by his death, he redeemed from that vanity and corruption under which, according to St Paul, it had groaned from the fall till the preaching of the gospel. Hence it is that our blessed Lord calls himself "the resurrection and the life," and always promises to those who should believe in him, that though they were dead, yet should they live, and that he would raise them up at the last day.

Among these various opinions respecting the destination of the death of Christ, it belongs not to us to decide. The serious reader, divesting himself of prejudice in favour of the system in which he has been educated, will search the scriptures, and adopt the theory which he shall find most explicitly taught in that sacred volume; but as in every system it is admitted, that *one purpose* for which Christ died was to redeem mankind from the everlasting power of the grave, and bring to light life and immortality, it is of the utmost importance to know whether that purpose has been fully attained. Death we see still triumphing over all the generations of men; and as the scriptures give us no hopes of being rescued from its dominion but through the medium of a resurrection, some sensible evidence seems necessary to evince that a general resurrection shall actually take place. This we are promised as one great benefit purchased for us by the sufferings of Christ sacrificed on the cross. And since the price has been *paid*, and paid thus *visibly*, the nature of the covenant requires that the benefit should be as *visibly enjoyed* by the person whose sufferings obtained it for his brethren. "If the Redeemer himself had not been seen to enjoy the fruits of the redemption procured, what hopes could have remained for the rest of mankind? Would not the natural conclusion have been, that the expedient of *redemption*, by the death and sacrifice of Jesus, had proved ineffectual?" This is the conclusion which St Paul himself draws: "If Christ be not risen (says he *), then is our preaching vain, and your faith is also vain; ye are yet in your sins. Then they also, who are fallen asleep in Christ, are perished—απωλοντο—are lost, as if they had never existed. But now (adds he) is Christ risen from the dead, and become the first fruits of them that *slept*. For since by man came *death*, by man came also the *resurrection* of the dead: For as in Adam *all die*, even so in Christ shall *all be made alive*."—So necessarily connected, in the opinion of the apostle, is the resurrection of Christ with the very essence of Christianity †.

We have in another place (see RESURRECTION, N° 50.) stated such arguments for the truth of this fundamental article of our common faith, as must carry conviction to every mind capable of estimating the force of evidence; we shall not here resume the subject.

Archbishop King has supposed ‡, that the human will is a faculty distinct from the understanding and the appetites; that activity is essential to it; and that previous to an election formed, it is equally indifferent to all objects. He thence infers, that a man may choose, and even take delight in, what is not naturally agreeable to any of his appetites; because when the choice is made, a relation is formed between the will and the object of choice, which, from being originally indifferent, now becomes a favourite object. But neither his Grace, nor any other asserter of human liberty, has ever affirmed or supposed, that any man or body of men could deliberately choose *evil* for its *own sake*, or enter zealously upon a tedious and difficult enterprise, from which *no good* could *possibly arise*, and from which *unmixed misery* was *clearly foreseen* as the *necessary result of every step of the progress*. Such, however, must have been the choice and the conduct of the apostles, when they resolved to preach a new religion founded on the resurrection of Jesus, if they did not certainly know that Jesus had risen from the dead. And this conduct must have been adopted, and, in opposition to every motive which can influence the human mind, have been persevered

Theology more peculiarly Christian.

186
One purpose for which Christ died was to bring to light life and immortality.

* 1 Cor. xv. 15—23.

† *Warburton's Sermon on the Resurrection.*

‡ *Origin of Evil*, 4th edit. ch. v. sect. 1. subsect. 3. and 4.

Theology more peculiarly Christian.

vered in by a great number of men and women, without the ſmalleſt contradiction having ever appeared in the various teſtimonies, which at different times, and under the cruelleſt tortures, they all gave to a variety of circumſtances, of which not one had its foundation in truth. He who can admit this ſuppoſition, will not ſurely object to the incredibility of miracles. The reſurrection of a man from the dead is an event ſo different indeed from the common courſe of things, that nothing but the moſt complete evidence can make it an object of rational belief; but as the reſurrection of Jeſus has always been ſaid to have had God for its Author, it is an effect which does not exceed the power of the cauſe aſſigned, and is therefore an event poſſible in itſelf and capable of proof. It is a deviation from the laws of nature, but it is not contradictory to any one of thoſe laws.

That a great number of men and women ſhould deliberately form a plan of ruin and miſery to themſelves, without a proſpect of the ſmalleſt advantage either in this world or in the next, is as different from the common courſe of things as the reſurrection from the dead; and therefore in itſelf at leaſt as great a miracle: but that they ſhould perſiſt in proſecuting this plan in the midſt of torments; that they ſhould ſpread themſelves over the whole world, and everywhere publiſh a number of falſehoods, without any one of them contradicting the reſt; that truth ſhould never eſcape them either in an unguarded moment, or when lingering on the rack, and yet that all their lies ſhould be in perfect agreement with each other; that they ſhould every one of them court ſufferings for a perſon whom they knew to be an impoſtor; that not one of the number—not even a ſingle woman—ſhould have ſo much compaſſion for a fellow-creature, as to reſcue him from the flames by confeſſing a truth which could injure nobody—not even the ſuffering deceivers themſelves;—all this is not only different from the common courſe of things, but directly contrary to the moſt known laws of nature, and is therefore not miraculous, but may be pronounced impoſſible. Yet this impoſſibility we muſt admit, or acknowledge, that as Chriſt died for our ſins, according to the Scriptures, and was buried; ſo he roſe again the third day according to the Scriptures; that he was ſeen of Cephas, then of the twelve; after that of above five hundred brethren at once; after that of James; then of all the apoſtles; and that he was laſt of all ſeen of St Paul *, who was converted by the viſion to preach the faith which till then he had perſecuted.

* 1 Cor. xv. 3—9.

187 Hence we are aſſured of our own reſurrection.

Thus are we aſſured, that "thoſe who have fallen aſleep in Chriſt are not loſt, ſince he is riſen from the dead, and become the firſt fruits of them that ſlept. For ſince by man came death, by man came alſo the reſurrection of the dead. For as in Adam all die, even ſo in Chriſt ſhall all be made alive. But every man in his own order: Chriſt the firſt-fruits, afterwards they that are Chriſt's at his coming; for all that are in the graves ſhall hear his voice, and ſhall come forth; they that have done good unto the reſurrection of life, and they that have done evil to the reſurrection of damnation †."

† 1 Cor. xv. 20—24. and St John v. 28, 29.

Our bleſſed Lord having converſed familiarly with the eleven apoſtles for forty days after his reſurrection, inſtructing them in the things pertaining to the kingdom of God; having extended their authority as his miniſters, by giving them a commiſſion to teach all nations, and make them his diſciples, by baptizing them in the name of the Father, and of the Son, and of the Holy Ghoſt; and having promiſed them power from on high to enable them to diſcharge the duties of ſo laborious an office—led them out as far as Bethany, that they might be witneſſes of his aſcenſion into heaven. "When they therefore were come together, they aſked of him, ſaying, Lord, wilt thou at this time reſtore again the kingdom to Iſrael? And he ſaid, it is not for you to know the times and the ſeaſons, which the Father hath put in his own power. But ye ſhall receive power after that the Holy Ghoſt is come upon you; and ye ſhall be witneſſes unto me, both in Jeruſalem, and in all Judea, and in Samaria, and unto the uttermoſt parts of the earth. But tarry ye in the city of Jeruſalem, until ye be endued with power from on high; and he lift up his hands and bleſſed them; and it came to paſs while he bleſſed them, he was parted from them, and a cloud received him out of their ſight. And while they looked ſtedfaſtly towards heaven, as he went up, behold, two men ſtood by them in white apparel; who alſo ſaid, ye men of Galilee, why ſtand ye gazing up into heaven? This ſame Jeſus, who is taken up from you into heaven, ſhall ſo come, in like manner as ye have ſeen him go into heaven. And they worſhipped him, and returned to Jeruſalem with great joy *."

Theology more peculiarly Chriſtian.

* St Luke xxiv. 49—53. and Acts i. 6—12.

188 Proofs of Chriſt's aſcenſion.

That our bleſſed Lord aſcended into heaven, will ſcarcely be denied in the preſent age by any one who admits that he roſe from the dead. The aſcenſion was indeed the natural conſequence of the reſurrection; for we cannot ſuppoſe that a man would be called back from the grave to live for ever in a world where all other men fall in ſucceſſion a prey to death. The purpoſe for which he died was to recover for the deſcendants of Adam every privilege which they had forfeited through his tranſgreſſion; and if, as has been generally believed, mankind were by the terms of the firſt covenant to enjoy eternal life in heaven, ſome proof was neceſſary that Chriſt by his death and reſurrection had opened the kingdom of heaven to all faithful obſervers of the terms of the ſecond. Hence it was propheſied † of the Meſſiah, in whom all the nations of the earth were to be bleſſed, that "he ſhould aſcend on high, lead captivity captive, and ſit on the right hand of God until his enemies ſhould be made his footſtool." It was therefore of the greateſt importance to the apoſtles to have ſufficient proof of their Maſter's exaltation to the right hand of the Majeſty on high; for otherwiſe they could neither have looked for an entrance into heaven themſelves, by a new and living way, as the author of the epiſtle to the Hebrews expreſſes it, nor have preached Jeſus as the Meſſiah promiſed to their fathers, ſince they could not have known that in him theſe prophecies were fulfilled. But the proof vouchſafed them was the moſt complete that the nature of the thing would bear. The ſpectators of the aſcenſion were many; for, according to the hiſtory of St Luke ‡, theſe who returned from the Mount of Olives to Jeruſalem, and prepared themſelves for the coming of the Holy Ghoſt, were in number about ſix ſcore; and to ſuch a cloud of witneſſes the evangeliſt would not have appealed, had not the fact he was recording been very generally known. Yet theſe were perhaps but part of the witneſſes; for ſince

† Pſ. lxviii. 18. cx. 1. Micah ii. 13.

‡ Acts i. 12—16.

since Christ had told his disciples that he was to ascend to his Father and their Father, to his God and their God, and that he was going to prepare a place for them, that where he is there they might be likewise; we can hardly doubt but that all who believed in him as the Redeemer of the world would take care to be present, not only to view their Master's triumph over all his enemies, but also to have a sight of that glory which awaited themselves. It was on this occasion probably that he was seen after his resurrection by above five hundred brethren at once, of whom the greater part were alive at the writing of St Paul's first epistle to the Corinthians.

But though such multitudes of people saw Jesus lifted up from the mount, and gradually vanish out of their sight, some other evidence seemed necessary to certify them of the place to which he had gone. Two angels therefore appear, and attest what human eyes could not see, but what was indeed the consequence of what they had seen. They attest that Christ had ascended to heaven, not to descend again till the last day; and surely, with respect to this point, the citizens of heaven were the most unexceptionable witnesses. We must therefore acknowledge and confess, against all the wild heresies of old (K), that Jesus Christ the Son of God, who died and rose again, did with the same body and soul with which he had lived upon earth ascend up "into heaven, there to appear in the presence of God for us *." Having in the outward tabernacle of this world once offered up himself a pure and perfect sacrifice for the expiation of our sins, he entered within the veil into the most holy place, there to present his blood before God himself, in order to obtain mercy for us, and restore us to the Divine favour. So that, "if any man sin, we have an advocate with the Father, Jesus Christ the righteous, who is the propitiation for our sins, and not for ours only, but also for the sins of the whole world; and he is able to save to the uttermost those that come to God by him, seeing he ever liveth to make intercession for us." "Seeing then that we have a great high-priest, who is passed into the heavens, Jesus the Son of God, we may through him come boldly unto the throne of grace, that we may obtain mercy, and find grace to help in time of need."

But it is not the office of a priest only that our Lord discharges in heaven; he is represented as sitting on the right hand of God, to denote that regal authority with which he is now vested; "angels, and authorities, and powers, being made subject to him †." Hence it is, that after his resurrection, he said of himself ‡, "all power is given unto me in heaven and in earth;" for, as St Paul informs us §, "because he humbled himself and became obedient unto death, even the death of the cross, therefore God hath highly exalted him, and given him a name which is above every name: that at the name of Jesus every knee should bow, of things in heaven, and things in earth, and things under the earth." And this submission is due to him, because "God raised him from the dead, and set him at his own right hand in the heavenly places, far above all principalities and powers, and might, and dominion, and every name that is named, not only in this world, but also in that which is to come; and hath put all things under his feet, and gave him to be head over all things to the church *." As God, Christ possessed a kingdom, which, as it had not a beginning, can never have an end: but the dominion, of which the apostle is here treating, was conferred upon him as the mediator of the new covenant, and will no longer continue than till his enemies shall be subdued; for we are told, that "he must reign till he hath put all enemies under his feet; and that the last enemy which shall be destroyed is death." "He will ransom his subjects from the power of the grave; he will redeem them from death. O death, he will be thy plague; O grave, he will be thy destruction †." The trumpet shall sound, the graves shall be opened, all the sons and daughters of Adam shall return to life, and death shall be swallowed up in victory. "Then cometh the end, when the office of mediator ceasing, he shall have delivered up the kingdom to God, even the Father, when he shall have put down all rule and all authority and power. For when all things shall be subdued unto him, then shall the Son also himself be subject unto him that put all things under him, that God may be all in all ‡."

Theology more peculiarly Christian.

* Eph. i. 20, &c.

† Hosea xiii. 14.

‡ 1 Cor. xv. 24—28.

191 Descent of the Holy Ghost on the apostles.

The first conspicuous proof which our blessed Lord gave of being vested with supreme power, and made head over all things to the church, was on the day of Pentecost. He had told the apostles that he would pray the Father to give them another comforter, who should abide with them for ever, even the Spirit of truth, which should teach them all things, and bring all things to their remembrance which he had said unto them. He had assured them, that it was expedient for them that he himself should go away; "for if I go not away (said he *), the Comforter will not come unto you; but if I depart, I will send him unto you." At his last interview with them, just before his ascension, he had desired them to tarry at Jerusalem till they should be endued with power from on high, before they entered upon their great work of converting the nations. These promises were amply fulfilled; for "when the day of Pentecost was fully come, they were all with one accord in one place. And suddenly there came a sound from heaven as of a rushing mighty wind, and it filled all the house where they were sitting. And there appeared unto them cloven tongues, like as of fire, and it sat upon each of them. And they were all filled with the Holy Ghost, and began to speak with other tongues, as the Spirit gave them utterance. And there were

* John xvi. 7.

(H) There was one Apelles in the primitive church, who was condemned as a heretic for teaching that Christ's body was dissolved in the air, and that he ascended to heaven without it. The opinions of this man and his followers are stated at large and confuted by Tertullian, Gregory Nazianzen, and Epiphanius; and the reader who thinks such ridiculous notions worthy his notice, will find enough said of them in the Notes to the sixth article of Pearson's Exposition of the Creed. Perhaps it may be from a hint communicated in these Notes, that our great modern corrector of the evangelists has discovered, if it be indeed true that he pretends to have discovered, that Jesus Christ is still upon earth.

Theology more peculiarly Chriſtian.

dwelling at Jeruſalem Jews, devout men, out of every nation under heaven. Now when this was noiſed abroad, the multitude came together, and were confounded, becauſe that every man heard them ſpeak in his own language. And they were all amazed, and marvelled, ſaying one to another, Behold, are not all theſe who ſpeak Galileans? And how hear we every man in our own tongue, wherein we were born? Parthians, and Medes, and Elamites, and the dwellers in Meſopotamia, and in Judea, and Cappadocia, in Pontus and Aſia, Phrygia and Pamphylia, in Egypt and in the parts of Libya about Cyrene, and ſtrangers of Rome, Jews and proſelytes, Cretes and Arabians—we do hear them ſpeak in our tongues the wonderful works of God. And they were all amazed, and were in doubt, ſaying one to another, What meaneth this * !"

* Acts ii 1—13.

192 Certainty of that miracle.

That thoſe who heard the apoſtles ſpeak ſo many different languages were amazed, is what we ſhould naturally ſuppoſe; but that a ſingle individual among them remained unconvinced, is aſtoniſhing? for the gift of tongues on the day of Pentecoſt is one of the moſt palpable miracles that was ever wrought. It is likewiſe one of the beſt authenticated miracles; for the book entitled *the Acts of the Apoſtles* was written not more than 30 years after the event took place (ſee SCRIPTURE, N° 168.); and it is not conceivable that, within ſo ſhort a period, St Luke, or any man of common ſenſe, would have appealed for the truth of what he recorded to ſo many inveterate enemies of the Chriſtian name, had he not been aware that the miraculous gift of tongues was a fact incontrovertible. We all know how deſirous the Jewiſh rulers were to ſtop the progreſs of the faith, by whatever means; but if this miracle was not really performed, they had now an opportunity of doing it effectually by means to which truth and honour would give their approbation. Thouſands muſt have been alive in the city of Jeruſalem who were men and women at the time when the apoſtles were ſaid to have been thus ſuddenly inſpired with the tongues of the Parthians, Medes, and Elamites, &c.; and as theſe foreigners were themſelves either Jews by deſcent, or at leaſt proſelytes to the Jewiſh religion, ſurely the chief-prieſts would have found multitudes ready, both at home and abroad, to contradict this confident appeal of St Luke's if contradiction had been poſſible. We read however of no objection whatever being made to this miracle. Some of the audience, indeed, when the apoſtles addreſſed people of ſo many nations in all their reſpective languages, not underſtanding what was ſaid, and taking it for jargon which had no meaning, concluded, not unnaturally, that the ſpeakers were full of new wine, and mocked them for being drunk ſo early in the day; but this is a circumſtance which, ſo far from rendering the miracle doubtful, adds much to the credit of the hiſtorian, as it would hardly have occurred to the writer of a narrative wholly falſe, and would certainly not have been mentioned, had he known that the apoſtles really attempted to impoſe on the multitude unmeaning ſounds for foreign languages.

193 The gift of tongues permanent with the apoſtles.

As it is thus certain that the apoſtles were miraculouſly furniſhed with the gift of tongues, ſo the elegance and propriety of that miracle to atteſt the real deſcent of the Spirit of truth, who was to teach them all things, and endue them with power from on high to convert the nations, can never be enough admired by the pious Chriſtian; for words being the vehicle of knowledge, an ability to ſpeak the different languages of the earth was abſolutely neceſſary to enable thoſe who had been originally fiſhermen to go into all the world and preach the goſpel to every creature. Yet there have been writers *, who, though unable to call in queſtion the reality of the gift of tongues on the day of Pentecoſt, have contended, that it was a gift "not laſting, but inſtantaneous and tranſitory; not beſtowed upon them for the conſtant work of the miniſtry, but as an occaſional ſign only, that the perſon endowed with it was a choſen miniſter of the goſpel; which ſign, according to them, ceaſed and totally vaniſhed as ſoon as it had ſerved that particular purpoſe." The chief argument upon which this opinion is attempted to be built, is drawn from the ſcripture Greek, which is ſaid to be "utterly rude and barbarous, and abounding with every fault which can poſſibly deform a language; whereas we ſhould naturally expect to find an inſpired language pure, clear, noble, and affecting, even beyond the force of common ſpeech; ſince nothing can come from God but what is perfect in its kind. In ſhort, we ſhould expect, ſays the objecter, the purity of Plato and the eloquence of Cicero †."

Theology more peculiarly Chriſtian.

* *Dr Middleton* and *Lord Shaftesbury.*

194 Objections

† *Middleton's Eſſay on the Gift of Tongues.* ‡ *Warburton's Doctrine of Grace.*

In reply to this objection, it has been well obſerved ‡, that it ſuppoſes what is called the purity, elegance, and ſublimity, of language, to be ſomething natural and eſſential to human ſpeech, and inherent in the conſtitution of things. "But the matter is far otherwiſe. Theſe qualities are accidental and arbitrary, and depend on cuſtom and faſhion; modes of humanity as various as the differing climes of the earth; and as inconſtant as the tempers, genius, and circumſtances, of its inhabitants. For what is *purity*, but the uſe of ſuch terms and their combinations as the caprice of a writer or ſpeaker of authority hath preferred to their equals? what is *elegance*, but ſuch a turn of idiom as a faſhionable fancy hath brought into credit; and what is *ſublimity*, but the application of ſuch images as arbitrary and caſual connections, rather than their own native grandeur, have dignified and ennobled? The conſequence of this is, that the mode of compoſition which is a model of perfection to one nation or people, has always appeared either extravagant or mean to another. Aſiatic and Indian eloquence was eſteemed hyperbolical and unnatural by the Greeks and Romans, and is ſo eſteemed by us; whilſt the Greek and Roman eloquence in its turn appeared cold and inſipid to the warm inhabitants of the eaſt; and ours would appear perhaps ſtill colder. But the New Teſtament was deſigned for the rule of life to all mankind. Such a rule required inſpiration; and inſpiration, ſay the objecters, implies the moſt perfect eloquence. What human model then was the Holy Ghoſt to follow? for a human model it muſt have been, becauſe there was no other; and if there had, no other would have anſwered the purpoſe, which was to make a due impreſſion on the mind and affections. Should the eaſtern eloquence have been employed? But it would have been too ſwelling and animated for the weſt. Should the weſtern? This would have been too ſtill and inactive for the eaſt. Or ſuppoſe us only ſolicitous for what we beſt underſtand; which ſpecies of this latter genus ſhould the ſacred writers have preferred? The diſſolute ſoftneſs of the Aſiatic Greeks, or the dry conciſeneſs of the Spartans? The flowing exuberances

195 Anſwered.

Theology more peculiarly Christian.

logy uberances of Attic eloquence, or the grave severity of the Roman?

"But are there not some general principles of eloquence in common to all the species? There are. Why then should not these have been employed to credit the apostolic inspiration? Because the end even of these (replies our author), is to mislead reason, and inflame the passions; which being abhorrent to the truth and purity of our holy religion, were very fitly rejected by the inspired penman. Besides, it might easily be known to have been the purpose of Providence, though such purpose had not been expressly declared, that the gospel should bear all possible marks of its divine original, as well in the course of its progress as in the circumstances of its promulgation. To this end, the human instruments of its conveyance were mean and illiterate, and chosen from among the lowest of the people, that when the world saw itself converted by the *foolishness of preaching*, as the only learned apostle thinks fit to call it, unbelievers might have no pretence to ascribe its success to the parts, or stations, or authority, of the preachers. Now had the language inspired into these illiterate men been the eloquence of Plato or Tully, Providence would have appeared to counteract its own measures, and to defeat the purpose best calculated to advance its glory. But God is wise, though man is a fool. The course of Providence was uniform and constant: It not only chose the weakest instruments, but carefully kept out of their hands that powerful weapon of WORDS which their adversaries might so easily have wrested to the dishonour of the gospel. Common sense tells us, that the style of an universal law should retain what is common to all languages, and neglect what is peculiar to each. It should retain nothing but CLEARNESS and PRECISION, by which the mind and sentiments of the writer are intelligibly conveyed to the reader. This quality is essential, invariably the same, and independent of custom and fashion. It is the consequence of syntax, the very thing in language which is least positive, as being formed on the principles of philosophy and logic: whereas all besides, from the very power of the elements and signification of the terms to the tropes and figures in composition, are arbitrary; and, as deviating from these principles, frequently vicious. But this quality of clearness and precision eminently distinguishes the writings of the New Testament; insomuch that it may be easily shown, that whatever difficulties occur in the sacred books do not arise from any imperfect information caused by this local or nominal barbarity of style; but either from the sublime or obscure nature of the things treated of, or from the intentional conciseness of the writers; who, in the casual mention of any thing not essential to the dispensation, always observe a studied brevity."

After much ingenious and sound reasoning on the nature of language in general, our author concludes, that the STYLE of the New Testament, even on the truth of what has been said to its discredit, is so far from proving the language not to be divinely inspired, that it bears one certain mark of that original. "Every language consists of two distinct parts, the single terms, and the phrases and idioms. Suppose now a foreign language to be instantaneously introduced into the minds of illiterate men like the apostles; the impression must be made either by fixing in the memory the terms and single words only with their signification, as, for instance, Greek words corresponding to such or such Syriac or Hebrew words; or else, together with that simple impression, by enriching the mind with all the phrases and idioms of the language so inspired. But to enrich the mind with the peculiar phrases and idiom of a foreign language, would require a previous impression to be made of the manners, notions, fashions, and opinions, of the people to whom that language is native; because the idiom and phrases arise from, and are dependent on, these manners. But this would be a waste of miracles without sufficient cause or occasion; for the Syriac or Hebrew idiom, to which the Jews were of themselves enabled to adapt the Greek or any other words, abundantly served the useful purposes of the gift of tongues, which all centered in those tongues, being so spoken and written as to be CLEARLY UNDERSTOOD. Hence it follows, that if the style of the New Testament were indeed derived from that language which was miraculously impressed upon the apostles on the day of Pentecost, it must be just such a one as in reality we find it to be; that is, it must consist of Greek words in the Syriac or Hebrew idiom."

196 Divinity of the Holy Ghost.

The immediate author of this gift, so necessary to the propagation of the gospel, was the Spirit of truth, or the Comforter, who is the Holy Ghost and the third person in the blessed Trinity. That there are three persons in the one Godhead, has been shewn at large in a former section of this article; and that the Holy Ghost is one of these three, might be safely concluded from the form of baptism instituted by Christ himself. But as more plausible objections have been urged against his divinity than any that we have met with against the divinity of Christ, it may not be improper to consider these before we proceed to give an account of the graces which he imparted to the infant church, and of the apostles preaching under his influence. By the Arians the Holy Ghost is considered as a creature; by the Socinians and modern Unitarians, as they call themselves, the words *Holy Ghost* are supposed to express, not a person or spiritual subsistence, but merely an energy or operation, a quality or power, of the Father, whom alone they acknowledge to be God. If this doctrine can be confuted, the Arian hypothesis will fall to the ground of itself; for it is not conceivable that any inspired teacher should command his followers to be baptized in the name of the self-existent God and two creatures.

197 Objections.

It is admitted by the Socinians themselves, that in the Scriptures many things are spoken of the Holy Ghost which can be properly predicated only of a person; but the inference drawn from this concession they endeavour to invalidate by observing, that in scripture there are likewise expressions in which things are predicated of abstract virtues, which can be literally true only of such persons as practise these virtues. Thus when St Paul says *, that "charity suffereth long and is kind, charity envieth not, charity vaunteth not itself, is not puffed up, &c." we cannot suppose his meaning to be, that these actions are performed by charity in the abstract, but that every charitable person, in consequence of that one Christian grace, suffereth long and is kind, envieth not, vaunteth not himself, and is not puffed up, &c. In like manner, say they, personal actions are attributed to the Holy Ghost, which itself is

* 1 Cor. xiii. 4—8.

Theology more peculiarly Christian.

no person, but only the virtue, power, or efficacy, of God the Father; because God the Father, who is a person, performs such actions by that power, virtue, or efficacy, in himself, which is denominated the Holy Ghost. Thus when we read * that "the Spirit said unto Peter, Behold three men seek thee; arise therefore and get thee down, and go with them, doubting nothing, for I have sent them;" we must understand that God the Father was the person who spoke these words and sent the three men; but because he did so by that virtue in him which is called the *Spirit*, therefore the *Spirit* is said to have spoken the words and sent the men. Again, when "the Holy Ghost said † to those at Antioch, Separate me Barnabas and Saul for the work whereunto I have called them;" we are to conceive that it was God the Father who commanded the two apostles to be separated for the work to which he had called them; but because he had done all this by that power within him which is called the Holy Ghost, therefore his words and actions are attributed to the Holy Ghost, just as long-suffering in men is attributed to charity.

* Acts x. 19, 20.

† Acts xiii. 2.

198 Answered.

This reasoning has a plausible appearance, and would be of much force were *all* the actions which in scripture are attributed to the Holy Ghost of such a nature as that they could be supposed to have proceeded from the person of God the Father in consequence of any particular power or virtue in him; but this is far from being the case. Thus "Spirit is said ‡ to make intercession for us;" but with whom can we suppose God the Father, the fountain of divinity, to intercede? Our Saviour assured § his disciples, that the Father would, in his name, send to them the Holy Ghost, who is the Comforter; that he would himself send the Comforter unto them from the Father; that the Comforter should not speak of himself, but speak only what he should hear; and that he should receive of Christ's, and shew it unto them. But we cannot, without blasphemy and absurdity, suppose that the Father would, in the name of Christ, send himself; that the Son would send the Father from the Father; and the Father would not speak of himself, but speak only what he heard; or that either the Father in person, or a quality of the Father, should receive any thing of Christ to shew unto the apostles.

‡ Rom. viii. 26, 27.

§ St John xiv 26. xv. 26. xvi. 13, 14, 15.

The sagacity of Socinus perceived the force of such objections as these to his notion of the Holy Ghost being nothing more than the power of the Father personified; and therefore he invented another *prosopopeia* to serve his purpose in the interpretation of those texts to which this one cannot be applied. "The Spirit of God (says he ‖) may be considered either as a property or power in God, or as the things on which that power is working. When taken in the former sense, the Spirit, where any personal attribute is given to it, means God the Father; when taken in the latter sense, it means the man on whom the power of the Father is working; who, as long as he is affected by that power, is therefore called the Spirit of God;" and he quotes, we think most absurdly, the tenth verse of the second chapter of the first epistle to the Corinthians, as a text in which by the Spirit is meant an inspired man who could search all things, yea, even THE DEEP THINGS OF GOD.

‖ *Faust. Socinus in Resp. ad Wickam*, cap. 10.

How his modern followers, who deny the plenary inspiration even of Christ, will relish such a degree of inspiration as this, which raises mere men to a temporary equality with God, we know not; but leaving them to settle the dispute with their master, we shall produce one or two passages in which personal attributes are given to the Spirit of God, when it is impossible to conceive that Spirit, either as a power inherent in the Divine Father, or as the person on whom that power is operating. We need not bring new texts into view, as some of those already quoted will serve our purpose. When our Saviour promises that the *Holy Ghost*, *the Comforter*, *the Spirit of truth*, should be sent by the Father and the Son to the apostles, we have seen, that by this Spirit he could not mean the Father or a property of the Father; neither could he possibly mean the apostles themselves, unless we are to suppose that the Father and the Son sent St Peter to St Peter, and that St Peter, so sent, came to St Peter! Again, when Christ saith of the Holy Ghost, "he shall receive of mine, and shall shew it unto you," he could not, for the reason already assigned, mean by the Holy Ghost the Father or the power of the Father; and surely his meaning was not, that the apostles, under the influence of the power of the Father, should receive something and shew it each to himself! The Holy Ghost therefore is unquestionably a person; for though there are many passages of scripture in which the *gifts* of the Holy Ghost are called the *Holy Ghost*, they are so called by a very common figure of speech, in which the effect receives the name of its cause: and since this person is joined with the Father and the Son in the formula of Christian baptism; since they who lied to the Holy Ghost are said * to have lied unto God; since blasphemy against him is a more heinous offence than the same sin against even the Father or the Son †; and since it was by the operation of the Holy Ghost that Jesus Christ was conceived of the Virgin Mary, and even on that account called the ‡ Son of God—it follows that the Holy Ghost is God, of the same substance with the Father and Son.

Theology more peculiarly Christian.

* Acts v. 4.

† Mark iii. 28, 29.

‡ Luke i. 35.

199 The apostles miraculously instructed in the principles of religion.

It was this Divine Spirit which, on the day of Pentecost, inspired the apostles with the knowledge of different languages; and as these were given only to enable them to preach the gospel to every creature, it can admit of no doubt but that he, who so amply provided the means of preaching, would take care that the gospel should be preached in purity. Our Saviour had told his apostles, that the Comforter would guide them into all the truth (εις πασαν την αληθειαν), and bring all things to their remembrance, whatsoever he had said unto them; but if they had not comprehended the meaning of what he said, the bare remembrance of his sayings would have been of little importance. That before this miraculous shedding abroad of the Spirit they had but a very imperfect knowledge of his doctrines, and of the purpose for which he had come into the world, is apparent from that unseasonable question which they put to him when assembled to witness his glorious ascension; "Lord, wilt thou at this time restore again the kingdom to Israel?"

200 Their great need of such instruction.

Their minds still cherished with fondness the vain prospect of temporal power; but after the day of Pentecost they were directed to nobler objects. From the same Spirit they received diversities of gifts besides that of language; for we are assured by St Paul *, when speaking of the early converts to Christianity in general,

* 1 Cor. xii. 8—12.

ral, that "to one was given by the Spirit the word of WISDOM; to another the word of KNOWLEDGE by the same Spirit; to another FAITH by the same Spirit; to another the gifts of HEALING by the same Spirit; to another the working of MIRACLES; to another PROPHECY; to another DISCERNING OF SPIRITS; to another DIVERS KINDS of TONGUES; to another the INTERPRETATION OF TONGUES:" and these gifts, which were severally divided either among private Christians or among the inferior orders of ministers in the church, we have reason to believe were all bestowed in a greater or less degree upon each of the apostles.

Men thus endowed were well qualified to declare unto the world all the council of God. By the word of *wisdom* they communicated to the Gentile nations a pure system of what is called *natural religion;* turning them from the vanity of idols to the worship of the living God: by the word of *knowledge*, they preached the great doctrines of revelation both to Jews and Gentiles, shewing them that there is none other name under heaven given unto men whereby they may be saved than the name of Jesus Christ (L); and by their gifts of *healing* and of *miracles*, &c.; they were enabled to prove unanswerably, that their doctrines were divine. They taught everywhere the unity of God, the creation of the world, the fall of man, the necessity of redemption, the divinity of the Redeemer, his sacrifice on the cross to restore mankind to their forfeited immortality, and the terms of the new covenant into which they had through him been graciously admitted by God.

Such a view as our limits would admit of we have given of all these doctrines, except that which respects the terms of the gospel covenant; but these being explicitly stated only by St Paul and St James, we could not till now investigate them, without violating the historical order into which, for the sake of perspicuity, we have digested the several parts of this short system. Our Saviour himself has indeed taught with great plainness the necessity of faith and baptism to the salvation of those who have an opportunity of hearing the gospel preached with power (see BAPTISM): and in his sermon on the mount, which is such a lecture of ethics founded on religion as the Son of God only could have delivered, we learn, that "unless our righteousness shall exceed the righteousness of the Scribes and Pharisees, we shall in no case enter into the kingdom of heaven; that not every one who saith unto Christ, Lord, Lord, shall enter into the kingdom of heaven, but he who doth the will of the Father who is in heaven; and that many will say to him at the day of judgment, Lord, Lord, have we not prophesied in thy name, and in thy name done many wonderful works?" which could not be done without faith; to whom he will, notwithstanding, say, "Depart from me, ye that work iniquity*." St Paul, however, seems to attribute our justification to the bare act of believing; for he repeatedly assures us, "that a man is justified by faith without the deeds of the law;" while St James, on the other hand, affirms, "that by works a man is justified, and not by faith only." This apparent difference in the language of the two apostles, has produced among divines opinions really different respecting the justification of Christians; and the principal of these opinions it is our duty to state.

Theology more peculiarly christian.

* St Matt. v. 20. vii. 21.—24.

201

Meaning of justification.

Between *pardon* of sin and *justification* there is so close a connection, that many writers seem to consider the terms as synonymous, and to infer, that he who is pardoned is *ipso facto* justified. That every Christian, who shall be pardoned at the judgment of the great day, will likewise be justified, is indeed true; but in propriety of speech, *justification* is a word of very different import from *pardon*, and will entitle the Christian to what mere pardon could not lead him to expect. An innocent person, when falsely accused and acquitted, is *justified* but not *pardoned;* and a criminal may be *pardoned*, though he cannot be *justified* or declared innocent. A man whose sins are pardoned is free from punishment; but the justified Christian is entitled to everlasting life, happiness, and glory. If we were only pardoned through Christ, we should indeed escape the pains of hell, but could have no claim to the enjoyments of heaven; for these, being more than the most perfect human virtue can merit, must be, what in the scriptures they are always said to be, "the gift of God through Jesus Christ our Lord." Hence it is that St Paul, distinguishing, as we have done upon his authority, between mere remission of sins and justification of life, declares †, that "Jesus our Lord was *delivered* for our *offences*, and *raised* again for our *justification*."

† Romans iv. 25.

The word justification, as used both by St Paul and St James, has been very generally considered as a forensic term expressing the sentence of a judge. The most eminent reformed divines of all denominations ‡, and even many of the Romanists themselves, have strenuously contended, that this is its genuine sense, when it is distinguished from mere remission of sins, regeneration, and sanctification; and if so, it will signify God's pronouncing a person *just*, either as being perfectly blameless, or as having fulfilled certain conditions required of him in the Christian covenant. But that "there is not a just man upon earth, who doth good and sinneth not," is made known to us by the most complete evidence possible, the joint dictates of our own consciences and of divine

‡ *Limborch, Bull, Waterland, Warburton, Beveridge, Vitringa, Gill*, &c.

(L) It is not perhaps easy to determine what is here meant by the word of WISDOM and the word of KNOWLEDGE, as distinguished from each other. By the former (λογος σοφιας), Bishop Warburton understands all the great principles of natural religion. "The ancients (says he) used the word σοφια in this peculiar sense; it is used in the same sense by St Paul in Col. iv. 5.; and we can hardly give it any other in the place before us, where we see the word of wisdom distinguished from the word of knowledge (λογος γνωσεως), which evidently means all the great principles of revelation; the term γνωσις being as peculiarly applied by Christian writers to revealed religion as σοφια is by the Gentiles to the natural. St Paul uses the word in this sense in 2 Cor. xi. 6. where he says, Ει δι και ιδιωτης τω λογω αλλου τη γνωσει; and St Peter in his first epistle, chap. iii. verse 7. Hence those early heretics who so much deformed the simplicity and purity of the Christian faith by visionary pretences to superior knowledge of revelation, took from this word the name of Gnostics." See *Warburton's Sermon on the Office and Operation of the Holy Ghost.*

Theology more peculiarly Christian.

divine revelation; and therefore whoſoever is pronounced juſt by the Judge of all the earth, muſt be ſo, either becauſe, though not abſolutely blameleſs, he has performed the conditions required of him in the covenant of grace, or becauſe Chriſt has fulfilled all righteouſneſs in his ſtead.

202 It is a forenſic term.

If this be the Scripture notion of juſtification, it muſt be wholly the act of God, and cannot be the effect either of our faith or of our virtue. Accordingly, we are ſaid by the apoſtle to be juſtified freely by his grace through the redemption that is in Jeſus Chriſt; whom *God hath ſet forth* to be a propitiation through faith in his blood *. The act of juſtification therefore proceeds from the divine philanthropy, and cannot be performed by the inſtrumentality of faith; for it is not God, but man, who believes; and man is not the juſtifier of himſelf. To talk of any kind of *inſtrument* of juſtification beſides the propitiation ſet forth by God, is indeed to make uſe of very improper language: "Omnis cauſa inſtrumentalis (ſays Biſhop Bull †), ſuo modo in effectum influit, eique effecti productio propriè attribui poteſt. Jam vero, cum juſtificatio nihil aliud ſit quam gratioſus Dei actus, quo peccata noſtra nobis condonet, ac nos ad ſalutem acceptet, valde abſurdum eſſet dicere, vel fidem, vel opera noſtra, vel quidvis aliud noſtri aut remittere peccata noſtra, aut perſonas noſtras acceptare: quod tamen, ſi inſtrumentalis cauſa juſtificationis fides ſit, planè dicendum eſſet."

* Rom. iii. 24, 25.

† *Harmonia Apoſtolica*, cap. ii. § 9.

In this ſentiment of the biſhop of St David's ſome of the moſt eminent divines both among the Calviniſts and Arminians agree. Many, however, have choſen to treat of juſtification not only in the active ſenſe, as it is the act of God, for all admit that it is he who juſtifies; but likewiſe in a paſſive ſenſe, as it means our *privilege* or *poſſeſſion* holden of him, when we are ſaid to be juſtified by his grace. In this view of the ſubject they may talk, with ſufficient propriety, of an inſtrument of juſtification, not as the mean by which it is conveyed, but as the medium through which it is received by the true Chriſtian. And hence it follows, that Waterland and Warburton ſtrenuouſly maintain the doctrine of the Weſtminſter Confeſſion, "that faith receiving and reſting on Chriſt is the alone inſtrument of juſtification; though it cannot be alone in the perſon juſtified, but muſt ever be accompanied with all other ſaving graces, and be a faith which worketh by love."

But notwithſtanding this agreement between the leaders of the rival ſects, they have found abundant matter of controverſy reſpecting faith and works, in deciding the great queſtion, "Whether, when God juſtifies man, he conſiders him as abſolutely righteous on account of Chriſt's righteouſneſs performed in his ſtead; or only as juſt, becauſe he has fulfilled the conditions of the covenant of grace, which does not require of him perfect righteouſneſs?" The former is the doctrine of the more rigid Calviniſts, the latter that of the Arminians or Remonſtrants.

‡ *Body of Divinity*, vol. ii. book iii. chap. 8. § 5.

"A notion (ſays Dr Gill ‡) obtained ſome years ago, that a relaxation of the law and the ſeverities of it has been obtained by Chriſt; and a new law, a remedial law, a law of milder terms, been introduced by him, which is the goſpel; the terms of which are, faith, repentance, and new obedience; and though theſe be imperfect, yet, being ſincere, they are accepted by God in the room of perfect righteouſneſs. But every article of this ſcheme (continues he) is wrong; for the law is not relaxed, nor any of its ſeverities abated; Chriſt came not to deſtroy, but to fulfil it; and therefore it requires the ſame holy, juſt, and good things, as ever. Nor is the goſpel a new law. There is nothing in it (he ſays) which looks like a law; for it has no commands in it, but all promiſes, being a pure declaration of grace and ſalvation by Chriſt; nor are faith, repentance, and a new obedience, required by it as conditions of man's acceptance with God. Faith and repentance are goſpel doctrines, and parts of the goſpel miniſtry; they are graces, and not terms required to be performed by men of themſelves. Faith is the gift of God, and repentance is a grant from him. It is not true (continues our author) that God will accept of an imperfect righteouſneſs in the room of a perfect one; nor can any thing more highly reflect upon the juſtice and truth of God, who is the judge of all the earth, than to ſuppoſe that he can ever account that as a righteouſneſs which is not one."

Theology more peculiarly Christian.

203 Doctrine of the Calviniſts reſpecting it.

Having thus proved by arguments which were almoſt in the ſame words ſtated long before by Biſhop Beveridge *, that the goſpel is no relaxation of the law, he proceeds to lay down his own notions of juſtification, of which (he ſays) "the ſole matter, or that for the ſake of which a ſinner is juſtified before God, is the righteouſneſs of Chriſt—that which he did and ſuffered on earth, in our nature, in our ſtead, and as our repreſentative. This is commonly called his active and paſſive obedience; and when the purity and holineſs of his own nature was added to it, the whole made up the δικαιωμα του νομου, *the righteouſneſs of the law*, which was fulfilled by him as the head and repreſentative of his people †; for whatever the law required is neceſſary to a ſinner's juſtification before God, and it required of ſinners more than it did of man in innocence. Man was created with a pure and holy nature, conformable to the pure and holy law of God; and it was incumbent on him to continue ſo, and to yield in it perfect and ſinleſs obedience, in the failure whereof he was threatened with death. Man did fail, by which his nature was vitiated and corrupted, and his obedience became faulty and imperfect. He therefore became liable to the penalty of the law, and ſtill perfect obedience was required of him. To the juſtification of a ſinner therefore is required the moſt complete obedience, active and paſſive; or, in other words, purity of nature, perfect obedience, and the ſufferings of death; all which meet in Chriſt, the repreſentative of his people, in whom they are juſtified. There are indeed ſome divines (continues our author) who exclude the active obedience of Chriſt from being any part of the righteouſneſs by which men are juſtified. They allow it to have been a condition requiſite in him as a Mediator, qualifying him for his office; but deny that it is the matter of juſtification, or reckoned for righteouſneſs to man. But without the active obedience of Chriſt the law would not be ſatisfied; the language of which is, *Do and live;* and unleſs its precepts be obeyed, as well as its penalty endured, it cannot be ſatisfied; and unleſs it be ſatisfied there can be no juſtification. If therefore men are juſtified by the righteouſneſs of Chriſt, it muſt be by his active obedience imputed and made over to them, ſo as to become their's, *even as David deſcribeth the bleſſedneſs of the man unto whom God imputeth righteouſneſs without works* ‡. That this is really the way in which men are juſtified, our author thinks evident,

* See his *Private Thoughts of Religion.*

† Rom. viii. 4.

‡ Rom. iv. 6.

evident, because they must be justified either by an inherent or by an imputed righteousness; but they cannot be justified by their own inherent righteousness, for that is imperfect, and therefore not justifying. Hence the apostle 'counts all things but dung, that he may win Christ and be found in him; not having his own righteousness, which is of the law, but that which is *through the faith of Christ*, the righteousness which is of *God by faith* *.' But by such a righteousness as this a man cannot be justified in any other way than by an imputation of it to him. Whence it follows, that '*as by one man's disobedience many were made sinners* by imputation, so *by the obedience of one shall many be made* righteous, by having that obedience placed to their own account."

As this author properly considers justification as the act of God, he does not approve of the language in which faith is called the instrument either of conferring or receiving it. "Faith (says he †) is merely the evidence of justification to the person justified; for 'faith is the evidence of things not seen.' The righteousness of God, of the God-man and Mediator Jesus Christ, is revealed from faith to faith in the everlasting gospel ‡; and therefore must be before it is revealed, and before the faith to which it is revealed. Faith is that grace whereby a soul, having seen its want of righteousness, beholds in the light of the Divine Spirit a complete righteousness in Christ, renounces its own, lays hold on that, puts it on as a garment, rejoices in it, and glories of it; the Spirit of God witnessing to his spirit that he is a justified person: and so he is evidently and declaratively 'justified in the name of the Lord Jesus, and by the spirit of our God ||'. Faith adds nothing to the *esse*, only to the *bene esse* of justification; which is a complete act in the eternal mind of God, without the being or consideration of faith, or any foresight of it. In the account of God, a man is as much justified before his faith as after it; and after he does believe, his justification depends not on his acts of faith, for though *we believe not, yet God abides faithful* to his covenant-engagements with his Son, by whose suretyship-righteousness the elect are justified; but by faith men have a comfortable sense, perception, and apprehension, of their justification, and enjoy that peace of soul which results from it. It is by that only, under the testimony of the Divine Spirit, that they know their interest in it, and can claim it, and so have the comfort of it."

Though this language differs from that of the Westminster Confession, the author seems not to teach a different doctrine; for if faith be that grace by which a soul renounces its own righteousness, and lays hold of Christ's, which it puts on as a garment, it must be that very thing which the compilers of the Confession meant by their definition of faith receiving and resting on Christ and his righteousness, when they called it "the alone instrument of justification." Accordingly our author elsewhere * teaches, that "true faith in sensible sinners assents to Christ and embraces him, not merely as a Saviour of man in general, but as a special suitable Saviour for them in particular. It proceeds upon Christ's being revealed *in* them as well as *to* them, by the spirit of wisdom and revelation, in the knowledge of him as a Saviour that becomes them. It comes not merely through external teachings by the hearing of the word from men; for no man, saith our blessed Lord, can come to me except the Father draw him; but such souls as are thus drawn, having heard and learned of the Father, believe not only in the *doctrine* of Christ, but also in *himself*, trusting in him alone for everlasting life and salvation."

Theology more peculiarly Christian.

Were it not that this author, in every thing that he writes, has an eye to the doctrine of election and reprobation, which he carries to a greater height than almost any other divine with whose works we are acquainted, he would differ little in his notions of justification from the more moderate Arminians. "Justification (says Limborch) is the merciful and gracious act of God, whereby he fully absolves from all guilt the truly penitent and believing soul, through, and for the sake of Christ apprehended by a true faith: or gratuitously remits sins upon the account of faith in Jesus Christ, and graciously imputes that faith for righteousness." Here indeed the imputation of Christ's righteousness is expressly denied; but Dr Waterland, who can hardly be considered as a Calvinist, seems to contend for the imputation of that righteousness to the sinner, as well as for faith being the instrument by which it is received.

204 And of the more moderate Arminians.

"It cannot be for nothing (says that able writer *) that St Paul so often and so emphatically speaks of man's being justified by faith, or through faith in Christ's blood; and that he particularly notes it of Abraham, that he *believed*, and that his faith was counted to him for justification, when he might as easily have said that Abraham, to whom the gospel was preached, was justified by gospel-faith and obedience, had he thought faith and obedience equally instruments of justification. Besides, it is on all hands allowed, that though St Paul did not directly oppose faith to *evangelical works*, yet he comprehended the works of the *moral law* under those which he excluded from the office of *justifying*, in his sense of the word justification. He even used such arguments as extended to all kinds of works; for Abraham's works were excluded, though they were undoubtedly evangelical. To prove that he interprets the apostle's doctrine fairly, our author quotes, from the genuine epistle of Clemens of Rome, a passage, in which it appears beyond a doubt that this fellow-labourer of St Paul so understood the doctrine of justifying faith as to oppose it even to evangelical works, however exalted. It is true (continues our author), Clemens elsewhere, and St Paul almost everywhere, insists upon true holiness of heart and obedience of life as indispensable conditions of salvation or justification; and of that, one would think, there could be no question among men of any judgment or probity. But the question about conditions is very distinct from the other question about instruments; and therefore both parts may be true, viz. that faith and obedience are equally conditions, and equally indispensable where opportunities permit; and yet faith over and above is emphatically the instrument both of receiving and holding justification, or a title to salvation.

* *Summary View of Justification.*

205 Faith the instrument of it.

"To explain this matter more distinctly, let it be remembered, that God may be considered either as a party contracting with man on very gracious terms, or as a Judge to pronounce sentence on him. Man can enter into the covenant, supposing him adult, only by assenting to it, and accepting it, to have and to hold it on such kind of tenure as God proposes: that is to say, upon a self-denying tenure, considering himself as a guilty man standing in need of pardon, and of borrowed merits, and at length resting upon mercy. So here, the previous question is, Whether a person shall consent to hold a privilege upon this submissive kind of tenure or not?

Theology more peculiarly Christian.

not? Such assent or consent, if he comes into it, is the very thing which St Paul and St Clemens call *faith*. And this previous and general question is the question which both of them determine against any proud claimants who would hold by a more self-admiring tenure.

"Or if we next consider God as sitting in judgment, and man before the tribunal going to plead his cause; here the question is, What kind of plea shall a man resolve to trust his salvation upon? Shall he stand upon his innocence, and rest upon strict law? or shall he plead guilty, and rest in an act of grace? If he chooses the former, he is proud, and sure to be cast: if he chooses the latter, he is safe so far in throwing himself upon an act of grace. Now this question also, which St Paul has decided, is previous to the question, What conditions even the act of grace itself finally insists upon? A question which St James in particular, and the general tenure of the whole Scripture, has abundantly satisfied; and which could never have been made a question by any considerate or impartial Christian. None of our works are good enough to stand by themselves before him who is of purer eyes than to behold iniquity. Christ only is pure enough for it at first hand, and they that are Christ's at second hand in and through him. Now because it is by faith that we thus interpose, as it were, Christ between God and us, in order to gain acceptance by him; and therefore faith is emphatically the instrument whereby we receive the grant of justification. Obedience is equally a condition or qualification, but not an instrument, not being that act of the mind whereby we look up to God and Christ, and whereby we embrace the promises."

206 Faith and obedience its conditions.

But though our author contends that faith is the instrument of justification, he does not, like the Antinomians, teach that it will save men without works. "The covenant of grace (says he) has conditions annexed to it of great importance, for without them no instruments can avail. These are faith and obedience, as St James hath particularly maintained. St Paul had before determined the general and previous question respecting the plea by which we ought to abide; and when some libertines, as is probable, had perverted his doctrine of faith and grace, St James showed that the very faith which rests in a covenant of grace implies a cordial submission to the conditions of that covenant, otherwise it would be nothing but an empty ceremony. The perfect agreement between St Paul and St James in the article of *justification*, appears very clear and certain. St Paul declares, that in order to come at justification, it is necessary to stand upon grace, not upon merit; which St James does not deny, but rather confirms, in what he says of the perfect law of liberty (James i. 25. ii. 12.). St Paul makes faith the instrument of receiving that grace; which St James does not dispute, but approves by what he says of Abraham (ii. 23.); only he maintains also, that in the conditionate sense, justification depends equally upon faith and good works; which St Paul also teaches and inculcates in effect, or, in other words, through all his writings. If St Paul had had precisely the same question before him which St James happened to have, he would have decided just as St James did; and if St James had had precisely the same question before him which St Paul had, he would have determined just as St Paul did. Their principles were exactly the same, but the questions were diverse; and they had different adversaries to deal with, and opposite extremes to encounter, which is a common case.

Theology more peculiarly Christian.

"It may be noted, that that faith which is here called a *condition*, is of much wider compass than that particular kind of faith which is precisely the instrument of justification. For faith as a condition means the whole complex of Christian belief, as expressed in the creeds; while faith as an instrument means only the laying hold on grace, and resting in Christ's merits in opposition to our own deservings: though this also, if it is a vital and operative principle (and if it is not, it is nothing worth), must of course draw after it an hearty submission to, and observance of, all the necessary conditions of that covenant of grace wherein we repose our whole trust and confidence. So that St Paul might well say, "Do we then make void the law (the moral law) through faith? God forbid: Yea, we establish the law *." We exempt no man from religious duties; which are duties still, though they do not merit nor are practicable to such a degree as to be above the need of pardon: they are necessary conditions in their measure of justification, though not sufficient in themselves to justify, nor perfect enough to stand before God or to abide trial: therefore Christ's merits must be taken in to supply their defects: and so our resting in Christ's atonement by an humble self-denying faith is our last resort, our anchor of salvation both sure and stedfast, after we have otherwise done our utmost towards the fulfilling of God's sacred laws, towards the performing of all the conditions required.

* Rom. iii. 31.

"That good works, internal and external, are according as opportunities offer and circumstances permit, *conditions* properly so called, is clear from the whole tenor of Scripture, as hath been often and abundantly proved by our own divines (M), and is admitted by the most judicious among the foreign Reformed (N). Yet some have been very scrupulous as to this innocent name, even while they allow the absolute necessity of good works as indispensable qualifications for future blessedness. Why not conditions therefore as well as qualifications? Perhaps because that name might appear to strike at absolute predestination, or unconditional election; and there may lie the scruple: otherwise the difference appears to lie rather in words than in things.

"Some will have them called not conditions, but *fruits* or *consequents* of justification. If they mean by justification the same as the grace of the Holy Spirit, and the first grace of faith springing from it, they say true; and then there is nothing more in it than an improper use of the word *justification*, except that from abuse of words very frequently arises some corruption of doctrine. If they mean only, that outward acts of righteousness are fruits of inward habits or dispositions; that

(M) Bull. *Op. Latin.* p. 412, 414, 415, 430, 434, 514, 516, 544, 583, 645, 668. *Edit. ult.*—Stillingfleet's Works, vol. iii. p. 367, 380, 393, 398.—Tillotson's Posthumous Sermons, vol. ii. p. 484, 487.

(N) Vossius *de Bonis Operibus*, Thes. x. p. 370.—Op. tom. vi.—*Frid. Spanhem. fil.* Op. tom. iii. p. 141, 159.

ogy that alſo is undoubtedly true: but that is no reaſon why internal acts, virtues, graces (good works of the mind), ſhould not be called conditions of juſtification; or why the outward acts ſhould not be juſtly thought conditions of preſerving it. But if they mean that juſtification is ordinarily given to adults, without any preparative or previous conditions of faith and repentance, that indeed is very new doctrine and dangerous, and opens a wide door to carnal ſecurity and to all ungodlineſs."

Such is the doctrine of Chriſtian juſtification as it has been taught by the followers of Calvin, and by ſome of the moſt eminent Arminians who flouriſhed in the end of the 17th and beginning of the 18th century. They appear not, from this view of their opinions, to differ ſo widely as ſome of them have wiſhed the world to believe. It is evident that Dr Waterland, though he rejects ſome of the diſtinguiſhing tenets of Calviniſm, lays greater ſtreſs upon faith in his ſcheme of juſtification than Dr Gill himſelf; and that they both conſider it as the *inſtrument* by which the adult Chriſtian muſt receive the imputed righteouſneſs of Chriſt. The greater part of modern Arminians, however, exclaim againſt the imputation of Chriſt's righteouſneſs, as a doctrine falſe in itſelf, and fraught with the moſt pernicious conſequences; and they would be ready to tell Dr Gill, in his own words, that of his ſcheme every article is wrong. It is not true (ſay they) that God exacts of man, or ever did exact of him, an obedience abſolutely perfect; for under every diſpenſation man was in a ſtate of diſcipline, and had habits of virtue and piety to acquire; and it is probable that his progreſs in piety, virtue, and wiſdom, will continue for ever, as none but God is perfect and ſtationary, and incapable of deviating from the line of rectitude. Moſt of them, after Biſhop Bull, diſlike the uſe of ſuch unſcriptural phraſes as *the inſtrument of juſtification*, applied either to faith or to works; and think, that by conſidering God as the ſole juſtifier of man, upon certain conditions, they can more preciſely aſcertain the diſtinct provinces of faith and obedience in the ſcheme of juſtification, than either their brethren of the old ſchool of Arminius, or their rivals of the ſchool of Calvin.

By the very conſtitution of man, piety and virtue are duties which, if he do not ſincerely perform, he muſt of courſe forfeit the favour of his Maker; but the moſt perfect performance of his natural duties would not entitle him to a ſupernatural and eternal reward. Eternal life is the *gift* of God through Jeſus Chriſt; and it is ſurely reaſonable that we ſhould acknowledge it to be ſo, and not claim it as a debt due to our merits. The pious and virtuous man has a natural claim to more happineſs than miſery during the period of his exiſtence, a claim founded on the attributes of that God who called him into being; but he has no natural claim to a future life, and ſtill leſs to a perpetuity of exiſtence. This is a truth not more clearly taught in the holy ſcripture than conſonant to the ſoundeſt philoſophy: and yet, by not attending to it, have St Paul and St James been ſet at variance, and the moſt oppoſite doctrines taught reſpecting the juſtification of Chriſtians.

Becauſe faith in Chriſt cannot entitle a wicked man to eternal *happineſs*, one claſs of divines ſeem to infer that ſuch faith is not neceſſary to Chriſtian *juſtification*, and that "his faith cannot be wrong whoſe life is in the right." They proceed upon the ſuppoſition that man is naturally immoral; that piety and virtue are entitled to reward; and that therefore the pious and virtuous man, whatever be his belief, muſt undoubtedly inherit an eternal reward. But this is very fallacious reaſoning. That piety and virtue are through the divine juſtice and benevolence entitled to reward, is indeed a truth incontrovertible; but that man who is of yeſterday is naturally immortal; that a being who began to exiſt by the mere good will of his Maker, has in himſelf a principle of perpetual exiſtence independent of that will—is a direct contradiction. Whatever began to be, can be continued in being only by the power, and according to the pleaſure, of the infinite Creator; but it pleaſed the Creator of his free grace at firſt to promiſe mankind eternal life, on the ſingle condition of their firſt father's obſerving one poſitive precept. That precept was violated, and the free gift loſt: but the covenant was renewed in Chriſt, who "by his death hath aboliſhed death, and by his reſurrection hath brought to light life and immortality." The condition annexed to the gift thus reſtored was faith; for "being juſtified by faith *, we have peace with God through our Lord Jeſus Chriſt; by whom alſo we have acceſs by faith into this grace wherein we ſtand, and rejoice in the hope of the GLORY OF GOD." Faith therefore in the Son of God and Saviour of the world, is not only a condition, but the *ſole* condition, of that juſtification which is peculiarly Chriſtian; for ſince Chriſt, without any co-operation of ours, hath purchaſed for us the free gift of eternal life, we ſhall be guilty of the groſſeſt ingratitude to our Divine Benefactor, and impiouſly claim an independence on God, if we look upon that gift either as a right inherent in our nature, or as a debt due to our meritorious deeds.

Theology more peculiarly Chriſtian.

209 Faith the ſole condition of the juſtification peculiarly Chriſtian;

* Rom. v. 1, 2.

But though faith be the condition of juſtification, as that implies the inheritance of *eternal life*, there are other conditions to be performed before a man can be put in poſſeſſion of *eternal felicity*. By a law long prior to the promulgation of the goſpel—a law interwoven with our very being—no man can enjoy the favour of his Maker, who does not make it his conſtant endeavour "to do juſtly, to love mercy, and to walk humbly with his God.". This law was in force before man fell; it continues to be in force now that he is redeemed; and it will not be abrogated even at that period when faith ſhall give place to viſion, and hope to enjoyment. By the grace of the Chriſtian covenant, all mankind are rendered immortal in conſequence of the death and reſurrection of Chriſt, who is the Lamb ſlain, in the divine decree, from the foundation of the world; but to obtain immortal *happineſs*, they muſt obſerve the conditions both of nature and of revealed religion, which are repentance from dead works, and faith in Chriſt the Redeemer. The former is that condition upon which alone we can retain the Divine favour, and of courſe enjoy either preſent or future happineſs; the latter is a moſt equitable acknowledgement required of us, that perpetual conſcious exiſtence is neither a right inherent in our nature, nor a debt due to our virtuous obedience, but merely the gift of God through Jeſus Chriſt our Lord.

210 but not of obtaining eternal happineſs.

211 The different conditions of divine favour and of eternal life.

"To make the diſtinct provinces of faith and works in the buſineſs of juſtification clear, let us ſuppoſe (ſays Biſhop Warburton †), that, at the publication of the goſpel, all to whom the glad tidings of immortality were

† *Div. Leg.* book ix. chap. 3.

Theology more peculiarly Chriſtian.

were offered on the condition of *faith in Jeſus* had been moral or virtuous men, and on that account entitled (as natural religion teacheth) to the favour of God and an abundant reward; is it not ſelf-evident that FAITH ALONE, excluſive of the condition of good works, would, in that caſe, have been the very thing which *juſtified* or entitled them to life *everlaſting*? But are *good works*, therefore, of no uſe in the Chriſtian ſyſtem? So far from it, that thoſe only who ſerve God in ſincerity and in truth are capable of the juſtification which faith alone embraces; for, to illuſtrate this matter by a familiar inſtance, ſuppoſe a Britiſh monarch to beſtow, in *free gift*, a certain portion of his own *domains*, to which immortality may well be compared, upon ſuch of his ſubjects as ſhould perform a certain ſervice to which they were not obliged by the laws of the kingdom; it is evident that the performance of this laſt ſervice ONLY would be the thing which entitled them to the *free gift*. Yet it is obvious that obedience to the laws, which gave them a claim to protection as ſubjects, in the enjoyment OF THEIR OWN PROPERTY (to which the reward offered by natural religion may be compared), would be a previous and neceſſary qualification to their enjoyment of their new poſſeſſion; ſince it is abſurd to ſuppoſe that ſuch a *gift* could be intended for rebels and traitors, or indeed for any but good and faithful ſervants of their king and country." Well therefore might the apoſtle reprove the ignorance or licentiouſneſs of certain of his converts at Rome, in his queſtion—"Do we then make void the LAW through FAITH? God forbid! yea, we ESTABLISH THE LAW;" obedience to it being the previous qualification of all who are entitled to the fruits of juſtifying faith—LIFE AND IMMORTALITY.

212 Illuſtrated by a familiar example.

Had proper attention been paid to this diſtinction, which St Paul everywhere makes between ſuch duties as are common to all religions that are true, and thoſe which are peculiar to the Chriſtian revelation, many uſeleſs controverſies might have been avoided reſpecting the inſtrument of juſtification and the conditions of the Chriſtian covenant. By not attending to it, the divines of one ſchool, who perceive that the mere belief of any truth whatever cannot entitle a man to eternal felicity, have almoſt dropt faith from their ſyſtem of Chriſtianity, and taught moral duties like Pagan philoſophers; whilſt another party, who err almoſt as far in their interpretations of ſcripture, finding eternal life repreſented as the *gift of God*, and faith in Chriſt as the inſtrument or means by which that gift muſt be accepted, have expunged from their ſyſtem the neceſſity of good works, forgetting ſurely that wicked believers, like believing devils, may be doomed to an eternity of torments. But the ſum of Chriſtianity, as we are taught by the beloved diſciple, is comprehended in this one commandment of God, "that we ſhould believe on the name of his Son Jeſus Chriſt, and love one another as he gave us commandment." In perfect harmony with him, the great apoſtle of the Gentiles aſſures us*, that "in Chriſt Jeſus nothing can avail to our eternal happineſs but faith which WORKETH BY LOVE;" and he informs Titus †, that it "is a true ſaying, and what he wills to be conſtantly affirmed, that they who have believed in God be careful to maintain good works."

213 Sum of Chriſtianity.

* Gal. v. 6.

† Chap. iii. 8.

Indeed no man can have complete faith in Chriſt who believes not the promiſes of the goſpel; but all thoſe promiſes, except the ſingle one of reſurrection from the dead to perpetual conſcious exiſtence, are made to us upon the expreſs condition that we obey the law of the goſpel; "for God will render to every man according to his deeds: to them that are contentious and do not obey the truth, but obey unrighteouſneſs, indignation and wrath; tribulation and anguiſh upon every ſoul of man that doth evil, of the Jew firſt and alſo of the Gentile; but glory, honour, and peace to every man that worketh good, to the Jew firſt and alſo to the Gentile *."

Theology more peculiarly Chriſtian.

* Rom. ii. 8, 9.

Such are the notions of juſtification entertained by thoſe who in the preſent age have been conſidered as the leaders † of the ſect of Arminians. How far they are juſt, the reader muſt decide for himſelf; but under every view of this doctrine which we have taken, the Chriſtian covenant appears much more gracious than that into which Adam was admitted in paradiſe: ſince it affords room for repentance, even to that man, who may be ſo unhappy as to be drawn for a time into apoſtaſy from the terms of the covenant. Whether the death of Chriſt therefore was a *direct* atonement for the actual ſins of men, or only operated as ſuch *indirectly* by procuring for them repeated opportunities of repentance, it is an undoubted truth, that "if through the offence of one many be dead, much more the grace of God, and the gift by grace, which is by one man, Jeſus Chriſt, hath abounded unto many. And not as it was by one that ſinned, ſo is the gift: for the judgment was of one offence to *condemnation*, but the free gift is of many offence to *juſtification* ‡."

† *Warburton and Law*, &c.

214 The Chriſtian covenant more gracious than the paradiſaical.

‡ Rom. v. 16, 17.

Thus graciouſly has the divine goodneſs diſplayed itſelf in the reſtoration of our loſt inheritance. But it ſtopt not here. The ſame bountiful Lord of life, for its further ſecurity, imparts to every true believer the ſtrength and light of his holy ſpirit to ſupport faith in working out our own ſalvation. Our bleſſed Saviour promiſed, before he left this world, to ſend to his followers the Holy Ghoſt or Comforter to abide with them for ever, to guide them into all truth, to bring all things to their remembrance whatſoever he had ſaid unto them, and, as we learn from other paſſages of ſcripture, to "work in them both to will and to do of his good pleaſure." How amply this promiſe was fulfilled to the apoſtles, we have already ſeen; but we are not to ſuppoſe that it was reſtricted to them. As man is deſigned for a ſupernatural ſtate in heaven, he ſtands in need of ſupernatural direction to guide him to that ſtate. "No man (ſays our Saviour) can come to me except the Father draw him; for as no man knoweth the things of a man ſave the ſpirit of a man which is in him, even ſo none knoweth the things of God but the Spirit of God." This omniſcient Spirit indeed "ſearcheth all things, yea even the deep things of God," and revealeth them to the ſons of men, to enlighten their underſtandings and purify their hearts. The grace which he ſheds abroad is either external and general, or internal and particular. The former has been extended to the whole church of God under the patriarchal, Moſaic, and Chriſtian diſpenſations, in ſuch a revelation of the divine will as was ſufficient to inſtruct men unto eternal life, whether they had a clear view or not of that ſtupendous plan of redemption, by which the kingdom of heaven was opened to them after the forfeiture of the terreſtrial paradiſe; for there have been "holy prophets ever ſince the world began;

215 Chriſtians ſanctified by the Holy Ghoſt, w

ogy began; and prophecy came not at any time by the will of man, but holy men of God spake as they were moved by the Holy Ghost*." Hence it is that all scripture was given by inspiration of God to teach us every thing which it is necessary for us to know and believe; and the scripture is that work of the Spirit which is extended to the universal church.

But the same spirit which thus generally reveals the object of faith to the church, does likewise particularly illuminate the minds of individual believers, working in them an assent to that which is taught them from the written word. It was thus that "the Lord opened the heart of Lydia †; that she attended to the things which were spoken by Paul;" it is thus that "the word preached doth not profit if it be not mixed with faith in them who hear it ‡;" and it is thus that "God deals to every man the measure of faith §;" for "by grace are we saved through faith, which is not of ourselves; it is the gift of God ||." This illumination of the Spirit was conveyed to the apostles "in a sound from heaven as of a rushing mighty wind," because it was meant to testify to the world that they were chosen ministers of the gospel; but the ordinary Christian receives it "in the still small voice," because it is conveyed to him only to "open his understanding that he may understand the scriptures."

Another operation of the Spirit on the minds of believers is that which in scripture is called REGENERATION; for "according to his mercy God saveth us by the washing of regeneration and renewing of the Holy Ghost*, which he sheds on us abundantly through Jesus Christ our Lord." To those who believe that we derive from Adam a corrupted nature, this particular grace must appear so absolutely necessary, that without it we could have no relish for heaven or heavenly things. "The natural man (we are told) receiveth not the things of the spirit of God; for they are foolishness to him; neither can he know them, because they are spiritually discerned." Indeed whatever be the powers of our moral faculties, when compared with those of our first father, it is so long before they be completely developed, that we should infallibly be lost, if we were not blessed by a supernatural guide, when reason is incapable of directing our conduct. Our passions and appetites are in their full strength before experience has furnished the mind with materials, by means of which motives may be weighed; and therefore it would be impossible, during the giddy period of youth, to keep them in due subjection, or to prevent vicious habits from being formed, were we not influenced by divine grace. So true is it, that "except a man be born again of water and of the Holy Ghost, he cannot enter into the kingdom of God." This change in our dispositions, from an immoderate attachment to earth to a relish for the things of heaven, is in scripture called "a renewing of our minds, a new creation, a new man;" in opposition to our natural disposition, which is called "the old man, corrupted according to the deceitful lusts." The ancient fathers of the church, as well as some very eminent modern divines†, generally speak of baptism as the instrument in God's hand of man's regeneration; and for the truth of their opinion they appeal to John iii. 3, 5. Ephes. v. 25, 26. and 1 Cor. vi. 11. in which great stress is certainly laid on the washing of water, as well as on sanctification by the word.

A third office of the Holy Spirit is to lead, direct, and govern us through all the periods of our lives. Without such a leader and guide, the temptations with which we are surrounded would certainly overcome us, and we should faint long before we arrive at the end of our journey. By the very constitution of our nature we are subjected in some degree to the influence of sense, of which the objects are present, whilst the enjoyments of heaven are future, and seen, as at a distance, only by the eye of faith; but "the law of the Spirit of life, in Christ Jesus, hath made us free from the law of sin and death;" for God worketh in us both to will and to do of his good pleasure; and as many as are thus led by the spirit of God, they are the sons of God; and while they walk in the Spirit, they do not fulfil the lusts of the flesh." Without the aid of the same Spirit, we could not even make our prayers acceptable; for since "our confidence in God is, that he heareth us only when we ask any thing according to his will; and since we know not what we should pray for as we ought, the Spirit itself maketh intercession for us with groanings which cannot be uttered *.

Theology more peculiarly Christian.

217 guides them through life,

* Rom. viii. 26.

A fourth operation of the Holy Ghost, as he is the sanctifier of Christians, is to join them to Christ, and make them members of that one body of which he is the head. "For by one Spirit are we all baptized into one body †; and as the body is one and hath many members, and all the members of that one body being many are one body, so also is Christ." "Hereby we know that God abideth in us, by the Spirit which he hath given us;" and as, in the ordinary course of his dealings with Christians, this Spirit is first given in baptism, so is it continued to the faithful by the instrumentality of the Lord's supper. That ordinance we have elsewhere (see *SUPPER of the Lord*) proved to be a federal rite; and surely no time can be supposed so highly sanctified for the reception of the graces of the Holy Spirit, as that in which we renew our federal union with our Lord and Master in the communion of his body and blood.

† 1 Cor. xii. 12, 13.

218 unites them to Christ,

It is likewise the office of the Holy Ghost to give us an earnest of our everlasting inheritance, to create in us a sense of the paternal love of God, and thereby to assure us of the adoption of sons. "As many as are led by the Spirit of God, they are the SONS of God; and because we are sons, God hath sent forth the spirit of his Son into our hearts. For we have not received the spirit of bondage again to fear; but we have received the Spirit of adoption, whereby we cry Abba Father; the Spirit itself bearing witness with our spirit, that we are the children of God ‡."

‡ Gal. iv. 6 Rom. viii. 15, 16.

As the gifts of grace are generally annexed to means, to the proper use of the word and sacraments, it is a sixth office of the same Spirit to sanctify such persons as are regularly set apart for the work of the ministry, and ordained to offer up the public prayers of the people; to bless them in the name of God; to teach the doctrines of the gospel; to administer the sacraments instituted by Christ; and to perform all things necessary "for the perfecting of the saints, for the work of the ministry, for the edifying of the body of Christ §." The same Spirit which illuminated the apostles, and endowed them with power from above to perform personally their apostolic functions, fitted them also for sending others, as they were sent by their Divine Master; and for esta-

219 and sanctifies the administrations of the ministers of the gospel.

§ Eph. iv. 12.

Theology more peculiarly Christian.

bliſhing ſuch a conſtitution of the church as was beſt adapted for preſerving Chriſtians in the unity of the Spirit and bond of peace. They committed a ſtanding power to a ſucceſſive miniſtry to be conveyed down to the end of the world; and thoſe who are veſted with that power are obliged to "take heed unto themſelves, and to all the flock over which the HOLY GHOST hath made them overſeers, to feed the church of God, and to contend earneſtly for the faith which was once delivered unto the ſaints*." See EPISCOPACY, INDEPENDENTS, PRESBYTERIANS, POPE, and QUAKERS.

* Acts xx. 28. and Jude ver. 3.

By theſe, and the like means, doth the Spirit of God ſanctify the ſons of men; and in conſequence of this ſanctification proceeding immediately from his office, he is called the HOLY Spirit and the COMFORTER. This is ſuch a proviſion "for renewing us in the ſpirit of our minds, and enabling us to put on the new man, which, after God, is created in righteouſneſs and true holineſs," as, when made known by revelation, appears to have been expedient, may be conceived to have been even neceſſary, and, though reaſon could hardly have hoped for it, is contradicted by none of our natural notions either of God or of man. Many, however, are the controverſies to which it has given riſe in the church of God; ſome contending that it is given only unto the elect, upon whom it operates with reſiſtleſs efficacy; others affirming that it is offered to all, but in ſuch a manner as that, by the abuſe of their free will, it may be "reſiſted, grieved, and quenched;" and ſome few, ſtill intoxicated with the pride of PELAGIUS, think it is not neceſſary, and of courſe is not beſtowed.

220 Controverſies occaſioned by this doctrine

The queſtions concerning *election*, the *efficacy of grace*, and the final *perſeverance of the ſaints*, we have ſtated elſewhere, and given a ſummary view of the arguments by which the contending parties maintain their reſpective opinions (ſee PREDESTINATION); and the texts of Scripture which we have juſt quoted, under the different heads of ſanctification, ſhow ſufficiently that the opinion of Pelagius is directly contrary to the doctrine of the apoſtles. It may not be improper to enquire whether it be as agreeable to reaſon and experience as its patrons ſeem to imagine.

221 diſcuſſed elſewhere.

If it be unreaſonable to expect any aſſiſtance from the Spirit of God in carrying on the work of our own ſalvation, how came ſo many of the wiſeſt and beſt of men in all ages to believe, that he who ſincerely endeavours to diſcharge his duty is ſupported in that endeavour by aſſiſtance from heaven? That ſuch was the popular belief of the early Greeks, is evident from the poems of Homer; in which we everywhere find ſome god calming the paſſions of the heroes, altering their determinations when improper, and inſpiring them with wiſdom. Nor was this the ſentiment of the poets only. Socrates, it is well known, profeſſed to believe that his own conduct was under the direction of a ſuperior ſpirit, which he called a *dæmon*; and Plutarch, as we find him quoted by Wollaſton, ſpeaks of the gods aſſiſting men, by "exciting the powers or faculties of the ſoul; by ſuggeſting ſecret principles, imaginations, or thoughts; or, on the contrary, by diverting or ſtopping them." Of the ſame opinion muſt Cicero have been, when he ſaid, "ſtabit illud quidem, quod locum hunc continet, de quo agimus, eſſe Deos, et eorum providentia mundum adminiſtrari, eoſdemque conſulere rebus humanis, nec ſolum *univerſis*, verum etiam SINGULIS†;" for it is not conceivable that a particular providence can be adminiſtered without the influence of the Deity on the minds of men. That the poets and philoſophers of the heathen world derived theſe notions from primeval tradition, cannot, we think, be queſtioned; but if they were abſurd in themſelves, or apparently contradictory to the laws of nature, they would not ſurely have been ſo univerſally embraced; for it will ſcarcely be denied, that Socrates and Cicero were men of as great natural ſagacity as Pelagius or any of his followers. It is indeed ſo far from being incredible that the Father of ſpirits occaſionally directs the thoughts and actions of men, that we believe there are very few who have made obſervations on themſelves and their own affairs, who have not found, on reflection, many inſtances in which their uſual judgment and ſenſe of things were *overruled*, they know not *how* or *why*; and that the actions which they performed in thoſe circumſtances have had conſequences very remarkable in their general hiſtory. See PROVIDENCE, N° 18, 19.

Theology more peculiarly Chriſtian.

222 Opinions of the heathens concerning it.

† *De Div.* lib. i. ſect. 51.

This being the caſe, why ſhould the pride of Chriſtians make them heſitate to admit, on the authority of divine revelation, what Socrates, and Plutarch, and Cicero, and all the virtuous and wiſe men of antiquity, admitted in effect, on no better evidence than that of oral tradition, ſupported by their own meditations on their own thoughts, and the principles of their own conduct? Is it that they ſee not ſuch beneficial effects of Chriſtianity as to induce them to believe the profeſſors of that religion to be indeed "choſen to ſalvation through the ſanctification of the Spirit‡?" Let them ſtudy the practical precepts of the goſpel, conſider the conſequences which they have had on the peace and happineſs of ſociety, and compare the general conduct of Chriſtians with that of the Jews, Pagans, and Mahometans (ſee RELIGION), and they will doubtleſs find reaſon to alter their opinion; and let thoſe who embrace the truth, remember, that as they are the temple of God, if the Spirit of God dwell in them, "it is their indiſpenſable duty to cleanſe themſelves from all filthineſs of the fleſh and ſpirit; to follow peace with all men, and holineſs, without which, no man ſhall ſee the Lord; and to work out their own ſalvation with fear and trembling, ſince it is God who worketh in them both to will and to do of his good pleaſure."

‡ Theſſ. ii. 3.

223 The goſpel the laſt revelation.

From this ſhort view of the ſeveral diſpenſations of revealed religion, it is evident that the goſpel is not only the beſt but the laſt gift of the kind which man has to expect from his Maker; that the ſcheme of revelation is completed; and that the pretences of Mahomet and of more modern enthuſiaſts to divine inſpiration are not only falſe, but fraught with contradictions. All theſe men admit the divine origin of the Moſaic and Chriſtian religions; but it appears from the ſcriptures, in which thoſe religions are taught, that the ſyſtem of revealed truths which conſtitute the Patriarchal, Moſaic, and Chriſtian revelations, commenced with the fall of man, and that it muſt therefore neceſſarily end with his reſtoration to life and immortality by the ſacrifice of Chriſt upon the croſs. A new revelation therefore like that of Mahomet cannot be admitted without rejecting the whole Bible, though the impoſtor himſelf everywhere acknowledges the inſpiration of Abraham, of Moſes, and of Chriſt. Nor is greater regard due to the claims of Chriſtian enthuſiaſts. Such as pretend to

have

have been in heaven *, and thence to have brought spiritual discoveries to the earth, have either forgotten or never understood, that in the scriptures of the Old and New Testaments the great scene of Providence appears to be closed in the full completion of its one regular, entire, and eternal purpose; that St Paul has pronounced † a curse on any man or angel from heaven who shall preach another gospel than what has been already preached by the apostles and evangelists; that in their writings we are taught every thing which it is our duty to believe or to practise in order to our own salvation; and that we have the promise of our blessed Lord himself, that the Spirit of truth shall remain with us to guide us into all necessary truth, till that great day when he shall come again to judge the world in righteousness, and render to every man according to his works.

Theology more peculiarly Christian.

THE

THEOPHRASTA, a genus of plants belonging to the class pentandria. See BOTANY *Index*.

THEOPHRASTUS, the philosopher, was born about 371 years before Christ, and was successively the disciple of Plato and of Aristotle. He succeeded Aristotle in the Peripatetic school, and conducted the charge with such high reputation that he had about 2000 scholars. He is highly celebrated for his industry, learning, and eloquence; and for his generosity and public spirit. He is said to have twice freed his country from the oppression of tyrants. He contributed liberally towards defraying the expence attending the public meetings of philosophers; which were held, not for the sake of show, but for learned and ingenious conversation. In the public schools he commonly appeared, as Aristotle had done, in an elegant dress, and was very attentive to the graces of elocution. He lived to the advanced age of 85: some say of 107. Towards the close of his life, he grew exceedingly infirm, and was carried to the school on a couch. He expressed great regret on account of the shortness of life; and complained that nature had given long life to stags and crows, to whom it is of so little value, and had denied it to man, who, in a longer duration, might have been able to attain the summit of science; but now, as soon as he arrives within sight of it, is taken away. His last advice to his disciples was, that, since it is the lot of man to die as soon as he begins to live, they would take more pains to enjoy life as it passes, than to acquire posthumous fame. His funeral was attended by a large body of Athenians. He wrote many valuable works, of which all that remain are, several treatises on the Natural History of Plants and Fossils; Of Winds, Of Fire, &c. a rhetorical work entitled "Characters," and a few Metaphysical Fragments.

To Theophrastus we are indebted for preserving the works of Aristotle. See ARISTOTLE.

THEOPOMPUS, a celebrated Greek orator and historian, was born in the island Chios, and flourished in the reign of Alexander the Great. He was one of the most famous of all the disciples of Isocrates, and won the prize from all the panegyrists whom Artemisia invited to praise Mausolus. He wrote several works, which are lost.

THEOREM, a proposition which terminates in theory, and which considers the properties of things already made or done; or it is a speculative proposition deduced from comparing together several definitions. A theorem is something to be proved, and a problem something to be done.

THE

THEORETIC, something relating to theory, or that terminates in speculation. Theoretic || Thermæ.

THEORY, in general, denotes any doctrine which terminates in speculation, without considering the practical uses or application thereof.

THEOSOPHISTS, a sect of men who pretend to derive all their knowledge from divine illumination. They boast that, by means of this celestial light, they are not only admitted to the intimate knowledge of God, and of all divine truth, but have access to the most sublime secrets of nature. They ascribe it to the singular manifestation of divine benevolence, that they are able to make such a use of the element of fire, in the chemical art, as enables them to discover the essential principles of bodies, and to disclose stupendous mysteries in the physical world. They even pretend to an acquaintance with those celestial beings which form the medium of intercourse between God and man, and to a power of obtaining from them, by the aid of magic, astrology, and other similar arts, various kinds of information and assistance. *Ibid.*

To this class belonged Paracelsus, Robert Fludd, Jacob Bœhmen, Van Helmont, Peter Poiret, and the Rosicrucians. They are also called *FIRE-Philosophers*.

THERAPEUTÆ, a term applied to those that are wholly in the service of religion. This general term has been applied to particular sects of men, concerning whom there have been great disputes among the learned.

THERAPEUTICS, that part of medicine which acquaints us with the rules that are to be observed, and the medicines to be employed, in the cure of diseases.

THERMÆ, hot baths or bagnios. Luxury and extravagance were in nothing carried to such heights as in the thermæ of the Roman emperors. Ammian complains, that they were built to such an extent as to equal whole provinces; from which Valesius would abate, by reading *piscinæ* instead of *provinciæ*. And yet after all, the remains of some still standing are sufficient testimonies for Ammian's censure; and the accounts transmitted of their ornaments and furniture, such as being laid with precious stones (Seneca), set round with seats of solid silver (Pliny), with pipes and cisterns of the same metal (Statius), add to, rather than take from, the censure. The most remarkable bagnios were those of Diocletian and Caracalla at Rome, great part of which remains at this day; the lofty arches, stately pillars, variety of foreign marble, curious vaulting of the roofs, great number of spacious apartments, all attract the curiosity of

[Therma, Thermometer.

of the traveller. They had alſo their ſummer and winter baths.

THERMOMETER, an inſtrument for meaſuring the degree of heat or cold in any body.

1 Invention of the thermometer. *Martine's Eſſays.* * *Chem.* I. p. 152, 156. † *Life F. Paul*, p. 158. ‡ *Vit. Galil.* p. 67. || *Corn. in Galen.* p. 736—842. § *De Mot. Animal.* II. prop. 175. * *Opera Poſth.* p. 30.

The thermometer was invented about the beginning of the 17th century; but, like many other uſeful inventions, it has been found impoſſible to aſcertain to whom the honour of it belongs. Boerhaave * aſcribes it to Cornelius Drebbel of Alcmar, his own countryman. Fulgenzio † attributes it to his maſter Paul Sarpi, the great oracle of the Venetian republic; and Viviani gives the honour of it to Galileo ‡. But all theſe are poſthumous claims. Sanctorio || claims this honour to himſelf; and his aſſertion is corroborated by Borelli § and Malpighi * of the Florentine academy, whoſe partiality is not to be ſuſpected in favour of a member of the Patavinian ſchool.

Perhaps the beſt way to reconcile theſe different claims would be, to ſuppoſe that the thermometer was really invented by different perſons about the ſame time. We know that there are certain periods in the progreſs of the arts when the ſtream of human genius runs in the ſame direction, and moves towards the ſame object. That part of the current which reaches the object firſt may poſſeſs the title; but the other parts follow ſo rapidly and arrive ſo ſoon after, that it is impoſſible for a ſpectator to decide which is firſt in point of time.

2 The air-thermometer deſcribed.

The firſt form of this inſtrument for meaſuring the degrees of heat and cold, was the air-thermometer. It is a well known fact that air expands with heat ſo as to occupy more ſpace than it does when cold, and that it is condenſed by cold ſo as to occupy leſs ſpace than when warmed, and that this expanſion and condenſation is greater or leſs according to the degree of heat or cold applied. The principle then on which the air-thermometer was conſtructed is very ſimple. The air was confined in a tube by means of ſome coloured liquor; the liquor roſe or fell according as the air became expanded or condenſed. What the firſt form of the tube was, cannot now perhaps be well known; but the following deſcription of the air-thermometer will fully explain its nature.

Plate DXXXIII. fig. 1.

The air-thermometer conſiſts of a glaſs tube BE, fig. 1. connected at one end with a large glaſs ball A, and at the other end immerſed in an open veſſel, or terminating in a ball DE, with a narrow orifice at D; which veſſel, or ball, contains any coloured liquor that will not eaſily freeze. Aquafortis tinged of a fine blue colour with a ſolution of vitriol or copper, or ſpirit of wine tinged with cochineal, will anſwer this purpoſe. But the ball A muſt be firſt moderately warmed ſo that a part of the air contained in it may be expelled through the orifice D; and then the liquor preſſed by the weight of the atmoſphere will enter the ball DE, and riſe, for example, to the middle of the tube at C, at a mean temperature of the weather; and in this ſtate the liquor by its weight, and the air included in the ball A, &c. by its elaſticity, will counterbalance the weight of the atmoſphere. As the ſurrounding air becomes warmer, the air in the ball and upper part of the tube, expanding by heat, will drive the liquor into the lower ball, and conſequently its ſurface will deſcend; on the contrary, as the ambient air becomes colder, that in the ball is condenſed, and the liquor preſſed by the weight of the atmoſphere will aſcend; ſo that the liquor in the tube will aſcend or deſcend more or leſs according to the ſtate of the air contiguous to the inſtrument. To the tube is affixed a ſcale of the ſame length, divided upwards and downwards from the middle C into 100 equal parts, by means of which the aſcent and deſcent of the liquor in the tube, and conſequently the variations in the cold or heat of the atmoſphere, may be obſerved.

Ther. mer

3 Its de

This inſtrument was extremely defective; for the air in the tube was not only affected by the heat and cold of the atmoſphere, but alſo by its weight.

4 The f of wir therm meter

The air being found improper for meaſuring with accuracy the variations of heat and cold according to the form of the thermometer which was firſt adopted, another fluid was propoſed about the middle of the 17th century by the Florentine academy. This fluid was ſpirit of wine, or alcohol, as it is now generally named. The alcohol being coloured, was incloſed in a very fine cylindrical glaſs tube previouſly exhauſted of its air, having a hollow ball at one end A, fig. 2. and hermetically ſealed at the other end D. The ball and tube are filled with rectified ſpirit of wine to a convenient height, as to C, when the weather is of a mean temperature, which may be done by inverting the tube into a veſſel of ſtagnant coloured ſpirit, under a receiver of the air-pump, or in any other way. When the thermometer is properly filled, the end D is heated red hot by a lamp, and then hermetically ſealed, leaving the included air of about one-third of its natural denſity, to prevent the air which is in the ſpirit from dividing it in its expanſion. To the tube is applied a ſcale, divided from the middle, into 100 equal parts, upwards and downwards. Fig. 2

As ſpirit of wine is capable of a very conſiderable degree of rarefaction and condenſation by heat and cold, when the heat of the atmoſphere increaſes the ſpirit dilates, and conſequently riſes in the tube; and when the heat decreaſes, the ſpirit deſcends, and the degree or quantity of the motion is ſhown by a ſcale.

5 Its defe

The ſpirit of wine thermometer was not ſubject to ſome of the inconveniences which attended the air thermometer. In particular, it was not affected by variations in the weight of the atmoſphere: accordingly it ſoon came into general uſe among philoſophers. It was, at an early period, introduced into Britain by Mr Boyle. To this inſtrument, as then uſed, there are, however, many objections. The liquor was of different degrees of ſtrength, and therefore different tubes filled with it, when expoſed to the ſame degree of heat, would not correſpond. There was alſo another defect: The ſcale which was adjuſted to the thermometer did not commence at any fixed point. The higheſt term was adjuſted to the great ſunſhine heats of Florence, which are too variable and undetermined; and frequently the workman formed the ſcale according to his own fancy. While the thermometer laboured under ſuch diſadvantages it could not be of general uſe. *Martin's Eſſays.*

6 Differe fixed po propoſed philoſo phers.

To obtain ſome fixed unalterable point by which a determined ſcale might be diſcovered, to which all thermometers might be accurately adjuſted, was the ſubject which next drew the attention of philoſophers. Mr Boyle, who ſeems at an early period to have ſtudied this ſubject with much anxiety, propoſed the freezing of the eſſential oil of aniſeeds as a convenient point for graduating thermometers; but this opinion he ſoon laid aſide. Dr Halley next propoſed that thermometers

ſhould

should be graduated in a deep pit under ground, where the temperature both in winter and summer is pretty uniform; and that the point to which the spirit of wine should rise in such a subterraneous place should be the point from which the scale should commence. But this proposal was evidently attended with such inconveniences that it was soon abandoned. He made experiments on the boiling point of water, of mercury, and of spirit of wine; and he seems rather to give a preference to the spirit of wine*. He objected to the freezing of water as a fixed point, because he thought that it admitted considerable latitude.

It seems to have been reserved to the all-conquering genius of Sir Isaac Newton to determine this important point, on which the accuracy and value of the thermometer depends. He chose, as fixed, those points at which water freezes and boils; the very points which the experiments of succeeding philosophers have determined to be the most fixed and convenient. Sensible of the disadvantages of spirit of wine, he tried another liquor which was homogeneous enough, capable of a considerable rarefaction, about 15 times greater than spirit of wine. This was linseed oil. It has not been observed to freeze even in very great colds, and it bears a heat about four times that of water before it boils. With these advantages it was made use of by Sir Isaac Newton, who discovered by it the comparative degree of heat for boiling water, melting wax, boiling spirit of wine, and melting tin; beyond which it does not appear that this thermometer was applied. The method he used for adjusting the scale of this oil thermometer was as follows: Supposing the bulb, when immerged in thawing snow, to contain 10,000 parts, he found the oil expand by the heat of the human body so as to take up $\frac{1}{19}$th more space, or 10,256 such parts; and by the heat of water boiling strongly 10,725; and by the heat of melting tin 11,516. So that reckoning the freezing point as a common limit between heat and cold, he began his scale there, marking it 0, and the heat of the human body he made 12°; and consequently, the degrees of heat being proportional to the degrees of rarefaction, or 256 : 725 :: 12 : 34, this number 34 will express the heat of boiling water; and by the same rule, 72 that of melting tin †. This thermometer was constructed in 1701.

To the application of oil as a measure of heat and cold, there are insuperable objections. It is so viscid, that it adheres too strongly to the sides of the tube. On this account it ascends and descends too slowly in case of a sudden heat or cold. In a sudden cold, so great a portion remains adhering to the sides of the tube after the rest has subsided, that the surface appears lower than the corresponding temperature of the air requires. An oil thermometer is therefore not a proper measure of heat and cold.

All the thermometers hitherto proposed were liable to many inconveniences, and could not be considered as exact standards for pointing out the various degrees of temperature. This led Reaumur to attempt a new one, an account of which was published in the year 1730 in the Memoirs of the Academy of Sciences. This thermometer was made with spirit of wine. He took a large ball and tube, the dimensions and capacities of which were known; he then graduated the tube, so that the space from one division to another might contain 1000th part of the liquor; the liquor containing 1000 parts when it stood at the freezing point. He adjusted the thermometer to the freezing point by an artificial congelation of water: then putting the ball of his thermometer and part of the tube into boiling water, he observed whether it rose 80 divisions: if it exceeded these, he changed his liquor, and by adding water lowered it, till upon trial it should just rise 80 divisions; or if the liquor, being too low, fell short of 80 divisions, he raised it by adding rectified spirit to it. The liquor thus prepared suited his purpose, and served for making a thermometer of any size, whose scale would agree with his standard. Thermometer. *Martine's Essays on the Construction of Thermometers.*

10 Its defects.

This thermometer was far from being perfect. As the bulbs were three or four inches in diameter, the surrounding ice would be melted before its temperature could be propagated to the whole spirits in the bulb, and consequently the freezing point would be marked higher than it should be. Dr Martine accordingly found, that instead of coinciding with the 32d degree of Fahrenheit, it corresponded with the 34th, or a point a little above it. Reaumur committed a mistake also respecting the boiling point; for he thought that the spirit of wine, whether weak or strong, when immerged in boiling water, received the same degree of heat with the boiling water. But it is well known that highly rectified spirit of wine cannot be heated much beyond the 175th degree of Fahrenheit, while boiling water raises the quicksilver 37 degrees higher. There is another thermometer that goes by the name of *Reaumur's*, which shall be afterwards described.

11 Mercurial thermometers.

At length a different fluid was proposed, by which thermometers could be made free from most of the defects hitherto mentioned. This fluid was mercury, and seems first to have occurred to Dr Halley in the last century; but it was not adopted by him on account of its having a smaller degree of expansibility than the other fluids used at that time*. Boerhaave says that the mercurial thermometer was first constructed by Olaus Roemer; but the honour of this invention is generally given to Fahrenheit of Amsterdam, who presented an account of it to the Royal Society of London in 1724.

* *Phil. Transf.* vol. xvii. or *Abr.* vol. ii.

12 Properties of air, alcohol, and oil.

That we may judge the more accurately of the propriety of employing mercury, we will compare its qualities with those of the fluids already mentioned, air, alcohol, and oil.

Air is the most expansible fluid, but it does not receive nor part with its heat so quickly as mercury. Alcohol does not expand much by heat. In its ordinary state it does not bear a much greater heat than 175° of Fahrenheit; but when highly rectified it can bear a greater degree of cold than any other liquor hitherto employed as a measure of temperature. At Hudson's Bay, Mr Maenab, by a mixture of vitriolic acid and snow, made it to descend to 69 below 0 of Fahrenheit. This is an inconvenience, however, attending the use of this liquor; it is not possible to get it always of the same degree of strength. As to oil, its expansion is about 15 times greater than that of alcohol; it sustains a heat of 600°, and its freezing point is so low that it has not been determined; but its viscosity renders it useless.

13 Thermometrical properties of mercury.

Mercury is superior to alcohol and oil, and is much more manageable than air. 1. As far as the experiments

Thermometer.

ments already made can determine, it is of all the fluids hitherto employed in the construction of thermometers, that which measures most exactly equal differences of heat by equal differences of its bulk: its dilatations are in fact very nearly proportional to the augmentations of heat applied to it (A). 2. Of all liquids it is the most easily freed from air. 3. It is fitted to measure high degrees of heat and cold. It sustains a heat of 600° of Fahrenheit's scale, and does not congeal till it fall 39 or 40 degrees below 0. 4. It is the most sensible of any fluid to heat and cold, even air not excepted. Count Rumford found that mercury was heated from the freezing to the boiling point in 58 seconds, while water took two minutes 13 seconds, and common air 10 minutes and 17 seconds. 5. Mercury is a homogeneous fluid, and every portion of it is equally dilated or contracted by equal variations of heat. Any one thermometer made of pure mercury is, *cæteris paribus*, possessed of the same properties with every other thermometer made of pure mercury. Its power of expansion is indeed about six times less than that of spirit of wine, but it is great enough to answer most of the purposes for which a thermometer is wanted.

Recherches sur les Mod. de l'Atmosphere.

** Phil. Transf.* for 1786.

14 Fixed points.

The fixed points which are now universally chosen for adjusting thermometers to a scale, and to one another, are the boiling and freezing points of water. The boiling water point, it is well known, is not an invariable point, but varies some degrees according to the weight and temperature of the atmosphere. In an exhausted receiver, water will boil with a heat of 98° or 100°; whereas in Papin's digester it will require a heat of 412. Hence it appears that water will boil at a lower point, according to its height in the atmosphere, or to the weight of the column of air which presses upon it. In order to ensure uniformity therefore in the construction of thermometers, it is now agreed that the bulb of the tube be plunged in the water when it boils violently, the barometer standing at 30 English inches (which is its mean height round London, and the temperature of the atmosphere 55°. A thermometer made in this way, with its boiling point at 212°, is called by Dr Horsley *Bird's Fahrenheit*, because Mr Bird was the first person who attended to the state of the barometer in constructing thermometers.

Ther. met.

1 Rule to adjust therm. to these.

As artists may be often obliged to adjust thermometers under very different pressures of the atmosphere, philosophers have been at pains to discover a general rule which might be applied on all occasions. M. de Luc, in his *Recherches sur les Mod. de l'Atmosphere*, from a series of experiments, has given an equation for the allowance on account of this difference, in Paris measure, which has been verified by Sir George Shuckburgh *; also Dr Horsley, Dr Maskelyne, and Sir George Shuckburgh, have adapted the equation and rules to English measures, and have reduced the allowances into tables for the use of the artist. Dr Horsley's rule, deduced from De Luc's, is this:

* *Phil. Transf.* 1775 1778.

$$\frac{99}{8990000}\log. z - 92.804 = h,$$

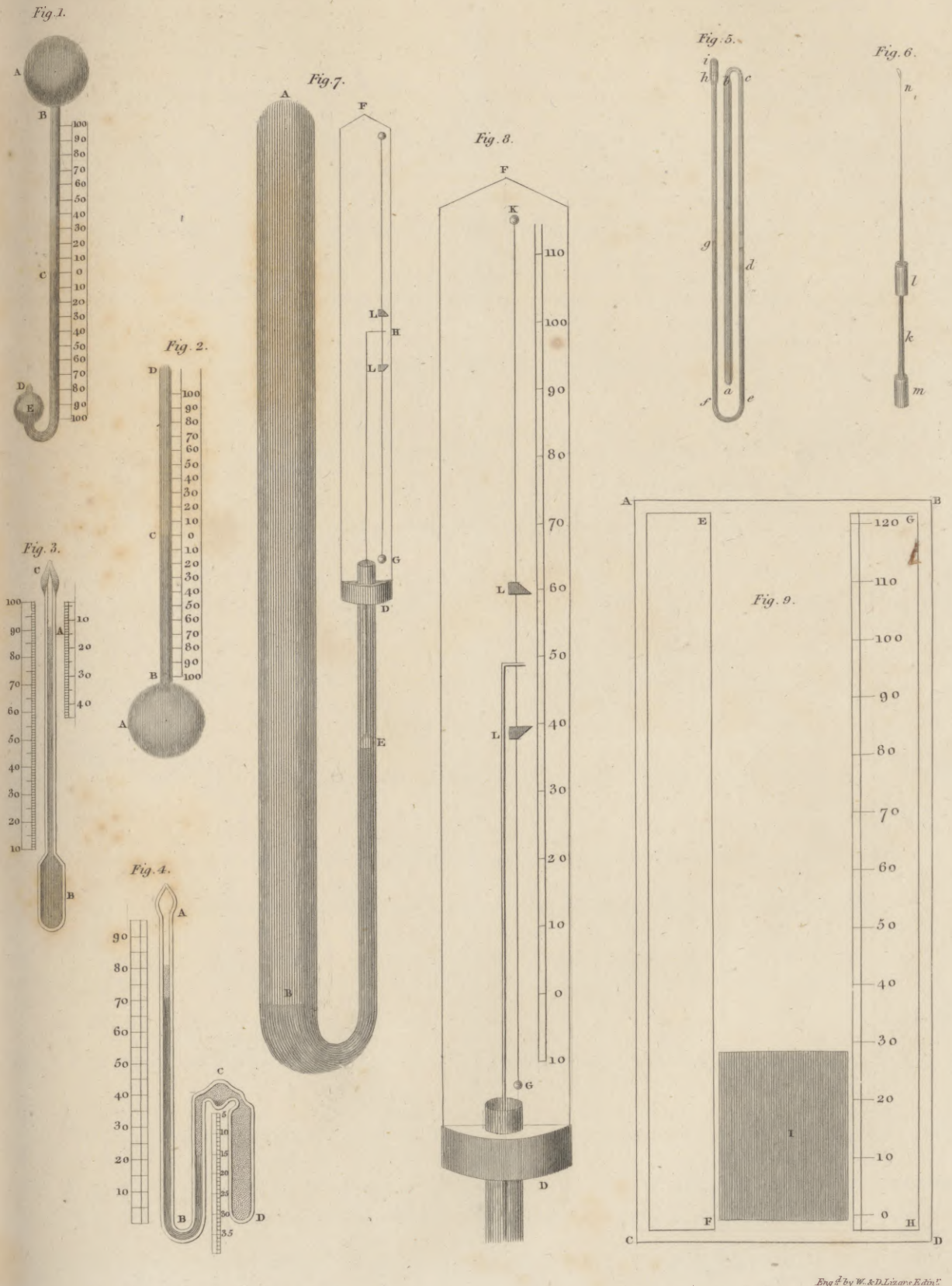
where h denotes the height of a thermometer plunged in boiling water, above the point of melting ice, in degrees of Bird's Fahrenheit, and z the height of the barometer in 10ths of an inch. From this rule he has computed the following table, for finding the heights, to which a good Bird's Fahrenheit will rise when plunged in boiling water, in all states of the barometer, from 27 to 31 English inches; which will serve, among other uses, to direct instrument-makers in making a true allowance for the effect of the variation of the barometer, if they should be obliged to finish a thermometer at a time when the barometer is above or below 30 inches; though it is best to fix the boiling point when the barometer is at that height.

Equation

(A) We have affirmed that the expansions of the bulk of quicksilver by heat are nearly (for they are not strictly so) in a regular arithmetical progression, according to the quantity of heat it is exposed to; and such seems to be the case according to the Table published by M. de Luc, at page 309 of his first volume on the Modifications of the Atmosphere. The following extract of this table shows these variations: and the first and second differences are added, in order to render these irregularities more sensible. They are such as can hardly be conceived from the nature of any substance, without the influence of extraneous and accidental causes, which may have escaped the attention of the observer; neither have they been found exactly true by Dr Crawford. M. de Luc supposes the whole heat from melting ice to that of boiling water to be divided into 80 parts; by the fractional subdivisions of which he expresses the absolute quantities of heat, answering to each 5 or 10 degrees of Reaumur's thermometer (=22,5 of Fahrenheit's scale); so that the whole sum of these fractions amounts exactly to the assumed number 80. They are as follow:

Cronstedt's Mineral. 83, vol.

	Reaumur's Thermometer.	*Fahrenheit's Thermometer.*	*Quantities of heat.*	*First differences.*	*Second differences.*
Degrees	80	212			
	70	189.5	9.44	.16	
	60	167	9.60	.10	+.06
	50	144.5	9.70	.16	—.06
	40	122	9.86	.22	—.06
	30	99.5	10.08	.12	+.10
	20	77	10.20	.18	—.06
	10	54.5	10.38	.56	—.18
	0	32	10.74		



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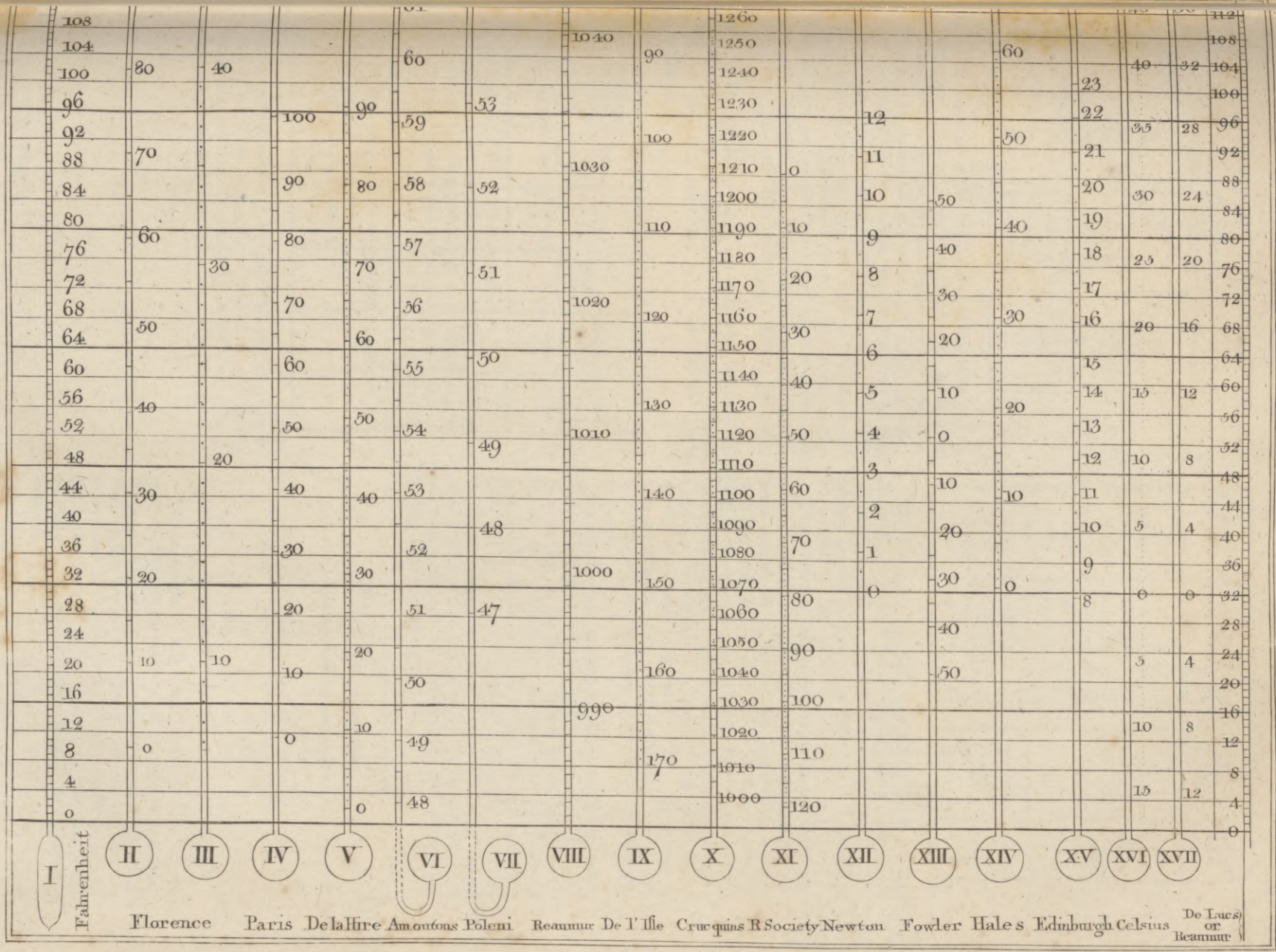


W. Train Sculpt

Equation of the Boiling Point.

Barometer.	*Equation.*	*Difference.*
31.0	+ 1.57	
		0.78
30.5	+ 0.79	
		0.79
30.0	0.00	
		0.80
29.5	— 0.80	
		0.82
29.0	— 1.62	
		0.83
28.5	— 2.45	
		0.85
28.0	— 3.31	
		0.86
27.5	— 4.16	
		0.88
27.0	— 5.04	

The numbers in the firſt column of this table expreſs heights of the quickſilver in the barometer in Engliſh inches and decimal parts: the ſecond column ſhows the equation to be applied, according to the ſign prefixed, to 212° of Bird's Fahrenheit, to find the true boiling point for every ſuch ſtate of the barometer. The boiling point for all intermediate ſtates of the barometer may be had with ſufficient accuracy, by taking proportional parts, by means of the third column of differences of the equations. See Philoſophical Tranſactions, vol. lxiv. art. 30.; alſo Dr Maſkelyne's Paper, vol. lxiv. art. 20.

In the following table we have the reſult of fifteen different obſervations made by Sir George Shuckburgh compared with the reſult of M. de Luc's rules.

Height of the Barometer reduced to the ſame temperature of 50°.	Mean Boiling Point by Obſervation.	Boiling Point by De Luc's Rules.	Height of Barometer.	Boiling Point by Obſervation.	Boiling Point by De Luc's Rules.
Inch.	°	°	Inch.	°	°
26.498	207.07	208.54	30.008	213.22	213.47
27.241	208.64	208.84	30.207	213.58	213.79
27.954	209.87	210.03	30.489	214.15	214.23
28.377	210.50	210.81	30.763	214.37	214.66
28.699	211.27	211.34	30.847	214.83	214.79
28.898	211.50	211.67	30.957	214.96	214.96
28.999	211.60	211.85			
29.447	212.55	212.74			
29.805	212.95	213.15			

Sir George Shuckburgh has alſo ſubjoined the following general table for the uſe of artiſts in conſtructing the thermometer, both according to his own obſervations and thoſe of M. de Luc.

Thermometer.

Height of the Barometer.	Correct. of the Boiling Point.	Difference.	Correct. according to M. de Luc.	Difference.
	°		°	
26.0	— 7.09		— 6.83	
		.91		.90
26.5	— 6.18		— 5.93	
		.91		.89
27.0	— 5.27		— 5.04	
		.90		.88
27.5	— 4.37		— 4.16	
		.89		.87
28.0	— 3.48		— 3.31	
		.89		.86
28.5	— 2.59		— 2.45	
		.87		.83
29.0	— 1.72		— 1.62	
		.87		.82
29.5	— 0.85		— 0.80	
		.85		.80
30.0	0.00		0.00	
		.85		.79
30.5	+ 0.85		+ 0.79	
		.84		.78
31.0	+ 1.69		+ 1.57	

18 Obſervations made by a committee of the Royal Society for adjuſting the fixed points.

The Royal Society, fully appriſed of the importance of adjuſting the fixed points of thermometers, appointed a committee of ſeven gentlemen to conſider of the beſt method for this purpoſe; and their report is publiſhed in the Phil. Tranſ. vol. lxvii. part ii. art. 37.

They obſerved, that though the boiling point be placed ſo much higher on ſome of the thermometers now made than on others, yet this does not produce any conſiderable error in the obſervations of the weather, at leaſt in this climate; for an error of $1\frac{1}{2}$° in the poſition of the boiling point, will make an error only of half a degree in the poſition of 92°, and of not more than a quarter of a degree in the point of 62°. It is only in nice experiments, or in trying the heat of hot liquors, that this error in the boiling point can be of much importance.

In adjuſting the freezing as well as the boiling point, the quickſilver in the tube ought to be kept of the ſame heat as that in the ball. When the freezing point is placed at a conſiderable diſtance from the ball, the pounded ice ſhould be piled to ſuch a height above the ball, that the error which can ariſe from the quickſilver in the remaining part of the tube not being heated equally with that in the ball, ſhall be very ſmall, or the obſerved point muſt be corrected on that account according to the following table:

19 Table for correcting the freezing point.

Heat of the Air.	Correction.
42°	.00087
52	.00174
62	.00261
72	.00348
82	.00435

The correction in this table is expreſſed in 1000th parts of the diſtance between the freezing point and the ſurface of the ice: e. gr. if the freezing point ſtands ſeven inches above the ſurface of the ice, and the heat of the room is 62, the point of 32° ſhould be placed 7×.00261, or .018 of an inch lower than the obſerved point. A diagonal ſcale will facilitate this correction.

Thermometer.

The committee obſerve, that in trying the heat of liquors, care ſhould be taken that the quickſilver in the tube of the thermometer be heated to the ſame degree as that in the ball; or if this cannot be done conveniently, the obſerved heat ſhould be corrected on that account; for the manner of doing which, and a table calculated for this purpoſe, we muſt refer to their excellent report in the Phil. Tranſ. vol. lxvii. part ii. art. 37.

20 The quickſilver in the tube ought to be heated to the ſame degree as that in the ball.

With regard to the choice of tubes, they ought to be exactly cylindrical. But though the diameter ſhould vary a little, it is eaſy to manage that matter in the manner propoſed by the Abbé Nollet *, by making a ſmall portion of the quickſilver, e. gr. as much as fills up an inch or half an inch, ſlide backward and forward in the tube; and thus to find the proportions of all its inequalities, and from thence to adjuſt the diviſions to a ſcale of the moſt perfect equality. The capillary tubes are preferable to others, becauſe they require ſmaller bulbs, and they are alſo more ſenſible, and leſs brittle. The moſt convenient ſize for common experiments has the internal diameter about the 40th or 50th of an inch, about nine inches long, and made of thin glaſs, that the riſe and fall of the mercury may be better ſeen.

21 The tubes ought to be cylindrical and capillary.

* *Leçons de Phyſ. Exp.* tom. iv. p. 376.

22 The number of degrees into which the ſcale ought to be divided.

The next thing to be conſidered, is of what number of degrees or diviſions the ſcale ought to conſiſt, and from what point it ought to commence. As the number of the diviſions of the ſcale is an arbitrary matter, the ſcales which have been employed differ much from one another in this circumſtance. Fahrenheit has made 180 degrees between the freezing and boiling water point. Amontons made 73, and Sir Iſaac Newton only 34. There is, however, one general maxim, which ought to be obſerved: *That ſuch an arithmetical number ſhould be choſen as can eaſily be divided and ſubdivided, and that the number of diviſions ſhould be ſo great that there ſhall ſeldom be occaſion for fractions.* The number 80 choſen by Reaumur anſwers extremely well in this reſpect, becauſe it can be divided by ſeveral figures without leaving a remainder; but it is too ſmall a number: the conſequence of which is, that the degrees are placed at too great a diſtance from one another, and fractions muſt therefore be often employed. We think, therefore, that 160 would have been a more convenient number. Fahrenheit's number 180 is large enough, but when divided its quotient ſoon becomes an odd number.

23 At what point the ſcale ought to commence.

As to the point at which the ſcale ought to commence, various opinions have been entertained. If we knew the beginning or loweſt degree of heat, all philoſophers would agree, that the loweſt point of the thermometer ought to be fixed there; but we know neither the loweſt nor the higheſt degrees of heat; we obſerve only the intermediate parts. All that we can do, then, is to begin it at ſome invariable point, to which thermometers made in different places may eaſily be adjuſted. If poſſible too, it ought to be a point at which a natural well-known body receives ſome remarkable change from the effects of heat or cold. Fahrenheit began his ſcale at the point at which ſnow and ſalt congeal. Kirwan propoſes the freezing point of mercury. Sir Iſaac Newton, Hales, and Reaumur adopted the freezing point of water. The objection to Fahrenheit's loweſt point is, that it commences at an artificial cold never known in nature, and to which we cannot refer our feelings, for it is what few can ever experience. There would be ſeveral great advantages gained, we allow, by adopting the freezing point of mercury. It is the loweſt degree of cold to which mercury can be applied as a meaſure; and it would render unneceſſary the uſe of the ſigns plus and minus, and the extenſion of the ſcale below 0. But we object to it, that it is not a point well known; for few, comparatively ſpeaking, who uſe thermometers, can have an opportunity of ſeeing mercury congealed. As to the other advantage to be gained by adopting the freezing point of mercury, namely, the abolition of negative numbers, we do not think it would counterbalance the advantage, to be enjoyed by uſing a well-known point. Beſides, it may be aſked, Is there not a propriety in uſing negative numbers to expreſs the degree of cold, which is a negative thing? Heat and cold we can only judge of by our feelings: the point then at which the ſcale ſhould commence, ought to be a point which can form to us a ſtandard of heat and cold; a point familiar to us from being one of the moſt remarkable that occurs in nature, and therefore a point to which we can with moſt clearneſs and preciſion refer to in our minds on all occaſions. This is the freezing point of water choſen by Sir Iſaac Newton, which of all the general changes produced in nature by cold is the moſt remarkable. It is, therefore, the moſt convenient point, for the thermometers to be uſed in the temperate and frigid zones; we may ſay over the globe, for even in the hotteſt countries of the torrid zone many of the mountains are perpetually covered with ſnow.

The thermometers which are at preſent in moſt general uſe, are Fahrenheit's, De l'Iſle's, Reaumur's, and Celſius's. Fahrenheit's is uſed in Britain, De l'Iſle's in Ruſſia, Reaumur's and the thermometre centigrade in France, and Celſius's, the ſame as the laſt named, in Sweden. They are all mercurial thermometers. For their deſcription and the method of comparing them together, ſee CHEMISTRY, N° 198—201. See alſo Plate DXXXIV.

As in meteorological obſervations it is neceſſary to attend to the greateſt riſe and fall of the thermometer, attempts have been made to conſtruct a thermometer which might regiſter the greateſt degree of heat, or greateſt degree of cold, which took place during the abſence of the obſerver. In 1757 Lord Charles Cavendiſh preſented to the Royal Society of London a thermometer in two different forms; the one contrived to mark the greateſt degree of heat, and the other the greateſt degree of cold.

The firſt conſiſts of a glaſs tube AB, fig. 3. with a cylindrical bulb B at the lower end, and capillary at the top, over which there is fixed a glaſs ball C. The bulb and part of the tube are filled with mercury, the top of which ſhows the degrees of heat as uſual. The upper part of the tube above the mercury is filled with ſpirit of wine; the ball C is alſo filled with the ſame liquor almoſt to the top of the capillary tube. When the mercury riſes the ſpirit of wine is alſo raiſed, and falls into the ball C, which is ſo made that the liquor cannot return into the tube when the mercury ſinks; conſequently the height of the ſpirit of wine in the ball, added to that in the tube, will give the greateſt degree of heat to which the thermometer has pointed ſince laſt obſervation. When a new obſervation is to be made, the inſtrument muſt be inclined

ermo- inclined till the liquor in the ball cover the end of the
eter. capillary tube.

In this thermometer it is evident that the mercury must be affected by the weight and elasticity of the spirit of wine, and therefore it will not correspond to any of the common mercurial thermometers.

4. The thermometer for showing the greatest degree of cold is represented in fig. 4. by the crooked tube ABCD. This instrument is filled with spirit of wine, with the addition of as much mercury as is sufficient to fill both legs of the syphon, and about a fourth or fifth part of the hollow ball C. We are not told what the proportion of mercury was to that of spirit of wine. The degrees of heat are shown by the rise or fall of the mercury in the leg AB. The thermometer marks the greatest fall by means of the hollow ball C. When the mercury in the longer leg sinks by cold, that in the shorter will rise and run over into the ball C, from which it cannot return when the mercury subsides in the shorter and rises in the longer leg. The upper part of the shorter leg will therefore be filled with a column of spirits of a length proportional to the increase of heat; the bottom or lower surface of which, by means of a proper scale, will show how much the mercury has been lower than it is; which being subtracted from the present height will give the lowest point to which the mercury has fallen. That the thermometer may be fitted for a new observation, the mercury must be made to run back from the ball into the shorter leg, by inclining the tube and heating the ball.

27 Six's rmome- In 1782 Mr Six proposed another self-registering thermometer. It is properly a spirit of wine thermometer, though mercury is also employed for supporting an
. 5. index. *a b*, fig. 5. in a thin tube of glass 16 inches long, and $\frac{5}{18}$ths of an inch caliber: *c d e* and *f g h* are smaller tubes about $\frac{1}{20}$th of an inch caliber. These three tubes are filled with highly rectified spirit of wine, except the space between *d* and *g*, which is filled with mercury. As the spirit of wine contracts or expands in the middle tube, the mercury falls or rises in the outside tubes.
. 6. An index, such as that represented in fig. 6. is placed on the surface, within each of these tubes, so light as to float upon it. *k* is a small glass tube $\frac{1}{4}$ths of an inch long, hermetically sealed at each end, and including a piece of steel wire nearly of its own length. At each end *l*, *m*, of this small tube, a short tube of black glass is fixed, of such a diameter as to pass freely up and down within either of the outside tubes of the thermometer *e e* or *f h*. From the upper end of the index is drawn a spring of glass to the fineness of a hair, and about $\frac{1}{5}$ths of an inch long; which being placed a little oblique, presses lightly against the inner surface of the tube, and prevents the index from descending when the mercury descends. These indexes being inserted one into each of the outside tubes, it is easy to understand how they point out the greatest heat or cold that has happened in the observer's absence. When the spirit of wine in the middle tube expands, it presses down the mercury in the tube *h f*, and consequently raises it in the tube *e c*; consequently the index on the left hand tube is left behind and marks the greatest cold, and the index in the right hand tube rises and marks the greatest heat.

28 uther- 'd's ther- ometer. In 1790 a paper was given in to the Royal Society of Edinburgh, describing two thermometers, newly invented, by Dr John Rutherford of Middle Bailish; the one for registering the highest and the other for registering the lowest degree of heat to which the thermometer has risen or fallen during the absence of the observer. An account of them may be found in the third volume of the Transactions of the Society. Thermometer.

29 Mr Keith's thermometer. A new self-registering thermometer has been invented by Mr Keith of Ravelstone, which we consider as the most ingenious, simple, and perfect, of any which has hitherto appeared. Its simplicity is so great, that it requires only a very short description to make it intelligible.

Fig. 7. AB, fig. 7. is a thin glass tube about 14 inches long and $\frac{1}{4}$ths of an inch caliber, close or hermetically sealed at top. To the lower end, which is open, there is joined the crooked glass tube BE, seven inches long, and $\frac{4}{10}$ths of an inch caliber, and open at top. The tube AB is filled with the strongest spirit of wine, and the tube BE with mercury. This is properly a spirit of wine thermometer, and the mercury is used merely to support a piece of ivory or glass, to which is affixed a wire for raising one index or depressing another, according as the mercury rises or falls. E is a small conical piece of ivory or glass, of such a weight as to float on the surface of the mercury. To the float is joined a wire called the *float-wire*, which reaches upwards to H, where it terminates in a knee bent at right angles. The float-wire, by means of an eye at *a*, moves easily along the small harpsichord wire GK. LL are two indexes made of thin black oiled silk, which slide upwards or downwards with a force not more than two grains. The one placed above the knee points out the greatest rise, and the one placed below it points out the greatest fall, of the thermometer.

When the instrument is to be prepared for an observation, both indexes are to be brought close to the knee H. It is evident, that when the mercury rises, the float and float-wire, which can be moved with the smallest force, will be pushed upwards till the mercury become stationary. As the knee of the float-wire moves upwards, it will carry along with it the upper index L. When the mercury again subsides, it leaves the index at the highest point at which it was raised, for it will not descend by its own weight: As the mercury falls the float-wire does the same; it therefore brings along with it the lower index L, and continues to depress it till it again becomes stationary or ascend in the tube; in which case it leaves the lower index behind it as it had formerly left the upper. The scale to which the indexes point is placed parallel to the slender harpsichord wire. It may be seen more distinctly in fig. 8. Fig. 8. That the scale and indexes may not be injured by the wind and rain, a cylindrical glass cover, close at top, and made so as exactly to fit the part GF, is placed over it.

The ingenious inventor has another improvement in contemplation, which, if upon trial it be found to answer, will make this thermometer as perfect as can be desired, provided there do not arise some errors from the variable pressure of the atmosphere. He proposes to adapt clock-work to this thermometer, in such a way as to register with the utmost precision the degrees of heat and cold for every month, day, and minute in the year. The principles on which this clockwork is to be formed we shall forbear to describe, hoping that the author himself, after his experiment has met with the success

Thermometer.

which we ardently wiſh, will favour the world with his own account of it.

The ſame ingenious gentleman has invented a ſelf-regiſtering barometer, upon the ſame principles with the ſelf-regiſtering thermometer. We have had the pleaſure of ſeeing both; and are convinced that they will fully gratify the wiſhes of all who are engaged in meteorological ſtudies. He is alſo in expectation of being ſoon able to produce an air-thermometer free from the defects of thoſe which were formerly made, as he has found out a way of preventing it from being affected by the preſſure of the atmoſphere.

30 M. de Luc's ſuppoſed improvements.

M. de Luc has deſcribed the beſt method of conſtructing a thermometer, fit for determining the temperature of the air, in the menſuration of heights by the barometer. He has alſo ſhown how to divide the ſcale of a thermometer, ſo as to adapt it for aſtronomical purpoſes in the obſervation of refractions.

31 Mr Cavallo has propoſed a thermometrical barometer.

Mr Cavallo, in 1781, propoſed the conſtruction of a thermometrical barometer, which, by means of boiling water, might indicate the various gravity of the atmoſphere, or the height of the barometer. But as he does not ſay that the inſtrument has been tried with the deſired ſucceſs, we forbear to deſcribe it. Thoſe who wiſh to know his ideas reſpecting it may conſult the Philoſophical Tranſactions, vol. lxxi. p. 524.

32 The thermometers deſcribed above too limited.

The thermometers hitherto deſcribed are very limited in their extent; they indeed point out to us the loweſt degrees of heat which are commonly obſerved even in cold climates, but they by no means reach to thoſe degrees of heat which are very familiar to us. The mercurial thermometer extends no farther than to 600 of Fahrenheit's ſcale, the heat of boiling mercury; but we are ſure that the heat of ſolid bodies, when heated to ignition, or till they emit light, far exceeds the heat of boiling mercury.

33 Sir Iſaac Newton's method of extending the ſcale of the thermometer.

In order to remedy this defect, Sir Iſaac Newton, whoſe genius overcame thoſe obſtacles which ordinary minds could not approach, attempted by an ingenious experiment to extend the ſcale to any degree required. Having heated a maſs of iron red hot, and expoſed it to the cold air, he obſerved the time which elapſed till it became cold, or of the ſame temperature with the air; and when the heat ſo far decreaſed that he could apply ſome known meaſure (as a thermometer) to it, he obſerved the degrees of heat loſt in given times; and thence drew the general concluſion, that the quantities of heat loſt in given ſmall ſpaces are always proportional to the heat remaining in the body, reckoning the heat to be the exceſs by which it is warmer than the ambient air. So that taking the number of minutes which it took to cool after it came to a determined point in an arithmetical progreſſion, the decrements of the heat of the iron would be continually proportional. Having by this proportion found out the decrements of heat in a given time after it came to a known point, it was eaſy, by carrying upwards the ſame proportion to the beginning of its cooling, to determine the greateſt heat which the body had acquired. This proportion of Sir Iſaac's was found by Dr Martine to be ſomewhat inaccurate. The heat of a cooling body does not decreaſe exactly in proportion to that which the body retains. As the reſult of many obſervations, he found that two kinds of proportion took place, an arithmetical as well as the geometrical proportion which Sir Iſaac Newton had adopted; namely, that the decrements of heat were partly proportional to the times (that is, that quantities of heat are loſt in equal times), as well as partly in proportion to the remaining heat; and that if theſe two are added together the rule will be ſufficiently accurate. By the geometrical proportion which Sir Iſaac Newton adopted he diſcovered the heat of metals red hot or in fuſion.

Martine's Eſſays.

Ther... meter. Therm... ter.

This method, ſo ſucceſsfully purſued by Sir Iſaac, was ſufficient to form a ſcale of high degrees of heat, but was not convenient for practical purpoſes. Accordingly the late Mr Wedgwood invented a very ſimple thermometer which marks with much preciſion the different degrees of ignition from a dull red heat viſible in the dark to the heat of an air-furnace. It conſiſts of two rulers fixed upon a ſmooth flat plate, a little farther aſunder at the one end than at the other, leaving an open longitudinal ſpace between them. Small pieces of alum and clay mixed together are made of ſuch a ſize as juſt to enter at the wide end; and are heated along with the body whoſe heat we wiſh to determine. The earthy body contracts according to the degree of heat, ſo that when applied to the wide end of the gage, it will ſlide on towards the narrow end, leſs or more according to the degree of heat to which it has been expoſed.

34 Mr W... wood's therm... ter for meaſur... high d... grees o... heat

35 deſcribe...

ABCD, fig. 9. is a ſmooth flat plate; and EF and GH two rulers or flat pieces, a quarter of an inch thick, fixed flat upon the plate, with the ſides that are towards one another made perfectly true, a little farther aſunder at one end EG than at the other end FH: thus they include between them a long converging canal, which is divided on one ſide into a number of ſmall equal parts, and which may be conſidered as performing the offices both of the tube and ſcale of the common thermometer. It is obvious, that if a body, ſo adjuſted as to fit exactly at the wider end of this canal, be afterwards diminiſhed in its bulk by fire, as the thermometer pieces are, it will then paſs further in the canal, and more and more ſo according as the diminution is greater; and converſely, that if a body, ſo adjuſted as to paſs on to the narrow end, be afterwards expanded by fire, as is the caſe with metals, and applied in that expanded ſtate to the ſcale, it will not paſs ſo far; and that the diviſions on the ſide will be the meaſures of the expanſions of the one, as of the contractions of the other, reckoning in both caſes from that point to which the body was adjuſted at firſt.

Fig. 9.

Philoſop... cal Tra... actions, vol. lxxi.

I is the body whoſe alteration of bulk is thus to be meaſured. This is to be gently puſhed or ſlid along towards the end FH, till it is ſtopped by the converging ſides of the canal. See CHEMISTRY, N° 1412.

A very ingenious application of Fahrenheit's thermometer has been made by Mrs Lovi, glaſs-blower in Edinburgh, for aſcertaining the temperature of compoſt dunghills, for regulating the temperature of hot-beds, and obſerving the changes of temperature in corn and hayſtacks when they are put up damp. This may be called an agricultural thermometer, and has been found of great uſe for the above purpoſes.

THERMOPYLÆ, in *Ancient Geography*, a narrow paſs or defile, between the waſh of the Sinus Maliacus on the eaſt, and ſteep mountains, reaching to Oeta, made dreadful by unpaſſable woods, on the weſt; leading from Theſſaly to Locris and Bœotia. Theſe mountains

tains divide Greece in the middle, in the same manner as the Apennine does Italy; forming one continued ridge from Leucate on the west to the sea on the east, with thickets and rocks interspersed; that persons even prepared for travelling, much less an army encumbered with baggage, cannot easily find a commodious passage. In the valley verging towards the Sinus Maliacus, the road is only sixty paces broad; the only military way for an army to pass, if not obstructed by an enemy; and therefore the place is called *Pylæ*, and by others, on account of its hot water, *Thermopylæ*. Ennobled by the brave stand made by Leonidas and 300 Spartans against the whole army of Persia; and by the bold resolution of blind Euthycus, choosing rather to fall there in fight, than return to Sparta, and escape the common danger. Famous also for the Amphictyones, the common council or states general of Greece, assembling there twice a-year, spring and autumn. For an account of the battle of Thermopylæ at which Leonidas with a handful of men engaged the Persian army, see SPARTA.

THESEA, in antiquity, feasts celebrated by the Athenians in honour of Theseus, consisting of sports and games, with mirth and banquets. Such as were poor and unable to contribute to them were entertained at the public expence.

THESEUS, a famous hero of antiquity, ranked among the demigods, whose history is fabulous. He was the reputed son of Ægeus king of Athens. He threw Sciron, a cruel robber, down a precipice; fastened Procrustes tyrant of Attica to a bending pine, which being let loose tore him asunder; killed the Minotaur kept in the labyrinth by King Minos, in Crete; and by the assistance of that prince's daughter, Ariadne, who gave him a clue, escaped out of that labyrinth, and sailed with his deliverer to the isle of Naxos, where he had the ingratitude to leave her.

Theseus afterwards overcame the Centaurs, subdued the Thebans, and defeated the Amazons. He assisted his friend Pirithous in his expedition to the infernal regions to carry off Proserpine; but was imprisoned by Pluto, till he was released by Hercules. He is also said to have established the Isthmian games, in honour of Neptune; to have united the twelve cities of Attica; and to have founded a republic there, 1236 B. C. Some time after, taking a voyage into Epirus, he was seized by Aidonius king of the Molossians; meanwhile Menestheus rendered himself master of Athens. But at length Theseus being released from prison, retired to Scyros, where King Lycomedes caused him to be thrown from the top of a rock. Theseus had several wives; the first of whom was Helena the daughter of Tyndarus; the second, Hypolita queen of the Amazons; and the last, Phedra sister to Ariadne, who punished him for his infidelity to her sister, by her incestuous passion for his son Hippolitus.

THESIS, a general position which a person advances, and offers to maintain. In taking degrees in universities, the candidates are generally obliged to write a thesis, which they must afterwards defend.

THESIUM, BASE FLUELLIN; a genus of plants belonging to the class of pentandria, and order of monogynia. See BOTANY *Index*.

THESPIS, a famous Greek tragic poet, and the first representer of tragedy at Athens. He carried his troop from village to village in a waggon, from which they performed their pieces. Alcestis was the first tragedy they performed at Athens, 536 B. C. See THEATRE. Thespis || Theurgy.

THESSALIAN CHAIR, so called from Thessaly, where chairs of this figure were most in use; it is recommended by Hippocrates * in place of a machine for reducing a recent luxation of the shoulder bone. The back of this chair is perpendicular to the seat, as Galen tells us; by which construction it is distinguished and accommodated to the operation.

* *Lib. de Art.*

THESSALY, a country of Greece, whose boundaries have been different at different periods. Properly speaking, Thessaly was bounded on the south by the southern parts of Greece, or Græcia Propria; east, by the Ægean; north, by Macedonia and Mygdonia; and west, by Illyricum and Epirus. It was generally divided into four separate provinces, Thessaliotis, Pelasgiotis, Istiæotis, and Phthiotis, to which some add Magnesia. It has been severally called *Æmonia*, *Pelasgicum*, *Argos*, *Hellas*, *Argeia*, *Dryopis*, *Pelasgia*, *Pyrrhæa*, &c. The name of Thessaly is derived from Thessalus, one of its monarchs. Thessaly is famous for a deluge which happened there in the age of Deucalion. Its mountains and cities are also celebrated, such as Olympus, Pelion, Ossa, Larissa, &c. The Argonauts were partly natives of Thessaly. The inhabitants of the country passed for a treacherous nation, so that false money was called *Thessalian coin*, and a perfidious action a *Thessalian deceit*. Thessaly was originally governed by kings, till it became subject to the Macedonian monarchs. The cavalry was universally esteemed, and the people were superstitious and addicted to the study of magic and incantations. See *Lucan*, lib. vi. ver. 438, &c.; *Dionys.* 219; *Curt.* lib. iii. cap. 2.; *Ælian*, *Var. Hist.* lib. iii. cap. 1.; *Paus.* lib iv. cap. 36. lib. x. cap. 1.; *Mela*, lib. ii. cap. 3.; *Justin*, lib. vii. cap. 6.; *Diod.* iv.

Lempriere's Dictionary.

Thessaly is now called *Janna*, a province of European Turkey, bounded by Macedonia on the north, by the Archipelago on the east, by Achaia or Livadia on the south, and by Epirus on the west.

THETIS, in Pagan mythology, the wife of Oceanus, and the mother of Nereus and Doris, who were married to each other; and from this marriage sprung the nymphs of the earth and sea. Among the sea nymphs there was one named *Thetis the Younger*, who excelled all the rest in beauty, and for whom Jupiter conceived such a passion, that he resolved to espouse her: but being informed by the Destinies that she would bring forth a son who would rise above his father, he married her to Peleus. To their nuptials all the gods and goddesses were invited except Discord, who, to be revenged for this contempt, threw a golden apple into the assembly, on which was engraven, *For the Fairest*. Juno, Pallas, and Venus, disputed for this apple; but Paris being chosen to decide the difference, adjudged it to Venus. From this marriage of Thetis and Peleus sprung Achilles.

THEURGY, Θεουργια, a name which the ancients gave to that sacred part of magic which we sometimes call *white magic*, or the *white art*.

The word is formed from Θεος, "God," and εργον, "work;" q. d. the art of doing divine things, or things which God alone can do: or the power of working extraordinary and supernatural things, by invoking the names

names of God, ſaints, angels, &c. Accordingly, thoſe who have written of magic in general, divide it into three parts: the firſt whereof is called *theurgy*, as operating by divine or celeſtial means; the ſecond, *natural magic*, performed by the powers of nature; and the third, comprehending *necromancy*, *ſorcery*, and *witchcraft* or *magic*, performed by the aſſiſtance of demons or departed men. See MAGIC.

THIBET. See TIBET.

THIGH. See ANATOMY, N° 58.

THINKING, a general name for any act or operation of the mind. See METAPHYSICS.

THIRLAGE. See LAW, N° clxx. 12—18.

THIRST, an uneaſy ſenſation ariſing from a deficiency of the ſaliva to moiſten the inward parts of the mouth. Hence ariſes a ſtrong deſire for drink; and thirſt is a ſymptom generally attending fevers of all kinds.—Thirſt is beſt allayed by acids; water kept a while in the mouth, then ſpit out, and repeated as required; a bit of bread chewed with a little water, which latter may be gradually ſwallowed; if the perſon is very hot, brandy is the beſt for holding in the mouth, but ſhould be ſpit out again: except in fevers, large draughts of cold water are hurtful.

Preſervation againſt Hunger and THIRST. See HUNGER.

THISTLE, a name applied to different genera and ſpecies of plants belonging chiefly to the ſyngeneſia claſs. See CARDUUS, ONOPORDUM, SERRATULA, SONCHUS, and alſo DIPSACUS, BOTANY *Index*.

Order of the THISTLE, or *of St Andrew*, a military order of knighthood in Scotland, the riſe and inſtitution of which is variouſly related by different authors. Leſley biſhop of Roſs reports, that the night before the battle between Athelſtan king of Northumberland and Hungus king of the Picts, a bright croſs, in form of that whereon St Andrew (the tutelar ſaint of Scotland) ſuffered martyrdom, appeared to Hungus; who having gained the victory, ever after bore the figure of that croſs on his banners. Others aſſert, that Achaius king of Scotland firſt inſtituted this order, after having made the famous league offenſive and defenſive with Charlemagne king of France. But although the thiſtle had been acknowledged as the ſymbol of the kingdom of Scotland from the reign of Achaius, yet ſome refer the beginning of this order to Charles VII. of France. Others place the foundation of it as low as the year 1500.

The chief and principal enſign is a gold collar compoſed of thiſtles and ſprigs of rue interlinked with amulets of gold, having pendent thereto the image of St Andrew with his croſs, and the motto, NEMO ME IMPUNE LACESSET. "No body ſhall provoke me with impunity."

The ordinary or common enſign worn by the knights is a ſtar of four ſilver points, and over them a green circle, bordered and lettered with gold, containing the ſaid motto, and in the centre is a thiſtle; all which is embroidered on their left breaſt, and worn with the collar, with a green ribband over the left ſhoulder, and brought under the right arm; pendent thereto is the image of St Andrew, with his croſs, in a purple robe, within an oval of gold enamelled vert, with the former motto; but ſometimes they wear, encircled in the ſame manner, a thiſtle crowned.

About the time of the Reformation, this order was dropped, till James II. of Great Britain reſumed it, by creating eight knights. The Revolution unſettled it again; and it lay neglected, till Queen Anne, in 1703, reſtored it to the primitive deſign, of twelve knights of St Andrew.

THLAPSI, BASTARD-CRESS, or *Mithridate-Muſtard*; a genus of plants belonging to the claſs of tetradynamia. See BOTANY *Index*.

THOLOUSE. See TOULOUSE.

THOMÆANS, THOMISTS. See *CHRISTIANS of St Thomas*.

THOMAS AQUINAS. See AQUINAS.

St THOMAS's *Day*, a feſtival of the Chriſtian church, obſerved on Dec. 21. in commemoration of St Thomas the apoſtle.

St THOMAS *of Canterbury's Day*, a feſtival of the Romiſh church, obſerved on Dec. 29. in memory of Thomas Becket archbiſhop of Canterbury, who was murdered, or, as the Romaniſts ſay, martyred, in the reign of King Henry II.

THOMAS *the Reymour*, called alſo *Thomas Lermont*, and *Thomas of Erceldon*, was born at Erceldon, a village near Melroſe in Tweeddale, in what year is uncertain; but he was an old man when Edward I. was carrying on war in Scotland.

The character of Lermont as a prophet, and which was common to him with Linus, Orpheus, and other early poets in many countries, aroſe, if we may believe Mackenyie in his Lives of Scottiſh Writers, from his having conferences with Eliza, a nun and propheteſs at Haddington. Lermont put her predictions into verſe, and thus came in for his ſhare of the prophetic ſpirit. None of theſe ancient prophecies now remain; but the following, which pretends to be one of them, is given from a manuſcript of the time of Edward I. or II. The counteſs of Dunbar is the lady famous for the defence of her caſtle againſt the Engliſh. Her proper title was *Counteſs of March*; but it was common in theſe times to ſtyle a nobleman from his chief reſidence. Thus Gilbert Strongbow, earl of Pembroke, is called *Earl of Striguil*, from his reſidence at Striguil caſtle, near Chepſtow, Monmouthſhire, &c.

Pinkerton. Account Scottiſh Poets.

La Counteſſe de Donbar demande a Thomas de Eſſedoune, quant la guere d'Eſcoce prendreit fyn. E yl la repoundy, et dyt—

When man as mad a kyng of a capped mon.
When mon is levere other mons thyng than is owen.
When londe thouys foreſt, and foreſt ys felde.
When hares kendles othe herſton.
When Wyt and Wille werres togedere.
When mon makes ſtables of kyrkes; and ſteles caſtles wyth ſtyes.
When Rokeſbourh nys no burgh; ant market is at Forwyleye.
When the alde is gan, and the newe is come that doue noht.
When Bambourne ys donged with dede men.
When men ledes men in ropes to buyen ant to ſellen.
When a quarter of whaty whete is chaunged for a colt of ten markes.
When prude prikes, ant pees is leyd in priſoun.
When a Scot ne may hym hude aſe hare in forme, that the Engliſh ne ſhall hym fynde.

When

Thomas Thomson.

When ryht ant wrong aſtente the togedere.
When laddes weddeth lovedies.
When Scottes flen ſo faſte, that for faute of ſhip, hy drouneth hemſelve.
When ſhal this be?
Nouther in thyne tyme, ne in myne.
Ah comen, ant gone,
Withinne twenty wynter ant on.

In fact, the prophecies of Lermont appear to have been merely traditional; nay, it ſeems doubtful if he ever pretended to ſuch folly, notwithſtanding Mackenyie's ſtory of Eliza. The reverence of the people for a learned and reſpectable character ſeems to have been the ſole foundation of Thomas's claim to prophecy. But, in the 16th century, prophecies were made, and aſcribed to him, as well as others given to Bede, Merlin, &c. (A). They were printed at Edinburgh, 1615; reprinted 1680, and 1742.

THOMISM. See AQUINAS.

THOMSON, JAMES, an excellent Britiſh poet, the ſon of a Scotch divine, was born in the ſhire of Roxburgh in 1700, and was educated in the univerſity of Edinburgh with a view to the miniſtry. But his genius inclining him to the ſtudy of poetry, which he ſoon found would be incompatible with that of theology, or at leaſt might prevent his being provided for in that way in his own country, he relinquiſhed his views of engaging in the ſacred function, and repaired to London in conſequence of ſome encouragement which he had received from a lady of quality there, a friend of his mother.

The reception he met with wherever he was introduced, emboldened him to riſk the publication of his excellent poem on Winter.—This piece was publiſhed in 1726; and from the univerſal applauſe it met with, Mr Thomſon's acquaintance was courted by people of the firſt taſte and faſhion. But the chief advantage which it procured him was the acquaintance of Dr Rundle, afterward biſhop of Derry, who introduced him to the late lord chancellor Talbot; and ſome years after, when the eldeſt ſon of that nobleman was to make his tour on the continent, Mr Thomſon was choſen as a proper companion for him. The expectations which his Winter had raiſed, were fully ſatisfied by the ſucceſſive publications of the other ſeaſons; of Summer, in the year 1727; of Spring, in the following year; and of Autumn, in a quarto edition of his works, in 1730. Beſide the Seaſons, and his tragedy of Sophoniſba, written and acted with applauſe in the year 1729, he had, in 1727, publiſhed his poem to the memory of Sir Iſaac Newton, with an account of his chief diſcoveries; in which he was aſſiſted by his friend Mr Gray, a gentleman well verſed in the Newtonian philoſophy. That ſame year the reſentment of our merchants, for the interruption of their trade by the Spaniards in America, running very high, Mr Thomſon zealouſly took part in it, and wrote his Britannia, to rouſe the nation to revenge.

With the honourable Charles Talbot, our author viſited moſt of the courts in Europe, and returned with his views greatly enlarged; not only of exterior nature and the works of art, but of human life and manners, and of the conſtitution and policy of the ſeveral ſtates, their connections, and their religious inſtitutions. How particular and judicious his obſervations were, we ſee in his poem of Liberty, begun ſoon after his return to England. We ſee at the ſame time to what a high pitch his care of his country was raiſed, by the compariſons he had all along been making of our happy government with thoſe of other nations. To inſpire his fellow-ſubjects with the like ſentiments, and ſhow them by what means the precious freedom we enjoy may be preſerved, and how it may be abuſed or loſt, he employed two years in compoſing that noble work, upon which he valued himſelf more than upon all his other writings. On his return to England with Mr Talbot (who ſoon after died), the chancellor made him his ſecretary of briefs; a place of little attendance, ſuiting his retired indolent way of life, and equal to all his wants. From this office he was removed, when death, not long after, deprived him of his noble patron. He then found himſelf reduced to a ſtate of a precarious dependence. In this ſituation, having created ſome few debts, and his creditors finding that he had no longer any certain ſupport, became inexorable; and imagined by confinement to force that from his friends, which his modeſty would not permit him to aſk. One of theſe occaſions furniſhed Quin, the celebrated actor, with an opportunity of diſplaying the natural goodneſs of his heart, and the diſintereſtedneſs of his friendſhip. Hearing that Thomſon was confined in a ſpunging houſe for a debt of about 70l. he repaired to the place; and, having inquired for him, was introduced to the bard. Thomſon was a good deal diſconcerted at ſeeing Quin, as he had always taken pains to conceal his wants; and the more ſo, as Quin told him he was come to ſup with him. His anxiety upon this head was however removed, upon Quin's informing him, that, as he ſuppoſed it would have been inconvenient to have had the ſupper dreſſed in the place they were in, he had ordered it from an adjacent tavern; and, as a prelude, half a dozen of claret was introduced. Supper being over, and the bottle circulating pretty briſkly, Quin ſaid, "It is time now we ſhould balance accounts." This aſtoniſhed Thomſon, who imagined he had ſome demand upon him; but Quin perceiving it, continued, "Mr Thomſon, the pleaſure I have had in peruſing your works I cannot eſtimate at leſs than a hundred pounds, and I inſiſt upon now acquitting the debt." On ſaying this, he put down a note of that value, and took his leave, without waiting for a reply.

The profits ariſing from his works were not inconſiderable; his tragedy of Agamemnon, acted in 1738, yielded a good ſum. But his chief dependence was upon the prince of Wales, who ſettled on him a handſome allowance, and honoured him with many marks of particular favour. Notwithſtanding this, however, he was

(A) Sibilla and Baniſter Anglicus are mentioned in the time of Edward IV. (MSS. Cot. Dom. A. IX.) A long Latin prophecy of Bridlington is there given. Waldhave and Eltraine ſeem alſo Engliſh prophets. In the whole collection, therefore, Thomas is the only Scottiſh one.

Thomſon. was refuſed a licence for his tragedy of Edward and Eleonora, which he had prepared for the ſtage in the year 1736, for ſome political reaſons. Mr Thomſon's next performance was the Maſque of Alfred, written in the year 1740 jointly with Mr Mallet, by the command of the prince of Wales, for the entertainment of his royal highneſs's court at Clifden, his ſummer reſidence.

Mr Thomſon's poem, entitled the Caſtle of Indolence, was his laſt work publiſhed by himſelf; his tragedy of Coriolanus being only prepared for the theatre, when a fatal accident robbed the world of one of the beſt of men and beſt of poets. He would commonly walk the diſtance between London and Richmond (where he lived) with any acquaintance that offered, with whom he might chat and reſt himſelf, or perhaps dine by the way. One ſummer evening being alone in his walk from town to Hammerſmith, he had over-heated himſelf, and in that condition imprudently took a boat to carry him to Kew; apprehending no bad conſequence from the chill air on the river, which his walk to his houſe, towards the upper end of Kew-lane, had always hitherto prevented. But now the cold had ſo ſeized him, that the next day he was in a high fever. This, however, by the uſe of proper medicines, was removed, ſo that he was thought out of danger; till the fine weather having tempted him to expoſe himſelf once more to the evening dews, his fever returned with violence, and with ſuch ſymptoms as left no hopes of a cure. His death happened on the 27th of Auguſt 1748.

Mr Thomſon had improved his taſte upon the fineſt originals, ancient and modern. The autumn was his favourite ſeaſon for poetical compoſition, and the deep ſilence of the night he commonly choſe for his ſtudies. The amuſement of his leiſure hours were civil and natural hiſtory, voyages, and the beſt relations of travellers. Though he performed on no inſtrument, he was paſſionately fond of muſic, and would ſometimes liſten a full hour at his window to the nightingales in Richmond gardens; nor was his taſte leſs exquiſite in the arts of painting, ſculpture, and architecture. As for the more diſtinguiſhing qualities of his mind and heart, they beſt appear in his writings. There his devotion to the Supreme Being, his love of mankind, of his country, and friends, ſhine out in every page; his tenderneſs of heart was ſo unbounded, that it took in even the brute creation. It is not known, that through his whole life he ever gave any perſon a moment's pain, either by his writings or otherwiſe. He took no part in the political ſquabbles of his time, and was therefore reſpected and left undiſturbed by both ſides. Theſe amiable virtues did not fail of their due reward; the applauſe of the public attended all his productions, and his friends loved him with an enthuſiaſtic ardour.

"As a writer (ſays Dr Johnſon), he is entitled to one praiſe of the higheſt kind; his mode of thinking, and of expreſſing his thoughts, is original. His blank verſe is no more the blank verſe of Milton, or of any other poet, than the rhymes of Prior are the rhymes of Cowley. His numbers, his pauſes, his diction, are of his own growth, without tranſcription, without imitation. He thinks in a peculiar train, and thinks always as a man of genius; he looks round on Nature and on life with the eye which Nature beſtows only on a poet; the eye that diſtinguiſhes, in every thing repreſented to its view, whatever there is on which imagination can delight to be detained, and with a mind that at once comprehends the vaſt, and attends to the minute. The reader of the Seaſons wonders that he never ſaw before what Thomſon ſhews him, and that he never yet has felt what Thomſon impreſſes." Thomſon || Thornhi

Johnſon's Lives of the Poets.

His teſtamentary executors were the lord Lyttelton, whoſe care of our poet's fortune and fame ceaſed not with his life; and Mr Mitchell, a gentleman equally noted for the truth and conſtancy of his private friendſhip, and for his addreſs and ſpirit as a public miniſter. By their united intereſts, the orphan play of Coriolanus was brought on the ſtage to the beſt advantage; from the profits of which, and the ſale of manuſcripts and other effects, a handſome ſum was remitted to his ſiſters. His remains were depoſited in the church of Richmond, under a plain ſtone, without any inſcription. A handſome monument was erected to him in Weſtminſter abbey in the year 1762, the charge of which was defrayed by the profits ariſing from a ſplendid edition of all his works in 4to; Mr Millar the bookſeller, who had purchaſed all Mr Thomſon's copies, giving up his property on this grateful occaſion. A monument has alſo been erected to him at the place of his birth.

THOR, the eldeſt and braveſt of the ſons of Odin and Frea, was, after his parents, the greateſt god of the Saxons and Danes while they continued heathens. They believed, that Thor reigned over all the aerial regions, which compoſed his immenſe palace, conſiſting of 540 halls; that he launched the thunder, pointed the lightning, and directed the meteors, winds, and ſtorms. To him they addreſſed their prayers for favourable winds, refreſhing rains, and fruitful ſeaſons; and to him the fifth day of the week, which ſtill bears his name, was conſecrated. *Henry's Hiſtory of Great Britain*, vol. part iv.

THORAX. See ANATOMY.

WHITE or *HAW* THORN. See CRATÆGUS, BOTANY *Index*.

THORN, a town of Poland, in Regal Pruſſia, and in the palatinate of Culm. It was formerly a Hanſeatic town, and ſtill enjoys great privileges; is large and well fortified; but part of the fortifications, and a great number of houſes, were ruined by the Swedes, in 1703. It is ſeated on the Viſtula, and contains 10,000 inhabitants. E. Long. 18. 30. N. Lat. 52. 55.

THORNBACK. See RAIA, ICHTHYOLOGY *Index*.

THORNHILL, SIR JAMES, an eminent Engliſh painter, was born in Dorſetſhire in 1676, of an ancient family; but was conſtrained to apply to ſome profeſſion by the diſtreſſes of his father, who had been reduced to the neceſſity of ſelling his family eſtate. His inclination directed him to the art of painting; and on his arrival at London he applied to his uncle, the famous Dr Sydenham, who enabled him to proceed in the ſtudy of the art under the direction of a painter who was not very eminent. However, the genius of Thornhill made ample amends for the inſufficiency of his inſtructor, and by a happy application of his talents he made ſo great a progreſs, that he gradually roſe to the higheſt reputation. *Dictionary of Painters*

His genius was well adapted to hiſtorical and allegorical compoſitions; he poſſeſſed a fertile and fine invention; and he ſketched his thoughts with great eaſe, freedom, and ſpirit. He excelled alſo equally in portrait,

Thornhill and Thrace.

trait, perſpective, and architecture; ſhewed an excellent taſte for deſign, and had a free and firm pencil. Had he been ſo fortunate as to have ſtudied at Rome and Venice, to acquire greater correctneſs at the one, and a more exact knowledge of the perfection of colouring at the other, no artiſt among the moderns might perhaps have been his ſuperior. Nevertheleſs, he was ſo eminent in many parts of his profeſſion, that he muſt for ever be ranked among the beſt painters of his time; and his performances in the dome of St Paul's church at London, in the hoſpital at Greenwich, and at Hampton-court, are ſuch public proofs of his merit as will convey his name to poſterity with great honour.

This painter lived in general eſteem; he enriched himſelf by the excellence of his works; was appointed ſtate-painter to Queen Anne, from whom he received the honour of knighthood; had the ſingular ſatisfaction to repurchaſe his family eſtate; and was ſo much diſtinguiſhed as to be elected one of the members of parliament. He died in 1732.

THOROUGH-WAX, in *Botany*. See BUPLEURUM.

THOTH, or THEUT, (called by the Phœnicians *Taaut*, by the Greeks *Hermes*, and by the Romans *Mercury*), was a Phœnician of very ſuperior talents, and one of the civilizers of mankind. He was prime miniſter to Oſiris, whom, after his death, he deified; and he was himſelf deified by his countrymen the Egyptians, for the benefits that he had rendered to the human race. See MERCURY, MYTHOLOGY, N° 34. and POLYTHEISM, N° 18.

THOUGHT, a general name for all the ideas conſequent on the operations of the mind, and even on the operations themſelves. See METAPHYSICS.

THOUGHT, in compoſition. See ORATORY, Part I. and II.

THOUINIA, a genus of plants belonging to the claſs of diandria, and order of monogynia. See BOTANY *Index*.

THRACE, a country very frequently mentioned by the Greek and Latin writers, deriving its name, according to Joſephus, from Tiras one of the ſons of Japhet. It was bounded on the north by Mount Hæmus; on the ſouth, by the Ægean ſea; on the weſt, by Macedon and the river Strymon; and on the eaſt, by the Euxine ſea, the Helleſpont, and the Propontis.—The Thracian Cherſoneſus is a peninſula incloſed on the ſouth by the Ægean ſea, on the weſt by the gulf of Melas, and on the eaſt by the Helleſpont; being joined on the north to the continent by a neck of land about 37 furlongs broad. The inland parts of Thrace are very cold and barren, the ſnow lying on the mountains the greateſt part of the year; but the maritime provinces are productive of all ſorts of grain and neceſſaries for life; and withal ſo pleaſant, that Mela compares them to the moſt fruitful and agreeable countries of Aſia.

The ancient Thracians were deemed a brave and warlike nation, but of a cruel and ſavage temper; being, according to the Greek writers, ſtrangers to all humanity and good nature. It was to the Thracians, however, that the Greeks were chiefly indebted for the polite arts that flouriſhed among them; for Orphæus, Linus, Muſæus, Thamyris, and Eumolpus, all Thracians, were the firſt, as Euſtathius informs us, who charmed the inhabitants of Greece with their eloquence and melody, and perſuaded them to exchange their fierceneſs for a ſociable life and peaceful manners; nay, great part of Greece was anciently peopled by Thracians. Tereus, a Thracian, governed at Daulis in Phocis, where the tragical ſtory of Philomela and Progne was acted. From thence a body of Thracians paſſed over to Eubœa, and poſſeſſed themſelves of that iſland. Of the ſame nation were the Aones, Tembices, and Hyanthians, who made themſelves maſters of Bœotia: and great part of Attica itſelf was inhabited by Thracians, under the command of the celebrated Eumolpus. It is not, therefore, without the utmoſt ingratitude and injuſtice that the Greeks ſtyle them *Barbarians*, ſince to them chiefly they were indebted both for the peopling and poliſhing of their country. Thrace, Thraſhing.

Thrace was anciently divided into a number of petty ſtates, which were firſt ſubdued by Philip of Macedon. On the decline of the Macedonian empire, the country fell under the power of the Romans. It continued under ſubjection to them till the irruption of the Turks, in whoſe hands it ſtill remains.

THRASHING, in *Agriculture*, the operation by which corn is ſeparated from the ſtraw. This operation is performed in a variety of ways, ſometimes by the feet of animals, ſometimes by a flail, and ſometimes by a machine.

The moſt ancient method of ſeparating the corn from the ſtraw was by the hoofs of cattle or horſes. This was practiſed by the Iſraelites, as we find from the books of Moſes; it was alſo common among the Greeks and Romans *. Flails and thraſhing machines were alſo not uncommon among theſe nations †. The flail which was uſed by the Romans, called *baculus*, *fuſtis*, or *pertica*, was probably nothing more than a cudgel or pole. The thraſhing machine, which was called *tribula* or *tribulum*, and ſometimes *traha*, was a kind of ſledge made of boards joined together, and loaded with ſtone or iron. Horſes were yoked to this machine, and a man was ſeated upon it to drive them over the ſheaves of corn.

* *Pliny*, xviii. 30. *Virgil*, Georg. iii. 132. *Col.* ii. 21. *Tibull.* i. 5. 21.

† Iſaiah xviii. 27, *Homer*, Il. xx. 495.

Different methods are employed in different countries for ſeparating the corn from the ſtalk. In the greateſt part of France the flail is uſed; but in the ſouthern diſtricts it is generally performed by the feet of animals. Animals are alſo uſed for the ſame purpoſe in Spain, in Italy, in the Morea, in the Canaries, in China, and in the vicinity of Canton, where the flail is alſo ſometimes uſed. It appears that in hot climates the grains do not adhere ſo firmly to the ſtalk as in cold countries, and therefore may be more eaſily ſeparated. This will explain the reaſon why animals are ſo frequently employed in hot countries for treading out the corn; whereas in cold climates we know they are ſeldom tried, and have no reaſon to ſuppoſe that they would anſwer the purpoſe. In the Iſle of France in Africa, rice and wheat are thraſhed with poles, and maize with ſticks; for it has not been poſſible to teach the negroes the uſe of the flail.

The animals uſed for treading out corn are, oxen, cows, horſes, mules, and even aſſes when the quantity is not great. The operation is performed in this manner: The ſheaves, after being opened, are ſpread in ſuch a manner that the ears of the corn are laid as much uppermoſt as poſſible, and a man, ſtanding in the centre, holds the halters of the cattle, which are made to trot round as in a manege; whilſt other men with forks

Thraſhing. forks ſhake the ſtraw up from time to time, and the cattle are trotted over it again and again till they have beaten out all the grain. This method is expeditious enough; but beſides bruiſing a conſiderable quantity of corn, it requires a great many cattle, and injures the legs of the horſes and mules, which are preferred before cows and oxen for this work.

The flail is undoubtedly a much better inſtrument for thraſhing corn than the feet of animals, for it ſeparates the grain from the ſtraw and huſks both more effectually and more expeditiouſly; yet it is liable to many objections. It is a very laborious employment, too ſevere indeed even for a ſtrong man; and as it is uſually the intereſt of the thraſher rather to thraſh much than to thraſh clean, a good deal of corn will generally be left upon the ſtraw. It is therefore an object of great importance in huſbandry to procure a proper machine for ſeparating the corn from the ſtraw.

The firſt thraſhing machine attempted in modern times, of which we have received any account, was invented in Edinburgh by Mr Michael Menzies about the year 1732. It conſiſted of a number of inſtruments like flails, fixed in a moveable beam, and inclined to it at an angle of ten degrees. On each ſide of the beam in which the flails were fixed, floors or benches were placed for ſpreading the ſheaves on. The flails were moved backwards and forwards upon the benches by means of a crank fixed on the end of an axle, which made about 30 revolutions in a minute.

The ſecond thraſhing machine was invented by Mr Michael Stirling, a farmer in the pariſh of Dunblane, Perthſhire. Of this diſcovery we have received a very accurate and authentic account from his ſon, the reverend Mr Robert Stirling miniſter of Crieff.

It is an old proverb, that neceſſity is the mother of invention. This was verified on the preſent occaſion. Beſides his ordinary domeſtic ſervants, Mr M. Stirling had occaſion ſometimes to hire an additional number to thraſh out his grain, and frequently found it difficult to procure ſo many as he needed. This naturally led him to reflect whether the operation of thraſhing could not eaſily be performed by machinery. Accordingly, ſo early as the year 1753, under the pretence of joining in the amuſements of his children, he formed in miniature a water mill, in which two iron ſprings, made to riſe and fall alternately, repreſented the motion of two flails, by which a few ſtalks of corn put under them might be ſpeedily thraſhed. This plan he executed on a ſcale ſufficiently large within two years after, making the ſprings about ten feet long, each of which had one end firmly ſcrewed into a ſolid plank, and the other terminated in a round batoon of ſolid iron, two feet long and above an inch in diameter. Under theſe the ſheaves were conveyed gradually forward in a narrow channel or trough, by paſſing between two indented horizontal cylinders, ſimilar to thoſe now uſed in the moſt of the thraſhing mills in that part of the country, and called *feeders*. In this manner the thraſhing was executed completely, and with conſiderable rapidity; but as the operation was performed on a low floor, and no method contrived for carrying off the ſtraw, the accumulation of it produced ſuch confuſion, and the removal of it was attended with ſuch danger, that this ſcheme was very ſoon entirely abandoned. The mortification ariſing from diſappointment, and eſpecially the ſcoffs of his neighbours, for what was univerſally accounted an abſurd and ridiculous attempt, ſerved only to ſtimulate the exertions of the inventor to accompliſh his deſigns on another plan. Thraſhing.

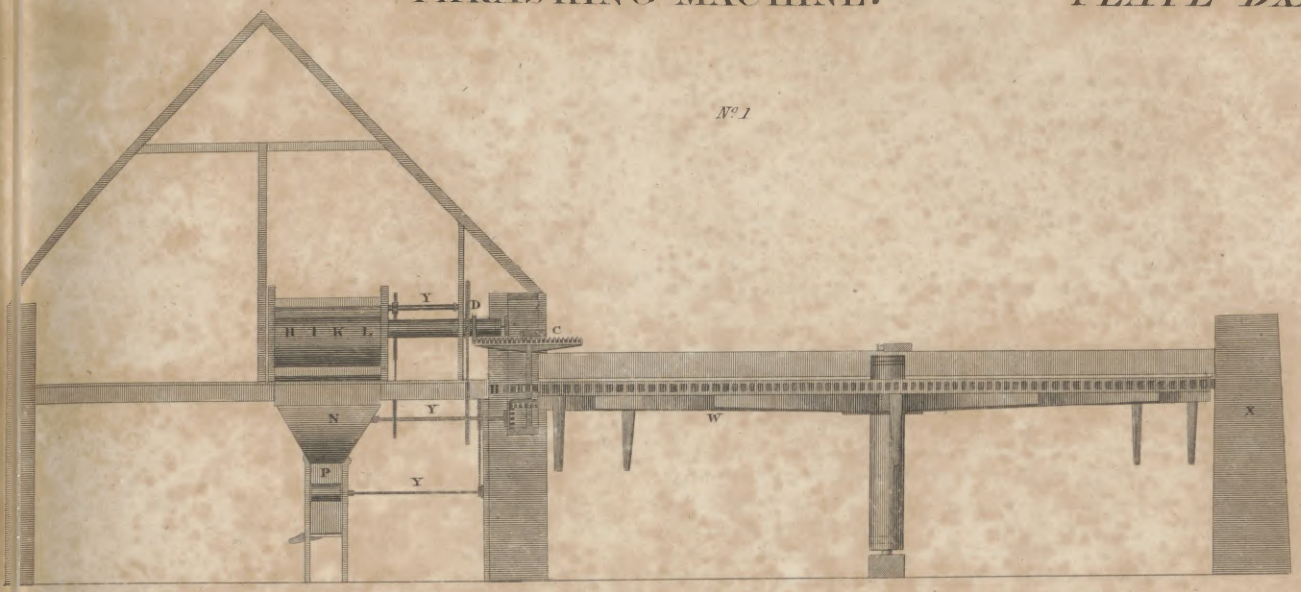
Laying aſide therefore the iron ſprings with the feeders, and all the apparatus adapted to them, he retained only an outer or water wheel, with an inner or cog-wheel moving on the ſame axle: to this inner wheel, which had 48 teeth or cogs, he applied a vertical trundle or pinion, with ſeven notches, the axle of which paſſed through a floor above the wheel, and having its upper pivot ſecured in a beam ſix feet above that floor. At the diſtance of three feet three inches above the floor two ſtraight pieces of ſquared wood, each four feet long, paſſed through the axle of the trundle at right angles, forming four arms, to be moved round horizontally. To the extremities of theſe arms were fixed four iron plates, each 20 inches long, and eight broad at the end next the arms, but tapering towards a point at the other end. This large horizontal fly, conſtituting four thraſhers, was incloſed within a wooden cylindrical box three feet and a half high and eight in diameter. On the top of the box was an opening or port (two or three ports were made at firſt, but one was found ſufficient) eight inches wide, and extending from the circumference a foot and a half towards its centre, through which the corn ſheaves deſcended, being firſt opened and laid one by one on a board with two ledges gently declining towards the port; on which board they were moderately preſſed down with a boy's hand, to prevent them from being too haſtily drawn in by the repeated ſtrokes of the thraſhers. Within the box was an inclined plane, along which the ſtraw and grain fell down into a wide wire riddle two feet ſquare, placed immediately under a hole of nearly the ſame ſize. The riddle received a jerk at every revolution of the ſpindle from a knob placed on the ſide of it, and was inſtantly thruſt backward by a ſmall ſpring preſſing it in the oppoſite direction. The ſhort ſtraw, with the grain and chaff which paſſed through the wide riddle, fell immediately into an oblong ſtrait riddle, which hung with one end raiſed and the other depreſſed, and was moved by a contrivance equally ſimple as the other; and having no ledge at the lower end, the long chaff which could not paſs through the riddle dropped from thence to the ground; while the grain and moſt of the chaff falling through the riddle into a pair of common barn-fanners that ſtood under it on the ground floor, the ſtrong grain, the weak, and the chaff, were all ſeparated with great exactneſs. The fanners were moved by a rope or band running circuitouſly in a ſhallow niche cut on the circumference of the cog-wheel. The ſtraw collected gradually in the bottom of the box over the wide riddle, and through an opening two and a half feet wide, and as much in height, left in that ſide of the box neareſt the brink of the upper floor, was drawn down to the ground with a rake by the perſon or perſons employed to form it into ſheaves or rolls.

Such was the thraſhing mill invented by Mr Michael Stirling, which, after various alterations and improvements he completed in the form now deſcribed, A. D. 1758. By experiment it was found that four bolls of oats, Linlithgow meaſure, could be thraſhed by it in 25 minutes. From that period he never uſed a common flail in thraſhing, except for humbling or bearding barley.

THRASHING MACHINE.

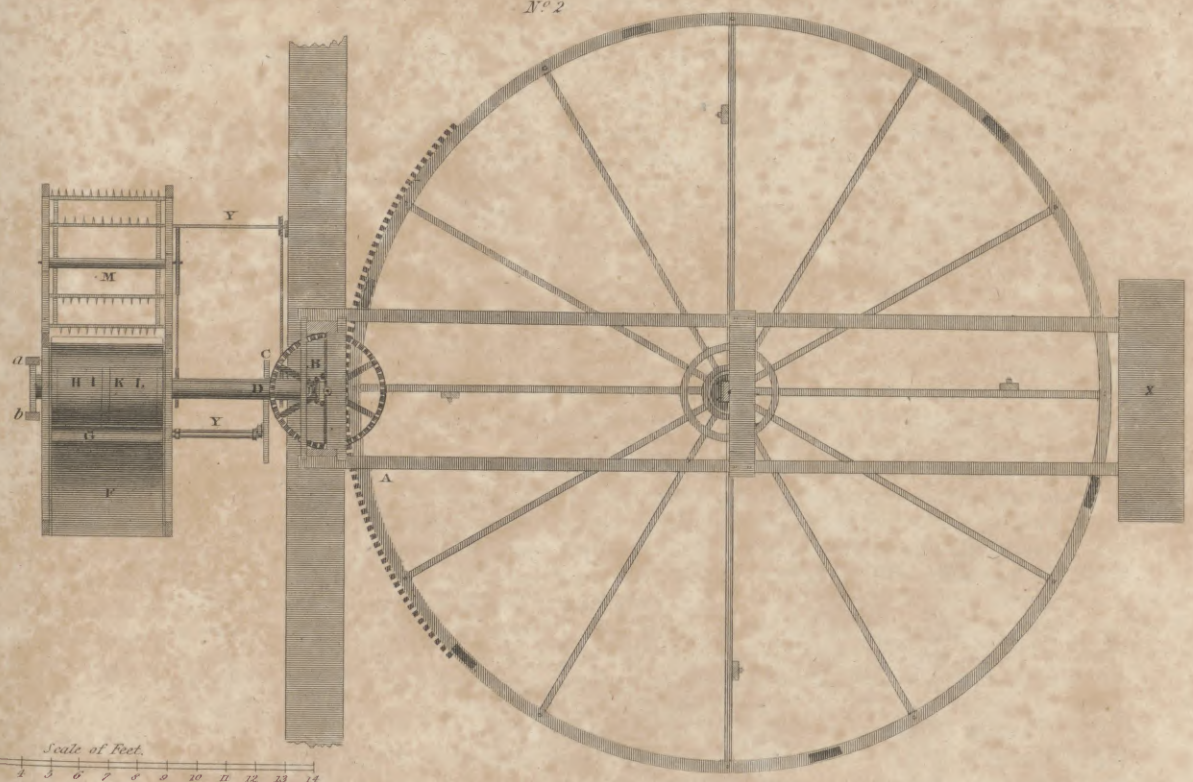
PLATE DXXXV.

N°1



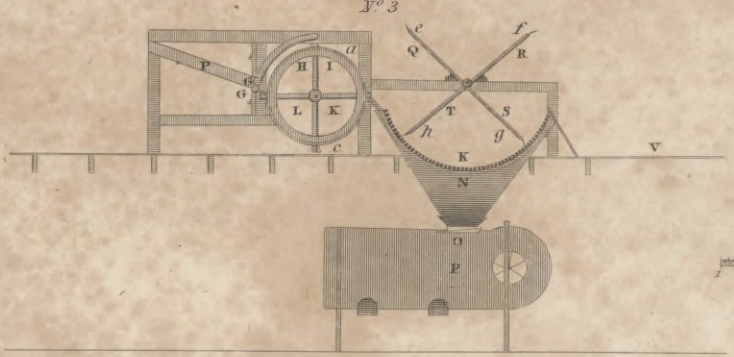
Scale of Feet.

N°2



Scale of Feet.

N°3



Scale of Feet.

Engraved by Wm D Lizars Edinburgh

Thrashing. ley. In every other kind of grain he performed the whole operation of thrashing with the mill; and continued always to use it till 1772, when he retired from business, and his thrashing mill became the property of his second son, who continued to use it with equal advantage and satisfaction. Several machines were constructed on the same plan, particularly one near Stirling, under Mr Stirling's direction, for Mr Moir of Leckie, in 1765, which, we understand, has been used ever since, and gives complete satisfaction to the proprietor. There was another erected in 1778 by Mr Thomas Keir (in the parish of Muthil and county of Perth), who has contrived a method of bearding barley with it: and by the addition of a small spindle with short arms contiguous to the front of the box, and moved by a band common to it and the great spindle to which it is parallel, the straw is shaken and whirled out of the box to the ground. That this machine did not come immediately into general use, was owing partly to the smallness of the farms in that part of the country, whose crops could easily be thrashed by the few hands necessarily retained on them for other purposes; and chiefly to an apprehension that the machine could only be moved by water; an apprehension which experience proves to be entirely groundless. The machine, however, was ingenious, and did great credit to the worthy inventor, and certainly deserved a better fate than it was destined to undergo.

A third thrashing mill was invented in 1772, by two persons nearly about the same time, and upon the same principles. The inventors were, Mr Alderton who lived near Alnwick, and Mr Smart at Wark in Northumberland. The operation was performed by rubbing. The sheaves were carried round between an indented drum of about six feet diameter, and a number of indented rollers arranged round the circumference of the drum, and attached to it by means of springs; so that while the drum revolved, the fluted rollers rubbed the corn off from the straw by rubbing against the flutings of the drum. But as a considerable quantity of the grain was bruised in passing between the rollers, the machine was soon laid aside.

In 1776 an attempt was made by Mr Andrew Meikle, an ingenious millwright in the parish of Tyningham, East Lothian, to construct a new machine upon the principles which had been adopted by Mr Menzies already mentioned. This consisted in making joints in the flails, which Mr Menzies had formed without any. But this machine, after much labour and expence, was soon laid aside, on account of the difficulty of keeping it in repair, and the small quantity of work performed, which did not exceed one boll or six Winchester bushels of barley per hour.

Some time after this, Mr Francis Kinloch, then junior of Gilmerton, having visited the machine invented in Northumberland, attempted an improvement upon it. He inclosed the drum in a fluted cover; and instead of making the drum itself fluted, he fixed upon the outside of it four fluted pieces of wood, which by means of springs could be raised a little above the circumference of the drum, so as to press against the fluted covering, and thus rub off the ears of corn as the sheaves passed round between the drum and the fluted covering. But not finding this machine to answer his expectation (for it bruised the grain in the same manner as the Northumberland machine did), he sent it to Mr Meikle, that he might, if possible, rectify its errors. Thrashing.

Mr Meikle, who had long directed his thoughts to this subject, applied himself with much ardour and perseverance to the improvement and correction of this machine; and after spending a good deal of time upon it, found it was constructed upon principles so erroneous, that to improve it was impracticable.

At length, however, Mr Meikle's own genius invented a model, different in principle from the machines which had already been constructed. This model was made in the year 1785; and in the following year the first thrashing machine on the same principles was erected in the neighbourhood of Alloa, in the county of Stirling, by Mr George Meikle the son of the inventor. This machine answered completely the wishes of Mr Stein, the gentleman for whom it was erected, who gave the most ample testimony of his satisfaction both to the inventor and to the public. The fame of this discovery soon spread over the whole country, and a great many farmers immediately applied to Mr Meikle, desiring to have thrashing-mills erected on their farms. The discovery, it appeared, would be profitable, and it was reasonable that the inventor should enjoy the profits of his invention. He accordingly applied for a patent; which, after considerable expence, arising from the opposition of some persons, who claimed a share in the discovery, was granted.—These machines are now becoming very common in many parts of Scotland, and are increasing very considerably in number every year over all the united kingdom.

We will now endeavour to describe this machine in its most improved state; which is so simple, that with the assistance of a plate, exhibiting the plan of elevation, fig. 1. the ground plan, fig. 2. and the 3d showing its essential parts in a distinct manner, we hope it will be easily understood by all our readers who have not had an opportunity of seeing it. The power employed for turning that part of the machine which separates the corn from the straw is produced by four wheels (when moved by horses), the teeth of which move in one another and turn the drum, on which four scutchers are fixed. The sheaves are introduced between two fluted rollers, which hold them firm, and draw them in gradually, while the scutchers strike off the grain from the straw as it passes through. This will suffice for a general idea of this machine. We will now be more particular. Plate DXXXV.

The large spur-wheel A, fig. 1. and 2. which has 276 cogs, is horizontal, and moves the pinion B, which has 14 teeth. The pinion B moves the crown-wheel C, which has 84 teeth; the wheel C moves a second pinion D, which has 16 teeth; and the pinion D moves the drum HIKL. The drum is a hollow cylinder three feet and a half diameter, and placed horizontally; on the outside of which the scutchers are fixed by strong screw bolts. The scutchers consist of four pieces of wood, faced on one side with a thin plate of iron, placed at an equal distance from each other, and at right angles to the axis of the drum. Fig. 1. and 2.

The sheaves are spread on an inclined board F, fig. 3. from which they are introduced between two fluted rollers GG made of cast iron, about three inches and a half in diameter, and making about 35 revolutions in a minute. As these rollers are only about three quarters Fig. 3.

Thraſhing. of an inch diſtant from the ſcutchers or leaves of the drum HIKL, they ſerve to hold the ſheaves faſt, while the ſcutchers *a*, *b*, *c*, *d*, moving with prodigious velocity, ſeparate the grain completely from the ſtraw, and at the ſame time throw out both grain and ſtraw upon the concave rack M, lying horizontally with ſlender parallel ribs, ſo that the corn paſſes through them into a hopper N placed below. From the hopper it paſſes through a harp or riddle O into a pair of fanners P, from which, in the moſt improved machines, it comes out clean and fit for the market. The ſtraw, after being thrown by the ſcutchers *a*, *b*, *c*, *d*, into the rack, is removed from it by a rake QRST into a place contiguous V. The rake conſiſts of four thin pieces of wood or leaves; on the end of each of theſe leaves is ranged a row of teeth *e*, *f*, *g*, *h*, five inches long. The rake moves in a circular manner in the concave rack, while the teeth catch hold of the ſtraw, and throw it out of the rack. Theſe are all the eſſential parts of the machine; the reſt may be eaſily underſtood by the references to the Plate. W is the horſe-courſe, N° 1, which is 27 feet diameter. X is the pillar for ſupporting the beams on which the axle of the ſpur-wheel is fixed. YYY are three ſpindles for moving the two fluted rollers, the rake, and fanners. To the deſcription now given we have only to add, that the drum has a covering of wood Z at a ſmall diſtance above it, for the purpoſe of keeping the ſheaves cloſe to the ſcutchers.

The advantages of this machine are many. As the drum makes 300 revolutions in a minute, the four ſcutchers together make 200 ſtrokes in the ſame ſpace of time. From ſuch power and velocity, it is evident that much work muſt be performed. When the horſes go at the rate of two and one-third miles per hour, from three to ſix bolls will be thraſhed; but as the quantity thraſhed will be leſs when the ſtraw is long than when it is ſhort, we ſhall take the average at four bolls. One gentleman, whoſe veracity and accuracy we can depend on, aſſures us, that his mill thraſhed 63 bolls in a day; by which, we ſuppoſe, he meant 10 hours. To prove the ſuperior advantage of this machine to the common method of thraſhing with flails, a gentleman ordered two equal quantities of oats to be thraſhed by the mill and by flails. When the corn was cleaned and meaſured, he obtained one-ſixteenth more from the ſheaves thraſhed by the mill than from thoſe thraſhed by the flail. We are alſo informed by another gentleman who has ſtudied this machine with much attention, and calculated its advantages with care, that, independently of having the corn much cleaner ſeparated from the ſtraw than is uſually done by flails, there is a ſaving of 30 or 40 per cent. in the expence of thraſhing.

The number of perſons requiſite for attending the mill when working is ſix: One perſon drives the horſes; a ſecond hands the ſheaves to a third, who unties them, while a fourth ſpreads them on the inclined boards and preſſes them gently between the rollers; a fifth perſon is neceſſary to riddle the corn as it falls from the fanners, and a ſixth to remove the ſtraw (A). Thraſ

This machine can be moved equally well by water, wind, or horſes. Mr Meikle has made ſuch improvements on the wind-mill as to render it much more manageable and convenient than formerly; and we are informed many wind-mills are now erecting in different parts of the country. As to the comparative expence of theſe different machines, the erection of the horſe machine is leaſt; but then the expence of employing horſes muſt be taken into conſideration. One of this kind may be erected for 70l. A water-mill will coſt 10l. more on account of the expence of the water-wheel. A wind-mill will coſt from 200l. to 300l. ſterling.

THRAVE *of* CORN, an expreſſion denoting 24 ſheaves or four ſhocks of ſix ſheaves to the ſhock; though in ſome countries they only reckon 12 ſheaves to the thrave.

THRASYBULUS, a renowned Athenian general and patriot, the deliverer of his country from the yoke of the 30 tyrants, lived about 294 B. C*. * See A

THRASYMENUS LACUS, in *Ancient Geography*, tica, N a lake of Etruria, near Peruſia, and not far from the 99—17 Tiber, fatal to the Romans in the Punic war. Now *Il Lago de Perugia* in the Eccleſiaſtical State.

THREAD, a ſmall line made up of a number of fine fibres of any vegetable or animal ſubſtance, ſuch as flax, cotton, or ſilk; from which it takes its name of linen, cotton, or ſilk thread.

THREATENING LETTERS. Knowingly to ſend any letter without a name, or with a fictitious name, demanding money, or any other valuable thing, or threatening (without any demand) to kill or fire the houſe of any perſon, is made felony without benefit of clergy. And ſending letters, threatening to accuſe any perſon of a crime puniſhable with death, tranſportation, pillory, or other infamous puniſhment, with a view to extort from him any money or other valuable chattels, is puniſhable by ſtatute 30 Geo. II. cap. 24. at the diſcretion of the court, with fine, impriſonment, pillory, whipping, or tranſportation for ſeven years.

THRESHING. See THRASHING.

THRIFT. See STATICE, BOTANY *Index*.

THRINAX, SMALL JAMAICA FAN-PALM, a genus of plants belonging to the claſs of palmæ. See BOTANY *Index*.

THRIPS, a genus of inſects belonging to the order of hemiptera. See ENTOMOLOGY *Index*.

THROAT, the anterior part of an animal, between the head and the ſhoulders.

THROAT-WORT. See CAMPANULA, BOTANY *Index*.

THRONE, a royal ſeat or chair of ſtate, enriched with ornaments of architecture and ſculpture, raiſed on one or more ſteps, and covered with a kind of canopy. Such are the thrones in the rooms of audience of kings and other ſovereigns.

THROSTLE.

(A) We add, on the authority of an experienced farmer, that of the ſix perſons neceſſary to attend the thraſhing machine, only two can in juſtice be charged to the account of the machine; namely, the perſon who manages the horſes, and the one who feeds the machine: For in the uſual mode of thraſhing by the flail, it requires the ſame number of perſons as the thraſhing machine does to clear an equal quantity of corn from the chaff in the ſame time.

THROSTLE. See TURDUS, } ORNITHOLOGY *Index.*
THRUSH. See TURDUS, }

THRUSH, or *Aphtha*. See MEDICINE *Index*.

THRYALLIS, a genus of plants belonging to the class decandria, and order of monogynia; and in the natural system ranging under the 38th order, *Tricoccæ*. See BOTANY *Index*.

THUANUS, JACOBUS AUGUSTUS, youngest son of the president de Thou, was famous for his erudition. He was born in 1553; and having finished his studies and travels, was made president a-mortier, and took possession thereof in 1595. He was employed in several important offices of state, and in reforming the university of Paris. He wrote the history of his own time in Latin, from the year 1543 to 1608, in 138 books; a work, both for subject and style, worthy of the ancients. He also left memoirs of his own life, besides poems; and died at Paris, 1617.

THUCYDIDES, a celebrated Greek historian, was born at Athens 471 B. C. He was the son of Olorus, and grandson of Miltiades, who is thought to have been descended from Miltiades the famous Athenian general, and to have married the king of Thrace's daughter. He was educated in a manner suitable to his quality, that is, in the study of philosophy and eloquence. His master in the former was Anaxagoras, in the latter Antiphon; one, by his description in the eighth book of his History, for power of speech almost a miracle, and feared by the people on that account. Suidas and Photius relate, that when Herodotus recited his history in public, a fashion in use then and many ages after, Thucydides felt so great a sting of emulation, that it drew tears from him; insomuch that Herodotus himself took notice of it, and congratulated his father on having a son who showed so wonderful an affection to the Muses. Herodotus was then 29 years of age, Thucydides about 16.

When the Peloponnesian war began to break out, Thucydides conjectured truly, that it would prove a subject worthy of his labour; and it no sooner commenced than he began to keep a journal. This explains the reason why he has attended more to chronological order than to unity of design. During the same war he was commissioned by his countrymen to relieve Amphipolis; but the quick march of Brasidas the Lacedæmonian general defeated his operations; and Thucydides, unsuccessful in his expedition, was banished from Athens. This happened in the eighth year of this celebrated war; and in the place of his banishment the general began to write an impartial history of the important events which had happened during his administration, and which still continued to agitate the several states of Greece. This famous history is continued only to the 21st year of the war, and the remaining part of the time till the demolition of the walls of Athens was described by the pen of Theopompus and Xenophon. Thucydides wrote in the Attic dialect, as being possessed of most vigour, purity, elegance, and energy. He spared neither time nor money to procure authentic materials; and the Athenians, as well as their enemies, furnished him with many valuable communications, which contributed to throw great light on the different transactions of the war. His history has been divided into eight books; the last of which is imperfect, and supposed to have been written by his daughter.

Thucydides ‖ Thuringia.

The historian of Halicarnassus has often been compared with the son of Olorus, but each has his peculiar excellence. Sweetness of style, grace and elegance of expression, may be called the characteristics of the former; while Thucydides stands unequalled for the fire of his descriptions, the conciseness, and at the same time the strong and energetic manner of his narratives. His relations are authentic, as he himself was interested in the events he mentions; his impartiality is indubitable, as he nowhere betrays the least resentment against his countrymen, and the factious partizans of Cleon, who had banished him from Athens. The history of Thucydides was so admired by Demosthenes, that he transcribed it eight different times, and read it with such attention, that he could almost repeat it by heart. Thucydides died at Athens, where he had been recalled from his exile about 411 years B. C.

The best edition of Thucydides is that of Oxford, published in 1696, folio, and that of Duker, published at Amsterdam in 1731, folio.

THUJA, the ARBOR VITÆ; a genus of plants belonging to the class of monadelphia, and order of monœcia; and in the natural system ranging under the 51st order, *Coniferæ*. See BOTANY *Index*.

THULE, or THYLÆ, in *Ancient Geography*, an island in the most northern parts of the German ocean. Its situation was never accurately ascertained by the ancients, hence its present name is unknown by modern historians. Some suppose that it is the island now called Iceland, or part of Greenland, and others that it was *Foula*. See FOULA.

THUMB, in *Anatomy*, one of the extremities of the hand.

THUMB-Cap, an uninhabited island in the South sea, lies about seven leagues north-west of Lagoon island; it is low, woody, of a circular form, and not much above a mile in compass.

THUMMIM. See URIM.

THUNBERGIA, a genus of plants belonging to the class of didynamia. See BOTANY *Index*.

THUNDER, the noise occasioned by the explosion of a flash of lightning echoed back from the inequalities on the surface of the earth, in like manner as the noise of a cannon is echoed, and in particular circumstances forms a rolling lengthened sound. See ELECTRICITY.

THUNDERBOLT. When lightning acts with extraordinary violence, and breaks or shatters any thing, it is called a *thunderbolt*; which the vulgar, to fit it for such effects, suppose to be a hard body, and even a stone. But that we need not have recourse to a hard solid body to account for the effects commonly attributed to the thunderbolt, will be evident to any one who considers those of the pulvis fulminans and of gunpowder; and more especially the astonishing powers of electricity. It has been supposed that meteoric stones may have given rise to the notion of a thunderbolt.

THUNDER-House. See ELECTRICITY.

THURINGIA, a division of the circle of Upper Saxony in Germany. It is a fruitful tract, abounding in corn, especially wheat; in black cattle, sheep, and horses. It is about 73 miles in length, and as much in breadth. It contains 47 towns, 14 boroughs, betwixt 700 and 800 villages, 300 noble estates, 7 superintendencies, and 5 under-consistories. Thuringia, the country of the ancient Thuringi, or Catti, a branch of the Vandals,

Thuringia || Tibet.

Vandals, mentioned by Tacitus, was formerly a kingdom, afterwards a county, then a landgravate, and was governed by its own princes for many ages, till 1124, when it devolved to the marquis of Miſnia, and, with that country, afterwards to the duke of Saxony. But the modern Thuringia is only a part of the ancient, nay, but a part of the ancient South Thuringia, which comprehends beſides, a large ſhare of the modern Franconia, Heſſe, &c. On the extinction of the male line of the ancient landgraves in 1247, it came to the margraves of Meiſſen, anceſtors to the preſent electoral family. The elector has no voice in the diet, on account of his ſhare in the landgravate or circle of Thuringia. Erfurt is the capital.

THURSDAY, the fifth day of the Chriſtian week, but the ſixth of that of the Jews.

THUS, FRANKINCENSE, a ſolid brittle reſin, brought to us in little globes or maſſes, of a browniſh or yellowiſh colour on the outſide, internally whitiſh or variegated with whitiſh ſpecks. It is ſuppoſed to be the produce of the pine that yields the common turpentine, and to concrete upon the ſurface of the terebinthinate juice ſoon after it has iſſued from the tree. See INCENSE.

THUYA. See THUJA.

THYMUS, THYME; a genus of plants belonging to the claſs of didynamia, and in the natural ſyſtem ranging under the 42d order, *Verticillatæ*. See BOTANY *Index*.

THYMUS. See ANATOMY *Index*.

THYRSUS, in antiquity, the ſceptre which the poets put into the hand of Bacchus, and wherewith they furniſhed the menades in their Bacchanalia.

THYRSUS, a mode of flowering reſembling the cone of a pine. It is, ſays Linnæus, a panicle contracted into an oval or egg-ſhaped form. The lower footſtalks, which are longer, extend horizontally, whilſt the upper ones are ſhorter and mount vertically. Lilac and butter-bur furniſh examples.

TIARA, an ornament or habit wherewith the ancient Perſians covered their head; and with which the Armenians and kings of Pontus are repreſented on medals; theſe laſt, becauſe they were deſcended from the Perſians. Latin authors call it indifferently *tiara* and *cidaris*. Strabo ſays the tiara was in form of a tower; and the ſcholiaſt on Ariſtophanes's comedy, Αχαρνης, act i. ſcene 2. affirms that it was adorned with peacocks feathers.

TIARA is alſo the name of the pope's triple crown. The tiara and keys are the badge of the papal dignity; the tiara of his civil rank, and the keys of his juriſdiction: for as ſoon as the pope is dead, his arms are repreſented with the tiara alone, without the keys. The ancient tiara was a round high cap. John XXIII. firſt encompaſſed it with a crown. Boniface VIII. added a ſecond crown; and Benedict XII. a third.

TIARELLA, a genus of plants, belonging to the claſs of decandria; and in the natural ſyſtem ranging under the 13th order, *Succulentæ*. See BOTANY *Index*.

TIBER, a great river of Italy which runs through the pope's territories, paſſing by Perugia and Orvietto; and having viſited Rome, falls into the Tuſcan ſea at Oſtia, 15 miles below that city.

TIBET, called by the Tartars *Barantola*, *Bootan*, or *Tangoot*, and by the Chineſe *Tſang*, is ſituated between 27° and 35° north latitude; and is reckoned to be 1350 miles from eaſt to weſt, and 480 from north to ſouth. It is bounded on the north by the country of the Mongols and the deſert of Kobi; on the eaſt by China; on the weſt by Hindoſtan, and on the ſouth by the ſame country and the kingdom of Ava. In the valleys lying between the lower mountains are many tribes of Indian people; and a diſpute happening between the heirs of one of the rajahs or petty princes, one party called to their aſſiſtance the Boutaners, and the other the Britiſh. The latter prevailed; and the fame of Britiſh valour being carried to the court of Tibet, the Teeſhoo Lama, who ruled the ſtate under the Delai-Lama, at that time in his minority, ſent a deputation to Bengal, deſiring peace for the prince who had been engaged in war with the Britiſh. This was readily granted by the governor; and Mr Bogle was ſent ambaſſador to the court of Tibet, where he reſided ſeveral months; and after an abſence of a year and a quarter, returned to Calcutta. The account of this gentleman's expedition hath not been publiſhed by himſelf; but from Mr Stewart's letter to Sir John Pringle, publiſhed in the Philoſophical Tranſactions, vol. lxvii. we learn the following particulars, collected from his papers. Tib

"Mr Bogle divides the territories of the Delai-Lama into two different parts. That which lies immediately contiguous to Bengal, and which is called by the inhabitants *Doopo*, he diſtinguiſhes by the name of *Bootan;* and the other, which extends to the northward as far as the frontiers of Tartary, called by the natives *Pu*, he ſtyles *Tibet*. Bootan is ruled by the Dah Terriah, or Deb Rajah. It is a country of ſteep and inacceſſible mountains, whoſe ſummits are crowned with eternal ſnow; they are interſected with deep valleys, through which pour numberleſs torrents that increaſe in their courſe, and at laſt, gaining the plains, loſe themſelves in the great rivers of Bengal. Theſe mountains are covered down their ſides with foreſts of ſtately trees of various ſorts; ſome (ſuch as pines, &c.) which are known in Europe; others, ſuch as are peculiar to the country and climate. The valleys and ſides of the hills which admit of cultivation are not unfruitful, but produce crops of wheat, barley, and rice. The inhabitants are a ſtout and warlike people, of a copper complexion, in ſize rather above the middle European ſtature, haſty and quarrelſome in their temper, and addicted to the uſe of ſpirituous liquors; but honeſt in their dealings, robbery by violence being almoſt unknown among them. The chief city is Taſſey Seddein, ſituated on the Patchoo. Tibet begins properly from the top of the great ridge of the Caucaſus, and extends from thence in breadth to the confines of Great Tartary, and perhaps to ſome of the dominions of the Ruſſian empire. The woods, which everywhere cover the mountains in Boutan, are here totally unknown; and, except a few ſtraggling trees near the villages, nothing of the ſort is to be ſeen. The climate is extremely ſevere and rude. At Chamnanning, where he wintered, although it be in latitude 31° 39′, only 8° to the northward of Calcutta, he often found the thermometer in his room at 29° by Fahrenheit's ſcale; and in the middle of April the ſtanding waters were all frozen, and heavy ſhowers of ſnow perpetually fell. This, no doubt, muſt be owing to the great elevation of the country, and to the

vaſt

Tibet.

vaſt frozen ſpace over which the north wind blows uninterrupted from the pole, through the vaſt deſerts of Siberia and Tartary, till it is ſtopped by this formidable wall.

"The Tibetians are of a ſmaller ſize than their ſouthern neighbours, and of a leſs robuſt make. Their complexions are alſo fairer, and many of them have even a ruddineſs in their countenances unknown to the other climates of the eaſt. Thoſe whom Mr Bogle ſaw at Calcutta appeared to have quite the Tartar face. They are of a mild and cheerful temper; the higher ranks are polite and entertaining in converſation, in which they never mix either ſtrained compliments or flattery. The common people, both in Bootan and Tibet are clothed in coarſe woollen ſtuffs of their own manufacture, lined with ſuch ſkins as they can procure: but the better orders of men are dreſſed in European cloth, or China ſilk, lined with the fineſt Siberian furs. The uſe of linen is totally unknown among them. The chief food of the inhabitants is the milk of their cattle, prepared into cheeſe, butter, or mixed with the flour of a coarſe barley or of peaſe, the only grain which their ſoil produces; and even theſe articles are in a ſcanty proportion: but they are furniſhed with rice and wheat from Bengal and other countries in their neighbourhood. They alſo are ſupplied with fiſh from the rivers in their own and the neighbouring provinces, ſalted and ſent into the interior parts. They have no want of animal food from the cattle, ſheep, and hogs, which are raiſed on their hills; and are not deſtitute of game. They have a ſingular method of preparing their mutton, by expoſing the carcaſe entire, after the bowels are taken out, to the ſun and bleak northern winds which blow in the months of Auguſt and September, without froſt, and ſo dry up the juices and parch the ſkin, that the meat will keep uncorrupted for the year round. This they generally eat raw, without any other preparation.

"The religion and political conſtitution of this country, which are intimately blended together, would make a conſiderable chapter in its hiſtory. It ſuffices to ſay, that at preſent, and ever ſince the expulſion of the Eluth Tartars, the kingdom of Tibet is regarded as depending on the empire of China, which they call *Cathay;* and there actually reſide two mandarins, with a garriſon of a thouſand Chineſe, at Lahaſſa the capital, to ſupport the government; but their power does not extend far: and in fact the Lama, whoſe empire is founded on the ſureſt grounds, perſonal affection and religious reverence, governs every thing internally with unbounded authority. Every body knows that the Delai Lama is the great object of adoration for the various tribes of heathen Tartars, who roam through the vaſt tract of continent which ſtretches from the banks of the Volga to Correa on the ſea of Japan, the moſt extenſive religious dominion, perhaps, on the face of the globe. See Lama.

"It is an old notion, that the religion of Tibet is a corrupted Chriſtianity: and even Father Diſederii, a Jeſuit (but not of the Chineſe miſſion) who viſited the country about the beginning of this century, thinks he can reſolve all their myſteries into ours; and aſſerts, with a truly myſtical penetration, that they have certainly a good notion of the Trinity, ſince in their addreſs to the Deity, they ſay as often *konciok-oik* in the plural as *konciok* in the ſingular, and with their roſaries pronounce theſe words *om*, *ha*, *hum*. The truth is, that the religion of Tibet, from whatever ſource it ſprung, is pure and ſimple in its ſource, conveying very exalted notions of the Deity, with no contemptible ſyſtem of morality: but in its progreſs it has been greatly altered and corrupted by the inventions of worldly men; a fate we can hardly regret in a ſyſtem of error, ſince we know that that of truth has been ſubject to the ſame. Polygamy, at leaſt in the ſenſe we commonly receive the word, is not in practice among them; but it exiſts in a manner ſtill more repugnant to European ideas; for there is a plurality of huſbands, which is firmly eſtabliſhed and highly reſpected there. In a country where the means of ſubſiſting a family are not eaſily found, it ſeems not impolitic to allow a ſet of brothers to agree in raiſing one, which is to be maintained by their joint efforts. In ſhort, it is uſual in Tibet for the brothers in the family to have a wife in common, and they generally live in great harmony and comfort with her; not but ſometimes little diſſenſions will ariſe (as may happen in families conſtituted upon different principles), an inſtance of which Mr Bogle mentions in the caſe of a modeſt and virtuous lady, the wife of half a dozen of the Teeſhoo Lama's nephews, who complained to the uncle that the two youngeſt of her huſbands did not furniſh that ſhare of love and benevolence to the common ſtock which duty and religion required of them. In ſhort, however ſtrange this cuſtom may appear to us, it is an undoubted fact that it prevails in Tibet.

"The dead are expoſed on the pinnacle of ſome neighbouring mountain, to be devoured by wild beaſts and birds of prey, or waſted away by time and the viciſſitudes of the weather in which they lie. The mangled carcaſes and bleached bones lie ſcattered about; and amidſt this ſcene of horror, ſome miſerable old wretch, man or woman, loſt to all feelings but thoſe of ſuperſtition, generally ſets up an abode, to perform the diſmal office of receiving the bodies, aſſigning each a place, and gathering up the remains when too widely diſperſed."

To the account of Tibet which we have given from the communications of Mr Bogle, we may add the information which we have obtained from a later traveller, Mr Saunders * ſurgeon at Boglepoer in Bengal, who made a journey into Tibet in the year 1783. His obſervations chiefly reſpect the natural productions and diſeaſes of the country.

* *Paper in the Phil. Tranſ.* vol. lxxix.

The plants which Mr Saunders found were almoſt all European plants, a great number of them being natives of Britain. From the appearance of the hills he concludes that they muſt contain many ores of metal and pyrites. There are inexhauſtible quantities of tincal or borax, and rock-ſalt is plentiful; gold-duſt is found in great quantities in the beds of rivers, and ſometimes in large maſſes, lumps, and irregular veins; lead, cinnabar containing a large proportion of quickſilver, copper, and iron, he thinks might eaſily be procured. But the inhabitants of Tibet have no better fuel than the dung of animals. A coal mine would be a valuable diſcovery. We are told, that in ſome parts of China bordering on Tibet coal is found and uſed as fuel.

It is remarkable that the ſame diſeaſe prevails at the foot

Tibet || Tickell.

foot of the mountains of Tibet as in Switzerland at the foot of the Alps, a glandular ſwelling in the throat commonly called *goitre*.

The language ſpoken in Tibet is different from that of the Tartars. The aſtronomers are acquainted with the motion of the heavenly bodies, and able to calculate eclipſes; but the lamas are generally ignorant; few of them can read, much leſs underſtand their ancient books.

TIBULLUS, AULUS ALBIUS, a Roman knight, and a celebrated Latin poet, was born at Rome 43 B. C. He was the friend of Horace, Ovid, Macer, and other great men in the reign of Auguſtus. He accompanied Meſſala Corvinus in his expedition againſt the iſland of Corcyra: but falling ſick, and being unable to ſupport the fatigues of war on account of the weakneſs of his conſtitution, he quitted the profeſſion of arms, and returned to Rome, where he died before the year 17; when Ovid ſhowed his grief for his death by writing a fine elegy upon him. Tibullus wrote four books of elegies, which are ſtill extant: they are written in a tender and agreeable ſtyle, and in very elegant Latin. Muret and Joſeph Scaliger have written learned and curious commentaries on the works of this poet. The beſt edition of Tibullus is that of Janus Bronckhuſius, publiſhed at Amſterdam in 1708, in one volume quarto. We have an Engliſh poetical verſion by Mr Grainger.

TIBUR, in *Ancient Geography*, a town of Latium, pleaſantly ſituated on the Anio. Here Horace had his villa and houſe; and here he wiſhed to end his days. Here Adrian built an extraordinary villa called *Tiburtina*, inſcribed with the names of the provinces and of the moſt conſiderable places, (Spartian); near which Zenobia had a houſe called *Zenobia*, (Trebellius, Pollio). Hither Auguſtus often retreated on account of its ſalubrity, (Suetonius): for which it is greatly recommended, (Martial). Anciently, when the Romans had far extended their territory, it was the utmoſt place of baniſhment, (Ovid). It had a temple of Hercules; and therefore called *Herculeum*. In the temple was a library, (A. Gellius). Now *Tivoli* in the Campagna di Roma, on the Teverone.

TICINUS, in *Ancient Geography*, a river in Inſubria, riſing in Mount Adula, traverſing the Lacus Verbanus ſouthwards, and falling into the Po near Ticinum. Between this river and the Po Hannibal gained his firſt victory over the Romans under P. Scipio. The general himſelf eſcaped with the utmoſt difficulty, and that by the bravery of his ſon the firſt Scipio Africanus. Now the *Teſino*, riſing in Mount Godard, running ſouth through the Lago Maggiore and Milan, by Pavia, into the Po.

TICK. See ACARUS, ENTOMOLOGY *Index*.

TICKELL, THOMAS, an excellent Engliſh poet, was the ſon of the Reverend Richard Tickell, and was born in 1686, at Bridekirk in Cumberland. He was educated at Queen's college, Oxford, of which he was made fellow; and while he continued at that univerſity, he addreſſed to Mr Addiſon a complimentary copy of verſes on his Opera of Roſamond, which introduced him to an acquaintance with that gentleman, who diſcovering his merit, became his ſincere friend. On Mr Addiſon being made ſecretary of ſtate, he appointed Mr Tickell his under-ſecretary; and on his being obliged to reſign that office on account of his ill health, he recommended him ſo effectually to Mr Craggs his ſucceſſor, that he was continued in his poſt till that gentleman's death. In 1724, Mr Tickell was appointed ſecretary to the lords juſtices in Ireland, and enjoyed that place as long as he lived. He wrote ſome poems, which, when ſeparately publiſhed, met with a favourable reception, and paſſed through ſeveral editions: they are now printed in the ſecond volume of the Minor Poets. After Mr Addiſon's death Mr Tickell had the care of the edition of his works printed in 4 vols. 4to; to which he prefixed an account of Mr Addiſon's life, and a poem on his death. Mr Tickell died in the year 1740.

TICKERA, a conſiderable article of merchandiſe in Fezzan in Africa; it is valued by travellers as a portable and highly ſalubrious food. It is a preparation of pounded dates, and the meal of Indian corn, formed into a paſte, and highly dried in an oven.

TICKSEED, SUN-FLOWER. See COREOPSIS, BOTANY *Index*.

TICUNAS. See POISON.

TIDE, is a word which expreſſes that riſing and falling of the waters which are obſerved on all maritime coaſts.

There is a certain depth of the waters of the ocean which would obtain if all were at reſt: but obſervation ſhows that they are continually varying from this level, and that ſome of theſe variations are regular and periodical.

1*ſt*, It is obſerved, that on the ſhores of the ocean, and in bays, creeks, and harbours, which communicate freely with the ocean, the waters riſe up above this mean height twice a-day, and as often ſink below it, forming what is called a FLOOD and an EBB, a HIGH and LOW WATER. The whole interval between high and low water is called a TIDE; the water is ſaid to FLOW and to EBB; and the riſing is called the FLOOD-TIDE, and the falling is called the EBB TIDE.

2*d*, It is obſerved, that this riſe and fall of the waters is variable in quantity. At Plymouth, for inſtance, it is ſometimes 21 feet between the greateſt and leaſt depth of the water in one day, and ſometimes only 12 feet.

Theſe different heights of tide are obſerved to ſucceed each other in a regular ſeries, diminiſhing from the greateſt to the leaſt, and then increaſing from the leaſt to the greateſt. The greateſt is called a SPRING TIDE, and the leaſt is called a NEAP TIDE.

3*d*, This ſeries is completed in about 15 days. More careful obſervation ſhows that two ſeries are completed in the exact time of a lunation. For the ſpring tide in any place is obſerved to happen preciſely at a certain interval of time (generally between two and three days) after new or full moon; and the neap tide at a certain interval after half moon: or, more accurately ſpeaking, it is obſerved that the ſpring tide always happens when the moon has got a certain number of degrees eaſtward of the line of conjunction and oppoſition, and the neap tide happens when ſhe is a certain number of degrees from her firſt or laſt quadrature. Thus the whole ſeries of tides appears to be regulated by the moon.

4*th*, It is obſerved that high water happens at new and full moon, when the moon has a certain determined poſition with reſpect to the meridian of the place of obſervation, preceding or following the moon's

ſouthing

ſouthing a certain interval of time; which is conſtant with reſpect to that place, but very different in different places. Tide.

5th, The time of high water in any place appears to be regulated by the moon; for the interval between the time of high water and the moon's ſouthing never changes above three quarters of an hour, whereas the interval between the time of high water and noon changes ſix hours in the courſe of a fortnight.

6th, The interval between two ſucceeding high waters is variable. It is leaſt of all about new and full moon, and greateſt when the moon is in her quadratures. As two high waters happen every day, we may call the double of their interval a TIDE DAY, as we call the diurnal revolution of the moon a *lunar day*. The tide is ſhorteſt about new and full moon, being then about $24^h\ 37'$; about the time of the moon's quadratures it is $25^h\ 27'$. Theſe values are taken from a mean of many obſervations made at Barbadoes by Dr Maſkelyne.

7th, The tides in ſimilar circumſtances are greateſt when the moon is at her ſmalleſt diſtance from the earth, or in her perigee, and, gradually diminiſhing, are ſmalleſt when ſhe is in her apogee.

8th, The ſame remark is made with reſpect to the ſun's diſtance, and the greateſt tides are obſerved during the winter months of Europe.

9th, The tides in any part of the ocean increaſe as the moon, by changing her declination, approaches the zenith of that place.

10th, The tides which happen while the moon is above the horizon are greater than the tides of the ſame day when the moon is below the horizon.

Such are the regular phenomena of the tides. They are important to all commercial nations, and have therefore been much attended to. It is of the tides, in all probability, that the Bible ſpeaks, when God is ſaid to ſet bounds to the ſea, and to ſay, "thus far ſhall it go, and no farther."

Homer is the earlieſt profane author who ſpeaks of the tides. Indeed it is not very clear that it is of them that he ſpeaks (in the 12th book of the Odyſſey) when he ſpeaks of Charybdis, which riſes and retires thrice in every day. Herodotus and Diodorus Siculus ſpeak more diſtinctly of the tides in the Red ſea. Pytheas of Marſeilles is the firſt who ſays any thing of their cauſe. According to Strabo he had been in Britain, where he muſt have obſerved the tides of the ocean. Plutarch ſays expreſsly that Pytheas aſcribed them to the moon. It is ſomewhat wonderful that Ariſtotle ſays ſo little about the tides. The army of Alexander, his pupil, were ſtartled at their firſt appearance to them near the Perſian gulf; and we ſhould have thought that Ariſtotle would be well informed of all that had been obſerved there. But there are only three paſſages concerning them in all Ariſtotle's writings, and they are very trivial. In one place he ſpeaks of great tides obſerved in the north of Europe; in another, he mentions their having been aſcribed by ſome to the moon; and in a third, he ſays, that the tide in a great ſea exceeds that in a ſmall one.

The Greeks had little opportunity of obſerving the tides. The conqueſts and the commerce of the Romans gave them more acquaintance with them. Cæſar ſpeaks of them in the 4th book of his Gallic War. Strabo, after Poſidonius, claſſes the phenomena into daily, monthly, and annual. He obſerves, that the ſea riſes as the moon gets near the meridian, whether above or below the horizon, and falls again as ſhe riſes or falls; alſo, that the tides increaſe at the time of new and full moon, and are greateſt at the ſummer ſolſtice. Pliny explains the phenomena at ſome length; and ſays, that both the ſun and moon are their cauſe, dragging the waters along with them (B. II. c. 97.). Seneca (*Nat. Queſt.* III. 28.) ſpeaks of the tide with correctneſs; and Macrobius (*Somn. Scip.* I. 6.) gives a very accurate deſcription of their motions.

It is impoſſible that ſuch phenomena ſhould not exerciſe human curioſity as to their cauſe. Plutarch (*Plaut. Phil.* III. 17.), Galileo (*Syſt. Mund.* Dial. 4.), Riccioli in his *Almageſt*, ii. p. 374, and Gaſſendi, ii. p. 27. have collected moſt of the notions of their predeceſſors on the ſubject; but they are of ſo little importance, that they do not deſerve our notice. Kepler ſpeaks more like a philoſopher (*De Stella Martis*, and *Epit. Aſtron.* p. 555.). He ſays that all bodies attract each other, and that the waters of the ocean would all go to the moon were they not retained by the attraction of the earth; and then goes on to explain their elevation under the moon and on the oppoſite ſide, becauſe the earth is leſs attracted by the moon than the nearer waters, but more than the waters which are more remote.

The honour of a complete explanation of the tides was reſerved for Sir Iſaac Newton. He laid hold of this claſs of phenomena as the moſt inconteſtable proof of univerſal gravitation, and has given a moſt beautiful and ſynoptical view of the whole ſubject; contenting himſelf, however, with merely exhibiting the chief conſequences of the general principle, and applying it to the phenomena with ſingular addreſs. But the wide ſteps taken by this great philoſopher in his inveſtigation leave ordinary readers frequently at fault: many of his aſſumptions require the greateſt mathematical knowledge to ſatisfy us of their truth. The academy of Paris therefore propoſed to illuſtrate this among other parts of the principles of natural philoſophy, and publiſhed the theory of the tides as a prize problem. This produced three excellent diſſertations by M'Laurin, Daniel Bernoulli, and Euler. Aided by theſe, and chiefly by the ſecond, we ſhall here give a phyſical theory, and accommodate it to the purpoſes of navigation by giving the rules of calculation. We have demonſtrated in our diſſertations on the phyſical principles of the celeſtial motions, that it is an unexcepted fact, that every particle of matter in the ſolar ſyſtem is actually deflected toward every other particle; and that the deflection of a particle of matter toward any diſtant ſphere is proportional to the quantity of matter in that ſphere directly, and to the ſquare of the diſtance of the particle from the centre of that ſphere inverſely: and having found that the heavineſs of a piece of terreſtrial matter is nothing but the ſuppoſed opponent to the force which we exert in carrying this piece of matter, we conceive it as poſſeſſing a property, that is, diſtinguiſhing quality, manifeſted by its being *gravis* or heavy. This is heavineſs, *gravitas*, gravity; and the manifeſtation of this quality, or the event in which it is ſeen, whether it be directly falling, or deflecting in a parabolic curve, or ſtretching a coiled ſpring, or breaking a rope, or ſimply preſſing on its ſupport, is *gravitatio*, gravitation; and the body is ſaid to gravitate. When all obſtacles are removed from the

Tide. body, as when we cut the ſtring by which a ſtone is hung, it moves directly downwards, *tendit ad terram. Si diſcindatur funis tenderet lapis ad terram. Dum vero funis integer perſtet, lapis terram verſus niti cenſetur.* By ſome metaphyſical proceſs, which it is needleſs at preſent to trace, this *niſus ad motum* has been called a *tendency* in our language. Indeed the word has now come to ſignify the energy of any active quality in thoſe caſes where its ſimpleſt and moſt immediate manifeſtation is prevented by ſome obſtacle. The ſtone is now ſaid to tend towards the earth, though it does not actually approach it, being withheld by the ſtring. The ſtretching the ſtring in a direction perpendicular to the horizon is conceived as a full manifeſtation of this tendency. This tendency, this energy of its heavineſs, is therefore named by the word which diſtinguiſhes the quality; and it is called *gravitation*, and it is ſaid to *gravitate*.

But Sir Iſaac Newton diſcovered that this deflection of a heavy body differs in no reſpect from that general deflection obſerved in all the bodies of the ſolar ſyſtem. For 16 feet, which is the deflection of a ſtone in one ſecond, has the very ſame proportion to $\frac{1}{7}$th of an inch, which is the ſimultaneous deflection of the moon, that the ſquare of the moon's diſtance from the centre of the earth has to the ſquare of the ſtone's diſtance from it, namely, that of 3600 to 1.

Thus we are enabled to compare all the effects of the mutual tendencies of the heavenly bodies with the tendency of gravity, whoſe effects and meaſures are familiar to us.

If the earth were a ſphere covered to a great depth with water, the water would form a concentric ſpherical ſhell; for the gravitation of every particle of its ſurface would then be directed to the centre, and would be equal. The curvature of its ſurface therefore would be every where the ſame, that is, it would be the uniform curvature of a ſphere.

Plate DXXXVI. fig. 1. It has been demonſtrated in former articles, after Sir Iſaac Newton, that the gravitation of a particle C (fig. 1.) to the centre O, is to that of a particle E at the ſurface as CO to EO. In like manner the gravitation of *o* is to that of *p* as *o* to *p* O. If therefore EO and O*p* are two communicating canals, of equal lengths, the water in both would be in equilibrio, becauſe each column would exert the ſame total preſſure at O. But if the gravitation of each particle in *p* O be diminiſhed by a certain proportion, ſuch as $\frac{1}{100}$th of its whole weight, it is plain that the total preſſure of the column *p* O will be $\frac{1}{100}$th part leſs than that of the column EO. Therefore they will no longer be in equilibrio. The weight of the column EO will prevail; and if a hollow tower P*p* be built at the mouth of the pit *p o*, the water will ſink in EO and riſe in O*p*, till both are again in equilibrio, exerting equal total preſſures at O. Or we may prevent the ſinking at E by pouring in more water into the tower P*p*. The ſame thing muſt happen in the canal *f c* perpendicular to EO, if the gravitation of every particle be diminiſhed by a force acting in the direction CF, and proportional to the diſtance of the particle from C, and ſuch, that when *c* C is equal to *o* O, the force acting on *c* is equal to the force acting on *o*. In order that the former equilibrium may be reſtored after this diminution of the gravitation of the column *f* C, it is plain that more water muſt be poured into the oblique tower *f* F. All this is evident when we conſider the matter hydroſtatically. The gravitation of the particle *c* may be repreſented by *o* O; but the diminution of the preſſure occaſioned by this at O is repreſented by C *c*. Tide

Hence we can collect this much, that the whole diminution of preſſure at C is to the whole diminution of preſſure at O as the ſum of all the lines *c* C to the ſum of all the lines *o* O, that is, as *f* C^2 to PO^2. But the weight of the ſmall quantity of water added in each tower is diminiſhed in the ſame proportion; therefore the quantity added at F*f* muſt be to the quantity added at P*p* as *f* C to *p* O. Therefore we muſt have F*f*: P*p*=*f* C : *p* O, and the points E, F, P, muſt be in the circumference of an ellipſe, of which PO and EO are the tranſverſe and conjugate ſemi-axes.

What we have here ſuppoſed concerning the diminution of gravity in theſe canals is a thing which really obtains in nature. It was demonſtrated, when treating of the PRECESSION *of the Equinoxes*, that if the ſun or moon lie in the direction OP, at a very great diſtance, there reſults from the unequal gravitation of the different particles of the earth a diminution of the gravity of each particle; which diminution is in a direction parallel to OP, and proportional to the diſtance of the particle from a plane paſſing through the centre of the earth at right angles to the line OP.

Thus it happens that the waters of the ocean have their equilibrium diſturbed by the unequal gravitation of their different particles to the ſun or to the moon; and this equilibrium cannot be reſtored till the waters come in from all hands, and riſe up around the line joining the centres of the earth and of the luminary. The ſpherical ocean muſt acquire the form of a prolate ſpheroid generated by the revolution of an ellipſe round its tranſverſe axis. The waters will be higheſt in that place which has the luminary in its zenith, and in the antipodes to that place; and they will be moſt depreſſed in all thoſe places which have the luminary in their horizon. P and P′ will be the poles, and EOQ will be the equator of this prolate ſpheroid.

Mr Ferguſon, in his Aſtronomy, aſſigns another cauſe of this arrangement, viz. the difference of the centrifugal forces of the different particles of water, while the earth is turning round the common centre of gravity of the earth and moon. This, however, is a miſtake. It would be juſt if the earth and moon were attached to the ends of a rod, and the earth kept always the ſame face toward the moon.

It is evident that the accumulation at P and P′, and the depreſſion at the equator, muſt augment and diminiſh in the ſame proportion with the diſturbing force. It is alſo evident that its abſolute quantity may be diſcovered by our knowledge of the proportion of the diſturbing force to the force of gravity.—Now this proportion is known; for the proportion of the gravitation of the earth's centre to the ſun or moon, to the force of gravity at the earth's ſurface, is known; and the proportion of the gravitation of the earth's centre to the luminary, to the difference of the gravitations of the centre and of the ſurface, is alſo known, being very nearly the proportion of the diſtance of the luminary to twice the radius of the earth.

Although this reaſoning, by which we have aſcertained the elliptical form of the watery ſpheroid, be ſufficiently

ciently convincing, it is very imperfect, being accommodate to one condition only of equilibrium, viz. the equilibrium of the canals fc and co. There are several other conditions equally necessary to which this lax reasoning will not apply, such as the direction of the whole remaining gravitation in any point F. This must be perpendicular to the surface, &c. &c. Nor will this mode of investigation ascertain the eccentricity of the spheroid without a most intricate process. We must therefore take the subject more generally, and show the proportion and directions of gravity in every point of the spheroid. We need not, however, again demonstrate that the gravitation of a particle placed any where without a perfect spherical shell, or a sphere consisting of concentric spherical shells, either of uniform density, or of densities varying according to some function of the radius, is the same as if the whole matter of the shell or sphere were collected in the centre. This has been demonstrated in the article ASTRONOMY. We need only remind the reader of some consequences of this theorem which are of continual use in the present investigation.

1. The gravitation to a sphere is proportional to its quantity of matter directly, and to the square of the distance of its centre from the gravitating particle inversely.

2. If the spheres be homogeneous and of the same density, the gravitations of particles placed on their surfaces, or at distances which are proportional to their diameters, are as the radii; for the quantities of matter are as the cubes of the radii, and the attractions are inversely as the squares of the radii; and therefore the whole gravitations are as $\frac{r^3}{r^2}$, or as r.

3. A particle placed within a sphere has no tendency to the matter of the shell which lies without it, because its tendency to any part is balanced by an opposite tendency to the opposite part. Therefore,

4. A particle placed any where *within* a homogeneous sphere gravitates to its centre with a force proportional to its distance from it.

It is a much more difficult problem to determine the gravitation of particles to a spheroid. To do this in general terms, and for every situation of the particle, would require a train of propositions which our limits will by no means admit; we must content ourselves with as much as is necessary for merely ascertaining the ratio of the axes. This will be obtained by knowing the ratio of the gravitation at the pole to that at the equator. Therefore,

Let N m S q N (fig. 2.) be a section through the axis of an oblate homogeneous spheroid, which differs very little from a sphere. NS is the axis, mq is the equatorial diameter, O is the centre, and NMSQ is the section of the inscribed sphere. Let P be a particle situated at any distance without the sphere in its axis produced; it is required to determine the gravitation of this particle to the whole matter of the spheroid?

Draw two lines PAC, PBD, very near to each other, cutting off two small arches AB, CD; draw GA a, HB b, IC c, KD d, perpendicular to the axis; also draw OE and AL perpendicular to PAC, and OF perpendicular to PD, cutting PC in f. Join OA.

Let OA, the radius of the inscribed sphere, be r, and OP the distance of the gravitating particle be d, and M m, the elevation of the equator of the spheroid, or the ellipticity, be e. Also make $AE = x$, and $OE = y$, $= \sqrt{r^2 - x^2}$. Then $AE - BF = \dot{x}$ and $Ff = \dot{y}$, $= \frac{x\dot{x}}{\sqrt{r^2 - x^2}}$. Tide.

Suppose the whole figure to turn round the axis OP. The little space AB ba will generate a ring of the redundant matter; so will CD dc. This ring may be considered as consisting of a number of thin rings generated by the revolution of A a. The ring generated by A a is equal to a parallelogram whose base is the circumference described by A, and whose height is A a. Therefore let c be the circumference of a circle whose radius is 1. The ring will be $A\,a \times c \times AG$. But because $m\,a$ N is an arch of an ellipse, we have $M\,m : A\,a = MO : AG = r : AG$, and $A\,a = M\,m \times \frac{AG}{r}$, $= \frac{e}{r} AG$. Therefore the surface of this ring is $= c\frac{e}{r} AG^2$.

We have supposed the spheroid to be very nearly spherical, that is, e exceedingly small in comparison of r. This being the case, all the particles in A a, and consequently all the particles in the ring generated by the revolution of A a, will attract the remote particle P with the same force that A does very nearly. We may say the same thing of the whole matter of the ring generated by the revolution of AB ba. This attraction is exerted in the direction PA by each individual particle. But every action of a particle A is accompanied by the action of a particle A′ in the direction PA′. These two compose an attraction in the direction PO. The whole attraction in the directions similar to PA is $= c \times \frac{e}{r} \frac{AG^2}{PA^2} \times GH$, for GH measures the number of parallel plates of which the solid ring is composed. This being decomposed in the direction PG is $= c \times \frac{e}{r} \times \frac{AG^2 \cdot PG}{PA^3} \times GH$. But $\frac{AG^2}{PA^2} = \frac{OE^2}{PO^2}$, and $\frac{PG}{PA} = \frac{PE}{PO}$. Therefore the attraction of the ring, estimated in the direction PO, is $= c \times \frac{e}{r} \times \frac{OE^2 \cdot PE}{PO^3} \times GH$.

Further, by the nature of the circle, we have HG : AB = AG : AO; also AB : BL = AO : OE. But PA : AG = PO : OE, and $OE = \frac{AG \times PO}{PA}$. Therefore

$$AB : BL = AO : \frac{AG \cdot PO}{PA}, = AO \cdot PA : PO \cdot AG$$

Also BL : LA = EO : EA,
And LA : Ff = PA : Pf, = ultimately PA : PE.
Therefore, by equality, HG : Ff = AG . AO . PA . EO . PA : AO . PO . AG . EA . PE.
Or HG : Ff = EO . PA^2 : PO . EA . PE.
and $HG = Ff \times \frac{EO \cdot PA^2}{PO \cdot PE \cdot EA}$.

Now substitute this value of HG in the formula expressing the attraction of the ring. This changes it to $c\frac{e}{r} \times \frac{OE^2 \cdot PE}{PO^3} \times \frac{OE \cdot PA^2}{PO \cdot PE \cdot EA} \times Ff$, or $c\frac{e}{r} \times \frac{OE^3 \cdot PA^2}{PO^4 \cdot EA} \times Ff$. In like manner, the attraction of

Tide. the ring generated by the revolution of CD dc is $c\frac{e}{r}\times\frac{OE^3\cdot PC^2}{PO^4\cdot EA}\times Ff$. Therefore the attraction of both is $=c\frac{e}{r}\times Ff\times\frac{OE^3}{PO^4\cdot EA}\times\overline{PA^2+PC^2}$, $=c\frac{e}{r}\times Ff\frac{y^3}{d^4\cdot x}\times\overline{PA^2+PC^2}$. But $PA^2+PC^2=2PE^2+2EA^2$, $=2PE^2+2x^2$. Therefore the attraction is $2c\frac{e}{r\,d^4}\times Ff\frac{y^3}{x}\times\overline{PE^2+x^2}$. But $Ff=\dot{y}$, $=\frac{x}{y}\dot{x}$. Therefore $Ff\frac{y^3}{x}=\frac{x}{y}\dot{x}\times\frac{y^3}{x}$, $=y^2\dot{x}$, $=\overline{r^2-x^2}\,\dot{x}$.

Therefore the attraction of the two rings is $2c\frac{e}{r\,d^4}\times\overline{r^2-x^2}\times\overline{PE^2+x^2}\times\dot{x}$. But $PE^2=PO^2-OE^2$, $=d^2-(r^2-x^2)=d^2-r^2+x^2$. Therefore the attraction of the two rings is

$$2c\frac{e}{r\,d^4}\times\overline{r^2-x^2}\times\overline{d^2-r^2+2x^2}\,\dot{x},=2c\frac{e}{r\,d^4}\times\overline{r^2d^2\dot{x}-r^4\dot{x}+2r^2x^2\dot{x}-d^2x^2\dot{x}+r^2x^2\dot{x}-2x^4\dot{x}}=2c\frac{e}{r\,d^4}\times\overset{*}{r^2d^2\dot{x}}+\overset{*}{3r^2x^2\dot{x}}-\overset{*}{r^4\dot{x}}-d^2x^2\dot{x}-2x^4\dot{x}.$$

The attraction of the whole ſhell of redundant matter will be had by taking the fluent of this formula, which is

$$2c\frac{e}{r\,d^4}\times\left(r^2d^2x+\frac{3r^2x^3}{3}-r^4x-\frac{d^2x^3}{3}-\frac{2x^5}{5}\right),$$

and then make $x=r$. This gives $2c\frac{e}{r\,d^4}(d^2r^3+r^5-r^5-\frac{1}{3}d^2r^3-\frac{2}{5}r^5)$, which is $=2c\frac{e}{r\,d^4}(\frac{2}{3}d^2r^3-\frac{2}{5}r^5)$, $=\frac{4ce\,r^2}{3\,d^2}-\frac{4r^4}{5d^4}$. To this add the attraction of the inſcribed ſphere, which is $\frac{2}{3}\frac{c\,r^3}{d^2}$, and we have the attraction of the whole ſpheroid

$$=\tfrac{2}{3}\frac{c\,r^3}{d^2}+\tfrac{4}{3}\frac{ce\,r^2}{d^2}-\tfrac{4}{5}\frac{ce\,r^4}{d^4}.$$

Cor. 1. If the particle P is ſituated preciſely in N, the pole of the ſpheroid, the attraction of the ſpheroid is $\frac{2}{3}cr+\frac{8}{15}ce$.

If the ſpheroid is not oblate, but oblong, and if the greater ſemiaxis be r, and the depreſſion at the equator be e, the analyſis is the ſame, taking e negatively. Therefore the attraction for a particle in the pole, or the gravitation of a particle in the pole, is $\frac{2}{3}cr-\frac{8}{15}ce$.

But if the polar ſemiaxis be $r+e$, and the equatorial radius be r, ſo that this oblong ſpheroid has the ſame axis with the former oblate one, the gravitation of a particle in the pole is $\frac{2}{3}cr+\frac{2}{15}ce$.

Cor. 2. If a number of parallel planes are drawn perpendicular to the equator of an oblong ſpheroid, whoſe longer ſemiaxis is $r+e$, and equatorial radius r, they will divide the ſpheroid into a number of ſimilar ellipſes; and ſince the ellipſe through the axis has $r+e$ and r for its two ſemiaxis, and the radius of a circle of equal area with this ellipſe is a mean proportional between r and $r+e$, and therefore very nearly $=r+\frac{1}{2}e$, when e is very ſmall in compariſon of r, a particle on the equator of the oblong ſpheroid will be as much attracted by theſe circles of equal areas, with their correſponding ellipſes, as by the ellipſes. Now the attraction at the pole of an oblate ſpheroid was $\frac{2}{3}cr+\frac{8}{15}ce$. Therefore putting $\frac{1}{2}e$ in place of e, the attraction on the equator of the oblong ſpheroid will be equal to $\frac{2}{3}cr+\frac{4}{15}ce$. Tic

Thus we have aſcertained the gravitations of a particle ſituated in the pole, and of one ſituated in the equator, of a homogeneous oblong ſpheroid. This will enable us to ſolve the following problem:

If the particles of a homogeneous oblong fluid ſpheroid attract each other with a force inverſely as the ſquares of their diſtances, and if they are attracted by a very diſtant body by the ſame law, and if the ratio of the equatorial gravity to this external force be given; to find what muſt be the proportion of the ſemiaxis, ſo that all may be in equilibrio, and the ſpheroid preſerve its form?

Let r be the equatorial radius, and $r+e$ be the polar ſemiaxis. Then the gravitation at the pole m is $\frac{2}{3}cr+\frac{2}{15}ce$, and the gravitation at the equator is $\frac{2}{3}cr+\frac{4}{15}ce$. Now by the gravitation towards the diſtant body placed in the direction of the polar axis, the polar gravitation is diminiſhed, and the equatorial gravitation is increaſed; and the increaſe of the equatorial gravitation is to the diminution of the polar gravitation as NO to $2m$O. Therefore if the whole attraction of the oblong ſpheroid for a particle on its equator be to the force which the diſtant body exerts there, as G to P, and if the ſpheroid is very nearly ſpherical, the abſolute weight at the equator will be $\frac{2}{3}cr+\frac{4}{15}ce+\frac{2}{3}cr\frac{P}{G}$. And the abſolute weight at the pole will be $\frac{2}{3}cr+\frac{2}{15}ce-\frac{2}{3}cr\frac{2P}{G}$. Their difference is $\frac{2}{15}ce+2cr\frac{P}{G}$.

Now if we ſuppoſe this ſpheroid to be compoſed of ſimilar concentric ſhells, all the forces will decreaſe in the ſame ratio. Therefore the weight of a particle in a column reaching from the equator to the centre will be to the weight of a ſimilarly ſituated particle of a column reaching from the pole to the centre, as the weight of a particle at the equator to the weight of a particle at the pole. But the whole weights of the two columns muſt be equal, that they may balance each other at the centre. Their lengths muſt therefore be reciprocally as the weights of ſimilarly ſituated particles; that is, the polar ſemiaxis muſt be to the equatorial radius, as the weight of a particle at the equator to the weight of a particle at the pole. Therefore we muſt have $\frac{2}{15}ce+2cr\frac{P}{G}:\frac{2}{3}cr+\frac{2}{15}ce-\frac{4}{3}cr\frac{P}{G}=e:r$.

Hence we derive $2r\frac{P}{G}=\frac{5}{15}e$, or $4G:15P=r:e$. This determines the form of the fluid ſpheroid when the ratio of G to P is given.

It is well known that the gravitation of the moon to the earth is to the diſturbing force of the ſun as 178,725 to 1 very nearly. The lunar gravitation is increaſed as ſhe approaches the earth in the reciprocal duplicate ratio of the diſtances. The diſturbing force of the ſun diminiſhes in the ſimple ratio of the diſtances; therefore the weight of a body on the ſurface of the earth is to the

diſturbing

de. disturbing force of the sun on the same body, in a ratio compounded of the ratio of 178,725 to 1, the ratio of 3600 to 1, and the ratio of 60 to 1; that is, in the ratio of 38604600 to 1. If the mean radius of the earth be 20934500 feet, the difference of the axis, or the elevation of the pole of the watery spheroid produced by the gravitation to the sun, will be $\frac{1.5}{4} \times \frac{20934500}{38604600}$ feet, or very nearly $24\frac{1}{2}$ inches. This is the tide produced by the sun on a homogeneous fluid sphere.

It is plain, that if the earth consists of a solid nucleus of the same density with the water, the form of the solar tide will be the same. But if the density of the nucleus be different, the form of the tide will be different, and will depend both on the density and on the figure of the nucleus.

If the nucleus be of the same form as the surrounding fluid, the whole will still maintain its form with the same proportion of the axis. If the nucleus be spherical, its action on the surrounding fluid will be the same as if all the matter of the nucleus by which it exceeds an equal bulk of the fluid were collected at the centre. In this case, the ocean cannot maintain the same form: for the action of this central body being proportional to the square of the distance inversely, will augment the gravity of the equatorial fluid more than it augments that of the circumpolar fluid; and the ocean, which was in equilibrio (by supposition), must now become more protuberant at the poles. It may, however, be again balanced in an elliptical form, when it has acquired a just proportion of the axes. The process for determining this is tedious, but precisely similar to the preceding.

If the density of the nucleus exceed that of the fluid about $\frac{1}{5\frac{1}{2}}$, we shall have $r : e = G : 3P$, which is nearly the form which has been determined for the earth, by the mensuration of degrees of the meridian, and by the vibration of pendulums. The curious reader will do well to consult the excellent dissertations by Clairaut and Boscovich on the Figure of the Earth, where this curious problem is treated in the most complete manner. Mr Bernoulli, in his dissertation on the Tides, has committed a great mistake in this particular. On the other hand, if the nucleus be less dense than the waters, or if there be a great central hollow, the elevation produced by the sun will exceed $24\frac{1}{2}$ inches.

It is needless to examine this any farther. We have collected enough for explaining the chief affections of the tides.

It is known that the earth is not a sphere, but swelled out at the equator by the diurnal rotation. But the change of form is so very small in proportion to the whole bulk, that it cannot sensibly affect the change of form afterwards induced by the sun on the waters of the ocean. For the disturbing force of the sun would produce a certain protuberance on a fluid sphere; and this protuberance depends on the ratio of the disturbing force to the force of gravity at the surface of this sphere. If the gravity be changed in any proportion, the protuberance will change in the same proportion. Therefore if the body be a spheroid, the protuberance produced at any point by the sun will increase or diminish in the same proportion that the gravity at this point has been changed by the change of form. Now the change of gravity, even at the pole of the terrestrial spheroid, is extremely small in comparison with the whole gravity. Therefore the change produced on the spheroid will not sensibly differ from that produced on the sphere; and the elevations of the waters above the surface, which they would have assumed independent of the sun's action, will be the same on the spheroid as on the sphere. For the same reason, the moon will change the surface already changed by the sun, in the same manner as she would have changed the surface of the undisturbed ocean. Therefore the change produced by both these luminaries in any place will be the same when acting together as when acting separately; and it will be equal to the sum, or the difference of their separate changes, according as these would have been in the same or in opposite directions. Tide.

Let us now consider the most interesting circumstances of the form of an elliptical tide, which differs very little from a sphere.

Let T (fig. 2.) be a point in the surface of the inscribed sphere, and let Z express the angular distance TOQ from the longer axis of the surrounding spheroid $S\,m\,N\,q$. Let TR, TW be perpendicular to the equatorial diameter and to the axis, so that they are the cosine and the sine of TOQ to the radius TO or QO. Let $S'\,q\,N'$ be a section of the circumscribed sphere. Draw OT cutting the spheroid in Z and the circumscribed sphere in t. Also let $s\,o\,n$ be a section of a sphere which has the same capacity with the spheroid, and let it cut the radius in r. Then, Fig. 2.

1. The elevation TZ of the point Z of the spheroid above the inscribed sphere is $= Q\,q \times \text{cof.}^2\,Z$, and the depression $t\,Z$ below the circumscribed sphere is $= Q\,q \times \text{sine}^2\,Z$. Produce RT till it meet the surface of the spheroid in V. The minute triangle VTZ may be considered as rectilineal, right-angled at Z, and therefore similar to OTR. Therefore $OT : TR = TV : TZ$. But in the ellipse OQ, or $OT : TR = Q\,q : TV$. Therefore $OT^2 : TR^2 = Q\,q : TZ$, and $TZ = \frac{Q\,q \cdot TR^2}{OT^2}$,

$$= Q\,q : \frac{Q\,q \times \text{cof.}^2\,Z}{1}, = Q\,q \times \text{cof.}^2\,Z.$$

And in the very same manner it may be shown, that $t\,Z = Q\,q \times \text{fin.}^2\,Z$.

2. The elevation of the point T above another point T', whose angular distance TOT' from the point T is 90°, is $= Q\,q \times \overline{\text{cof.}^2\,Z - \text{fin.}^2\,Z}$. Call the angle QOT' Z'. Then $T'\,Z' = Q\,q \times \text{cof.}^2\,Z'$, and $TZ - T', Z', = Q\,q \times \overline{\text{cof.}^2\,Z - \text{cof.}^2\,Z'}$. But the arch QT' is the complement of QT, and therefore $\text{cof.}^2\,Z' = \text{fin.}^2\,Z$. Therefore $TZ - T', Z' = Q\,q \times \overline{\text{cof.}^2\,Z - \text{fin.}^2\,Z}$.

3. $Q\,o = \frac{1}{3}\,Q\,q$. For the inscribed sphere is to the spheroid as OQ to $O\,q$. But the inscribed sphere is to the sphere $s\,o\,n$ as OQ^3 to $O\,o^3$. Therefore because the sphere $s\,o\,n$ is equal to the spheroid $S\,q\,N$, we have $OQ : O\,q = OQ^3 : O\,o^3$, and $O\,o$ is the first of two mean proportionals between OQ and $O\,q$. But $Q\,q$ is very small in comparison with OQ. Therefore $Q\,o$ is very nearly $\frac{1}{3}$ of $Q\,q$.

Since $s\,o\,n$ is the sphere of equal capacity, it is the form of the undisturbed ocean. The best way therefore of conceiving the changes of form produced by the sun or moon, or by both together, is to consider the elevations or depressions which they produce above or below this surface. Therefore,

4. The

Tide.

4. The elevation rZ of the point Z above the equicapacious ſphere is evidently $= Q\,q \times \text{cof.}^2 Z - \frac{1}{3} Q\,q$. Alſo the depreſſion r'Z′ of the point Z′ is $= Q\,q \times \text{ſin.}^2 Z' - \frac{1}{3} Q\,q$.

N. B. Either of theſe formulæ will anſwer for either the elevation above, or the depreſſion below, the natural ocean: For if cof.^{2}Z is leſs than $\frac{1}{3}$, the elevation given by the formula will be negative; that is, the point is below the natural ſurface. In like manner, when ſin.^{2}Z′ is leſs than $\frac{2}{3}$, the depreſſion is negative, and the point is above the ſurface. But if cof.^{2}Z be $= \frac{1}{3}$, or ſin.^{2}Z′ be $= \frac{2}{3}$, the point is in the natural ſurface. This marks the place where the ſpheroid and the equal ſphere interſect each other, viz. in P′, the arch P′ o being 54° 44′ very nearly, and PS = 35° 16′.

Let S repreſent the whole elevation of the pole of the ſolar tide above its equator, or the difference between high and low water produced by the ſun; and let M repreſent the whole elevation preduced by the moon. Let x and y repreſent the zenith diſtances of the ſun and moon with reſpect to any point whatever on the ocean. Then x and y will be the arches intercepted between that point and the ſummits of the ſolar and lunar tides. Then the elevation produced by both luminaries in that plane is $S \cdot \text{cof.}^2 x - \frac{1}{3} S + M \cdot \text{cof.}^2 y - \frac{1}{3} M$; or, more conciſely, $S \cdot \text{cof.}^2 x + M \cdot \text{cof.}^2 y - \frac{1}{3}\overline{S+M}$, and the depreſſion is $S \cdot \text{ſin.}^2 x + M \cdot \text{ſin.}^2 y - \frac{1}{3}\overline{S+M}$.

Let the ſun and moon be in the ſame point of the heavens. The ſolar and lunar tides will have the ſame axis; the coſines of x and y will each be 1, and the elevation at the compound pole will be $S+M-\frac{1}{3}\overline{S+M} = \frac{2}{3}\overline{S+M}$. The depreſſion at any point 90° from this pole will be $\frac{1}{3}\overline{S+M}$, and the whole tide is S + M.

Let the moon be in quadrature, as in a (fig. 3.). The appearance at s will be known, by conſidering that in this place the coſine of x is 1, and the coſine of y is 0. Therefore the elevation at $s = S - \frac{1}{3}\overline{S+M} = \frac{2}{3} S - \frac{1}{3} M$. The depreſſion at $a = S - \frac{2}{3}\overline{S+M} = \frac{1}{3} S - \frac{2}{3} M$. The difference or whole tide $= \overline{S - M}$. In like manner, the whole elevation at a above the inſcribed ſphere is M—S.

Hence we ſee that the whole tide, when the moon is in quadrature is the difference of S and M. We alſo ſee, that if M exceeds S, the water will be higher at a than at s. Now it is a matter of obſervation, that in the quadratures it is high water under the moon, and low water under the ſun. It is alſo a matter of obſervation, that in the free ocean, the ebb tide, or the water at s, immediately under the ſun, is below the natural ſurface of the ocean. Hence we muſt conclude, that $\frac{2}{3}$ S is leſs than $\frac{1}{3}$ M, or that M is more than double of S. This agrees with the phenomena of nutation and preceſſion, which ſeem to make S = $\frac{2}{5}$ of M.

In all other poſitions of the ſun and moon, the place of high water will be different. It is high water where the ſum of the elevations produced by both luminaries above the natural ocean is greateſt; and the place of low water is where the depreſſion below the natural ocean is greateſt. Therefore, in order that it may be high water, we muſt have $S \cdot \text{cof.}^2 x + M \cdot \text{cof.}^2 y - \frac{1}{3}\overline{S+M}$ a maximum; or, neglecting the conſtant quantity $\frac{S+M}{3}$, we muſt have $S \cdot \text{cof.}^2 x + M \cdot \text{cof.}^2 y$ a maximum.

In like manner, to have low water in a place where the zenith diſtances of the ſun and moon are v and w, we muſt have $S \cdot \text{ſin.}^2 v + M \cdot \text{ſin.}^2 w$ a maximum.

Lemma 1. If we conſider the ſines and coſines of angles as numeral fractions of the radius 1, then we have cof.^{2}Z = $\frac{1}{2} + \frac{1}{2}$ cof.^{2}Z, and ſin.^{2}Z = $\frac{1}{2} - \frac{1}{2}$ cof.^{2}Z.

Let $a\,m\,s$ (fig. 3.) be a quadrant of a circle of which O is the centre, and Os is the radius. On Os deſcribe the ſemicircle OMS, cutting Om in M. Draw sM, and produce it till it cut the quadrant in n. Alſo draw MC to the centre of the ſemicircle, and MD and $n\,d$ perpendicular to Os. Fig. 3.

It is plain that sM is perpendicular to OM; and if Os be radius, sM is the ſine of the angle sOM, which we may call Z; OM is its coſine: and becauſe Os : OM = OM : OD, and Os : OD = Os^2 : OM^2, and OD may repreſent cof.^{2}Z. Now OD = OC + CD. If Os = 1, then OC = $\frac{1}{2}$. CD = CM · cof. MCD, = CM · cof. 2 MOD, = $\frac{1}{2}$ · cof. 2Z. Therefore, cof.^{2}Z = $\frac{1}{2} + \frac{1}{2}$ cof. 2Z.

In like manner, becauſe Os : sM = sM : sD, sD is = ſin.^{2}Z. This is evidently = $\frac{1}{2} - \frac{1}{2}$ cof. 2Z.

Lemma 2. Cof.^{2}Z — ſin.^{2}Z = cof. 2Z. For, becauſe sM is perpendicular to OM, the arch $s\,n$ is double of the arch $s\,m$, and becauſe MD is parallel to $n\,d$, $s\,d$ is = 2 sD, and dD = ſin.^{2}Z. Therefore Od = cof.^{2}Z — ſin.^{2}Z. But Od is the coſine of $n\,s$, = cof. 2Z and cof.^{2}Z — ſin.^{2}Z = cof. 2Z.

By the firſt Lemma we ſee, that in order that there may be high water at any place, when the zenith diſtances of the ſun and moon are x and y, we muſt have $S \cdot \text{cof. } 2x + M \cdot \text{cof. } 2y$ a maximum.

That this may be the caſe, the fluxion of this formula muſt be = 0. Now we know that the fluxions of the coſines of two arches are as the ſines of thoſe arches. Therefore we muſt have $S \cdot \text{ſin. } 2x + M \cdot \text{ſin. } 2y = 0$, or $S \cdot \text{ſin. } 2x = -M \cdot \text{ſin. } 2y$, which gives us ſin. 2$x$: ſin. 2y = M : S.

In like manner, the place of low water requires ſin. 2v : ſin. 2w = M : S.

From this laſt circumſtance we learn, that the place of low water is 0, removed 90° from the place of high water; whereas we might have expected, that the ſpheroid would have been moſt protuberant on that ſide on which the moon is: For the ſines of 2v and of 2w have the ſame proportion with the ſines of 2x and of 2y. Now we know that the ſine of the double of any arch is the ſame with the ſine of the double of its complement. Therefore if low water be really diſtant 90° from high water, we ſhall have ſin. 2x : ſin. 2y = ſin. 2v : ſin. 2w. But if it is at any other place, the ſines cannot have this proportion.

Now let s be the point of the earth's ſurface which has the ſun in the zenith, and m the point which has the moon in the zenith. Let h be any other point. Draw Oh cutting the ſemicircle OMs in H. Make CM to CS as the diſturbing force of the moon to that of the ſun; and draw Sv parallel, and St, Mr perpendicular to HH′. Join MH and MH′. The angle HCs is double of the angle HOs, and MCH is double of MH′H, or of its equal MOH. Becauſe HMH is a ſemicircle, HM is perpendicular to MO. Therefore

fore if HH′ be considered as radius, HM is the ſine, and H′M is the coſine of MH′H. And C r is $=$MC · coſ. $2y$, $=$ M · coſ. $2y$. And C t is SC · coſ. $2x$. Therefore tr or S′v is $=$ S · coſ. $2x$ + M · coſ. $2y$. Therefore tr or S v will expreſs the whole difference of elevation between h and the points that are 90 degrees from it on either ſide (by *Lemma* 2.); and if h be the place of high water, it will expreſs the whole tide, becauſe the high and low waters were ſhown to be 90° aſunder. But when h is the place of high water, S v is a maximum. Becauſe the place of the moon, and therefore the point M, is given, S v will be a maximum when it coincides with SM, and CH is parallel to SM.

This ſuggeſted to us the following new, and not inelegant, ſolution of the problem for determining the place of high water.

Let s Q o q s (fig. 4. and 5.) be a ſection of the terraqueous globe, by a plane paſſing through the ſun and moon, and let O be its centre. Let s be the point which is immediately under the ſun, and m the place immediately under the moon. Biſect O s in C, and deſcribe round C the circle OM s LO, cutting O m in M. Take C s to repreſent the diſturbing force of the moon, and make C s to CS as the force of the moon to that of the ſun (ſuppoſing this ratio to be known). Join MS, and draw CH parallel to it. Draw OH h, and l OL l' perpendicular to it. And laſtly, draw CI perpendicular to SM. Then we ſay that m and its oppoſite m' are the places of high water, l and l' are the places of low water, MS is the height of the tide, and MI, SI are the portions of this tide produced by the moon and ſun.

For it is plain, that in this caſe the line S v of the laſt propoſition coincides with MS, and is a maximum. We may alſo obſerve, that MC : CS$=$ſin. MSC : ſin. SMC, $=$ ſin. HCS : ſin. MCH, $=$ ſin. $2h$ O s : ſin. $2h$ O m, $=$ ſin. $2x$: ſin. $2y$, or M : S $=$ ſin. $2x$: ſin. $2y$, agreeably to what was required for the maximum.

It is alſo evident, that MI $=$ MC · coſ. CMI, $=$ M · coſ. $2y$, and SI $=$ SC · coſ. ISC, $=$ S · coſ. $2x$; and therefore MS is the difference of elevation between h and the points l and l', which are 90° from it, and is therefore the place of low water; that is, MS is the whole tide.

The elevation of every other point may be determined in the ſame way, and thus may the form of the ſpheroid be completely determined.

If we ſuppoſe the figure to repreſent a ſection through the earth's equator (which is the caſe when the ſun and moon are in the equator), and farther ſuppoſe the two luminaries to be in conjunction, the ocean is an oblong ſpheroid, whoſe axis is in the line of the ſyzigies, and whoſe equator coincides with the ſix hour circle. But if the moon be in any other point of the equator, the figure of the ocean will be very complicated. It will not be any figure of revolution; becauſe neither its equator (or moſt depreſſed part) nor its meridians are circles. The moſt depreſſed part of its equator will be in that ſection through the axis which is perpendicular to the plane in which the luminaries are ſituated. And this greateſt depreſſion, and its ſhorteſt equatorial diameter, will be conſtant, while its other dimenſions vary with the moon's place. We need not inquire more minutely into its form; and it is ſufficient to know that all the ſections perpendicular to the plane paſſing through the ſun and moon are ellipſes. Tide.

This conſtruction will afford us a very ſimple, and, we hope, a very perſpicuous explanation of the chief phenomena of the tides. The well informed reader will be pleaſed with obſerving its coincidence with the algebraic ſolution of the problem given by Daniel Bernoulli, in his excellent diſſertation on the Tides, which ſhared with M'Laurin and Euler the prize given by the Academy of Sciences at Paris, and with the eaſe and perſpicuity with which the phenomena are deducible from it, being in ſome ſort exhibited to the eye.

In our application, we ſhall begin with the ſimpleſt caſes, and gradually introduce the complicating circumſtances which accommodate the theory to the true ſtate of things.

We begin, therefore, by ſuppoſing the earth covered, to a proper depth, with water, forming an ocean concentric with its ſolid nucleus.

In the next place, we ſuppoſe that this ocean adopts in an inſtant the form which is conſiſtent with the equilibrium of gravity and the diſturbing forces.

Thirdly, We ſuppoſe the ſun ſtationary, and the moon to move eaſtward from him above 12$\frac{1}{2}$° every day.

Fourthly, We ſuppoſe that the ſolid nucleus turns round its proper axis to the eaſtward, making a rotation in 24 ſolar hours. Thus any place of obſervation will ſucceſſively experience all the different depths of water.

Thus we ſhall obtain a certain SUCCESSION of phenomena, preciſely ſimilar to the ſucceſſion obſerved in nature, with this ſole difference, that they do not correſpond to the contemporaneous ſituations of the ſun and moon. When we ſhall have accounted for this difference, we ſhall preſume to think that we have given a juſt theory of the tides.

We begin with the ſimpleſt caſe, ſuppoſing the ſun and moon to be always in the equator. Let the ſeries begin with the ſun and moon in conjunction in the line O s. In this caſe the points s, m, and h coincide, and we have high water at 12 o'clock noon and midnight.

While the moon moves from s to Q, O m cuts the upper ſemicircle in M; and therefore CH, which is always parallel to MS, lies between MC and C s. Therefore h is between m and s, and we have high water after 12 o'clock, but before the moon's ſouthing. The ſame thing happens while the moon moves from o to q, during her third quarter.

But while the moon moves from her firſt quadrature in Q to oppoſition in o (as in fig. 5.), the line m O drawn from the moon's place, cuts the lower ſemicircle in M and CH, parallel to SM, again lies between M and s, and therefore h lies between m and o. The place of high water is to the eaſtward of the moon, and we have high water after the moon's ſouthing. The ſame thing happens while the moon is moving from her laſt quadrature in q to the next ſyzigy. In ſhort, the point H is always between M and s, and the place of high water is always between the moon and the *neareſt* ſyzigy. The place of high water overtakes the moon in each quadrature, and is overtaken by the moon in each ſyzigy. Therefore during the firſt and third quarters, the place of high water gradually falls behind the moon for ſome time, and then gains upon her again, ſo

5 33

Tide. as to overtake her in the next quadrature. But during the ſecond and fourth quarters, the place of high water advances before the moon to a certain diſtance, and then the moon gains upon it, and overtakes it in the next ſyzigy.

If therefore we ſuppoſe the moon to advance uniformly along the equator, the place of high water moves unequally, ſloweſt in the times of new and full moon, and ſwifteſt in the time of the quadratures. There muſt be ſome intermediate ſituations where the place of high water neither gains nor loſes upon the moon, but moves with the ſame velocity.

The rate of motion of the point h may be determined as follows: Draw C i, S n, making very ſmall and equal angles with HC and MS. Draw n C, and about S, with the diſtance S n, deſcribe the arch $n v$, which may be conſidered as a ſtraight line perpendicular to n S, or to MS.

Then, becauſe SM and S n are parallel to CH and C i, the points n and i are contemporaneous ſituations of M and H, and the arches n M, i H, are in the ratio of the angular motions of m and h. Alſo, becauſe $n v$ and n M are perpendicular to n S and n C, the angle $v n$ M is equal to the angle S n C, or SMC. Alſo, becauſe the angles $n v$ M and MIC are right angles, and the angles $v n$ M, CMI, are alſo equal, the triangles $v n$ M, CMI, are ſimilar. Therefore

n M : $n v$ = MC : MI. And

$n v$: iH = n S : i C, or = MS : MC; therefore

n M : iH = MS : MI. Therefore the angular motion of the moon is to the angular motion of the place of high water as MS to MI.

Therefore, when M′S is perpendicular to SC, and the point I coincides with S, the motion of high water is equal to that of the moon. But when M′S is perpendicular to SC, H′C is alſo perpendicular to C s, and the angle h' O s is 45°, and the high water is in the octant. While the moon paſſes from s to m', or the high water from s to h', the point I falls between M and S, and the motion of high water is ſlower than that of the moon. The contrary obtains while the moon moves from m' to Q, or the high water from the octant to the quadrature.

It is evident, that the motion of h in the third quarter of the lunation, that is, in paſſing from o to q, is ſimilar to its motion from s to Q. Alſo, that its motion from Q to o muſt retard by the ſame degrees as it accelerated in paſſing from s to Q, and that its motion in the laſt quarter from q to s is ſimilar to its motion from Q to o.

At new and full moon the point I coincides with C, and the point M coincides with s. Therefore the motion of the high water at full and change is to the motion of the moon as s C to s S. But when the moon is in quadrature, I coincides with C, and M with o. Therefore the motion of the moon is to that of high water as OS to OC or s C. Therefore the motion of high water at full and change is to its motion in the quadratures as OS to S s, or as the difference of the diſturbing forces to their ſum. The motion of the tide is therefore ſloweſt in the ſyzigies and ſwifteſt in the quadratures; yet even in the ſyzigies it paſſes the ſun along with the moon, but more ſlowly.

Let the interval between the morning tide of one day and that of the next day be called a *tide-day*. This is always greater than a ſolar day, or 24 hours, becauſe the place of high water is moving faſter to the eaſtward than the ſun. It is leſs than a lunar day, or 24h. 50′, while the high water paſſes from the ſecond to the third octant, or from the fourth to the firſt. It is equal to a lunar day when high water is in the octants, and it exceeds a lunar day while high water paſſes from the firſt to the ſecond octant, or from the third to the fourth. Tide.

The difference between a ſolar day and a tide day is called the PRIMING or the RETARDATION of the tides. This is evidently equal to the time of the earth's deſcribing in its rotation an angle equal to the motion of the high water in a day from the ſun. The ſmalleſt of theſe retardations is to the greateſt as the difference of the diſturbing forces to their ſum. Of all the phenomena of the tides, this ſeems liable to the feweſt and moſt inconſiderable derangements from local and accidental circumſtances. It therefore affords the beſt means for determining the proportion of the diſturbing forces. By a compariſon of a great number of obſervations made by Dr Maſkelyne at St Helena, and at Barbadoes (places ſituated in the open ſea), it appears that the ſhorteſt tide-day is 24 h. 37′, and the longeſt is 25 h. 27′. This gives M—S : M+S = 37 : 87, and S : M = 2 : 4.96; which differs only 1 part in 124 from the proportion of 2 to 5, which Daniel Bernoulli collected from a variety of different obſervations. We ſhall therefore adopt the proportion of 2 to 5 as abundantly exact. It alſo agrees exactly with the phenomena of the nutation of the earth's axis and the preceſſion of the equinoxes; and the aſtronomers affect to have deduced this proportion from theſe phenomena. But an intelligent reader of their writings will perceive more fineſſe than juſtice in this aſſertion. The nutation and preceſſion *do not* afford phenomena of which we can aſſign the ſhare to each luminary with ſufficient preciſion for determining the proportion of their diſturbing forces; and it is by means of many arbitrary combinations, and without neceſſity, that D'Alembert has made out this ratio. We cannot help being of opinion, that D'Alembert has accommodated his diſtribution of the phenomena to this ratio of 2 to 5, which Daniel Bernoulli (the beſt philoſopher and the moſt candid man of that illuſtrious family of mathematicians) had, with ſo much ſagacity and juſtneſs of inference, deduced from the phenomena of the tides. D'Alembert could not but ſee the value of this inference; but he wanted to ſhow his own addreſs in deducing it *proprio marte* forſooth from the nutation and preceſſion. His procedure in this reſembles that of his no leſs vain countryman De la Place, who affects to be highly pleaſed with finding that Mr Bode's diſcovery that Meyer had ſeen the Georgium Sidus in 1756, perfectly agreed with the theory of its motions which he (De la Place) had deduced from his own doctrines. Any well informed mathematician will ſee, that De la Place's data afforded no ſuch preciſion; and the Book on the Elliptical Motions of the Planets, to which he alludes, contains no grounds for his inference. This obſervation we owe to the author of a paper on that ſubject in the Tranſactions of the Royal Society of Edinburgh. We hope that our readers will excuſe this occaſional obſervation, by which we wiſh to do juſtice to the merit of a modeſt man, and one of the greateſt philoſophers of his time. Our only claim in the preſent diſſertation is the making his excellent performance

de. formance on the tides acceſſible to an Engliſh reader not much verſant in mathematical reſearches; and we are ſorry that our limits do not admit any thing more than a ſketch of it. But to proceed.

Aſſuming 2 : 5 as the ratio of SC to CM′, we have the angle CM′S=23° 34′ nearly, and *m′ o h′*=11° 47′; and this is the greateſt difference between the moon's place and the place of high water. And when this obtains, the moon's elongation *m′ o s* is 56° 47′ from the neareſt ſyzigy. Hence it follows, that while the moon moves uniformly from 56° 47′ weſt elongation to 56° 47′ eaſt, or from 123° 13′ eaſt to 123° 13′ weſt, the tide day is ſhorter than the lunar day; and while ſhe moves from 56° 47′ caſt to 123° 13′, or from 123° 13′ weſt to 56° 47′, the tide day is longer than the lunar day.

We now ſee the reaſon why

———The ſwelling tides obey the moon.

The time of high water, when the ſun and moon are in the equator, is never more than 47 minutes different from that of the moon's ſouthing (+ or — a certain fixed quantity, to be determined once for all by obſervation).

It is now an eaſy matter to determine the hour of high water correſponding to any poſition of the ſun and moon in the equator. Suppoſe that on the noon of a certain day the moon's diſtance from the ſun is *m s*. The conſtruction of this problem gives us *s h*, and the length of the tide day. Call this T. Then ſay 360° : *s m*=T : *t*, and *t* is the hour of high water.

Or, if we chooſe to refer the time of high water to the moon's ſouthing, we muſt find the value of *m h* at the time of the moon's ſouthing, and the difference *d* between the tide day and a mean lunar day L, and ſay 360 : *m h*=*d* : ϑ, the time of high water before the moon's ſouthing in the firſt and third quarters, but after it in the ſecond and fourth. The following table by Daniel Bernoulli exhibits theſe times for every 10th degree of the moon's elongation from the ſun. The firſt or leading column is the moon's elongation from the ſun or from the point of oppoſition. The ſecond column is the minutes of time between the moon's ſouthing and the place of high water. The marks — and + diſtinguiſh whether the high water is before or after the moon's ſouthing. The third column is the hour and minute of high water. But we muſt remark, that the firſt column exhibits the elongation, not on the noon of any day, but at the very time of high water. The two remaining columns expreſs the heights of the tides and their daily variations.

m s.	*m h.*	*s h.*	M. S.	M *v.*
°	′	h. ′		
0	0	0. 0	1000	
	—			13
10	11½—	0.28½	987	38
20	22 —	0.58	949	62
30	31½—	1.28½	887	81
40	40 —	2.—	806	91
50	45 —	2.35	715	105
60	46½—	3.13½	610	92
70	40½—	3.59½	518	65
80	25 —	4.55	453	24
90	0	6.—	429	—
	+			24
100	25 +	7. 5	453	65
110	40½+	8. 0½	518	92
120	46½+	8.46½	610	105
130	45 +	9.25	715	91
140	40 +	10.—	806	81
150	31½+	10.31½	887	6
160	22 +	11. 2	949	38
170	11½+	11.31½	987	13
180	0	12.—	1000	

The height of high water above the low water conſtitutes what is uſually called the tide. This is the intereſting circumſtance in practice. Many circumſtances render it almoſt impoſſible to ſay what is the elevation of high-water above the natural ſurface of the ocean. In many places the ſurface at low water is above the natural ſurface of the ocean. This is the caſe in rivers at a great diſtance from their mouths. This may appear abſurd, and is certainly very paradoxical; but it is a fact eſtabliſhed on the moſt unexceptionable authority. One inſtance fell under our own obſervation. The low-water mark at ſpring tide in the harbour of Alloa was found by accurate levelling to be three feet higher than the top of the ſtone pier at Leith, which is ſeveral feet above the high-water mark of this harbour. A little attention to the motion of running waters will explain this completely. Whatever checks the motion of water in a canal muſt raiſe its ſurface. Water in a canal runs only in conſequence of the declivity of this ſurface: (See RIVER). Therefore a flood tide coming to the mouth of a river checks the current of its waters, and they accumulate at the mouth. This checks the current farther up, and therefore the waters accumulate there alſo; and this checking of the ſtream, and conſequent riſing of the waters, is gradually communicated up the river to a great diſtance. The water riſes everywhere, though its ſurface ſtill has a ſlope. In the mean time, the flood tide at the mouth paſſes by, and an ebb ſucceeds. This muſt accelerate even the ordinary courſe of the river. It will more remarkably accelerate the river now raiſed above its ordinary level, becauſe the declivity at the mouth will be ſo much greater. Therefore the waters near the mouth, by accelerating, will ſink in their channel, and increaſe the declivity of the canal beyond them. This will accelerate the waters beyond them; and thus a ſtream more rapid than ordinary will be produced along the whole river,

Tide. river, and the waters will ſink below their ordinary level. Thus there will be an ebb below the ordinary ſurface as well as a flood above it, however ſloping that ſurface may be.

Hence it follows, that we cannot tell what is the natural ſurface of the ocean by any obſervations made in a river, even though near its mouth. Yet even in rivers we have regular tides, ſubjected to all the varieties deduced from this theory.

We have ſeen that the tide is always proportional to MS. It is greateſt therefore when the moon is in conjunction or oppoſition, being then S s, the ſum of the ſeparate tides produced by the ſun and moon. It gradually decreaſes as the moon approaches to quadrature; and when ſhe is at Q or q, it is SO, or the difference of the ſeparate tides. Suppoſing S s divided into 1000 equal parts, the length of MS is expreſſed in theſe parts in the fourth column of the foregoing table, and their differences are expreſſed in the fifth column.

We may here obſerve, that the variations of the tides in equal ſmall times are proportional to the ſine of twice the diſtance of the place of high water from the moon. For ſince M n is a conſtant quantity, on the ſuppoſition of the moon's uniform motion, M v is proportional to the variation of MS. Now M n : M v=MC : CI=1 : ſin. 2 y, and M n and MC are conſtant quantities.

Thus we have ſeen with what eaſe the geometrical conſtruction of this problem not only explains all the intereſting circumſtances of the tides, but alſo points them out, almoſt without employing the judgment, and exhibits to the eye the gradual progreſs of each phenomenon. In theſe reſpects it has great advantages over the very elegant algebraic analyſis of Mr Bernoulli. In that proceſs we advance almoſt without ideas, and obtain our ſolutions as detached facts, without perceiving their regular ſeries. This is the uſual pre-eminence of geometrical analyſis; and we regret that Mr Bernoulli, who was eminent in this branch, did not rather employ it. We doubt not but that he would have ſhown ſtill more clearly the connection and gradual progreſs of every particular. His aim, however, being to inſtruct thoſe who were to calculate tables of the different affections of the tides, he adhered to the algebraic method. Unfortunately it did not preſent him with the eaſieſt formulæ for practice. But the geometrical conſtruction which we have given ſuggeſts ſeveral formulæ which are exceedingly ſimple, and afford a very ready mode of calculation.

The fundamental problems are to determine the angle s O h or m O h, having m O s given; and to determine MS.

Let the given angle m O s be called a; and, to avoid the ambiguity of algebraic ſigns, let it always be reckoned from the neareſt ſyzigy, ſo that we may always have a equal to the ſum of x and y. Alſo make $d^2=\frac{S^2\times\text{ſin.}^2\,2a}{M^2+S^2+2M\times S\times\text{cof. }2a}$, which repreſents the $\frac{Sc^2}{SM^2}$ of fig. 4. or ſin.^{2} 2 y, and make $p=\frac{S\times\text{ſin. }2a}{M+S\times\text{cof. }2a}$, which is the expreſſion of $\frac{Sc}{Mc}$ of that figure, or of tan. 2 y. Then we ſhall have,

1. Sin. $y=\sqrt{\frac{1-\sqrt{1-d^2}}{2}}$. For we ſhall have cof. Tide. 2 $y=\sqrt{1-d^2}$. But ſin.^{2} $y=\frac{1}{2}-\frac{1}{2}$ cof. 2 y=1$-\frac{\sqrt{1-d^2}}{2}$, and ſin. $y=\sqrt{\frac{1-\sqrt{1-d^2}}{2}}$.

2. Tan. $y=\frac{p}{1+\sqrt{1+p^2}}$. For becauſe p is=tan. 2 y, $\sqrt{1+p^2}$ is the ſecant of 2 y, and $1+\sqrt{1+p^2}$: 1 =p : tan. y.

Theſe proceſſes for obtaining y directly are abundantly ſimple. But it will be much more expeditious and eaſy to content ourſelves with obtaining 2 y by means of the value of its tangent, viz. $\frac{S\cdot\text{ſin. }2a}{M+S\cdot\text{cof. }2a}$. Or, we may find x by means of the ſimilar value of its tangent $\frac{Md}{Sd}$ of fig. 4.

There is ſtill an eaſier method of finding both 2 x and 2 y, as follows.

Make M+S : M—S=tan. a : tan. b. Then b is the difference of x and y, as a is their ſum. For this analogy evidently gives the tangent of half the difference of the angles CSM and CMS of fig. 4. or of 2 x and 2 y. Therefore to a, which is half the ſum of 2 x +2 y, add b, and we have 2 x=a+b, or $x=\frac{a+b}{2}$, and $y=\frac{a-b}{2}$.

By either of theſe methods a table may be readily computed of the value of x or y for every value of a.

But we muſt recollect that the values of S and M are by no means conſtant, but vary in the inverſe triplicate ratio of the earth's diſtance from the ſun and moon; and the ratio of 2 to 5 obtains only when theſe luminaries are at their mean diſtances from the earth. The forces correſponding to the perigean, medium, and apogean diſtances are as follow.

	Sun.	Moon.
Apogean -	1.901	4.258
Medium -	2.	5.
Perigean -	2.105	5.925

Hence we ſee that the ratio of S to M may vary from 1.901 : 5.925 to 2.105 : 4.258, that is, nearly from 1 : 3 to 1 : 2, or from 2 : 6 to 2 : 4. The ſolar force does not vary much, and may be retained as conſtant without any great error. But the change of the moon's force has great effects on the tides both as to their time and their quantity.

I. In reſpect of their Time.

1. The tide day following a ſpring tide is 24 h. 27′ when the moon is in perigee, but 24 h. 33′ when ſhe is in apogee.

2. The tide day following neap tide is 25 h. 15′, and 25 h. 40′ in theſe two ſituations of the moon.

3. The greateſt interval of time between high water and the moon's ſouthing is 39′ and 61′; the angle

Tide. y being 9° 45′ in the first case, and 15° 15′ in the second.

II. In respect of their Heights.

1. If the moon is in perigee when new or full, the spring tide will be 8 feet instead of 7, which corresponds to her mean distance. The very next spring tide happens when she is near her apogee, and will be 6 feet instead of 7. The neap tides happen when she is at her mean distance, and will therefore be 3 feet.

But if the moon be at her mean distance when new or full, the two succeeding spring tides will be regular or 7 feet, and one of the neap tides will be 4 feet and the other only 2 feet.

Mr Bernoulli has given us the following table of the time of high water for these three chief situations of the moon, namely, her perigee, mean distance, and apogee. It may be had by interpolation for all intermediate positions with as great accuracy as can be hoped for in phenomena which are subject to such a complication of disturbances. The first column contains the moon's elongation from the sun. The columns P, M, A, contain the minutes of time which elapse between the moon's southing and high water, according as she is in perigee, at her mean distance, or in apogee. The sign — indicates the priority, and + the posteriority, of high water to the moon's southing.

☽ and ☉	P.	M.	A.
0	0	0	0
	—	—	—
10	9½	11½	14
20	18	22	27½
30	26	31½	39½
40	33	40	50
50	37½	45	56
60	38½	46½	58
70	33½	40½	50½
80	22	25	31
90	0	0	0
	+	+	+
100	21	25	31
110	33½	40½	50½
120	38½	46½	58
130	37½	45	56
140	33	40	50
150	26	31½	39½
160	18	22	27½
170	9½	11½	14
180	0	0	0

The reader will undoubtedly be making some comparison in his own mind of the deductions from this theory with the actual state of things. He will find some considerable resemblances; but he will also find such great differences as will make him very doubtful of its justness. In very few places does the high water happen within three-fourths of an hour of the moon's southing, as the theory leads him to expect; and in no place whatever does the spring tide fall on the day of new and full moon, nor the neap tide on the day of her quadrature. These always happen two or three days later. By comparing the difference of high water and the moon's southing in different places, he will hardly find any connecting principle. This shows evidently that the cause of this irregularity is local, and that the justness of the theory is not affected by it. By considering the phenomena in a navigable river, he will learn the real cause of the deviation. A flood tide arrives at the mouth of a river. The true theoretical tide differs in no respect from a wave. Suppose a spring tide actually formed on a fluid sphere, and the sun and moon then annihilated. The elevation must sink, pressing the under waters aside, and causing them to rise where they were depressed. The motion will not stop when the surface comes to a level; for the waters arrived at that position with a motion continually accelerated. They will therefore pass this position as a pendulum passes the perpendicular, and will rise as far on the other side, forming a high water where it was low water, and a low water where it was high water; and this would go on for ever, oscillating in a time which mathematicians can determine, if it were not for the viscidity, or something like friction, of the waters. If the sphere is not fluid to the centre, the motion of this wave will be different. The elevated waters cannot sink without diffusing themselves sidewise, and occasioning a great horizontal motion, in order to fill up the hollow at the place of low water. This motion will be greatest about half way between the places of high and low water. The shallower we suppose the ocean, the greater must this horizontal motion be. The resistance of the bottom (though perfectly smooth and even) will greatly retard it all the way to the surface. Still, however, it will move till all be level, and will even move a little farther, and produce a small flood and ebb where the ebb and flood had been. Then a contrary motion will obtain; and after a few oscillations, which can be calculated, it will be insensible. If the bottom of the ocean (which we still suppose to cover the whole earth) be uneven, with long extended valleys running in various directions, and with elevations reaching near the surface, it is evident that this must occasion great irregularities in the motion of the undermost waters, both in respect of velocity and direction, and even occasion small inequalities on the surface, as we see in a river with a rugged bottom and rapid current. The deviations of the under currents will drag with them the contiguous incumbent waters, and thus occasion greater superficial irregularities.

Tide.

Now a flood arriving at the mouth of a river, must act precisely as this great wave does. It must be propagated up the river (or along it, even though perfectly level) in a certain time, and we shall have high water at all the different places in succession. This is distinctly seen in all rivers. It is high water at the mouth of the Thames at three o'clock, and later as we go up the river, till at London bridge we have not high water till three o'clock in the morning, at which time it is again high water at the Nore. But, in the mean time, there has been low water at the Nore, and high water about half way to London; and while the high water is proceeding to London, it is ebbing at this intermediate place, and is low water there when it is high water at London and at the Nore. Did the tide extend as far beyond London as London is from the Nore, we

Tide. should have three high waters with two low waters interpoſed. The moſt remarkable inſtance of this kind is the Maragnon or Amazon river in South America. It appears by the obſervations of Condamine and others, that between Para, at the mouth of the river, and the conflux of the Madera and Maragnon, there are ſeven coexiſtent high waters, with ſix low waters between them. Nothing can more evidently ſhow that the tides in theſe places are nothing but the propagation of a wave. The velocity of its ſuperficial motion, and the diſtance to which it will ſenſibly go, muſt depend on many circumſtances. A deep channel and gentle acclivity will allow it to proceed much farther up the river, and the diſtance between the ſucceſſive ſummits will be greater than when the channel is ſhallow and ſteep. If we apply the ingenious theory of Chevalier Buat delivered in the article RIVER, we may tell both the velocity of the motion and the interval of the ſucceſſive high waters. It may be imitated in artificial canals, and experiments of this kind would be very inſtructive. We have ſaid enough at preſent for our purpoſe of explaining the irregularity of the times of high water in different places, with reſpect to the moon's ſouthing. For we now ſee clearly that ſomething of the ſame kind muſt happen in all great arms of the ſea which are of an oblong ſhape, and communicate by one end with the open ocean. The general tide in this ocean muſt proceed along this channel, and the high water will happen on its ſhores in ſucceſſion. This alſo is diſtinctly ſeen. The tide in the Atlantic ocean produces high water at new and full moon at a later and later hour along the ſouth coaſt of Great Britain in proportion as we proceed from Scilly iſlands to Dover. In the ſame manner it is later and later as we come along the eaſt coaſt from Orkney to Dover. Yet even in this progreſs there are conſiderable irregularities, owing to the ſinuoſities of the ſhores, deep indented bays, prominent capes, and extenſive ridges and valleys in the channel. A ſimilar progreſs is obſerved along the coaſts of Spain and France, the tide advancing gradually from the ſouth, turning round Cape Finiſterre, ranging along the north coaſt of Spain, and along the weſt and north coaſts of France.

The attentive conſideration of theſe facts will not only ſatisfy us with reſpect to this difficulty, but will enable us to trace a principle of connection amidſt all the irregularities that we obſerve.

We now add, that if we note the difference between the time of high water of ſpring tide, as given by theory, for any place, and the *obſerved time* of high water, we ſhall find this interval to be very nearly conſtant through the whole ſeries of tides during a lunation. Suppoſe this interval to be 40 hours. We ſhall find every other phenomenon ſucceed after the ſame interval. And if we ſuppoſe the moon to be in the place where ſhe was 40 hours before, the obſervation will agree pretty well with the theory, as to the ſucceſſion of tides, the length of tide day, the retardations of the tides, and their gradual diminution from ſpring to neap tide. We ſay pretty well; for there ſtill remain ſeveral ſmall irregularities, different in different places, and not following any obſervable law. Theſe are therefore local, and owing to local cauſes. Some of theſe we ſhall afterwards point out. There is alſo a general deviation of the theory from the real ſeries of tides. The neap tides, and thoſe adjoining, happen a little earlier than the corrected theory points out. Thus at Breſt (where more numerous and accurate obſervations have been made than at any other place in Europe), when the moon changes preciſely at noon, it is high water at 3 h. 28′. When the moon enters her ſecond quarter at noon, it is high water at 8 h. 40′, inſtead of 9 h. 48′, which theory aſſigns. Tide

Something ſimilar, and within a very few minutes equal, to this is obſerved in *every* place on the ſea-coaſt. This is therefore ſomething general, and indicates a real defect in the theory.

But this ariſes from the ſame cauſe with the other general deviation, viz. that the greateſt and leaſt tides do not happen on the days of full and half moon, but a certain time after. We ſhall attempt to explain this.

We ſet out with the ſuppoſition, that the water acquired in an inſtant the elevation competent to its equilibrium. But this is not true. No motion is inſtantaneous, however great the force; and every motion and change of motion produced by a ſenſible or finite force increaſes from nothing to a ſenſible quantity by infinitely ſmall degrees. Time elapſes before the body can acquire any ſenſible velocity; and in order to acquire the ſame ſenſible velocity by the action of different forces acting ſimilarly, a time muſt elapſe inverſely proportional to the force. An infinitely ſmall force requires a finite time for communicating even an infinitely ſmall velocity; and a finite force, in an infinitely ſmall time, communicates only an infinitely ſmall velocity; and if there be any kind of motion which changes by inſenſible degrees, it requires a finite force to prevent this change. Thus a bucket of water, hanging by a cord lapped round a light and eaſily moveable cylinder, will run down with a motion uniformly accelerated; but this motion will be prevented by hanging an equal bucket on the other ſide, ſo as to act with a finite force. This force prevents only infinitely ſmall accelerations.

Now let ALKF (fig. 6.) be the ſolid nucleus of the earth, ſurrounded by the ſpherical ocean *b h d g*. Let this be raiſed to a ſpheroid BHDG by the action of the moon at M, or in the direction of the axis CM. If all be at reſt, this ſpheroid may have the form preciſely competent to its equilibrium. But let the nucleus, with its ſpheroidal ocean, have a motion round C in the direction AFKL from weſt to eaſt. When the line of water BA is carried into the ſituation *sq* infinitely near to BA, it is no longer in equilibrio; for *s* is too elevated, and the part now come to B is too much depreſſed. There is a force tending to depreſs the waters at *s*, and to raiſe thoſe now at B; but this force is infinitely ſmall. It cannot therefore reſtore the ſhape competent to equilibrium till a ſenſible time has elapſed; therefore the diſturbing force of the moon cannot keep the ſummit of the ocean in the line MC. The force muſt be of a certain determinate magnitude before it can in an inſtant undo the inſtantaneous effect of the rotation of the waters and keep the ſummit of the ocean in the ſame place. But this effect is poſſible; for the depreſſion at *s* neceſſary for this purpoſe is nearly as the diſtance from B, being a depreſſion, not from a ſtraight line, but from a circle deſcribed with the radius CB. It is therefore an infiniteſimal of the firſt order, and may be reſtored in an inſtant, or the continuation of the depreſſion Fig. 6.

de. preſſion prevented by a certain finite force. Therefore there is ſome diſtance, ſuch as B y, where the diſturbing force of the moon may have the neceſſary intenſity. Therefore the ſpherical ocean, inſtead of being kept continually accumulated at B and D, as the waters turn round, will be kept accumulated at y and y', but at a height ſomewhat ſmaller. It is much in this way that we keep melted pitch or other clammy matter from running off from a bruſh, by continually turning it round, and it hangs protuberant, not from the loweſt point, but from a point beyond it, in the direction of its motion. The facts are very ſimilar. The following experiment will illuſtrate this completely, and is quite a parallel fact. Conceive GDH, the lower half of the ellipſe, to be a ſupple heavy rope or chain hanging from a roller with a handle. The weight of the rope makes it hang in an oblong curve, juſt as the force of the moon raiſes the waters of the ocean. Turn the roller very ſlowly, and the rope, unwinding at one ſide and winding up on the other ſide of the roller, will continue to form the ſame curve: but turn the roller very briſkly in the direction FKL, and the rope will now hang like the curve $u\,y'\,v$, conſiderably advanced from the perpendicular, ſo far, to wit, that the force of gravity may be able in an inſtant to undo the infinitely ſmall elevation produced by the turning.

We are very anxious to have this circumſtance clearly conceived, and its truth firmly eſtabliſhed; becauſe we have obſerved it to puzzle many perſons not unaccuſtomed to ſuch diſcuſſions: we therefore hope that our readers, who have got over the difficulty, will indulge us while we give yet another view of this matter, which leads us to the ſame concluſion.

It is certain that the interval between high and low water is not ſufficient for producing all the accumulation neceſſary for equilibrium in an ocean ſo very ſhallow. The horizontal motion neceſſary for gathering together ſo much water along a ſhallow ſea would be prodigious. Therefore it never attains its full height; and when the waters, already raiſed to a certain degree, have paſſed the ſituation immediately under the moon, they are ſtill under the action of accumulating forces, although theſe forces are now diminiſhed. They will continue riſing, till they have ſo far paſt the moon, that their ſituation ſubjects them to depreſſing forces. If they have acquired this ſituation with an accelerated motion, they will riſe ſtill farther by their inherent motion, till the depreſſing forces have deſtroyed all their acceleration, and then they will begin to ſink again. It is in this way that the nutation of the earth's axis produces the greateſt inclination, not when the inclining forces are greateſt, but three months after. It is thus that the warmeſt time of the day is a conſiderable while after noon, and that the warmeſt ſeaſon is conſiderably after midſummer. The warmth increaſes till the momentary waſte of heat exceeds the momentary ſupply. We conclude by ſaying, that it may be demonſtrated, that, in a ſphere fluid to the centre, the time of high water cannot be leſs, and may be more, than three lunar hours after the moon's ſouthing. As the depth of the ocean diminiſhes, this interval alſo diminiſhes.

It is perhaps impoſſible to aſſign the diſtance B y at which the ſummit of the ocean may be kept while the earth turns round its axis. We can only ſee, that it muſt be leſs when the accumulating force is greater, and therefore leſs in ſpring tides than in neap tides; but the difference may be inſenſible. All this depends on circumſtances which we are little acquainted with: many of theſe circumſtances are local; and the ſituation of the ſummit of the ocean, with reſpect to the moon, may be different in different places. Tide.

Nor have we been able to determine theoretically what will be the height of the ſummit. It will certainly be leſs than the height neceſſary for perfect equilibrium. Daniel Bernoulli ſays, that, after very attentive conſideration, he is convinced that the height at new or full moon will be to the theoretical height as the coſine of the angle BC y to radius, or that the height at y will be $Bb \times \frac{C\alpha}{Cb}$.

The reſult of all this reaſoning is, that we muſt always ſuppoſe the ſummit of the tide is at a certain diſtance eaſtward from the place aſſigned by the theory. Mr Bernoulli concludes, from a very copious compariſon of obſervations at different places, that the place of high water is about 20 degrees to the eaſtward of the place aſſigned by the theory. Therefore the table formerly given will correſpond with obſervation, if the leading column of the moon's elongation from the ſun be altered accordingly. We have inſerted it again in this place, with this alteration, and added three columns for the times of high water. Thus changed it will be of great uſe.

We have now an explanation of the acceleration of the neap tides, which ſhould happen 6 hours later than the ſpring tides. They are in fact tides correſponding to poſitions of the moon, which are 20° more, and not the real ſpring and neap tides. Theſe do not happen till two days after; and if the really greateſt and leaſt tides be obſerved, the leaſt will be found 6 hours later than the firſt.

Elong. of Moon.	High Water before or after Moon's Southing.			Time of High Water.		
	Perigee.	M. Diſt.	Apogee.	Perigee.	M. Diſt.	Apogee.
0	18 after	22 after	27½ after	0.18	0.22	0.27½
10	9½ do.	11½	14	0.49½	0.51½	0.54
20	0 do.	0	0	1.20	1.20	1.20
30	9½ bef.	11½ bef.	14 bef.	1.50½	1.48	1.46
40	18 do.	22	27½	2.22	2.18	2.12
50	26	31½	39½	2.54	2.48	2.40
60	33	40	50	3.27	3.20	3.10
70	37½	45	56	4.02½	3.55	3.44
80	38½	46½	58	4.41½	4.33	4.22
90	33½	40½	50½	5.26½	5.19	5.09
100	22	25	31	6.19	6.15	6.09
110	0	0	0	7.20	7.20	7.20
120	22 after	25 after	31 after	8.21	8.25	8.31
130	33½ after	40½	50½	9.13½	9.20	9.30
140	38½	46½	58	9.58½	10.06	10.18
150	37½	45	56	10.37½	10.45	10.56
160	33	40	50	11.13	11.20	11.30
170	26	31½	29½	11.46	11.51	11.59
180	18	22	27½	0.18	0.22	0.27

This table is general, and exhibits the time of high water,

Tide.

water, and their difference from thoſe of the moon's ſouthing, in the open ſea, from all local obſtructions. If therefore the time of high water in any place on the earth's equator (for we have hitherto conſidered no other) be different from this table (ſuppoſed correct), we muſt attribute the difference to the diſtinguiſhing circumſtances of the ſituation. Thus every place on the equator ſhould have high water on the day that the moon, ſituated at her mean diſtance, changes preciſely at noon, at 22 minutes paſt noon; becauſe the moon paſſes the meridian along with the ſun by ſuppoſition. Therefore, to make uſe of this table, we muſt take the difference between the firſt number of the column, intitled time of high water, from the time of high water at full and change peculiar to any place, and add this to all the numbers of that column. This adapts the table to the given place. Thus, to know the time of high water at Leith, when the moon is 50° eaſt of the ſun, at her mean diſtance from the earth, take 22′ from 4h. 30′, there remains 4.08. Add this to 2h. 48′ and we have 6° 56′ for the hour of high water. The hour of high water at new and full moon for Edinburgh is marked 4h. 30′ in Maſkelyne's tables, but we do not pretend to give it as the exact determination. This would require a ſeries of accurate obſervations.

It is by no means an eaſy matter to aſcertain the time of high water with preciſion. It changes ſo very ſlowly, that we may eaſily miſtake the exact minute. The beſt method is to have a pipe with a ſmall hole near its bottom, and a float with a long graduated rod. The water gets in by the ſmall hole, and raiſes the float, and the ſmallneſs of the hole prevents the ſudden and irregular ſtarts which waves would occaſion. Inſtead of obſerving the moment of high water, obſerve the height of the rod about half an hour before, and wait after high water till the rod comes again to that height. Take the middle between them. The water riſes ſenſibly half an hour before the top of the tide, and quickly changes the height of the rod, ſo that we cannot make a great miſtake in the time.

Mr Bernoulli has made a very careful compariſon of the theory thus corrected, with the great collection of obſervations preſerved in the *Depot de la Marine* at Breſt and Rochefort *; and finds the coincidence very great, and far exceeding any rule which he had ever ſeen. Indeed we have no rules but what are purely empirical, or which ſuppoſe a uniform progreſſion of the tides.

* See Mr Caſſini, *Mem. Acad. Par.* 1734.

The heights of the tides are much more affected by local circumſtances than the regular ſeries of their times. The regular ſpring tide ſhould be to the neap tide in the ſame proportion in all places; but nothing is more different than this proportion. In ſome places the ſpring tide is not double of the neap tide, and in other places it is more than quadruple. This prevented Bernoulli from attempting to fix the proportion of M to S by means of the heights of the tides. Newton had, however, done it by the tides at Briſtol, and made the lunar force almoſt five times greater than the ſolar force. But this was very ill-founded, for the reaſon now given.

Yet Bernoulli ſaw, that in all places the tides gradually decreaſed from the ſyzigies to the quadratures. He therefore preſumed, that they decreaſed by a ſimilar law with the theoretical tides, and has given a very ingenious method of accommodating the theory to any tides which may be obſerved. Let A be the ſpring tide, and B the neap tide in any place. Then form an M and an S from theſe, by making $M = \frac{A+B}{2}$, and $S = \frac{A-B}{2}$; ſo that M+S may be =A, and M−S=B agreeable to the theory. Then with this M and S compoſe the general tide T, agreeable to the conſtruction of the problem. We may be perſuaded that the reſult cannot be far from the truth. The following table is calculated for the three chief diſtances of the moon from the earth.

Elong. D & ☉	Height of the Tide.		
	Moon in Perigee.	Moon in Mean Diſt.	Moon in Apogee.
0	0.99A+0.15B	0.88A+0.12B	0.79A+0.08B
10	1.10A+0.04B	0.97A+0.03B	0.87A+0.02B
20	1.14A+0.00B	1.00A+0.00B	0.90A+0.00B
30	1.10A+0.04B	0.97A+0.03B	0.87A+0.02B
40	0.99A+0.15B	0.88A+0.12B	0.79A+0.08B
50	0.85A+0.32B	0.75A+0.25B	0.68A+0.18B
60	0.67A+0.53B	0.59A+0.41B	0.53A+0.29B
70	0.46A+0.75B	0.41A+0.59B	0.37A+0.41B
80	0.28A+0.96B	0.25A+0.75B	0.23A+0.53B
90	0.13A+1.13B	0.12A+0.88B	0.11A+0.62B
100	0.03A+1.24B	0.03A+0.97B	0.03A+0.68B
110	0.00A+1.28B	0.00A+1.00B	0.00A+0.70B
120	0.03A+1.24B	0.03A+0.97B	0.03A+0.68B
130	0.13A+1.13B	0.12A+0.88B	0.11A+0.62B
140	0.28A+0.96B	0.25A+0.75B	0.23A+0.53B
150	0.46A+0.75B	0.41A+0.59B	0.37A+0.41B
160	0.67A+0.53B	0.59A+0.41B	0.53A+0.29B
170	0.85A+0.32B	0.75A+0.25B	0.68A+0.18B
180	0.99A+0.15B	0.88A+0.12B	0.79A+0.08B

Obſerve that this table is corrected for the retardation ariſing from the inertia of the waters. Thus when the moon is 20 degrees from the ſun, the mean diſtance tide is 1.00A+0.00B, which is the theoretical tide correſponding to conjunction or oppoſition.

We have now given in ſufficient detail the phenomena of the tides along the equator, when the ſun and moon are both in the equator, ſhewing both their times and their magnitude. When we recollect that all the ſections of an oblong ſpheroid by a plane paſſing through an equatorial diameter are ellipſes, and that the compound tide is a combination of two ſuch ſpheroids, we perceive that every ſection of it through the centre, and perpendicular to the plane in which the ſun and moon are ſituated, is alſo an ellipſe, whoſe ſhorter axis is the equatorial diameter of a ſpring tide. This is the greateſt depreſſion in all ſituations of the luminaries; and the points of greateſt depreſſion are the lower poles of every compound tide. When the luminaries are in the equator, theſe lower poles coincide with the poles of the earth. The equator, therefore, of every compound tide is alſo an ellipſe: the whole circumference of which is lower than any other ſection of this tide, and gives the place of low water in every part of the earth. In like manner, the ſection through the four poles, upper and lower, gives the place of high water. Theſe two ſections are terreſtrial meridians or hour circles, when the luminaries are in the equator.

Hence

Hence it follows, that all we have already ſaid as to the times of high and low water may be applied to every place on the ſurface of the earth, when the ſun and moon are in the equator. But the heights of tide will diminiſh as we recede from the equator. The heights muſt be reduced in the proportion of radius to the coſine of the latitude of the place. But in every other ſituation of the ſun and moon all the circumſtances vary exceedingly. It is very true, that the determination of the elevation of the waters in any place whatever is equally eaſy. The difficulty is, to exhibit for that place a connected view of the whole tide, with the hours of flood and ebb, and the difference between high and low water. This is not indeed difficult; but the proceſs by the ordinary rules of ſpherical trigonometry is tedious. When the ſun and moon are not near conjunction or oppoſition, the ſhape of the ocean reſembles a turnip, which is flat and not round in its broadeſt part. Before we can determine with preciſion the different phenomena in connection, we muſt aſcertain the poſition or attitude of this turnip; marking on the ſurface of the earth both its elliptical equators. One of theſe is the plane paſſing through the ſun and moon, and the other is perpendicular to it, and marks the place of low water. And we muſt mark in like manner its firſt meridian, which paſſes through all the four poles, and marks on the ſurface of the earth the place of high water. The poſition of the greateſt ſection of this compound ſpheroid is frequently much inclined to the earth's equator; nay ſometimes it is at right angles to it, when the moon has the ſame right aſcenſion with the ſun, but a different declination. In theſe caſes the ebb tide on the equator is the greateſt poſſible; for the lower poles of the compound ſpheroid are in the equator. Such ſituations occaſion a very complicated calculus. We muſt therefore content ourſelves with a good approximation.

And firſt, with reſpect to the times of high water. It will be ſufficient to conceive the ſun and moon as always in one plane, viz. the ecliptic. The orbits of the ſun and moon are never more inclined than $5\frac{1}{2}$ degrees. This will make very little difference; for when the luminaries are ſo ſituated that the great circle through them is much inclined to the equator, they are then very near to each other, and the form of the ſpheroid is little different from what it would be if they were really in conjunction or oppoſition. It will therefore be ſufficient to conſider the moon in three different ſituations.

1. In the equator. The point of higheſt water is never farther from the moon than 15°, when ſhe is in apogee, and the ſun in perigee. Therefore if a meridian be drawn through the point of higheſt water to the equator, the arch *m h* of fig. 4. will be repreſented on the equator by another arch about $\frac{992}{1000}$ of this by reaſon of the inclination of the equator and ecliptic. Therefore to have the time of high water, multiply the numbers of the columns which expreſs the difference of high water and the moon's ſouthing by $\frac{992}{1000}$, and the products give the real difference.

2. Let the moon be in her greateſt declination. The arch of right aſcenſion correſponding to *m h* will be had by multiplying *m h*, or the time correſponding to it in the table, by $\frac{102}{92}$.

3. When the moon is in a middle ſituation between theſe two extremes, the numbers of the table will give the right aſcenſion correſponding to *m h* without any correction, the diſtance from the equator compenſating for the obliquity of the ecliptic arch *m h*. Tide.

The time of low water is not ſo eaſily found; and we muſt either go through the whole trigonometrical proceſs, or content ourſelves with a leſs perfect approximation. The trigonometrical proceſs is not indeed difficult: we muſt find the poſition of the plane through the ſun and moon. A great circle through the moon perpendicular to this is the line of high water; and another perpendicular circle cutting this at right angles is the circle of low water.

But it will be abundantly exact to conſider the tide as accompanying the moon only.

Let NQSE (fig. 7.) be a ſection of the terraqueous globe, of which N and S are the north and ſouth poles and EOQ the equator. Let the moon be in the direction OM, having the declination BQ. Let D be any place on the earth's ſurface. Draw the parallel LDC of latitude. Let B′F *b′f* be the ocean, formed into a ſpheroid, of which B *b* is the axis and *f* F the equator. Fig. 7.

As the place D is carried along the parallel CDL by the rotation of the earth, it will paſs in ſucceſſion through different depths of the watery ſpheroid. It will have high water when at C and L, and low water when it croſſes the circle *f* OF. Draw the meridian N *d* G, and the great circle B *d b*. The arch GQ, when converted into lunar hours (each about 62 minutes), gives the duration of the flood *d c* and of the ſubſequent ebb *c d*, which happen while the moon is above the horizon: and the arch EG will give the durations of the flood and of the ebb which happen when the moon is below the horizon. It is evident, that theſe two floods and two ebbs have unequal durations. When D is at C it has high water, and the height of the tide is CC′. For, the ſpheroid is ſuppoſed to touch the ſphere on the equator *f* OF, ſo that of CC′ is the difference between high and low water. At L the height of the tide is LL′; and if we deſcribe the circle LN *q*, C *q* is the difference of theſe high waters, or of theſe tides.

Hence it appears, that the two tides of one lunar day may be conſiderably different, and it is proper to diſtinguiſh them by different names. We ſhall call that a *ſuperior tide* which happens when the moon is above the horizon during high water. The other may be called the *inferior tide*. The duration of the ſuperior tide is meaſured by 2GQ, and that of the inferior tide by 2EG; and 4GO meaſures the difference between the whole duration of a ſuperior and of an inferior tide.

From this conſtruction we may learn in general,

1. When the moon has no declination, the durations and alſo the heights of the ſuperior and inferior tides are equal in all parts of the world. For in this caſe the tide equator *f* F coincides with the meridian NOS, and the poles B′*b′* of the watery ſpheroid are on the earth's equator.

2. When the moon has declination, the duration and alſo the height of a ſuperior tide at any place is greater than that of the inferior; or is leſs than it, according as the moon's declination and the latitude of the place are of the ſame or oppoſite names.

This is an important circumſtance. It frequently happens that the inferior tide is found the greateſt when it ſhould be the leaſt; which is particularly the caſe at the Nore. This ſhows, without further reaſoning, that the tide at the Nore is only a branch of the regular tide.

Tide. tide. The regular tide comes in between Scotland and the continent; and after travelling along the coaſt reaches the Thames, while the regular tide is juſt coming in again between Scotland and the continent.

3. If the moon's declination is equal to the colatitude of the place, or exceeds it, there will be only one tide in a lunar day. It will be a ſuperior or an inferior tide, according as the declination of the moon and the latitude of the place are of the ſame or oppoſite kinds. For the equator of the tide cuts the meridian in *f* and F. Therefore a place which moves in the parallel *cf* has high water when at *c*, and 12 lunar hours afterwards has low water when at *f*. And any place *k* which is ſtill nearer to the pole N has high water when at *k*, and 12 lunar hours afterwards has low water at *m*. Therefore, as the moon's declination extends to 30°, all places farther north or ſouth than the latitude 60° will ſometimes have only one tide in a lunar day.

4. The ſine of the arch GO, which meaſures $\frac{1}{4}$th of the difference between the duration of a ſuperior and inferior tide, is = tan. lat. × tan. decl. For in the ſpherical triangle *d*OG

Rad. : cotan. *d*OG = tan. *d*G : ſin. GO, and
Sin. GO = tan. *d*OQ × tan. *d*G, = tan. decl. × tan. lat.

Hence we ſee, that the difference of the durations of the ſuperior and inferior tides of the ſame day increaſe both with the moon's declination and with the latitude of the place.

The different ſituations of the moon and of the place of obſervation affect the heights of the tides no leſs remarkably. When the point D comes under the meridian NBQ in which the moon is ſituated, there is a ſuperior high water, and the height of the tide above the low water of that day is CC′. When D is at L, the height of the inferior tide is LL′. The elevation above the inſcribed ſphere is M × cof.^{2} *y*, *y* being the zenith diſtance of the moon at the place of obſervation. Therefore at high water, which by the theory is in the place directly under the moon, the height of the tide is as the ſquare of the coſine of the moon's zenith or nadir diſtance.

Hence we derive a conſtruction which ſolves all queſtions relating to the height of the tides with great facility, free from all the intricacy and ambiguities of the algebraic analyſis employed by Bernoulli.

With the radius CQ = M (the elevation produced by the moon above the inſcribed ſphere) deſcribe the circle *p*QPE (fig. 8.) to repreſent a meridian, of which P and *p* are the poles, and EQ the equator. Biſect CP in O; and round O deſcribe the circle PBCD. Let M be the place over which the moon is vertical, and Z be the place of obſervation. MQ is the moon's declination, and ZQ is the latitude of the place. Draw MC *m*, ZCN, cutting the ſmall circle in A and B. Draw AGI perpendicular to CP, and draw CI μ, which will cut off an arch E μ = QM. MZ and μN are the moon's zenith and nadir diſtances. Draw the diameter BD, and the perpendiculars IK, GH, and AF. Alſo draw OA, PA, AB, ID.

Fig. 8.

Then DF is the ſuperior tide, DK is the inferior tide, and DH is the arithmetical mean tide.

For the angles BCA, BDA, ſtanding on BA, are equal. Alſo the angles IDB, μCN, are equal, being ſupplements of the angle ICB. Therefore, if BD be made radius, DA and DI are the ſines of the zenith and nadir diſtances of the moon. Tide

But BD : DA = DA : DF. Therefore DF = M × cof.^{2} *y*, = the height Z$\varkappa$ of the ſuperior tide. Alſo DK = M · cof.^{2} *y*′, = the height *n n*′ of the inferior tide.

Alſo, becauſe IA is biſected in G, KF is biſected in H, and $DH = \frac{DK+DF}{2}$, = the medium tide.

Let us trace the relation of the conſequences of the various poſitions of Z and M, as we formerly conſidered the reſults of the various ſituations of the ſun and moon.

Firſt, then, let Z retain its place, and let M gradually approach it from the equator. When M is in the equator, A and I coincide with C, and the three points F, K, and H, coincide in *i*.

As M approaches to Z, A and I approach to B and D; DF increaſes, and DK diminiſhes. The ſuperior or inferior time is greateſt when the moon is in M or in N; and DF is then = M. As the moon paſſes to the northward of the place, the ſuperior and inferior tides both diminiſh till I comes to D; at which time MQ is equal to ZP, and there is no inferior tide. This however cannot happen if $\varkappa$ P is greater than 30°, becauſe the moon never goes farther from the equator. M ſtill going north, we have again a perpendicular from I on BD, but below I, indicating that the inferior tide, now meaſured by DK, belongs to the hemiſpheroid next the moon. Alſo, as M advances from the equator northward, DH diminiſhes continually. Firſt, while H lies between O and B, becauſe G approaches O; and afterwards, when G is above O and H lies between O and D. It is otherwiſe, however, if ZQ is greater than 45″; for then DB is inclined to EQ the other way, and DH increaſes as the point G riſes.

In the next place, let M retain its poſition, and Z proceed along the meridian.

Let us begin at the equator, or ſuppoſe Q the place of obſervation. BD then coincides with CP, and the three lines DF, DK, and DH, all coincide with PG, denoting the two equal tides Q*q* and E*e* and their medium, equal to either. As Z goes northward from Q, BOD detaches itſelf from COP; the line DF increaſes, while DK and DH diminiſh. When Z has come to M, F and B coincide with A, and DK and DH are ſtill more diminiſhed. When Z paſſes M, all the three lines DF, DK, and DH, continue to diminiſh. When Z comes to latitude 45°, DB is parallel to IA and EQ, and the point H coincides with O. This ſituation of Z has the peculiar property that DH (now DO) is the ſame, whatever be the declination of the moon. For IA being always parallel to DB, OK and OF will be equal, and DO will be half of DK and DF, however they may vary. When Z gets ſo far north that ZP is = MQ, the diameter *b d* falls on I; ſo that *d k* vaniſhes, and we have only *d f*. And when Z goes ſtill farther north, *d k* appears on the other ſide of I. When Z arrives at the pole, BD again coincides with PC, D with C, and DF, DK, and DH, coincide with CG.

Theſe variations of the points F, K, and H, indicate the following phenomena.

1. The

TIDE.

PLATE DXXXVI.

Fig. 1.

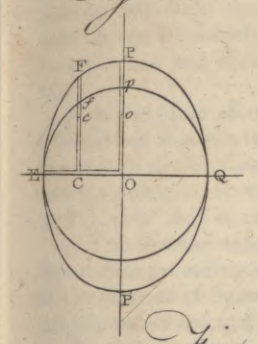


Fig. 2.

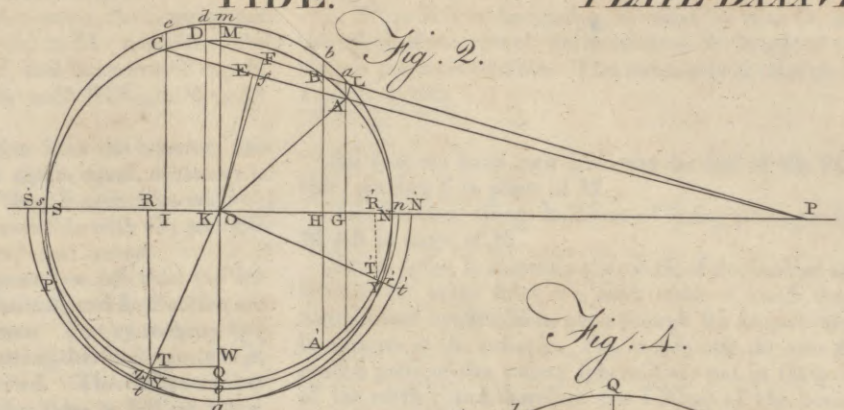


Fig. 3.

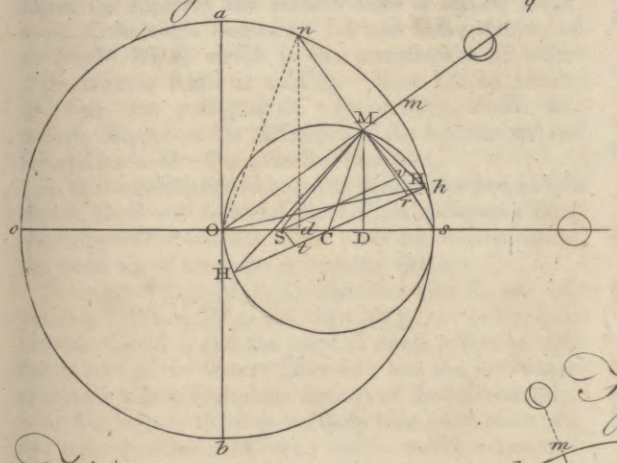


Fig. 4.

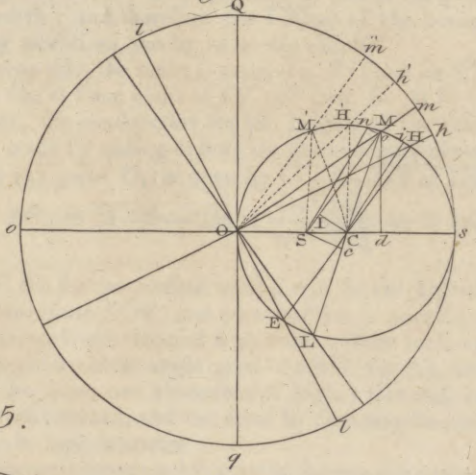


Fig. 5.

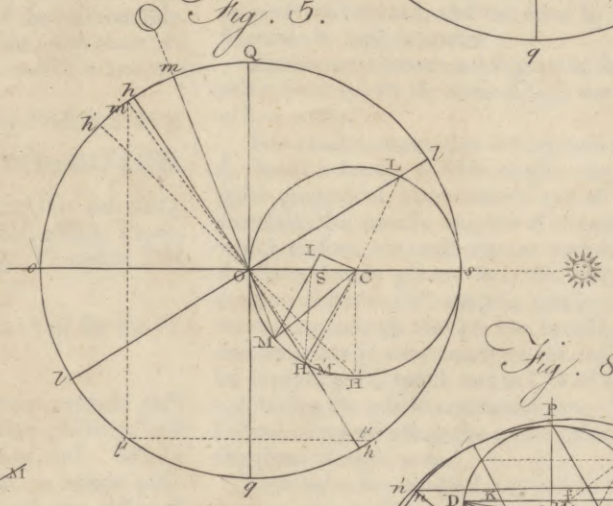


Fig. 6.

Fig. 7.

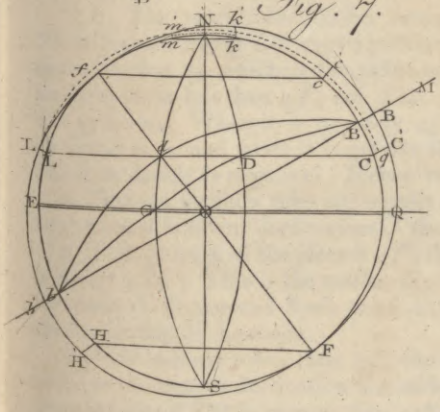
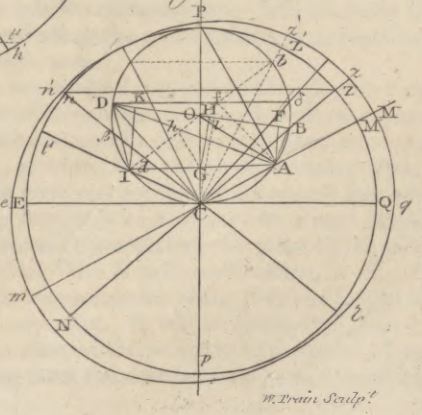


Fig. 8.



W. Prain Sculp.t

1. The greateſt tides happen when the moon is in the zenith or nadir of the place of obſervation: for then the point B coincides with A, and DF becomes DB; that is, = M, indicating the full tide BB′.

2. When the moon is in the equator, the ſuperior and inferior tides have equal heights, = M · cof.² lat. For then A and I coincide with C, and the points F and K coincide in *i*; and D*i* is = DB · cof.² BDC, = M · cof.² lat.

3. If the place of obſervation is in the equator, the inferior and ſuperior tides are again equal, whatever is the moon's declination: For then B coincides with C, and the points F, K, and H, coincide with G; and PG × PC · cof.² APG, = M · cof.² decl. moon.

4. The ſuperior tides are greater or leſs than the inferior tides according as the latitude and declination are of the ſame or of oppoſite names. For by making Q*ζ* = QZ, and drawing *ζ* C *n*, cutting the ſmall circle in *β*, we ſee that the figure is reverſed. The difference between the ſuperior and inferior tides is KF, or IA × coſin. of the angle formed by IA and DB; that is, of the angle BD*β*, which is the complement of twice ZQ; becauſe BOC = 2ZCQ. Now IA is 2GA, = 2OA · ſin. 2MQ = PC · ſin. 2MQ, = M · ſin. 2 decl. Therefore the difference of the ſuperior and inferior tides is M · ſin. 2 declin. ſin. 2 lat.

5. If the colatitude be equal to the declination, or leſs than it, there will be no inferior tide, or no ſuperior tide, according as the latitude of the place and declination of the moon are of the ſame or oppoſite names.

For when PZ = MQ, D coincides with I, and IK vaniſhes. When PZ is leſs than MQ, the point D is between C and I, and the point Z never paſſes through the equator of the watery ſpheroid; and the low water of its only tide is really the ſummit of the inferior tide.

6. At the pole there is no daily tide: but there are two monthly tides = M · ſin.² declin. and it is low water when the moon is in the equator.

7. The medium tide, repreſented by DH, is $= M \times \frac{1 + \text{cof. 2 lat.} \times \text{cof. 2 declin.}}{2}$. For DH = DO + OH. Now OH is equal to OG × cof. GOH = OG · cof. 2ZQ. And OG = OA · cof. GOA, = OA · cof. 2MQ. Therefore OH = OA · cof. 2ZQ · cof. 2MQ. Therefore DH = OA + OA · cof. 2ZQ · cof. 2MQ = $M \times \frac{1 + \text{cof. 2ZQ} \cdot \text{cof. 2MQ}}{2}$. Let this for the future be called *m*.

N. B. The moon's declination never exceeds 30°. Therefore cof. 2MQ is always a poſitive quantity, and never leſs than $\frac{1}{2}$, which is the coſine of 60°. While the latitude is leſs than 45°, cof. 2 lat. is alſo a poſitive quantity. When it is preciſely 45°, the coſine of its double is *o*; and when it is greater than 45, the coſine of its double is negative. Hence we ſee,

1. That the medium tides are equally affected by the northern and ſouthern declinations of the moon.

2. If the latitude of the place is 45°, the medium tide is always $\frac{1}{2}$ M. This is the reaſon why the tides along the coaſts of France and Spain are ſo little affected by the declination of the moon.

3. If the latitude is leſs than 45°, the mean tides increaſe as the moon's declination diminiſhes. The contrary happens if ZQ is greater than 45°. For DH increaſes or diminiſhes while the point G ſeparates from C according as the angle COD is greater or leſs than COB; that is, according as PCZ is greater or leſs than ZCQ. Tide.

4. When Z is in the equator, H coincides with G, and the effect of the moon's declination on the height of the tides is the moſt ſenſible. The mean tide is then = M $\frac{1 + \text{cof. 2MQ}}{2}$.

All that we have now ſaid may be ſaid of the ſolar tide, putting S in place of M.

Alſo the ſame things hold true of ſpring tides, putting M + S in place of M.

But in order to aſcertain the effects of declination and latitude on other tides, we muſt make a much more complicated conſtruction, even though we ſuppoſe both luminaries in the ecliptic. For in this caſe the two depreſſed poles of the watery ſpheroid are not in the poles of the earth; and therefore the ſections of the ocean, made by meridians, are by no means ellipſes.

In a neap tide, the moon is vertical at B (fig. 7. or 8.), and the ſun at ſome point of *f* F, 90° from B. If O be this point, the conſtruction for the heights of the tides may be made by adding to both the ſuperior and inferior tides for any point D, the quantity $\overline{\text{M + S — D′F or DK}} \times \text{ſin.}^2\, d\text{O} = \overline{\text{M + S — tide}} \times \frac{\text{ſin.}^2\, 2\text{Q}}{\text{cof.}^2\, \text{MQ}}$, as is evident. Fig. 7. or 8.

But if the ſun be vertical at *d*, *d* will be the higheſt part of the circle *f* OF, and no correction is neceſſary. But in this caſe the circle of high water will be inclined to the meridian in an angle equal to *d* BO (fig. 7.), and neither the times nor elevations of high water will be properly aſcertained, and the error in time may be conſiderable in high latitudes.

The inaccuracies are not ſo great in intermediate tides, and reſpect chiefly the time of high water and the height of low water.

The exact computation is very tedious and peculiar, ſo that it is hardly poſſible to give any account of a regular progreſs of phenomena; and all we can do is, to aſcertain the preciſe heights of detached points. For which reaſons, we muſt content ourſelves with the conſtruction already given. It is the exact geometrical expreſſion of Bernoulli's analyſis, and its conſequences now related contain all that he has inveſtigated. We may accommodate it very nearly to the real ſtate of things, by ſuppoſing PC equal, not to CO of fig. 4. but to MS, exhibiting the whole compound tide. And the point B, inſtead of repreſenting the moon's place, muſt repreſent the place of high water.

Thus have we obtained a general, though not very accurate, view of the phenomena which muſt take place in different latitudes and in different declinations of the ſun and moon, provided that the phyſical theory which determines the form and poſition of the watery ſpheroid be juſt. We have only to compute, by a very ſimple proceſs of ſpherical trigonometry, the place of the pole of this ſpheroid. The ſecond conſtruction, in fig. 8. ſhows us all the circumſtances of the time and height of high water at any point. It will be recollected, that in computing this place of the pole, the anticipation of 20 degrees, ariſing from the inertia of the waters, muſt be attended to.

Tide.

Were we to inſtitute a compariſon of this theory with obſervation, without farther conſideration, we ſhould ſtill find it unfavourable, partly in reſpect of the heights of the tides, and more remarkably in reſpect of the time of low water. We muſt again conſider the effects of the inertia of the waters, and recollect, that a regular theoretical tide differs very little in its progreſs from the motion of a wave. Even along the free ocean, its motion much reſembles that of any other wave. All waves are propagated by an oſcillatory motion of the waters, preciſely ſimilar to that of a pendulum. It is well known, that if a pendulum receive a ſmall impulſe in the time of every deſcent, its vibrations may be increaſed to infinity. Did the ſucceſſive actions of the ſun or moon juſt keep time with the natural propagation of the tides, or the natural oſcillations of the waters, the tides would alſo augment to infinity: But there is an infinite odds againſt this exact adjuſtment. It is much more probable that the action of to-day interrupts or checks the oſcillation produced by yeſterday's action, and that the motion which we perceive in this day's tide is what remains, and is compounded with the action of to-day. This being the caſe, we ſhould expect that the nature of any tide will depend much on the nature of the preceding tide. Therefore we ſhould expect that the ſuperior and inferior tides of the ſame day will be more nearly equal than the theory determines. The whole courſe of obſervation confirms this. In latitude 45°, the ſuperior and inferior tides of one day may differ in the proportion of $2\frac{1}{2}$ to 1, and the tides correſponding to the greateſt and leaſt declinations of the moon may differ nearly as much. But the difference of the ſuperior and inferior tides, as they occur in the liſt of Obſervations at Rochefort, is not the third part of this, and the changes made by the moon's declination is not above one-half. Therefore we ſhall come much nearer the true meaſure of a ſpring tide, by taking the arithmetical mean, than by taking either the ſuperior or inferior.

We ſhould expect leſs deviation from the theory in the gradual diminution of the tides from ſpring tide to neap tide, and in the gradual changes of the medium tide by the declination of the moon; becauſe the ſucceſſive changes are very ſmall; and when they change in kind, that is, diminiſh after having for ſome time augmented, the change is by inſenſible degrees. This is moſt accurately confirmed by obſervation. The vaſt collection made by Caſſini of the Obſervations at Breſt being examined by Bernoulli, and the medium of the two tides in one day being taken for the tide of that day, he found ſuch an agreement between the progreſſion of theſe medium tides and the progreſſion of the lines MS of fig. 4. that the one ſeemed to be calculated by the other. He found no leſs agreement in the changes of the medium tides by the moon's declination.

In like manner, the changes produced by the different diſtances of the moon from the earth, were found abundantly conformable to the theory, although not ſo exact as the other. This difference or inferiority is eaſily accounted for: When the moon changes in her mean diſtance, one of the neap tides is uncommonly ſmall, and therefore the ſucceſſive diminutions are very great, and one tide ſenſibly affects another. The ſame circumſtance operates when ſhe changes in apogee, by reaſon of a very large ſpring tide. And the changes correſponding both to the ſun's diſtance from the earth and his declination agreed almoſt exactly. Tide.

All theſe things conſidered together, we have abundant reaſon to conclude, that not only the theory itſelf is juſt in principle (a thing which no intelligent naturaliſt can doubt), but alſo that the data which are aſſumed in the application are properly choſen; that is, that the proportion of two to five is very nearly the true proportion of the mean ſolar and lunar forces. If we now compute the medium tide for any place in ſucceſſion, from ſpring tide to neap tide, and ſtill more, if we compute the ſeries of times of their occurrence, we ſhall find as great an agreement as can be deſired. Not but that there are many irregularities; but theſe are evidently ſo anomalous, that we can aſcribe them to nothing but circumſtances which are purely local.

This general rule of computation muſt be formed in the following manner:

The ſpring tide, according to theory, being called A, and the neap tide B, recollect that the ſpring tide, according to the regular theory, is meaſured by M + S. Recollect alſo, that when the lunar tide only is conſidered the ſuperior ſpring tide is $M \times \text{ſin.}^2$, ZM (fig. 8.). But when we conſider the action of two adjoining tides on each other, we find it ſafer to take the medium of the ſuperior and inferior tides for the meaſure; and this is $M \times \frac{1 + \text{cof.}^2\, 2ZQ \times \text{cof. } 2MQ}{2}$. Let this be called *m*. This being totally the effect of M as modified by latitude and declination, may be taken as its proper meaſure, by which we are to calculate the other tides of the monthly ſeries from ſpring tide to neap tide.

In like manner, we muſt compute a value for S, as modified by declination and latitude; call this *s*. Then ſay,

$$M + S : A = m + s : A \times \frac{m+s}{M+S}.$$

This fourth proportional will give the ſpring tide as modified for the given declination of the luminaries, and the latitude of the place.

Now recollect, that the medium tide, when the luminaries are in the equator, is $A \times \text{cof.}^2$ lat. Therefore let F be the ſpring tide *obſerved* at any place when the luminaries are in the equator; and let this be the medium of a great many obſervations made in theſe circumſtances. This gives $A \cdot \text{cof.}^2$ lat. (as modified by the peculiar circumſtances of the place) = F. Therefore the fourth proportional now given changes to $F \times \frac{m+s}{M+S \cdot \text{cof.}^2 \text{lat.}}$. And a ſimilar ſubſtitute for B is $G \times \frac{m-s}{M-S \cdot \text{cof.}^2 \text{lat.}}$.

Laſtly, To accommodate our formulæ to every diſtance of the earth from the ſun and moon, let D and Δ be the mean diſtances of the ſun and moon, and *d* and ∂ their diſtances at the given time; and then the two ſubſtitutes become

$$\frac{\Delta^3 d^3 M + \partial^3 D^3 S}{d^3 \partial^3 (M+S)} \times F \times \frac{m+s}{(M+S)\,\text{cof.}^2 \text{lat.}}.$$

$$\frac{\Delta^3 a^3 M - \partial^3 D^3 S}{d^3 \partial^3 (M-S)} \times G \times \frac{m+s}{(M-S)\,\text{cof.}^2 \text{lat.}}.$$

The

Tide. The half ſum of theſe two quantities will be the MC, and their half difference will be the SC, of fig. 4. with which we may now operate, in order to find the tide for any other day of the menſtrual ſeries, by means of the elongation a of the moon from the ſun; that is, we muſt ſay MC+CS : MC—CS = tan. a : tan. b; then $x = \frac{a+b}{2}$, and $y = \frac{a-b}{2}$. And MS, the height of the tide, is MC × cof. $2y$ + CS × cof. $2x$.

Such is the general theory of the tides, deduced from the principle of univerſal gravitation, and adjuſted to that proportion of the ſolar and lunar forces which is moſt conſiſtent with other celeſtial phenomena. The compariſon of the greateſt and leaſt daily retardations of the tides was with great judgment preferred to the proportion of ſpring and neap tides, ſelected by Sir Iſaac Newton for this purpoſe. This proportion muſt depend on many local circumſtances. When a wave or tide comes to the mouths of two rivers, and ſends a tide up each, and another tide of half the magnitude comes a fortnight after; the proportion of tides ſent up to any given places of theſe rivers may be extremely different. Nay, the proportion of tides ſent up to two diſtant places of the ſame river can hardly be the ſame; nor are they the ſame in any river that we know. It can be demonſtrated, in the ſtricteſt manner, that the farther we go up the river, where the declivity is greater, the neap tide will be ſmaller in proportion to the ſpring tide. But it does not appear that the time of ſucceſſion of the different tides will be much affected by local circumſtances. The tide of the ſecond day of the moon being very little leſs than that of the firſt, will be nearly as much retarded, and the intervals between their arrivals cannot be very different from the real intervals of the undiſturbed tides; accordingly, the ſucceſſion of the higheſt to the higheſt but one is found to be the ſame in all places, when not diſturbed by *different* winds. In like manner, the ſucceſſion of the loweſt and the loweſt but one is found equally invariable; and the higheſt and the loweſt tides obſerved in any place *muſt* be accounted the ſpring and neap tides of that place, whether they happen on the day of full and half moon or not. Nay, we can ſee here the explanation of a general deviation of the theory which we formerly noticed. A low tide, being leſs able to overcome obſtructions, will be ſooner ſtopped, and the neap tides ſhould happen a little earlier than by the undiſturbed theory.

With all theſe corrections, the theory now delivered will be found to correſpond with obſervation, with all the exactneſs that we can reaſonably expect. We had an opportunity of comparing it with the phenomena in a place where they are very ſingular, viz. in the harbour of Biſſeſtedt in Iceland. The equator of the watery ſpheroid frequently paſſes through the neighbourhood of this place, in a variety of poſitions with reſpect to its parallel of diurnal revolution, and the differences of ſuperior and inferior tides are moſt remarkable and various. We found a wonderful conformity to the moſt diverſified circumſtances of the theory.

There is a period of 18 years, reſpecting the tides in Iceland, taken notice of by the ancient Saxons; but it is not diſtinctly deſcribed. Now this is the period of the moon's nodes, and of the greateſt and leaſt inclination of her orbit to the equator. It is therefore the period of the poſitions of the equator of the tides which ranges round this iſland, and very ſenſibly affects them. Tide.

Hitherto we have ſuppoſed the tides to be formed on an ocean completely covering the earth. Let us ſee how thoſe may be determined which happen in a ſmall and confined ſea, ſuch as the Caſpian or the Black ſea. The determination in this caſe is very ſimple. As no ſupply of water is ſuppoſed to come into the baſon, it is ſuſceptible of a tide only by ſinking at one end and riſing at the other. This may be illuſtrated by fig. 6. where C s, C y, are two perpendicular planes bounding a ſmall portion of the natural ocean. The water will ſink at z and riſe at x, and form a ſurface $o\,t\,r$ parallel to the equilibrated ſurface $y\,s$. It is evident that there will be high water, or the greateſt poſſible riſe, at r, when the baſon comes to that poſition where the tangent is moſt of all inclined to the diameter. This will be when the angle t CB is 45° nearly, and therefore three lunar hours after the moon's ſouthing; at the ſame time, it will be low water at the other end. It is plain that the riſe and fall muſt be exceedingly ſmall, and that there will be no change in the middle. The tides of this kind in the Caſpian ſea, in latitude 45°, whoſe extent in longitude does not exceed eight degrees, are not above ſeven inches; a quantity ſo ſmall, that a ſlight breeze of wind is ſufficient to check it, and even to produce a riſe of the waters in the oppoſite direction. We have not met with any accounts of a tide being obſerved in this ſea.

It ſhould be much greater, though ſtill very ſmall, in the Mediterranean ſea. Accordingly, tides are obſerved there, but ſtill more remarkably in the Adriatic, for a reaſon which will be given by and by. We do not know that tides have been obſerved in the great lakes of North America. Theſe tides, though ſmall, ſhould be very regular.

Should there be another great baſon in the neighbourhood of $z\,x$, lying eaſt or weſt of it, we ſhould obſerve a curious phenomenon. It would be low water on one ſide of the ſhore z when it is high water on the other ſide of this partition. If the tides in the Euxine and Caſpian ſeas, or in the American lakes which are near each other, could be obſerved, this phenomenon ſhould appear, and would be one of the prettieſt examples of univerſal gravitation that can be conceived. Something like it is to be ſeen at Gibraltar. It is high water on the eaſt ſide of the rock about 10 o'clock at full and change, and it is high water on the weſt ſide, not a mile diſtant, at 12. This difference is perhaps the chief cauſe of the ſingular current which is obſerved in the Straits mouth. There are three currents obſerved at the ſame time, which change their directions every 12 hours. The ſmall tide of the Mediterranean proceeds along the Barbary ſhore, which is very uniform all the way from Egypt, with tolerable regularity. But along the northern ſide, where it is greatly obſtructed by Italy, the iſlands, and the eaſt coaſt of Spain, it ſets very irregularly; and the perceptible high water on the Spaniſh coaſt differs four hours from that of the ſouthern coaſt. Thus it happens, that one tide ranges round Europa point, and another along the ſhore near Ceuta, and there is a third current in the middle different from both. Its general direction is from the

Tide. Atlantic ocean into the Mediterranean ſea, but it ſometimes comes out when the ebb tide in the Atlantic is conſiderable.

Suppoſe the moon over the middle of the Mediterranean. The ſurface of the ſea will be level, and it will be half tide at both ends, and therefore within the Straits of Gibraltar. But without the Straits it is within half an hour of high water. Therefore there will be a current ſetting *in* from the Atlantic. About three and a half hours after, it is high water within and half ebb without. The current now ſets out from the Mediterranean. Three hours later, it is low water without the Straits and half ebb within; therefore the current has been ſetting out all this while. Three hours later, it is half flood without the Straits and low water within, and the current is again ſetting in, &c.

Were the earth fluid to the centre, the only ſenſible motion of the waters would be up and down, like the waves on the open ocean, which are not bruſhed along by ſtrong gales. But the ſhallowneſs of the channel makes a horizontal motion neceſſary, that water may be ſupplied to form the accumulation of the tide. When this is formed on a flat ſhelving coaſt, the water muſt flow in and out, on the flats and ſands, while it riſes and falls. Theſe horizontal motions muſt be greatly modified by the channel or bed along which they move. When the channel contracts along the line of flowing water, the wave, as it moves up the channel, and is checked by the narrowing ſhores, muſt be reflected back, and keep a-top of the waters ſtill flowing in underneath. Thus it may riſe higher in theſe narrow ſeas than in the open ocean. This may ſerve to explain a little the great tides which happen on ſome coaſts, ſuch as the coaſt of Normandy. At St Malo the flood frequently riſes 50 feet. But we cannot give any thing like a full or ſatisfactory account of theſe ſingularities. In the bay of Fundy, and particularly at Annapolis Royal, the water ſometimes riſes above 100 feet. This ſeems quite inexplicable by any force of the ſun and moon, which cannot raiſe the waters of the free ocean more than eight feet. Theſe great floods are unqueſtionably owing to the proper timing of certain oſcillations or currents adjoining, by which they unite, and form one of great force. Such violent motions of water are frequently ſeen on a ſmall ſcale in the motions of brooks and rivers; but we are too little acquainted with hydraulics to explain them with any preciſion.

We have ſeen that there is an oſcillation of waters formed under the ſun and moon; and that in conſequence of the rotation of the earth, the inertia and the want of perfect fluidity of the waters, and obſtructions in the channel, this accumulation never reaches the place where it would finally ſettle if the earth did not turn round its axis. The conſequence of this muſt be a general current of the waters from eaſt to weſt. This may be ſeen in another way. The moon in her orbit round the earth has her gravity to the earth diminiſhed by the ſun's diſturbing force, and therefore moves in an orbit leſs incurvated than ſhe would deſcribe independent of the ſun's action. She therefore employs a longer time. If the moon were ſo near the earth as almoſt to touch it, the ſame thing would happen. Therefore ſuppoſe the moon turning round the earth, almoſt in contact with the equator, with her natural undiſturbed periodic time, and that the earth is revolving round its axis in the ſame time, the moon would remain continually above the ſame ſpot of the earth's ſurface (ſuppoſe the city of Quito), and a ſpectator in another planet would ſee the moon always covering the ſame ſpot. Now let the ſun act. This will not affect the rotation of the earth, becauſe the action on one part is exactly balanced by the action on another. But it will affect the moon. It will move more ſlowly round the earth's centre, and at a greater diſtance. It will be left behind by the city of Quito, which it formerly covered. And as the earth moves round from weſt to eaſt, the moon, moving more ſlowly, will have a motion to the weſt with reſpect to Quito. In like manner, every particle of water has its gravity diminiſhed, and its diurnal motion retarded; and hence ariſes a general motion or current from eaſt to weſt. This is very diſtinctly perceived in the Atlantic and Pacific oceans. It comes round the Cape of Good Hope, ranges along the coaſt of Africa, and then ſets directly over to America, where it meets a ſimilar ſtream which comes in by the north of Europe. Meeting the ſhores of America, it is deflected both to the ſouth along the coaſt of Brazil, and to the north along the North American ſhores, where it forms what is called the *Gulf Stream*, becauſe it comes from the gulf of Mexico. This motion is indeed very ſlow, this being ſufficient for the accumulation of ſeven or eight feet on the deep ocean; but it is not altogether inſenſible. Tid

We may expect differences in the appearances on the weſtern ſhores of Europe and Africa, and on the weſtern ſhore of America, from the appearances on the eaſtern coaſts of America and of Aſia, for the general current obſtructs the waters from the weſtern ſhores, and ſends them to the eaſtern ſhores. Alſo when we compare the wide opening of the northern extremity of the Atlantic ocean with the narrow opening between Kamtſchatka and America, we ſhould expect differences between the appearances on the weſt coaſts of Europe and of America. The obſervations made during the circumnavigations of Captain Cook and others ſhow a remarkable difference. All along the weſt coaſt of North America the inferior tide is very trifling, and frequently is not perceived.

In the very ſame manner, the diſturbing forces of the ſun and moon form a tide in the fluid air which ſurrounds this globe, conſiſting of an elevation and depreſſion, which move gradually from eaſt to weſt. Neither does this tide ever attain that poſition with reſpect to the diſturbing planets which it would do were the earth at reſt on its axis. Hence ariſes a motion of the whole air from eaſt to weſt; and this is the principal cauſe of the trade-winds. They are a little accelerated by being heated, and therefore expanding. They expand more to the weſtward than in the oppoſite direction, becauſe the air expands on that ſide into air which is now cooling and contracting. Theſe winds very evidently follow the ſun's motion, tending more to the ſouth or north as he goes ſouth or north. Were this motion conſiderably affected by the expanſion of heated air, we ſhould find the air rather coming northward and ſouthward from the torrid zone, in conſequence of its expanſion in that climate. We repeat it, it is almoſt ſolely produced by the aerial tide, and is neceſſary for the very formation of this tide. We cannot perceive the accumulation. It cannot affect the barometer, as many

Tide. many think, becauſe, though the air becomes deeper, it becomes deeper only when it is made lighter by the gravitation to the ſun. Inſtead of preſſing more on the ciſtern of the barometer, we imagine that it preſſes leſs; becauſe, like the ocean, it never attains the height to which it tends. It remains always too low for equilibrium, and therefore it ſhould preſs with leſs force on the ciſtern of a barometer.

There is an appearance preciſely ſimilar to this in the planet Jupiter. He is ſurrounded by an atmoſphere which is arranged in zones or belts, probably owing to climate differences of the different latitudes, by which each ſeems to have a different kind of ſky. Something like this will appear to a ſpectator in the moon looking at this earth. The general weather and appearance of the ſky is conſiderably different in the torrid and temperate zones. Jupiter's belts are not of a conſtant ſhape and colour; but there often appear large ſpots or tracts of cloud, which retain their ſhape during ſeveral revolutions of Jupiter round his axis. To judge of his rotation by one of theſe, we ſhould ſay that he turns round in 9.55. There is alſo a brighter ſpot which is frequently ſeen, occupying one certain ſituation on the body of Jupiter. This is ſurely adherent to his body, and is either a bright-coloured country, or perhaps a tract of clouds hovering over ſome volcano. This ſpot turns round in 9.51¼. And thus there is a general current in his atmoſphere from eaſt to weſt.

Both the motion of the air and of the water tend to diminiſh the rotation of the earth round its axis; for they move ſlower than the earth, becauſe they are retarded by the luminaries. They muſt communicate this retardation to the earth, and muſt take from it a quantity of motion preciſely equal to what they want, in order to make up the equilibrated tide. In all probability this retardation is compenſated by other cauſes; for no retardation can be obſerved. This would have altered the length of the year ſince the time of Hipparchus, giving it a ſmaller number of days. We ſee cauſes of compenſation. The continual waſhing down of ſoil from the elevated parts of the earth muſt produce this effect, by communicating to the valley on which it is brought to reſt the exceſs of diurnal velocity which it had on the mountain top.

While we were employed on this article, a book was put into our hands called *Studies of Nature*, by a Mr Saint Pierre. This author ſcouts the Newtonian theory of the tides, as erroneous in principle, and as quite inſufficient for explaining the phenomena; and he aſcribes all phenomena of the tides to the liquefaction of the ices and ſnows of the circumpolar regions, and the greater length of the polar than of the equatorial axis of the earth. He is a man of whom we wiſh to ſpeak with reſpect, for his conſtant attention to final cauſes, and the proof thence reſulting of the wiſdom and goodneſs of God. For this he is entitled to the greater praiſe, that it required no ſmall degree of fortitude to reſiſt the influence of national example, and to retain his piety in the midſt of a people who have drunk the very dregs of the atheiſm of ancient Greece. This is a ſpecies of merit rarely to be met with in a Frenchman of the preſent day; but as a philoſopher, M. de St Pierre can lay claim to no other merit except that of having collected many important facts. The argument which he employs to prove that the earth is a prolate ſpheroid, is a direct demonſtration of the truth of the contrary opinion; and the melting of the ice and ſnows at the poles cannot produce the ſmalleſt motion in the waters. Were there even ten times more ice and ſnow floating on the northern ſea than there is, and were it all to melt in one minute, there would be no flux from it; for it would only fill up the ſpace which it formerly occupied in the water. Of this any perſon will be convinced, who ſhall put a handful of ſnow ſqueezed hard into a jar of water, and note the exact height of the water. Let the ſnow melt, and he will find the water of the ſame height as before. Tide ‖ Tillotſon.

Tide-Waiters, or *Tideſmen*, are inferior officers belonging to the cuſtomhouſe, whoſe employment is to watch or attend upon ſhips until the cuſtoms be paid: they get this name from their going on board ſhips on their arrival in the mouth of the Thames or other ports, and ſo come up with the tide.

TIEND, in *Scots Law*. See TEIND.

TIERCE, or TEIRCE, a meaſure of liquid things, as wine, oil, &c. containing the third part of a pipe, or 42 gallons.

TIERCED, in *Heraldry*, denotes the ſhield to be divided by any part of the partition-lines, as party, coupy, tranchy, or tailly, into three equal parts of different colours or metals.

TIGER. See FELIS, MAMMALIA *Index*.

Tiger-Wolf, the name of the hyæna at the Cape of Good Hope. See CANIS, MAMMALIA *Index*.

TIGRIS, a river of Aſia, which has its ſource near that of the Euphrates in the mountain Tchildir in Turkomania: afterwards it ſeparates Diarbeck from Erzerum, and Khuſiſtan from Irac-Arabia; and uniting with the Euphrates at Gorno, it falls into the gulf of Baſſorah, under the name of *Schat el-Arab*. This river paſſes by Diarbekir, Gezira, Mouſul, Bagdad, Gorno, and Baſſorah.

TILIA, LIME or LINDEN-TREE, a genus of plants belonging to the claſs of polyandria; and in the natural ſyſtem ranging under the *Columniferæ*. See BOTANY *Index*.

TILLEMONT, SEBASTIAN LE NAIN DE. See NAIN.

TILLER *of a SHIP*, a ſtrong piece of wood faſtened in the head of the rudder, and in ſmall ſhips and boats called the *helm*.

TILLOEA, a genus of plants belonging to the claſs of tetrandria; and in the natural ſyſtem ranging under the 13th order, *Succulentæ*. See BOTANY *Index*.

TILLOTSON, JOHN, a celebrated archbiſhop of Canterbury, was the ſon of Robert Tillotſon of Sowerby, in the pariſh of Halifax in Yorkſhire, clothier; and was born there in the year 1630. He ſtudied in Clare-hall, Cambridge; and in 1656 left this college, in order to become tutor to the ſon of Edmund Prideaux, Eſq. of Ford abbey in Devonſhire. He was afterwards curate to Dr Hacket, vicar of Cheſhunt, in Hertfordſhire. In 1663 he was preferred by Sir Thomas Barnardiſton to the rectory of Ketton or Keddington in the county of Suffolk; but was the next year choſen preacher to Lincoln's Inn, when he procured Ketton to be beſtowed on his curate. He was greatly admired in London for his ſermons; and in the ſame year was choſen Tueſday-lecturer at St Lawrence's church, London, where his lectures were frequented by all

Tillotſon || Time.

all the divines of the city, and by many perſons of quality and diſtinction. In 1666, he took the degree of Doctor of Divinity at Cambridge; in 1669, was made prebendary of Canterbury; in 1672, was admitted dean of that cathedral; and three years after, was made a prebendary of St Paul's cathedral, London. In 1679, he became acquainted with Charles earl of Shrewſbury, whom he converted from Popery; and the next year refuſed to ſign the clergy of London's addreſs of thanks to King Charles II. for not agreeing to the bill of excluſion of the duke of York. In 1683, he viſited the unfortunate Lord Ruſſel when under condemnation; and attended him in his laſt moments on the ſcaffold. In 1689, he was inſtalled dean of St Paul's; made clerk of the cloſet to King William and Queen Mary; and appointed one of the commiſſioners to prepare matters to be laid before the convocation, in order to a comprehenſion of all Proteſtants, as well diſſenters as churchmen; but this attempt was fruſtrated by the zeal of thoſe members of that body, who refuſed to admit of any alteration in things confeſſedly indifferent. In 1691, Dr Tillotſon was, notwithſtanding the warmeſt remonſtrances and intreaties on his part, conſecrated archbiſhop of Canterbury, and four days after was ſworn one of the privy council; their majeſties always repoſing an entire confidence in his prudence, moderation, and integrity. In 1694, he was ſeized with a palſy, of which he died in the 65th year of his age. He was interred in the church of St Lawrence Jewry, London, where a handſome monument is erected to his memory. This learned and pious divine, while living, was greatly inveighed againſt by the enemies of the revolution. After his death there was found a bundle of bitter libels which had been publiſhed againſt him, on which he had written with his own hand, "I forgive the authors of theſe books, and pray God that he may alſo forgive them." It is remarkable, that while this truly great man was in a private ſtation, he always laid aſide two-tenths of his income for charitable uſes. One volume in folio of Dr Tillotſon's ſermons was publiſhed in his life-time, and corrected by his own hand; they were tranſlated into French by Barbeyrac. Thoſe which came abroad after his death, from his chaplain Dr Barker, made two volumes in folio, the copy of which was ſold for 2500l. This was the only legacy he left to his family, his extenſive charity having conſumed his yearly revenues as conſtantly as they came to his hands. King William, however, gave two grants to his widow; the firſt of which was an annuity of 400l. during the term of her natural life, and the ſecond of 200l. as an addition to the former annuity. Dr Tillotſon wrote ſome other works beſides his Sermons; and alſo publiſhed Dr Barrow's works, and Dr Wilkins's Treatiſe of the Principles and Duties of Natural Religion, and a volume of that divine's Sermons.

TIMBER, wood fit for building, &c. See TREE, and *STRENGTH of Materials*.

TIMBERS, the ribs of a ſhip, or the incurvated pieces of wood, branching outward from the keel in a vertical direction, ſo as to give ſtrength, figure, and ſolidity, to the whole fabric. See SHIP-BUILDING, book i. chap. ii.

TIME, a ſucceſſion of phenomena in the univerſe, or a mode of duration marked by certain periods or meaſures, chiefly by the motion and revolution of the ſun.

Time || Timon.

The general idea which time gives in every thing to which it is applied, is that of limited duration. Thus we cannot ſay of the Deity, that he exiſts in time; becauſe eternity, which he inhabits, is abſolutely uniform, neither admitting limitation nor ſucceſſion. See METAPHYSICS, N° 209.

TIME, in *Muſic*, is an affection of ſound, by which it is ſaid to be long or ſhort, with regard to its continuance in the ſame tone or degree of tune.

Muſical time is diſtinguiſhed into *common* or *duple* time, and *triple* time.

Double, *duple*, or *common* time, is when the notes are in a duple duration of each other, viz. a ſemibreve equal to two minims, a minim to two crotchets, a crotchet to two quavers, &c.

Common or double time is of two kinds. The firſt when every bar or meaſure is equal to a ſemibreve, or its value in any combination of notes of a leſs quantity. The ſecond is where every bar is equal to a minim, or its value in leſs notes. The movements of this kind of meaſure are various, but there are three common diſtinctions; the firſt *ſlow*, denoted at the beginning of the line by the mark  ; the ſecond *briſk*, marked thus  ; and the third *very briſk*, thus marked  .

Triple time is when the durations of the notes are triple of each other, that is, when the ſemibreve is equal to three minims, the minim to three crotchets, &c. and it is marked T.

TIME-Keepers, or *Inſtruments for meaſuring Time*. See CLOCK, DIAL, WATCH, &c.

Harriſon's TIME-Keeper. See HARRISON and LONGITUDE.

TIMOLEON, a celebrated Corinthian general, who reſtored the Syracuſans to their liberty, and drove the Carthaginians out of Sicily. See SYRACUSE, N° 50—54.

TIMON the *Sceptic*, who is not to be confounded with Timon the *Miſanthrope*, was a Phliaſian, a diſciple of Pyrrho, and lived in the time of Ptolemy Philadelphus. He took ſo little pains to invite diſciples to his ſchool, that it has been ſaid of him, that as the Scythians ſhot flying, Timon gained pupils by running from them. He was fond of rural retirement; and was ſo much addicted to wine, that he had a ſucceſsful conteſt with ſeveral celebrated champions in drinking. Like Lucian, he wrote with ſarcaſtic humour againſt the whole body of philoſophers. The fragments of his ſatirical poem *Silli*, often quoted by the ancients, have been carefully collected by Henry Stephens in his *Poeſis Philoſophica*. Timon lived to the age of 90 years.

TIMON, ſurnamed *Miſanthropos*, or the *Man-hater*, a famous Athenian, who lived about 420 B. C. He was one day aſked, why he loved the young Alcibiades while he deteſted all the reſt of the human race? on which he replied, "It is becauſe I foreſee that he will be the ruin of the Athenians." He carefully avoided all ſorts of company; yet went one day to an aſſembly of the people, and cried with a loud voice, "That he had a fig-tree on which ſeveral perſons had hanged themſelves;

Timon || Timotheus.

themſelves; but as he intended to cut it down, in order to build a houſe on the place where it ſtood, he gave them notice of it, that if any of them had a mind to hang themſelves, they muſt make haſte and do it ſpeedily." He had an epitaph engraved on his tomb, filled with imprecations againſt thoſe who read it. Shakeſpeare has formed a tragedy on his ſtory.

TIMOR, an iſland of Aſia, in the Eaſt Indian ſea, to the ſouth of the Moluccas, and to the eaſt of the iſland of Java, being 150 miles in length, and 37 in breadth. It abounds in ſandal-wood, wax and honey; and the Dutch have a fort here. The inhabitants are Pagans, and are little better than ſavages; and ſome pretend they had not the uſe of fire many years ago.

TIMOTHEUS, one of the moſt celebrated poet-muſicians of antiquity, was born at Miletus, an Ionian city of Caria, 446 years B. C. He was contemporary with Philip of Macedon and Euripides; and not only excelled in lyric and dithyrambic poetry, but in his performance upon the cithara. According to Pauſanias, he perfected that inſtrument by the addition of four new ſtrings to the ſeven which it had before; though Suidas ſays it had nine before, and that Timotheus only added two, the 10th and 11th, to that number. See LYRE.

With reſpect to the number of ſtrings upon the lyre of Timotheus: The account of Pauſanias and Suidas is confirmed in the famous ſenatus-conſultum againſt him, ſtill extant, preſerved at full length in Boethius. Mr Stillingfleet has given an extract from it, in proof of the ſimplicity of the ancient Spartan muſic. The fact is mentioned in Athenæus; and Caſaubon, in his notes upon that author, has inſerted the whole original text from Boethius, with corrections. The following is a faithful tranſlation of this extraordinary Spartan act of parliament. "Whereas Timotheus the Mileſian, coming to our city, has diſhonoured our ancient muſic, and, deſpiſing the lyre of ſeven ſtrings, has, by the introduction of a greater variety of notes, corrupted the ears of our youth; and by the number of his ſtrings, and the novelty of his melody, has given to our muſic an effeminate and artificial dreſs, inſtead of the plain and orderly one in which it has hitherto appeared; rendering melody infamous, by compoſing in the chromatic inſtead of the enharmonic:——————The kings and the ephori have therefore reſolved to paſs cenſure upon Timotheus for theſe things: and, farther, to oblige him to cut all the ſuperfluous ſtrings of his eleven, leaving only the ſeven tones; and to baniſh him from our city; that men may be warned for the future not to introduce into Sparta any unbecoming cuſtom."——

The ſame ſtory, as related in Athenæus, has this additional circumſtance, That when the public executioner was on the point of fulfilling the ſentence, by cutting off the new ſtrings, Timotheus, perceiving a little ſtatue in the ſame place, with a lyre in his hand of as many ſtrings as that which had given the offence, and ſhowing it to the judges, was acquitted.

It appears from Suidas, that the poetical and muſical compoſitions of Timotheus were very numerous, and of various kinds. He attributes to him 19 nomes, or canticles, in hexameters; 36 proems, or preludes; 18 dithyrambics; 21 hymns; the poem in praiſe of Diana; one panegyric; three tragedies, the Perſians, Phinidas, and Laertes; to which muſt be added a fourth, mentioned by ſeveral ancient authors, called *Niobe*, without forgetting the poem on the birth of Bacchus. Stephen of Byzantium makes him author of 18 books of nomes, or airs, for the cithara, to 8000 verſes; and of 1000 Προοιμια, or preludes, for the nomes of the flutes. Timotheus || Tipperary.

Timotheus died in Macedonia, according to Suidas, at the age of 97; though the Marbles, much better authority, ſay at 90; and Stephen of Byzantium fixes his death in the fourth year of the 105th Olympiad, two years before the birth of Alexander the Great; whence it appears, that this Timotheus was not the famous player on the flute ſo much eſteemed by that prince, who was animated to ſuch a degree by his performance as to ſeize his arms; and who employed him, as Athenæus informs us, together with the other great muſicians of his time, at his nuptials. However, by an inattention to dates, and by forgetting that of theſe two muſicians of the ſame name the one was a Mileſian and the other a Theban, they have been hitherto often confounded.

TIMUR-BECK. See TAMERLANE.

TIN, a metallic ſubſtance. See CHEMISTRY and MINERALOGY *Index* for an account of its qualities and ores; and for the method of reducing its ores, ſee ORES, *Reduction of*.

TINCAL, the name by which crude or impure borax is ſometimes known. See BORAX, CHEMISTRY *Index*.

TINCTURE, in *Pharmacy*. See MATERIA MEDICA *Index*.

TINDAL, DR MATTHEW, a famous Engliſh writer, was the ſon of the reverend Mr John Tindal of Beer-Ferres in Devonſhire, and was born about the year 1657. He ſtudied at Lincoln college in Oxford, whence he removed to Exeter, and was afterwards elected fellow of All-Souls. In 1685 he took the degree of doctor of law, and in the reign of James II. declared himſelf a Roman Catholic; but ſoon renounced that religion. After the revolution he publiſhed ſeveral pamphlets in favour of government, the liberty of the preſs, &c. His "Rights of the Chriſtian Church aſſerted," occaſioned his having a violent conteſt with the high-church clergy; and his treatiſe "Chriſtianity as old as the Creation," publiſhed in 1730, made much noiſe, and was anſwered by ſeveral writers, particularly by Dr Conybeare, Mr Forſter, and Dr Leland. Dr Tindal died at London in Auguſt 1733. He left in manuſcript a ſecond volume of his "Chriſtianity as old as the Creation;" the preface to which has been publiſhed. Mr Pope has ſatirized Dr Tindal in his Dunciad.

TINDALE, WILLIAM. See TYNDALE.

TINNING, the covering or lining any thing with melted tin, or tin reduced to a very fine leaf. Looking-glaſſes are foliated or tinned with plates of beaten tin, the whole bigneſs of the glaſs, applied or faſtened thereto by means of quickſilver. See *FOLIATING of Looking Glaſſes*.

TINNITUS AURIUM, a noiſe in the ears like the continued ſound of bells, very common in many diſorders, particularly in nervous fevers.

TIPPERARY, a county of the province of Munſter in Ireland, bounded on the weſt by thoſe of Limerick and Clare, on the eaſt by the county of Kilkenny and Queen's county, on the ſouth by the county of Waterford.

Tipperary || Tirol.

ford, and on the north and north-east by King's-county and the territory of the ancient O'Carols. It extends about 52 miles in length, 27 in breadth, containing 599,500 acres, divided into 12 baronies, containing 169,000 inhabitants. It sends three members to parliament, viz. two for the county, and one for Clonmell. The north part of it is mountainous and cold; but in the south the air is milder, and the soil much more fertile, producing plenty of corn, and good pasture for the numerous herds of cattle and flocks of sheep with which it abounds. The north part is called *Ormond*, and for a long time gave the title of *earl*, and afterwards of *marquis* and *duke*, to the noble family of Butler, descended from a sister of Thomas à Becket archbishop of Canterbury, till, at the accession of George I. the last duke was attainted of high-treason, and died abroad. In that part of the county, the family had great prerogatives and privileges granted them by Edward III. Another district in this county was anciently called the *County of the Holy Cross of Tipperary*, from a famous abbey in it styled *Holy Cross*, on account of a piece of Christ's cross that was said to be preserved there. The remains of the abbey, or rather the spot where it stood, are still held in great veneration.

Gough's edit. of Camden's Britannia.

TIPSTAFF, an officer who attends the judges with a kind of staff tipped with silver, and takes into his charge all prisoners who are committed or turned over at a judge's chambers.

TIPULA, the CRANE-FLY; a genus of insects belonging to the order of *diptera*. See ENTOMOLOGY *Index*.

TIRE, in the sea language, is a row of cannon placed along a ship's side, either above upon deck, or below, distinguished by the epithets of *upper* and *lower tires*.

TIREE, or TIREY, one of the Western islands of Scotland, 10 miles long and from one to two in breadth, contains above 2000 inhabitants, and produces sheep and black cattle, with some grain and kelp. W. Long. 6. 48. N. Lat. 56. 32.

TIROL, or TYROL, a county of Germany in the circle of Austria, under which may be included the territories belonging to the bishops of Brixen, Trent, and Chur, the Teutonic Order, and the prince of Deitrichstein, the Austrian seigniories before the Arlberg, and the Austrian districts in Swabia. It is 150 miles in length, and 120 in breadth, and contains 28 large towns.

The face of the country is very mountainous. Of these mountains, some have their tops always buried in snow; others are covered with woods, abounding with game. Of the lower, some yield plenty of corn, others wine, and woods of chesnut trees. The valleys are exceeding fertile also, and pleasant. In some places considerable quantities of flax are raised, in others there is a good breed of horses and horned cattle; and, among the mountains, abundance of chamois and wild goats. In this country are also found garnets, rubies, amethysts, agates, carnelians, calcedonies, malachites, &c.; nor is it without hot baths, acid waters, salt pits, mines of silver, copper, and lead. The principal river of Tirol is the Inn, which, after traversing the country, and receiving a number of lesser streams into it, enters Bavaria, in which, at Passau, it falls into the Danube. The men here are very tall, robust, and vigorous; the women also are stout, and generally fair; and both sexes have a mixture of the Italian and German in their tempers and characters. As there is little trade or manufacture in the country, except what is occasioned by the mines and salt works, many of the common people are obliged to seek a subsistence elsewhere. A particular kind of salutation is used all over Tirol. When a person comes into a house, he says, "Hail! Jesus Christ:" the answer is, "May Christ be raised, and the Holy Virgin his mother." Then the master of the house takes the visitor by the hand. This salutation is fixed up in print at all the doors, with an advertisement tacked to it, importing, that Pope Clement XI. granted 100 days indulgence, and a plenary absolution, to those who should pronounce the salutation and answer, as often as they did it. The emperor has forts and citadels so advantageously situated on rocks and mountains all over the country, that they command all the valleys, avenues, and passes that lead unto it. The inhabitants, however, to keep them in good humour, are more gently treated, and not so highly taxed as those of the other hereditary countries. As to the states, they are much the same in this country as in the other Austrian territories, except that the peasants here send deputies to the diets. Tirol came to the house of Austria in the year 1363, when Margaret, countess thereof, bequeathed it to her uncles the dukes of Austria. The arms of Tirol are an eagle gules, in a field argent. The counts of Trap are hereditary stewards; the lords of Glosz, chamberlains; the princes of Trautson, marshals; the counts of Wolkenstein, masters of the horse and carvers; the house of Spaur, cup-bearers; the counts of Kungl, sewers and rangers; the counts of Brandis, keepers of the jewels; the house of Welsperg, purveyors and staff-bearers; and the counts of Coalto, falconers. Besides the governor, here are three sovereign colleges, subordinate to the court at Vienna, which sit at Inspruck, and have their different departments. Towards the expences of the military establishment of this country, the proportion is 100,000 florins yearly; but no more than one regiment of foot is generally quartered in it.

Tirol, Titan.

Tirol is divided into six quarters, as they are called; namely, those of the Lower and Upper Innthal, Vintsgow, Etch, Eisack, and Pusterthal.

TITAN, in fabulous history, the son of Cœlus and Terra, and the elder brother of Saturn, suffered the latter to enjoy the crown, on condition that he should bring up none of his male issue, by which means the crown should at length revert to him; but Jupiter being spared by the address of Rhea, Saturn's wife, Titan and his children were so enraged at seeing their hopes frustrated, that they took up arms to revenge the injury; and not only defeated Saturn, but kept him and his wife prisoners till he was delivered by Jupiter, who defeated the Titans; when from the blood of these Titans slain in the battle, proceeded serpents, scorpions, and all venomous reptiles. See SATURN.

Such is the account given by the poets of this family of Grecian and Roman gods. From the fragments of Sanchoniatho, however, and other ancient writers, many learned men have inferred that the Titans were an early race of ambitious heroes, who laid the foundation of that idolatry which quickly overspread the world, and that

Titan. that by assuming the names of the luminaries of heaven they contrived to get themselves every where adored as the *Dii majorum gentium*. That the word *Titan* signifies the sun, there can indeed be very little doubt. Every one knows that such was its signification in the Æolic dialect; and as it is evidently compounded of *Ti*, which, in some oriental tongues, signifies *bright* or *clear*, and *Tan*, which signifies a *country* or the *earth*, it may be safely concluded that *Titan* was the name of the sun before the word was imported into Greece. But the great question among antiquarians is, of what country was that race which, assuming to themselves the names of the heavenly bodies, introduced into the world that species of idolatry which is known by the appellation of *Hero-worship*?

M. Pezron, in a work published many years ago, and entitled *The Antiquities of Nations*, maintains that the Titans were a family of Sacæ or Scythians, who made their first appearance beyond Media and Mount Imaus, in the upper regions of Asia; that they were the descendants of Gomer the son of Japheth and grandson of Noah; and that after conquering a great part of the world, upon entering Upper Phrygia, they quitted their ancient name of Gomerians or Cimmerians, and assumed that of Titans. All this, he says, happened before the birth of Abraham and the foundation of the Assyrian monarchy; and he makes Uranus, their second prince in the order of succession, to have conquered Thrace, Greece, the island of Crete, and a great part of Europe. Uranus was succeeded by Saturn, and Saturn by Jupiter, who flourished, he says, 300 years before Moses, and divided his vast empire between himself, his brother Pluto, and his cousin-german Atlas, who was called *Telamon*. For the truth of this genealogy of the Titans M. Pezron appeals to the most approved Greek historians; but unluckily for his hypothesis, these writers have not a single sentence by which it can be fairly supported. It supposes not only the great antiquity of the Scythians, but likewise their early progress in arts and sciences, contrary to what we have proved in other articles of this work. See SCULPTURE, N° 4 and 5. and SCYTHIA.

Others, taking the fragment of Sanchoniatho's Phenician history for their guide, have supposed the Titans to have been the descendants of Ham. Of this opinion was Bishop Cumberland; and our learned friend Dr Doig, to whom we have been indebted for greater favours, indulged us with the perusal of a manuscript, in which, with erudition and ingenuity struggling for the pre-eminence, he traces that impious family from the profane son of Noah, and shows by what means they spread the idolatrous worship of themselves over the greater part of the ancient world. Cronus, of whose exploits some account has been given elsewhere (see SANCHONIATHO), he holds to be Ham; and tracing the progress of the family from Phœnicia to Cyprus, from Cyprus to Rhodes, thence to Crete, and from Crete to Samothrace, he finds reason to conclude that the branch called *Titans* or *Titanides* flourished about the era of Abraham, with whom, or with his son Isaac, he thinks the Cretan Jupiter must have been contemporary. As they proceeded from countries which were the original seat of civilization to others in which mankind had sunk into the grossest barbarism, it was easy for them to persuade the ignorant inhabitants that they derived the arts of civil life from their parent the sun, and in consequence of their relation to him to assume to themselves divine honours. To ask how they came to think of such gross impiety, is a question as foolish as it would be to ask how Ham their ancestor became so wicked as to entail the curse of God upon himself and his posterity. The origin of evil is involved in difficulties; but leaving all inquiries into it to be prosecuted by the metaphysician and moralist, it is surely more probable that the worship of dead men originated among the descendants of Ham than among those of Shem and Japheth; and that the fragment of Sanchoniatho, when giving an account of the origin of the Titans, the undoubted authors of that worship, is more deserving of credit than the fabulous and comparatively late writers of Greece and Rome. Titan. Tithes.

TITHES, in ecclesiastical law, are defined to be the tenth part of the increase, yearly arising and renewing from the profits of lands, the stock upon lands, and the personal industry of the inhabitants: the first species being usually called *predial*, as of corn, grass, hops, and wood; the second *mixed*, as of wool, milk, pigs, &c. consisting of natural products, but nurtured and preserved in part by the care of man; and of these the tenth must be paid in gross; the third *personal*, as of manual occupations, trades, fisheries, and the like; and of these only the tenth-part of the clear gains and profits is due.

We shall, in this article, consider, 1. The original of the right of tithes. 2. In whom that right at present subsists. 3. Who may be discharged, either totally or in part, from paying them.

1. As to their original, we will not put the title of the clergy to tithes upon any divine right; though such a right certainly commenced, and we believe as certainly ceased, with the Jewish theocracy. Yet an honourable and competent maintenance for the ministers of the gospel is undoubtedly *jure divino*, whatever the particular mode of that maintenance may be. For, besides the positive precepts of the New Testament, natural reason will tell us, that an order of men who are separated from the world, and excluded from other lucrative professions for the sake of the rest of mankind, have a right to be furnished with the necessaries, conveniences, and moderate enjoyments of life, at their expence; for whose benefit they forego the usual means of providing them. Accordingly all municipal laws have provided a liberal and decent maintenance for their national priests or clergy; ours, in particular, have established this of tithes, probably in imitation of the Jewish law: and perhaps, considering the degenerate state of the world in general, it may be more beneficial to the English clergy to found their title on the law of the land, than upon any divine right whatsoever, unacknowledged and unsupported by temporal sanctions. *Blackst. Comment.*

We cannot precisely ascertain the time when tithes were first introduced into this country. Possibly they were contemporary with the planting of Christianity among the Saxons by Augustin the monk, about the end of the sixth century. But the first mention of them which we have met with in any written English law, is a constitutional decree, made in a synod held A. D. 786, wherein the payment of tithes in general is strongly enjoined. This canon or decree, which at first bound not the laity, was effectually confirmed by two

Tithes. kingdoms of the heptarchy, in their parliamentary conventions of eſtates, reſpectively conſiſting of the kings of Mercia and Northumberland, the biſhops, dukes, ſenators, and people. Which was a few years later than the time that Charlemagne eſtabliſhed the payment of them in France, and made that famous diviſion of them into four parts; one to maintain the edifice of the church, the ſecond to ſupport the poor, the third the biſhop, and the fourth the parochial clergy.

The next authentic mention of them is in the *fœdus Edwardi et Guthruni*; or the laws agreed upon between King Guthrun the Dane, and Alfred and his ſon Edward the Elder, ſucceſſive kings of England, about the year 900. This was a kind of treaty between thoſe monarchs, which may be found at large in the Anglo-Saxon laws: wherein it was neceſſary, as Guthrun was a Pagan, to provide for the ſubſiſtence of the Chriſtian clergy under his dominion; and accordingly, we find the payment of tithes not only enjoined, but a penalty added upon non-obſervance: which law is ſeconded by the laws of Athelſtan, about the year 930. And this is as much as can certainly be traced out with regard to their legal original.

2. We are next to conſider the perſons to whom tithes are due. Upon their firſt introduction, though every man was obliged to pay tithes in general, yet he might give them to what prieſts he pleaſed; which were called *arbitrary conſecrations of tithes*; or he might pay them into the hands of the biſhop, who diſtributed among his dioceſan clergy the revenues of the church, which were then in common. But when dioceſes were divided into pariſhes, the tithes of each pariſh were allotted to its own particular miniſter; firſt by common conſent or the appointments of lords of manors, and afterwards by the written law of the land.

Arbitrary conſecrations of tithes took place again afterwards, and were in general uſe till the time of King John. This was probably owing to the intrigues of the regular clergy, or monks of the Benedictine and other orders, under Archbiſhop Dunſtan and his ſucceſſors; who endeavoured to wean the people from paying their dues to the ſecular or parochial clergy (a much more valuable ſet of men than themſelves), and were then in hopes to have drawn, by ſanctimonious pretences to extraordinary purity of life, all eccleſiaſtical profits to the coffers of their own ſocieties. And this will naturally enough account for the number and riches of the monaſteries and religious houſes which were founded in thoſe days, and which were frequently endowed with tithes. For a layman, who was obliged to pay his tithes ſomewhere, might think it good policy to erect an abbey, and there pay them to his own monks, or grant them to ſome abbey already erected; ſince for this donation, which really coſt the patron little or nothing, he might, according to the ſuperſtition of the times, have maſſes for ever ſung for his ſoul. But in proceſs of years, the income of the poor laborious pariſh-prieſts being ſcandalouſly reduced by theſe arbitrary conſecrations of tithes, it was remedied by Pope Innocent III. about the year 1200, in a decretal epiſtle ſent to the archbiſhop of Canterbury, and dated from the palace of Lateran: which has occaſioned Sir Henry Hobart and others to miſtake it for a decree of the council of Lateran, held A. D. 1179, which only prohibited what was called the *infeodation of tithes*, or their being granted to mere laymen; whereas this letter of Pope Innocent to the archbiſhop enjoined the payment of tithes to the parſons of the reſpective pariſhes where every man inhabited, agreeable to what was afterwards directed by the ſame pope in other countries. This epiſtle, ſays Sir Edward Coke, bound not the lay ſubjects of this realm; but being reaſonable and juſt, it was allowed of, and ſo became *lex terræ*. This put an effectual ſtop to all the arbitrary conſecrations of tithes; except ſome footſteps which ſtill continue in thoſe portions of tithes which the parſon of one pariſh hath, though rarely, a right to claim in another: for it is now univerſally held, that tithes are due, of common right, to the parſon of the pariſh, unleſs there be a ſpecial exemption. This parſon of the pariſh may be either the actual incumbent, or elſe the appropriator of the benefice; appropriations being a method of endowing monaſteries, which ſeems to have been deviſed by the regular clergy, by way of ſubſtitution to arbitrary conſecrations of tithes. Tithes.

3. We obſerved that tithes are due of common right to the parſon, unleſs by ſpecial exemption; let us therefore, ſee *thirdly*, who may be exempted from the payment of tithes, and how lands and their occupiers may be exempted or diſcharged from the payment of tithes, either in part or totally; firſt, by a real compoſition; or, ſecondly, by cuſtom or preſcription.

Firſt, A real compoſition is when an agreement is made between the owner of the lands and the parſon or vicar, with the conſent of the ordinary and the patron, that ſuch lands ſhall for the future be diſcharged from payment of tithes, by reaſon of ſome land or other real recompenſe given to the parſon in lieu and ſatisfaction thereof. This was permitted by law, becauſe it was ſuppoſed that the clergy would be no loſers by ſuch compoſition; ſince the conſent of the ordinary, whoſe duty it is to take care of the church in general, and of the patron, whoſe intereſt it is to protect that particular church, were both made neceſſary to render the compoſition effectual: and hence have ariſen all ſuch compoſitions as exiſt at this day by force of the common law. But experience ſhowing that even this caution was ineffectual, and the poſſeſſions of the church being by this and other means every day diminiſhed, the diſabling ſtatute 13 Eliz. c. 10. was made; which prevents among other ſpiritual perſons, all parſons and vicars from making any conveyances of the eſtates of their churches, other than for three lives of 21 years. So that now, by virtue of this ſtatute, no real compoſition made ſince the 13 Eliz. is good for any longer term than three lives or 21 years, though made by conſent of the patron and ordinary: which has indeed effectually demoliſhed this kind of traffic; ſuch compoſitions being now rarely heard of, unleſs by authority of parliament.

Secondly, a diſcharge by cuſtom or preſcription, is where time out of mind ſuch perſons or ſuch lands have been either partially or totally diſcharged from the payment of tithes. And this immemorial uſage is binding upon all parties; as it is in its nature an evidence of univerſal conſent and acquieſcence, and with reaſon ſuppoſes a real compoſition to have been formerly made. This cuſtom or preſcription is either *de modo decimandi*, or *de non decimando*.

A *modus decimandi*, commonly called by the ſimple name of a *modus* only, is where there is by cuſtom a particular

Tithes. particular manner of tithing allowed, different from the general law of taking tithes in kind, which are the actual tenth-part of the annual increaſe. This is ſometimes a pecuniary compenſation, as twopence an acre for the tithe of land: ſometimes it is a compenſation in work and labour, as that the parſon ſhall have only the twelfth cock of hay, and not the tenth, in conſideration of the owner's making it for him: ſometimes, in lieu of a large quantity of crude or imperfect tithe, the parſon ſhall have a leſs quantity when arrived at greater maturity, as a couple of fowls in lieu of tithe-eggs, and the like. Any means, in ſhort, whereby the general law of tithing is altered, and a new method of taking them is introduced, is called a *modus decimandi*, or ſpecial manner of tithing.

A preſcription *de non decimando* is a claim to be entirely diſcharged of tithes, and to pay no compenſation in lieu of them. Thus the king by his prerogative is diſcharged from all tithes. So a vicar ſhall pay no tithes to the rector, nor the rector to the vicar, for *eccleſia decimas non ſolvit eccleſiæ*. But theſe perſonal privileges (not ariſing from or being annexed to the land) are perſonally confined to both the king and the clergy; for their tenant or leſſee ſhall pay tithes, though in their own occupation their lands are not generally tithable. And, generally ſpeaking, it is an eſtabliſhed rule, that in lay hands, *modus de non decimando non valet*. But ſpiritual perſons or corporations, as monaſteries, abbots, biſhops, and the like, were always capable of having their lands totally diſcharged of tithes by various ways: as, 1. By real compoſition. 2. By the pope's bull of exemption. 3. By unity of poſſeſſion; as when the rectory of a pariſh, and lands in the ſame pariſh, both belonged to a religious houſe, thoſe lands were diſcharged of tithes by this unity of poſſeſſion. 4. By preſcription; having never been liable to tithes, by being always in ſpiritual hands. 5. By virtue of their order; as the Knights Templars, Ciſtercians, and others, whoſe lands were privileged by the pope with a diſcharge of tithes. Though, upon the diſſolution of abbeys by Henry VIII. moſt of theſe exemptions from tithes would have fallen with them, and the lands become tithable again, had they not been ſupported and upheld by the ſtatute 31 Henry VIII. c. 13. which enacts, that all perſons who ſhould come to the poſſeſſion of the lands of any abbey then diſſolved, ſhould hold them free and diſcharged of tithes, in as large and ample a manner as the abbeys themſelves formerly held them. And from this original have ſprung all the lands which being in lay hands, do at preſent claim to be tithe-free: for if a man can ſhow his lands to have been ſuch abbey-lands, and alſo immemorially diſcharged of tithes by any of the means before mentioned, this is now a good preſcription *de non decimando*. But he muſt ſhow both theſe requiſites: for abbey-lands, without a ſpecial ground of diſcharge, are not diſcharged of courſe; neither will any preſcription *de non decimando* avail in total diſcharge of tithes, unleſs it relates to ſuch abbey-lands.

It is univerſally acknowledged that the payment of tithes in kind is a great diſcouragement to agriculture. They are inconvenient and vexatious to the huſbandman, and operate as an impolitic tax upon induſtry. The clergyman, too, frequently finds them troubleſome and precarious; his expences in collecting are a conſiderable drawback from their value, and his juſt rights are with difficulty ſecured: he is too often obliged to ſubmit to impoſition, or is embroiled with his pariſhioners in diſputes and litigations, no leſs irkſome to his feelings than prejudicial to his intereſt, and tending to prevent thoſe good effects which his precepts ſhould produce. It is therefore of the utmoſt importance to parochial tranquillity, and even to religion, that ſome juſt and reaſonable ſtandard of compoſition could be fixed. Land has been propoſed, but in the preſent ſtate of the diviſion of property this is impoſſible: and as money is continually changing in its value, it would alſo be a very improper ſtandard, unleſs ſome plan could be formed by which the compoſition could be increaſed as the value of money diminiſhes. A plan of this kind has been publiſhed in the Tranſactions of the Society inſtituted at Bath, vol. iv. which thoſe who are intereſted in this ſubject may conſult for farther information. Tithes || Titian.

TITHING, (*Tithinga*, from the Sax. *Theothunge*, i. e. *Decuriam*), a number or company of ten men, with their families, knit together in a kind of ſociety, and all bound to the king, for the peaceable behaviour of each other. Anciently no man was ſuffered to abide in England above forty days, unleſs he were enrolled in ſome tithing.—One of the principal inhabitants of the tithing was annually appointed to preſide over the reſt, being called the *tithing-man*, the head-borough, and in ſome countries the borſeholder, or borough's ealder, being ſuppoſed the diſcreeteſt man in the borough, town, or tithing. The diſtribution of England into tithings and hundreds is owing to King Alfred. See BORSEHOLDER.

TITIANO VECELLI, or TITIAN, the moſt univerſal genius for painting of all the Lombard-ſchool, the beſt colouriſt of all the moderns, and the moſt eminent for hiſtories, portraits, and landſcapes, was born at Cadore, in the province of Friuli, in the ſtate of Venice, in 1477, or in 1480 according to Vaſari and Sandrart. His parents ſent him at ten years of age to one of his uncles at Venice, who finding that he had an inclination to painting, put him to the ſchool of Giovanni Bellino. *Pilkington's Dictionary of Painters.*

But as ſoon as Titian had ſeen the works of Giorgione, whoſe manner appeared to him abundantly more elegant, and leſs conſtrained than that of Bellino, he determined to quite the ſtyle to which he had ſo long been accuſtomed, and to purſue the other that recommended itſelf to him, by having more force, more relief, more nature, and more truth. Some authors affirm, that he placed himſelf as a diſciple with Giorgione; yet others only ſay, that he cultivated an intimacy with him; but it is undoubtedly certain that he ſtudied with that great maſter; that he learned his method of blending and uniting the colours; and practiſed his manner ſo effectually, that ſeveral of the paintings of Titian were taken for the performances of Giorgione; and then his ſucceſs inſpired that artiſt with an invincible jealouſy of Titian, which broke off their connection for ever after.

The reputation of Titian roſe continually; every new work contributed to extend his fame through all Europe; and he was conſidered as the principal ornament of the age in which he flouriſhed. And yet, Sandrart obſerves that amidſt all his applauſe and conſtant employment at Venice, his income and fortune were inconſiderable;

Titian. and he was more remarkable for the extenſiveneſs of his talents, than for the affluence of his circumſtances. But when his merit was made known to the emperor Chas. V. that monarch knew how to ſet a juſt value on his ſuperior abilities; he enriched him by repeated bounties, allowed him a conſiderable penſion, conferred on him the honour of knighthood, and, what was ſtill more, honoured him with his friendſhip. He painted the portrait of that benefactor ſeveral times; and it is recorded by Sandrart, that one day, while the emperor was ſitting for his picture, a pencil happening to drop from the painter, he ſtooped, took it up, and returned it; obligingly anſwering to the modeſt apology of the artiſt (who bluſhed at the condeſcenſion of ſo great a monarch), that the merit of a Titian was worthy of the attendance of an emperor.

The excellence of Titian was not ſo remarkably apparent in the hiſtorical compoſitions which he painted as in his portraits and landſcapes, which ſeem to be ſuperior to all competition; and even to this day, many of them preſerve their original beauty, being as much the admiration of the preſent age as they have deſervedly been of the ages paſt.—It is obſerved of Titian by moſt writers, that in the different periods of his life he had four different manners; one reſembling his firſt inſtructor Bellino, which was ſomewhat ſtiff; another, in imitation of Giorgione, more bold, and full of force; his third manner was the reſult of experience, knowledge, and judgment, beautifully natural, and finiſhed with exquiſite care, which manner was peculiarly his own; and in thoſe pictures which he painted between the years of approaching old age and his death may be noticed his fourth manner. His portraits were very differently finiſhed in his early, and in his latter time, according to the teſtimony of Sandrart. At firſt he laboured his pictures highly, and gave them a poliſhed beauty and luſtre, ſo as to produce their effect full as well when they were examined cloſely as when viewed at a diſtance; but afterwards, he ſo managed his penciling, that their greateſt force and beauty appeared at a more remote view, and they pleaſed leſs when they were beheld more nearly. So that many of thoſe artiſts who ſtudied to imitate him, being miſled by appearances which they did not ſufficiently conſider, have imagined that Titian executed his work with readineſs and a maſterly rapidity; and concluded that they ſhould imitate his manner moſt effectually by a freedom of hand and a bold pencil: Whereas in reality, Titian took abundance of pains to work up his pictures to ſo high a degree of perfection; and the freedom that appears in the handling was entirely effected by a ſkilful combination of labour and judgment.

It cannot be truly affirmed, that Titian equalled the great maſters of the Roman ſchool in deſign; but he always took care to diſpoſe his figures in ſuch attitudes as ſhowed the moſt beautiful parts of the body. His taſte in deſigning men was not generally ſo correct or elegant as it appeared in his boys and female figures; but his colouring had all the look of real fleſh, his figures breathe. He was not ſo bold as Giorgione, but in tenderneſs and delicacy he proved himſelf much ſuperior to him and all other artiſts. The expreſſion of the paſſions was not his excellence, though even in that reſpect many of his figures merited the juſteſt commendation; but he always gave his figures an air of eaſe and dignity. His landſcapes are univerſally allowed to be unequalled, whether we conſider the forms of his trees, the grand ideas of nature which appear in his ſcenery, or his diſtances which agreeably delude and delight the eye of every obſerver; and they are executed with a light, tender, and mellow pencil. He learned from nature the harmony of colours, and his tints ſeem aſtoniſhing, not only for their force, but their ſweetneſs; and in that reſpect his colouring is accounted the ſtandard of excellence to all profeſſors of the art. Titian || Title.

It would prove almoſt an endleſs taſk to enumerate the variety of works executed by this illuſtrious artiſt, at Rome, Venice, Bologna, and Florence, as well as thoſe which are to be ſeen in other cities of Italy, in England, Spain, Germany, and France; but there are two, which are mentioned as being truly admirable. One is, a Laſt Supper, preſerved in the refectory at the Eſcurial in Spain, which is inimitably fine; the other is at Milan, repreſenting Chriſt crowned with thorns. The principal figure in the latter has an attitude full of grace and dignity more than mortal, and the countenance ſhows a benevolence and humility, combined with dignity and pain, which no pencil but that of Titian could ſo feelingly have deſcribed. It is admirably coloured, and tenderly and delicately penciled; the heads are wonderfully beautiful, the compoſition excellent, and the whole has a charming effect by the chiaro-ſcuro.

He was of ſo happy a conſtitution, that he was never ill till the year 1576, when he died of the plague, at 99 years of age. His diſciples were Paulo Veroneſe, Giacomo Tintoret, Giacomo de Porte Baſſano, and his ſons.

TITLARK. See ALAUDA, ORNITHOLOGY *Index*.

TITLE, an appellation of dignity or rank given to princes and perſons of diſtinction.

Titles were not ſo common among the ancient Greeks or Romans as they are in modern times. Till the reign of Conſtantine the title of *Illuſtrious* was never given except to thoſe who were diſtinguiſhed in arms or letters: But at length it became hereditary in the families of princes, and every ſon of a prince was illuſtrious. The title of *Highneſs* was formerly given only to kings. The kings of England before the reign of Henry VIII. were addreſſed by the title of *your Grace*. That monarch firſt aſſumed the title of *Highneſs*, and afterwards that of *Majeſty*. The title of majeſty was firſt given him by Francis I. in their interview in 1520. Charles V. was the firſt king of Spain who aſſumed the ſame title.

Princes, nobles, and clergy, generally have one title derived from their territories and eſtates, and another derived from their rank or from ſome other remarkable circumſtance. The pope is called the *Biſhop of Rome*, and has the title of *Holineſs*. A cardinal has his name generally from ſome church, and is ſaluted by the name of *Eminent*, or *moſt Eminent*. An archbiſhop, beſides being named from his dioceſe, is called *his Grace* and *moſt Reverend:* a biſhop is alſo diſtinguiſhed by the name of his dioceſe, and has the title of *his Lordſhip* and *right Reverend*. Inferior clergymen are denominated *Reverend*.

The titles of crowned heads derived from their dominions it is unneceſſary to mention. It will be ſufficient to mention thoſe by which they are addreſſed. To an

emperor

Title || Tobacco.

emperor is given the title of *Imperial Majeſty;* to kings, that of *Majeſty;* to the princes of Great Britain, *Royal Highneſs;* to thoſe of Spain, *Infant;* to electors, *Electoral Highneſs;* to the grand duke of Tuſcany, *Moſt Serene Highneſs;* to the other princes of Italy and Germany, *Highneſs;* to the doge of Venice, *Moſt Serene Prince;* to the grand-maſter of Malta, *Eminence;* to nuncios and ambaſſadors of crowned heads, *Excellency;* to dukes, *Grace;* to marquiſes, earls, and barons, *Lordſhip.*

The emperor of China, among his titles, takes that of *Tien Su*, "Son of Heaven." The Orientals, it is obſerved, are exceedingly fond of titles; the ſimple governor of Schiras, for inſtance, after a pompous enumeration of qualities, lordſhips, &c. adds the titles of *Flower of Courteſy*, *Nutmeg of Conſolation*, and *Roſe of Delight.*

TITLE, in *Law*, denotes any right which a perſon has to the poſſeſſion of a thing, or an authentic inſtrument whereby he can prove his right. See the articles RIGHT, PROPERTY, &c.

TITLE to the Crown in the Britiſh Conſtitution. See SUCCESSION.

TITMOUSE. See PARUS, ORNITHOLOGY *Index.*

TITULAR, denotes a perſon inveſted with a title, in virtue of which he holds an office or benefice, whether he performs the functions thereof or not.

TITUS VESPASIANUS, the Roman emperor, the ſon of Veſpaſian; of whom it is related, that not being able to recollect any remarkable good action he had done on a certain day, he exclaimed, "I have loſt a day!" He might truly be called the *father of his people;* and though Rome laboured under various public calamities during his reign, ſuch was his equitable and mild adminiſtration, that he conſtantly preſerved his popularity. He was a great lover of learning, and compoſed ſeveral poems. He reigned but two years; and it is thought Domitian his brother poiſoned him, A. D. 81. aged 41. See (*Hiſtory of*) ROME.

TIVIOT HILLS. See CHEVIOT.

TIVOLI, the modern name of TIBUR.

TOAD. See RANA, ERPETOLOGY *Index.*

TOAD-Fiſh. See LOPHIUS, ICHTHYOLOGY *Index.*

TOAD-Flax. See ANTIRRHINUM, BOTANY *Index.*

TOAD-Stone, an argillaceous ſtone. See GEOLOGY.

TOBACCO. See NICOTIANA, BOTANY *Index*, and SNUFF.

TOBACCO-Pipe-Fiſh. See FISTULARIA, ICHTHYOLOGY *Index.*

TOBACCO-Pipes, Manufacture of. The art of making tobacco-pipes, or, as it is commonly called, *pipe-making*, though one of the ſimpleſt ſpecies of pottery, is ſufficiently curious to merit deſcription in a dictionary of arts and ſciences.

The proceſs of pipe-making may be divided into ſix ſtages; viz. 1. Beating or preparing the clay; 2. Rolling; 3. Moulding; 4. Trimming; 5. Drying; and, 6. Burning.

Preparation of the Clay.—The fine white clay employed by the pipe-makers, is dug from the quarries in maſſes of about a cubic foot each. Before it can be uſed in the manufacture of tobacco-pipes, it muſt be reduced to the conſiſtence of a tough paſte. To effect this, after its outer ſurface has been cleared from dirt or duſt, it is broken into ſmall pieces about as large as a gooſe's egg, and thrown into a tub with ſuch a quantity of ſoft water as experience has ſhewn to be ſufficient to bring it to the proper conſiſtence. After lying till it has ſoaked up all the water, which uſually requires from 12 to 24 hours, it is taken from the tub and laid on a thick ſtrong wooden bench. Here it is beaten by a heavy four-ſquare iron inſtrument, in ſuch a manner as to cut it from one end to the other into very thin ſlices. It requires conſiderable addreſs to perform this operation, and it is ſurpriſing how thin the workmen will ſometimes cut the ſlices, and how equally they will thus divide the clay. This beating is continued, alternately folding up the clay and ſlicing it, till the whole is perfectly ſmooth. It is then ready for rolling.

Tobacco.

Rolling.—The operation of rolling reduces the clay into pieces of a proper ſize and length for making pipes, and almoſt to the proper form. The roller ſits at a bench with a ſmooth board before him, and holds in his hand another ſmooth board about 18 inches long, four broad, and about half an inch thick, having one end rounded off on one ſide, ſo as to produce a correſponding hollow in the clay. He now takes a piece of the beaten clay, and rolls it out, firſt with his hands, and then with the board, till it acquire the form of a long ſlender cylinder, with one end conſiderably larger than the reſt. This large end is to form the bole, and the cylinder the ſhank of the future pipe. The pieces of clay thus formed are laid beſide each other on a flat board, and are now ready for moulding.

Moulding.—This is the moſt complex operation, and requires the greateſt number of inſtruments. The principal of theſe is the mould, which is compoſed of two long pieces of iron, formed ſo as to join together, and having their correſponding ſides cut into the ſhape of half a tobacco pipe, each piece being hollowed ſo as to form half a ſlender cylinder, with a larger cavity at the upper end, and at ſuch an angle as it is intended the bole of the pipe ſhall make with the ſhank. Juſt above that part of each ſide of the mould which ſtands beyond what is intended to form the bole, there is a notch for admitting a knife to cut off the ſuperfluous clay. To receive the united mould there is a vice, having at one end two upright poſts, between which moves a long lever, and to this lever, near the poſts, there is looſely attached a piece of iron ending below in a ſmooth conical head, capable of entering the large opening of the mould, but rather ſmaller than the opening, ſo as that when forced down into it, a ſufficient thickneſs of clay may be left between the cone and the ſides of the mould, to form the bole of the pipe. One ſide of this vice is fixed, and the other moveable, towards the former. The moveable ſide has attached to it an iron ſcrew with a very long lever as its handle, ſo that by turning the ſcrew one way or the other, the moveable ſide of the vice may be forced nearer the fixed ſide, or ſuffered to return to its original poſition.

Beſides theſe principal inſtruments, the moulder requires a ſlender ſteel wire, fixed in a handle at one end, and having its other extremity formed into a very ſmall head; a ſaucer containing wool well impregnated with oil, and a ſmall woollen or cotton bruſh.

When about to mould his pipes, he lays hold of the ſhank of one of the rolled pieces, and with great dexterity, which practice alone can teach, he paſſes up the

Tobacco. oiled wire through its whole length, till he finds it arrived at the commencement of the larger extremity of the clay. This extremity he then bends to the proper angle, and having oiled the inſide of each part of his mould, he lays the piece of clay with the wire in it, into one part of the mould, and covers it with the other. He now puts the mould containing the clay into the vice, and with the left hand turning round the handle of the ſcrew, ſo as to fix the mould firmly within the vice, he, with the right hand, preſſes down the lever with its conical head, and thus forms the cavity of the bole. He now withdraws the mould, cuts off with his knife the ſuperfluous clay from the bole, opens the mould, takes out the pipe, and now only withdraws the wire. He then lays the moulded pipe on a flat board, in the ſame manner as the rolled pieces before deſcribed. The pipes thus moulded require to be trimmed, that is, to have the prominences ariſing from the joining of the mould, and other ſuperfluous pieces of clay taken off, ſo as to render the ſurface ſmooth and round.

Trimming.—The operation of trimming is generally performed by boys and girls, as it requires very little ſkill. The trimmer has before him a ſmooth block of wood, about the length of the pipe, and of conſiderable thickneſs, elevated a little at the remote end. He has alſo a thick piece of ſmooth iron, one edge of which has acroſs it two or more ſemicylindrical grooves, capable of receiving half the ſhank of a pipe. Taking one of the rough moulded pipes, the trimmer carefully paſſes up the hollow of the ſhank, a wire ſimilar to that employed in moulding, and holding the pipe by the bole, while the ſhank lies before him on the wooden block, he pares off with a blunt knife all the excreſcences of clay, both from the ſhank and bole, and rubs the former, while lying on the block, with the grooved part of his iron, ſo as to render it as ſmooth as poſſible. He now cuts off the ragged piece at the extremity of the ſhank, withdraws the wire, and lays the pipe on the drying frame. One great object of the trimmer is, to ſee that the pipe is completely perforated, which he diſcovers by blowing through it; and if he finds the hole choked up, he muſt open it by puſhing the wire as far as poſſible. If this does not ſucceed, he breaks the pipe as uſeleſs.

Drying.—The pipe has now received all the work that can be beſtowed on it by the maker, previous to its being burned; but as the expoſing of it to heat, while ſoft and pliable, would make it crack, it is neceſſary that it be properly dried. For this purpoſe, a frame is prepared, compoſed of three or four long pieces of wood, faſtened to two end pieces in ſuch a manner, as that the middle of the frame ſhall be the loweſt, to give the ſhanks of the pipes that curve which they generally poſſeſs. After being trimmed, the pipes are laid beſide each other in this concave frame, with their boles hanging down over the edges of the frame, and their ſhanks bending within its hollow. In this poſition they are expoſed to the air till they are dry and firm. They are then ready for burning or baking.

Burning.—For burning or baking the pipes, there is to be prepared a kiln of a ſimple but peculiar conſtruction. It is built in the form of a cylinder, cloſe at the bottom and on the ſides, and open at the top. Below the bottom is a grate for receiving the fuel, and round the ſides are conſtructed vertical or ſpiral flues, opening at the top, and communicating below with the grate. The ſides of the furnace on its interior are pretty thin, and are formed of a cement compoſed of clay mixed with freſh cow dung. In the middle of the cavity is placed a pedeſtal compoſed of the ſame materials, for the pipes to lean againſt. When the pipes are ſufficiently dried, they are arranged round this pedeſtal, reſting againſt it, and againſt each other, with their boles next the bottom of the furnace. They are thus placed in ſucceſſive layers, till the furnace be ſufficiently full, when the open ſpace at top is filled up with bricks placed over each other, ſo as to leave interſtices for the free circulation of the air, and of the ſmoke and flame which iſſue through the flues. In theſe interſtices are laid ſeveral pieces of broken dried pipes, to ſerve as pyrometers for aſcertaining the ſtate of the included pipes during the burning. The fire is now lighted, and kept up, till, on examining the pieces of clay laid in the interſtices of the bricks, it is concluded that the pipes within the furnace are ſufficiently baked. The fire is then ſuffered to go out, and the whole to cool till the next day, when the bricks are taken down, the pipes removed, and packed in barrels for ſale. Tobacco Tobago

After being burnt, the pipes are ſometimes glazed, which is done by rubbing them, while warm, with flannel and a little white wax. In ſome places the extremities of the ſhanks are rendered ſmooth by dipping them before burning in the ordinary potters glazing, which prevents that adheſion to the lips ſo unpleaſant in new unglazed pipes.

TOBAGO, one of the Caribbee iſlands, ceded to Great Britain by the treaty of Paris in 1763, taken by the French in 1781, and retaken by the Britiſh in 1793. It lies in the latitude of 11 degrees 10 minutes north, and 59 degrees 40 minutes longitude weſt from London, about 40 leagues ſouth-by-weſt from Barbadoes, 35 ſouth-eaſt from St Vincents, 20 ſouth-eaſt from Grenada, 12 north-eaſt from the Spaniſh iſland of Trinidada, and between 30 and 40 north-eaſt from the Spaniſh main. According to the lateſt accounts, it is ſomewhat more than 30 miles in length from north-eaſt to ſouth-weſt, between 8 and 9 in breadth, and from 23 to 25 leagues in circumference. The Engliſh viſited this iſland very early, Sir Robert Dudley being there in the reign of Queen Elizabeth. In that of Charles I. William earl of Pembroke procured a grant of this, with two other ſmall iſlands; but died before he was able to carry into execution his deſign of ſettling them. In A. D. 1632 ſome merchants of Zealand ſent over a ſmall colony thither, and gave it the name of *New Walcheren*; but before they were able thoroughly to eſtabliſh themſelves, they were deſtroyed by the Indians aſſiſted by the Spaniards. Ten years after, James duke of Courland ſent a colony thither, who ſettled themſelves upon Great Courland bay, and made a conſiderable progreſs in planting. A. D. 1654, Meſſieurs Adrian and Cornelius Lampſius, two opulent merchants of Fluſhing, ſent a conſiderable number of people thither, who ſettled on the other ſide of the iſland, and lived in amity with the Courlanders, until they learned that the king of Sweden had ſeized the perſon of their duke and diſpoſſeſſed him of his dominions, when they attacked and forced his ſubjects to ſubmit. The duke being afterwards reſtored, he obtained from Charles II. a grant of this iſland, dated the 17th of November 1664.

ibago, bolſki. 1664. In the ſecond Dutch war the count d'Eſtrees, by order of his maſter, totally ruined it at the cloſe of the year 1677; and from that time it continued waſte till Britain took poſſeſſion of it after the treaty of Paris. The climate, notwithſtanding its vicinity to the line, is ſo tempered by the breezes from the ſea, as to be very ſupportable even to Europeans; and hath the ſame advantages with that of Grenada, in having regular ſeaſons, and alſo in being exempt from the hurricanes. There are throughout the iſland many riſing grounds, though, except at the north-eaſt extremity, there is no part of it that can be ſtyled mountainous; and even there the country is far from being rugged or impaſſable. The ſoil, if we may credit either Dutch or French writers, is as fertile and luxuriant as any of the iſlands, and very finely diverſified. Ground proviſions of all ſorts have been raiſed in great plenty, a vaſt variety of vegetables, excellent in their kind, ſome for food, ſome for phyſic. Almoſt every ſpecies of uſeful timber is to be found here, and ſome of an enormous ſize; amongſt others, the true cinnamon and nutmeg tree, as the Dutch confeſs, and of which none could be better judges; whole groves of ſaſſafras, and of trees that bear the true gum copal, with other odoriferous plants that render the air wholeſome and pleaſant. It is as well watered as can be wiſhed by rivers that fall into the ſea on both ſides, many ſmaller ſtreams, and fine freſh ſprings in almoſt every part of the iſland. The ſea-coaſt is indented by 10 or 12 fair and ſpacious bays, and there are amongſt theſe one or two ports capable of receiving as large ſhips as ever viſited thoſe ſeas. There are wild hogs in great plenty, abundance of fowls of different kinds, and a vaſt variety of ſea and river fiſh. At the north-eaſt extremity lies little Tobago, which is two miles long, and about half a mile broad, very capable of improvement.

TOBOLSKI, the capital of Siberia, is ſituated at the confluence of the rivers Tobol and Irtiſh, in N. Lat. 58° 12′, E. Long. 68° 18′. The city ſtands upon the aſcent of a high hill, the lower part of which is inhabited by Mahometan Tartars, who carry on a conſiderable traffic upon the river Irtiſh, and convey their merchandiſe quite acroſs Great Tartary, as far as China. The river Irtiſh is reckoned as rapid as the Danube; runs from the ſouth, and empties itſelf into the Oby: the Tobol waſhes the other ſide of the town, and a little below it falls into the Irtiſh. By means of theſe two rivers, there is a conſtant flow of merchandiſe into the city during the ſummer ſeaſon. Tobolſki is therefore a great mart for the commodities of Muſcovy, Tartary, and other countries: and here is a great concourſe of merchants. All ſorts of proviſions are plentiful and cheap. An hundred weight of rice is ſold for 16 copecs, equal to about eightpence ſterling; a ſturgeon weighing 40 pounds, for half that money; an ox for two rix-dollars, and every other article in proportion. The adjacent country abounds with game in great variety. The ſupreme court of judicature for all Siberia is held in this city, which is alſo the ſeat of a metropolitan, ſent hither from Moſcow to exerciſe ſpiritual juriſdiction over the whole kingdom. Tobolſki is well fortified, and defended by a ſtrong garriſon, under the command of the waiwode, who reſides in the place, and takes charge of the fur tribute, which is here depoſited in proper magazines. This governor enjoys a very extenſive command, and can occaſionally bring into the field 9000 men, beſides a ſtrong body of Tartars on horſeback, to make head againſt the Kalmucks and Coſſacks, in their repeated incurſions. A ſufficient number of Ruſſians, called *Jemſkoiks*, are kept in continual pay by the government, on the banks of the Irtiſh, to ſupply travellers on the czar's account with men, boats, or carriages, to convey them as far as Surgut on the Oby, a voyage of 200 leagues by water. This is the common method of travelling in the ſummer; but in winter the journey by land is not half ſo long, being performed in ſleds over the ice and ſnow, with which the country is covered. Theſe ſleds are moved by a pair of dogs, which will draw a load of 300 pounds with ſurpriſing expedition. They are hired at eaſy rates, and during one half of the year may be ſeen flying over the ſnow in great numbers. The city is ſuppoſed to contain 15,000 inhabitants. It is 800 miles eaſt from Moſcow, and 1000 from Peterſburgh. Tobolſki || Tokay Wine.

TODDA PANNA. See CYCAS, BOTANY *Index*.

TODDY, a name given to the juice of the cocoa-nut tree. See ARACK.—Toddy is alſo a name given to a mixture of ſpirits, water, and ſugar.

TODDY-Bird. See LOXIA, ORNITHOLOGY *Index*.

TODUS, the TODY; a genus of birds belonging to the order of picæ. See ORNITHOLOGY *Index*.

TOGA, in Roman antiquity, a wide woollen gown or mantle, which ſeems to have been of a ſemicircular form, without ſleeves; differing both in richneſs and largeneſs, according to the circumſtances of the wearer, and uſed only upon occaſion of appearing in public.

Every body knows that the toga was the diſtinguiſhed mark of a Roman: hence the *jus togæ*, or privilege of a Roman citizen; i. e. the right of wearing a Roman habit, and of taking, as they explain it, fire and water through the Roman empire.

TOKAY WINE, derives its name from a town of Hungary, where it is produced. There are four ſorts of wine made from the ſame grapes, diſtinguiſhed at Tokay by the names of *eſſence*, *auſpruch*, *maſſlach*, and the *common wine*. The eſſence is made by picking out the half-dried and ſhrivelled grapes, and putting them into a perforated veſſel, where they remain as long as any juice runs off by the mere preſſure of their own weight. This is put into ſmall caſks. The auſpruch is made by pouring the expreſſed juice of the grapes from which the former had been picked on thoſe that yielded the eſſence, and treading them with the feet. The liquor thus obtained ſtands for a day or two to ferment, and then is poured into ſmall caſks, which are kept in the air for about a month, and afterwards put into caſks. The ſame proceſs is again repeated by the addition of more juice to the grapes which have already undergone the two former preſſures, and they are now wrung with the hands; and thus is had the maſſlach. The fourth kind is made by taking all the kinds together at firſt, and ſubmitting them to the greateſt preſſure: this is chiefly prepared by the peaſants. The eſſence is thick, and very ſweet and luſcious: it is chiefly uſed to mix with the other kinds. The auſpruch is the wine commonly exported, and which is known in foreign countries by the name of *Tokay*.

The goodneſs of it is determined by the following rules. The colour ſhould neither be reddiſh nor very pale, but a light ſilver: in trying it, the palate and tip

of

Tokay Wine || Toledo.

of the tongue ſhould be wetted without ſwallowing it, and if it manifeſt any acrimony to the tongue it is not good; but the taſte ought to be ſoft and mild: when poured out, it ſhould form globules in the glaſs, and have an oily appearance: when genuine, the ſtrongeſt is always of the beſt quality: when ſwallowed, it ſhould have an earthy aſtringent taſte in the mouth, which is called the taſte of the root. All tokay wine has an aromatic taſte, which diſtinguiſhes it from every other ſpecies of wine. It keeps to any age, and improves by time: but is never good till about three years old. It is the beſt way to tranſport it in caſks; for when it is on the ſeas, it ferments three times every ſeaſon, and thus refines itſelf. When in bottles, there muſt be an empty ſpace left between the wine and the cork, otherwiſe it would burſt the bottle. A little oil is put upon the ſurface, and a piece of bladder tied over the cork. The bottles are always laid on their ſides in ſand. Phil. Tranſ. vol. lxiii. part ii. p. 292, &c.

TOKENS. See *TRADESMENS Tokens*.

TOISE, a French meaſure containing ſix of their feet, or a fathom.

TOLAND, JOHN, a famous writer, was born near Londonderry in Ireland in 1670, and educated in the Popiſh religion; but at 16 years of age embraced the principles of the Proteſtants. He ſtudied three years at the univerſity of Glaſgow; was created maſter of arts in the univerſity of Edinburgh; and afterwards completed his ſtudies at Leyden, where he reſided two years. He then went to Oxford, where, having the advantage of the public library, he collected materials upon various ſubjects, and compoſed ſome pieces; among which was, A Diſſertation to prove the received hiſtory of the tragical death of Atilius Regulus, the Roman conſul, to be a fable. He began likewiſe a work of greater conſequence, in which he undertook to ſhow that there are no myſteries in the Chriſtian religion. He publiſhed it in 1696 at London, under the title of *Chriſtianity not myſterious*. This book gave great offence, and was attacked by ſeveral writers. He afterward wrote in favour of the Hanoverian ſucceſſion, and many other pieces. In 1707 he went into Germany, where he viſited ſeveral courts; and in 1710 he was introduced to Prince Eugene, who gave him ſeveral marks of his generoſity. Upon his return to England he was for ſome time ſupported by the liberality of the earl of Oxford lord-treaſurer, and kept a country houſe at Epſom; but ſoon loſing his lordſhip's favour, he publiſhed ſeveral pamphlets againſt that miniſter's meaſures. In the laſt four years of his life he lived at Putney, but uſed to ſpend moſt part of the winter in London. Mr Toland died at London in 1722. He was a man of uncommon abilities, publiſhed a number of curious tracts, and was perhaps the moſt learned of all the infidel writers; but his private character was far from being an amiable one; for he was extremely vain, and wanted thoſe ſocial virtues which are the chief ornaments as well as duties of life. His poſthumous works, two volumes octavo, were publiſhed in 1726, with an account of his life and writings, by Mr Des Maizeaux.

TOLEDO, an ancient and trading city of Spain in New Caſtile, of which it was formerly the capital. About two centuries ago it is ſaid to have contained more than 200,000 inhabitants; but they are now diminiſhed to 20,000, or at moſt to 30,000. It is advantageouſly ſeated on the river Tajo, which ſurrounds it on two ſides; and on the land ſide, it has an ancient wall built by a Gothic king, and flanked with 100 towers. It is ſeated on a mountain, which renders the ſtreets uneven, and which are narrow; but the houſes are fine, and there are a great number of ſuperb ſtructures, beſides 17 public ſquares, where the markets are kept. The fineſt buildings are the royal caſtle and the cathedral church; which laſt is the richeſt and moſt conſiderable in Spain. It is ſeated in the middle of the city, joining to a handſome ſtreet, with a fine ſquare before it. Several of the gates are very large, and of bronze. There is alſo a ſuperb ſteeple, extremely high, from whence there is a very diſtant proſpect. The Sagrariro, or principal chapel, is a real treaſury, in which are 15 large cabinets let into the wall, full of prodigious quantities of gold and ſilver veſſels, and other works. There are two mitres of ſilver gilt, ſet all over with pearls and precious ſtones, with three collars of maſſy gold, enriched in like manner. There are two bracelets and an imperial crown of the Virgin Mary, conſiſting of large diamonds and other jewels. The weight of the gold in the crown is 15 pounds. The veſſel which contains the conſecrated wafer is of ſilver gilt, as high as a man, and ſo heavy, that it requires 30 men to carry it; within it is another of pure gold enriched with jewels. Here are 38 religious houſes, moſt of which are worthy a traveller's notice, with many other ſacred buildings, a great number of churches belonging to 27 pariſhes, and ſome hoſpitals. Without the town are the remains of an amphitheatre, and other antiquities.

Toledo, Toleratio

Toledo is an archbiſhop's ſee, and the ſeat of the primate of Spain. His revenue is ſaid to be worth 400,000 ducats, but there are large deductions to be made from it. It pays 15,000 ducats to the monks of the Eſcurial, beſides ſeveral other penſions. Toledo has alſo a univerſity. It was formerly celebrated for the exquiſite temper of the ſword blades made there. It is ſituated in E. Long. 3. 15. N. Lat. 39. 50. and is 37 miles ſouth from Madrid.

Swinburne's Travels in Spain.

TOLERATION, in matters of religion, is either civil or eccleſiaſtical. Civil toleration is an impunity and ſafety granted by the ſtate to every ſect that does not maintain doctrines inconſiſtent with the public peace: and eccleſiaſtical toleration is the allowance which the church grants to its members to differ in certain opinions, not reputed fundamental.

As the gods of Paganiſm were almoſt all local and tutelary, and as it was a maxim univerſally received that it was the duty of every man to worſhip, together with his own deities, the tutelary gods of the country in which he might chance to reſide, there was no room for perſecution in the Heathen world, on account of different ſentiments in religion, or of the different rites with which the various deities were worſhipped. Had the primitive Chriſtians joined their fellow-citizens in the worſhip of Jupiter, Juno, and the reſt of the rabble of Roman divinities, they would have been ſuffered to worſhip, without moleſtation, the Creator of the world and the Redeemer of mankind; for in that caſe the God of the Chriſtians would have been looked upon as a Being of the ſame kind with the gods of the empire; and the great principle of intercommunity would have remained unviolated. But the true God had expreſsly prohibited

Bourgoanne's Travels in Spain, vol. ii.

Toleration. prohibited both Jews and Chriſtians from worſhipping any other god beſides Himſelf; and it was their refuſal to break that precept of their religion which made their Heathen maſters look upon them as Atheiſts, and perſecute them as a people inimical to the ſtate. Utility, and not truth, was the object for which the Heathen legiſlatures ſupported the national religion. They well knew that the ſtories told by their poets of their different divinities, of the rewards of Elyſium, and of the puniſhments of Tartarus, were a collection of ſenſeleſs fables; but they had nothing better to propoſe to the vulgar, and they were not ſuch ſtrangers to the human heart, as to ſuppoſe that mankind could live together in ſociety without being influenced in their conduct by ſome religion.

Widely different from the genius of Paganiſm was the ſpirit of the Jewiſh diſpenſation. Truth, which is in fact always coincident with general utility, was the great object of the Moſaic law. The children of Iſrael were ſeparated from the reſt of the world, to preſerve the knowledge and worſhip of the true God, at a time when all the other nations on earth, forgetting the Lord that made them, were falling proſtrate to ſtocks and ſtones, and worſhipping devils and impure ſpirits. Such was the contagion of idolatry, and ſo ſtrong the propenſity of the Iſraelites to the cuſtoms and manners of the Egyptians, and other polytheiſtic nations around them, that the purpoſe of their ſeparation could not have been ſerved, had not Jehovah condeſcended to become not only their tutelary God, but even their ſupreme civil Magiſtrate (ſee THEOLOGY, N° 151.); ſo that under the Moſaic economy, idolatry was the crime of high treaſon, and as ſuch juſtly puniſhed by the laws of the ſtate. Among the Jews, the church and ſtate were not indeed different ſocieties. They were ſo thoroughly incorporated, that what was a ſin in the one was a crime in the other; and the forfeiture of eccleſiaſtical privileges was the forfeiture of the rights of citizens.

In many reſpects the Chriſtian religion is directly oppoſite to the ritual law of Moſes. It is calculated for all nations, and intended to be propagated among all. Inſtead of ſeparating one people from another, one of its principal objects is to diſſeminate univerſal benevolence, and to inculcate upon the whole human race, that mutual love which naturally ſprings from the knowledge that all men are brethren. Its ultimate end being to train its votaries for heaven, it concerns itſelf no farther with the affairs of earth than to enforce by eternal ſanctions the laws of morality; and the kingdom of its Founder not being of this world, it leaves every nation at liberty to fabricate its own municipal laws, ſo as beſt to ſerve its own intereſt in the various circumſtances in which it may be placed; and denounces a curſe upon all who pay not to thoſe laws the fulleſt obedience, when they are not obviouſly inconſiſtent with the laws of piety and virtue, which are of prior obligation. The Chriſtian church therefore muſt always remain a diſtinct ſociety from the ſtate; and though, till the preſent age of hazardous innovations, it has been deemed expedient in every country, where the truth of the goſpel is admitted, to give to the religion of Chriſt a legal eſtabliſhment, and to confer immunities on its miniſters, this meaſure has been adopted, not to ſecure the purity of the faith, which appeals to the private judgment of each individual, but merely to preſerve the peace of ſociety, and to put a reſtraint upon thoſe actions of which human laws cannot take cognizance. With religion, Chriſtian governments have no farther concern than as it tends to promote the practice of virtue. The early Chriſtians, however, not underſtanding the principle upon which penal laws were employed to preſerve the purity of the Jewiſh religion; and, as our bleſſed Lord obſerved to two of his apoſtles, not knowing what ſpirit they were of—haſtily concluded that they had a right to enforce the doctrines and worſhip of the New Teſtament, by the ſame means which had been uſed to preſerve the Iſraelites ſteady to the doctrines and worſhip of the Old. Hence, though they had ſuffered the cruelleſt perſecutions themſelves (ſee PERSECUTION), they no ſooner got the power of the ſtate in their hands, than they perſecuted the Pagans for their idolatry; and afterwards, when hereſies aroſe in the church, perſecuted one another for expreſſing in different phraſes metaphyſical propoſitions, of ſuch a nature as no human mind can fully comprehend. The apoſtle had forewarned them that there muſt be hereſies in the church, that they who are approved may be made manifeſt; but it did not occur to them that perſecution for opinion is the worſt of all hereſies, as it violates at once truth and charity. Toleration.

Hitherto theſe unhallowed means of bringing Chriſtians to uniformity of faith and practice, had been only occaſionally employed, from their not accurately diſtinguiſhing between the ſpirit of the goſpel and that of the law; but as ſoon as the biſhops of Rome had brought the inhabitants of Europe to recognize their infallibility in explaining articles of faith and deciding points of controverſy, perſecution became a regular and permanent inſtrument of eccleſiaſtical diſcipline. To doubt or to deny any doctrine to which theſe unerring inſtructors had given the ſanction of their approbation, was held to be not only a reſiſting of the truth, but an act of rebellion againſt their ſacred authority; and the ſecular power, of which, by various arts, they had acquired the abſolute direction, was inſtantly employed to avenge both.

"Thus Europe had been accuſtomed, during many centuries, to ſee ſpeculative opinions propagated or defended by force; the charity and mutual forbearance which Chriſtianity recommends with ſo much warmth, were forgotten, the ſacred rights of conſcience and of private judgment were unheard of, and not only the idea of toleration, but even the word itſelf, in the ſenſe now affixed to it, was unknown. A right to extirpate error by force, was univerſally allowed to be the prerogative of thoſe who poſſeſſed the knowledge of truth; and though the firſt reformers did not arrogate to themſelves in direct terms that infallibility which they had refuſed to the church of Rome, they were not leſs confident of the truth of their own doctrines, and required with equal ardour the princes of their party to check ſuch as preſumed to impugn or to oppoſe them. To this requeſt too many of theſe princes lent a willing ear. It flattered at once their piety and their pride to be conſidered as poſſeſſing all the rights of Jewiſh princes; and Henry the VIII. of England, after labouring to make his divines declare that all authority eccleſiaſtical as well as civil flows from the crown, perſecuted alternately the Papiſts and Proteſtants. Many of his ſucceſſors, whoſe characters were much better than his, thought themſelves duly *Robertſon's Hiſtory of Charles V.*

Toleration. authorized, in virtue of their acknowledged ſupremacy over all ſtates and conditions of men, to enforce by means of penal laws a uniformity of faith and worſhip among their ſubjects: and it was not till the revolution that any ſect in England ſeems to have fully underſtood, that all men have an unalienable right to worſhip God in the manner which to them may ſeem moſt ſuitable to his nature, and the relation in which they ſtand to him; or that it is impoſſible to produce uniformity of opinion by any other means than candid diſquiſition and ſound reaſoning. That the civil magiſtrate has a right to check the propagation of opinions which tend only to ſap the foundations of virtue, and to diſturb the peace of ſociety, cannot, we think, be queſtioned; but that he has no right to reſtrain mankind from publicly profeſſing any ſyſtem of faith, which comprehends the being and providence of God, the great laws of morality, and a future ſtate of rewards and puniſhments, is as evident as that it is the object of religion to fit mankind for heaven, and the whole duty of the magiſtrates to maintain peace, liberty, and property, upon earth. We have elſewhere obſerved (ſee TEST), that among a number of different ſects of Chriſtians, it is not the ſuperior purity of the ſyſtem of faith profeſſed by one of them, that gives it a right to the immunities of an eſtabliſhment in preference to all its rivals; but though the legiſlature is authorized, in certain circumſtances, to make a leſs pure ſyſtem the religion of the ſtate, it would be the height of abſurdity to ſuppoſe that any man, or body of men, can have authority to prevent a purer ſyſtem from being acknowledged as the religion of individuals. For propagating opinions and purſuing practices which neceſſarily create civil diſturbance, every man is anſwerable to the laws of his country; but for the ſoundneſs of his faith, and the purity of his worſhip, he is anſwerable to no tribunal but that which can ſearch the heart.

When churches are eſtabliſhed, and creeds drawn up as guides to the preaching of the national clergy, it is obvious that every clergyman who teaches any thing directly contrary to the doctrine of ſuch creeds, violates the condition on which he holds his living, and may be juſtly deprived of that living, whether his obnoxious opinion be in itſelf true or falſe, important or unimportant; but his puniſhment ſhould be extended no farther. To expel a Chriſtian from private communion for teaching any doctrine which is neither injurious to the ſtate nor contrary to the few ſimple articles which compriſe the ſum of the Chriſtian faith, is the groſſeſt tyranny; and the governors of that church which is guilty of it, uſurp the prerogative of the bleſſed Lord, who commanded the apoſtles themſelves not to be called maſters in this ſenſe; for one (ſays he) is your maſter (υμων ὁ καθηγητης), even Chriſt. It is indeed a hardſhip to deprive a man of his living for conſcientiouſly illuſtrating what he believes to be a truth of the goſpel, only becauſe his illuſtration may be different from that which had formerly been given by men fallible like himſelf; but if the eſtabliſhment of human compilations of faith be neceſſary, this hardſhip cannot be removed, but by making ſuch compilations as ſimple as poſſible, and drawing them up in ſcripture language. Such a reformation, could it be effected peaceably, would ſerve other good purpoſes; for while it would ſufficiently guard the purity of the faith, it would withdraw that temptation which too many eſtabliſhments throw in the way of men, to ſubſcribe to the truth of what they do not really believe; and it would effectually baniſh from the Chriſtian church every thing which can be called by the name of *perſecution*. See NONCONFORMISTS. Toleration || Tomb.

TOLL, a tax or cuſtom paid for liberty to vend goods in a market or fair, or for keeping roads in proper repair. The firſt appointment of a toll on highways of which we read, took place in 1346. See ROAD.

TOLOUSE. See TOULOUSE.

TOLU, a town of South America in Terra Firma, and in the government of Carthagena; famous for the fine balſam of Tolu, brought into Europe from thence, and produced from a tree like a pine. It is ſeated on a bay of the North ſea, 60 miles ſouth of Carthagena. W. Long. 75. 25. N. Lat. 9. 45.

TOLUIFERA, the BALSAM-of-TOLU TREE; a genus of plants belonging to the claſs of decandria. See BOTANY, p. 182. and CHEMISTRY, N° 2483.

TOMATOES. See SOLANUM, BOTANY *Index*.

TOMB, includes both the grave or ſepulchre wherein a defunct is interred, and the monument erected to preſerve his memory. The word is formed from the Greek τυμβος, *tumulus*, "ſepulchre;" or, according to Menage, from the Latin *tumba*, which ſignifies the ſame.

In many nations it has been cuſtomary to burn the bodies of the dead, and to collect the aſhes with pious care into an urn, which was depoſited in a tomb or ſepulchre. See BURNING. Among many nations it has alſo been the practice to lay the dead body in a tomb, without conſuming it, after having wrapped it up decently, and ſometimes placing it in a coffin. See COFFIN.

The tombs of the Jews were generally hollow places hewn out of a rock. Abraham buried Sarah in a cave. Such was the place too in which the kings of Judah and Iſrael were interred: and ſuch was the place in which the body of our Saviour was depoſited by Joſeph of Arimathea. But it is probable that the common people buried their dead in graves; for our Saviour compares the Phariſees to "graves which appear not, and the men that walk over them are not aware of them." Over the tombs, perhaps only of people of diſtinction, a ſtone or monument was erected, to intimate to paſſengers that they were burying places, that they might not pollute themſelves by touching them. With the ſame intention, as Lightfoot informs us, they whitened them every year on the 15th of February.

The Egyptians alſo buried their dead in caves, called *catacombs*. See CATACOMB. The pyramids, as ſome think, were alſo employed for the ſame purpoſe. Sometimes alſo, after embalming their dead, they placed them in niches in ſome magnificent apartment in their houſes.

The Greeks and Romans burned their dead, and depoſited their aſhes in a tomb. The Greeks interred the aſhes without the cities, by the ſides of their highways. Sometimes indeed, by way of particular honour, they were buried in an elevated part of the town; and the Lacedæmonians were allowed by Lycurgus to bury in the city and round their temples: But this was forbidden among the Romans by the law of the twelve tables, *In urbe ne ſepelito, neve urito;* yet Valerius Publicola, Poſthumus Tubertius, and the family of the Claudii, were buried in the Capitol. To bury by the ſides of public

mb. public roads was common among the Romans alſo; hence their epitaphs frequently began with *Siſte viator*. Highways were made choice of probably for two reaſons: 1. That the dead might not be offenſive or injure the health of the living, which they certainly would if buried in towns or populous places; and, 2dly, That they might hold out to travellers a leſſon of mortality, and teach the ruſtic moraliſt to die.

As it would ſwell this article to too great a ſize to deſcribe all the different kinds of tombs which have been uſed by different nations and ages, we muſt content ourſelves with ſhortly deſcribing the tombs of a few nations, and adding a few concomitant circumſtances.

The tombs of the Parſees are ſingular. The deceaſed, after lying a proper time in his own houſe, for the purpoſes of mourning, is carried, followed by his relations and friends, the females chanting a requiem, and depoſited in a tomb of the following conſtruction. It is a circular building, open at top, about 55 feet diameter, and 25 feet in height, filled to within 5 feet of the top, excepting a well of 15 feet diameter in the centre. The part ſo filled is terraced, with a ſlight declivity toward the well. Two circular grooves three inches deep are raiſed round the well; the firſt at the diſtance of four, the ſecond at ten, feet from the well. Grooves of the like depth or height, and four feet diſtant from each other at the outer part of the outer circle, are carried ſtraight from the wall to the well, communicating with the circular ones, for the purpoſe of carrying off the water, &c. The tomb, by this means, is divided into three circles of partitions: the outer, about ſeven feet by four: the middle ſix by three: the inner, four by two: the outer for the men, the middle for the women, the inner for the children; in which the bodies are reſpectively placed, wrapped looſely in a piece of cloth, and left to be devoured by the vultures; which is very ſoon done, as numbers of thoſe animals are always ſeen hovering and watching about theſe charnel houſes, in expectation of their prey. The friends of the deceaſed, or the perſons who have charge of the tomb, come at the proper time, and throw the bones into their receptacle, the well in the centre; for which purpoſe, iron rakes and tongs are depoſited in the tomb. The entrance is cloſed by an iron door, four feet ſquare, on the eaſtern ſide, as high up as the terrace, to which a road is raiſed. Upon the wall, above the door, an additional wall is raiſed, to prevent people from looking into the tomb, which the Parſees are particularly careful to prevent. A Perſian inſcription is on a ſtone inſerted over the door, which we once copied, but have forgotten its tenor. From the bottom of the wall ſubterraneous paſſages lead to receive the bones, &c. and prevent the well from filling.

Of the ancient ſepulchres found in Ruſſia and Siberia, ſome are perfect tumuli, raiſed to an enormous height, while others are almoſt level with the ground. Some of them are encompaſſed with a ſquare wall of large quarry ſtones placed in an erect poſition; others are covered only with a ſmall heap of ſtones, or they are tumuli adorned with ſtones at top. Some are walled with brick within, and vaulted over; others are no more than pits or common graves. In ſome the earth is excavated ſeveral fathoms deep; others, and eſpecially thoſe which are topped by a lofty tumulus, are only dug of a ſufficient depth for covering the carcaſe. In many of theſe ſepulchres the bones of men, and frequently of horſes, are found, and in a condition that renders it probable the bodies were not burnt before they were inhumed. Other bones ſhow clearly that they have been previouſly burnt; becauſe a part of them is unconſumed, and becauſe they lie in a diſordered manner, and ſome of them are wanting. Urns, in which other nations of antiquity have depoſited the aſhes of their dead, are never met with here. But ſometimes what remained of their bodies after the combuſtion, and even whole carcaſes, are found wrapped up in thin plates of gold. Many dead bodies are frequently ſeen depoſited together in one tomb; a certain indication that either a battle had been fought in the neighbourhood of the place, or that ſome families buried their relations in an hereditary tomb.

Tomb || Tone.

The Moors, like all other Mahometans, hold it contrary to the ſpirit of religion to bury their dead in moſques, and to profane the temple of the Moſt High by the putrefaction of dead bodies. In the infancy of the church the Chriſtians had the like reſpect for their temples. The burial grounds of the Mahometans are without the city; the emperors have their ſepulchres diſtinct and diſtant from the moſque, in ſanctuaries, built by themſelves: their tombs are exceedingly ſimple. *Chenier's Morocco*, vol. i.

All Mahometans inter the dead at the hour ſet apart for prayer. The defunct is not kept in the houſe, except he expires after ſunſet; but the body is tranſported to the moſque, whither it is carried by thoſe who are going to prayer. Each, from a ſpirit of devotion, is deſirous to carry in his turn. The Moors ſing at their burial ſervice; which uſage perhaps they have imitated after the Chriſtians of Spain. They have no particular colour appropriated to mourning. Women regularly go on the Friday to weep over and pray at the ſepulchres of the dead, whoſe memory they hold dear.

Among the northern nations it was cuſtomary to bury their dead under heaps of ſtones called *cairns*, or under barrows: (See the articles CAIRNS and BARROW). The inhabitants of Tibet, it is ſaid, neither bury nor burn their dead; but expoſe them on the tops of mountains. See TIBET.

TOMBUCTOO, a city of Africa, and capital of a rich and populous country, ſituated near the Niger, in E. Long. 1. 30. and N. Lat. 16. 30. Some manufactures, particularly that of cotton cloth, are carried on in Tombuctoo; and it has a conſiderable trade with the caravans. It is governed by a king, who has a guard of 3000 horſe. The country around abounds with wheat and barley, with numerous herds of cattle, ſo that milk and butter are in great plenty.

TOMPION, a ſort of bung or cork uſed to ſtop the mouth of a cannon. At ſea this is carefully encircled with tallow or putty, to prevent the penetration of the water into the bore, whereby the powder contained in the chamber might be damaged or rendered incapable of ſervice.

TON, a meaſure or weight. See TUN.

TONE, or TUNE, in *Muſic*, a property of ſound, whereby it comes under the relation of *grave* and *acute*;

Tone || Tonnage.

or the degree of elevation any ſound has, from the degree of ſwiftneſs of the vibrations of the parts of the ſonorous body.

The variety of tones in human voices ariſes partly from the dimenſions of the windpipe, which, like a flute, the longer and narrower it is, the ſharper the tone it gives; but principally from the head of the larynx or knot of the throat: the tone of the voice being more or leſs grave as the rima or cleft thereof is more or leſs open.

The word *tone* is taken in four different ſenſes among the ancients: 1. For any ſound; 2. For a certain interval, as when it is ſaid the difference between the diapente and diateſſaron is a tone; 3. For a certain locus or compaſs of the voice, in which ſenſe they uſed the Dorian, Phrygian, Lydian tones; 4. For tenſion, as when they ſpeak of an acute, grave, or a middle tone.

TONE is more particularly uſed, in muſic, for a certain degree or interval of tune, whereby a ſound may be either raiſed or lowered from one extreme of a concord to the other, ſo as ſtill to produce true melody.

TONGUE. See ANATOMY, N° 102.

TONIC, in *Muſic*, ſignifies a certain degree of tenſion, or the ſound produced by a vocal ſtring in a given degree of tenſion, or by any ſonorous body when put in vibration.

Tonic, ſays Rouſſeau, is likewiſe the name given by Ariſtoxenus to one of the three kinds of chromatic muſic, whoſe diviſions he explains, and which was the ordinary chromatic of the Greeks, proceeding by two ſemitones in ſucceſſion, and afterwards a third minor.

TONIC Dominant. See DOMINANT.

TONNAGE *and* POUNDAGE, an ancient duty on wine and other goods, the origin of which ſeems to have been this: About the 21ſt of Edward III. complaint was made that merchants were robbed and murdered on the ſeas. The king thereupon, with the conſent of the peers, levied a duty of 2s. on every ton of wine, and 12d. in the pound on all goods imported; which was treated as illegal by the commons. About 25 years after, the king, when the knights of ſhires were returned home, obtained a like grant from the citizens and burgeſſes, and the year after it was regularly granted in parliament. Theſe duties were diminiſhed ſometimes, and ſometimes increaſed; at length they ſeem to have been fixed at 3s. tonnage and 1s. poundage. They were at firſt uſually granted only for a ſtated term of years, as, for two years in 5 Ric. II.; but in Henry VI.'s time they were granted him for life by a ſtatute in the 31ſt year of his reign; and again to Edward IV. for the term of his life alſo: ſince which time they were regularly granted to all his ſucceſſors for life, ſometimes at the firſt, ſometimes at other ſubſequent parliaments, till the reign of Charles I.; when, as the noble hiſtorian expreſſes it, his miniſters were not ſufficiently ſolicitous for a renewal of his legal grant. And yet theſe impoſts were imprudently and unconſtitutionally levied and taken, without conſent of parliament, for 15 years together; which was one of the cauſes of thoſe unhappy diſcontents, juſtifiable at firſt in too many inſtances, but which degenerated at laſt into cauſeleſs rebellion and murder. For, as in every other, ſo in this particular caſe, the king (previous to the commencement of hoſtilities) gave the nation ample ſatisfaction for the errors of his former conduct, by paſſing an act, whereby he renounced all power in the crown of levying the duty of tonnage and poundage, without the expreſs conſent of parliament; and alſo all power of impoſition upon any merchandiſes whatever. Upon the reſtoration this duty was granted to King Charles II. for life, and ſo it was to his two immediate ſucceſſors; but now, by three ſeveral ſtatutes, 9 Ann. c. 6. 1 Geo. I. c. 12. and 3 Geo. I. c. 7. it is made perpetual, and mortgaged for the debt of the public.

Blackſt. Comment. vol. i.

Tonnage Tonquin

TONQUIN, a kingdom of Aſia, in the Eaſt Indies, beyond the Ganges; bounded on the north by the province of Yunnan in China, on the eaſt by the province of Canton and the bay of Tonquin, on the ſouth by Cochin China, and on the weſt by the kingdom of Laos. It is about 1200 miles in length and 500 in breadth; and is one of the fineſt and moſt conſiderable kingdoms of the Eaſt, as well on account of the number of inhabitants as the riches it contains and the trade it carries on. The country is thick ſet with villages; and the natives in general are of a middle ſtature and clean limbed, with a tawney complexion. Their faces are oval and flattiſh, and their noſes and lips well proportioned. Their hair is black, long, lank, and coarſe; and they let it hang down their ſhoulders. They are generally dexterous, nimble, active, and ingenious in mechanic arts. They weave a multitude of fine ſilks, and make curious lacker-works, which are tranſported to other countries. There is ſuch a number of people, that many want employment; for they ſeldom go to work but when foreign ſhips arrive. The money and goods brought hither by the Engliſh and Dutch put them in action; for they have not money of their own ſufficient to employ themſelves; and therefore one-third at leaſt muſt be advanced beforehand by the merchants: and the ſhips muſt ſtay here till the goods are finiſhed, which is generally five or ſix months. They are ſo addicted to gaming, that when every thing elſe is loſt, they will ſtake their wives and children. The garments of the Tonquineſe are made either of ſilk or cotton; but the poor people and ſoldiers wear only cotton of a dark tawney colour. Their houſes are ſmall and low; and the walls either of mud, or hurdles daubed over with clay. They have only a ground floor, with two or three partitions; and each room has a ſquare hole to let in the light. The villages conſiſt of 30 or 40 houſes, ſurrounded with trees; and in ſome places there are banks to keep the water from overflowing their gardens, where they have oranges, betels, melons, and ſalad-herbs. In the rainy ſeaſon they cannot paſs from one houſe to another without wading through the water; they ſometimes have boats. In the capital city called *Cacho* there are about 20,000 houſes with mud-walls, and covered with thatch; a few are built with brick, and roofed with pan-tiles. In each yard is a ſmall arched building like an oven, about ſix feet high, made of brick, which ſerves to ſecure their goods in caſe of fire. The principal ſtreets are very wide, and paved with ſmall ſtones. The king of Tonquin has three palaces in it, ſuch as they are; and near them are ſtables for his horſes and elephants. The houſe of the Engliſh factory is ſeated at the north end of the city, fronting the river, and is the beſt in the city. The people in general are courteous, and civil to ſtrangers; but the great men are proud, haughty, and ambitious; the ſoldiers inſolent, and the poor thieviſh. They buy all

their

Tonquin ‖ Tontine.

their wives, of which the great men have ſeveral; but the poor are ſtinted for want of money. In hard times the men will ſell both their wives and children to buy rice to maintain themſelves. The women offer themſelves to ſtrangers as wives while they ſtay, and agree with them for a certain price. Even the great men will offer their daughters to the merchants and officers who are likely to ſtay ſix months in the country. They are not afraid of being with child; for if they are girls they can ſell them well when they are young, becauſe they are fairer than the other inhabitants. Theſe women are ſaid to be very faithful; and are truſted with money and goods by the Europeans during their abſence, and will make great advantage with them. The firſt new moon in the year that happens after the middle of January, is a great feſtival; when they rejoice for 10 or 12 days together, and ſpend their time in all manner of ſports. Their common drink is tea, but they make themſelves merry with arrack. The language is ſpoken very much in the throat; and ſome of the words are pronounced through the teeth, and has a great reſemblance to the Chineſe. They have ſeveral mechanic arts or trades; ſuch as ſmiths, carpenters, joiners, turners, weavers, tailors, potters, painters, money-changers, paper-makers, workers in lacker, and bell-founders.—Their commodities are gold, muſk, ſilks, calicoes, drugs of many ſorts, woods for dyeing, lacquered wares, earthen wares, ſalt, aniſeeds, and worm-ſeeds. The lacquered ware is not inferior to that of Japan, which is accounted the beſt in the world. With all theſe merchandiſes, one would expect the people to be very rich, but they are in general very poor; the chief trade being carried on by the Chineſe, Engliſh, and Dutch. The goods imported, beſides ſilver, are ſaltpetre, ſulphur, Engliſh broad-cloth, pepper, ſpices, and great guns.

TONSILS. See ANATOMY, N° 102.

TONSURE, in *Eccleſiaſtical Hiſtory*, a particular manner of ſhaving or clipping the hair of eccleſiaſtics or monks. The ancient tonſure of the clergy was nothing more than polling the head, and cutting the hair to a moderate degree, for the ſake of decency and gravity: and the ſame obſervation is true with reſpect to the tonſure of the ancient monks. But the Romans have carried the affair of tonſure much farther; the candidate for it kneeling before the biſhop, who cuts the hair in five different parts of the head, viz. before, behind, on each ſide, and on the crown.

TONTINE, a loan given for life annuities with benefit of ſurvivorſhip; ſo called from the inventor Laurence Tonti, a Neapolitan. He propoſed his ſcheme in 1653 to reconcile the people to Cardinal Mazazine's government, by amuſing them with the hope of becoming ſuddenly rich. He obtained the conſent of the court, but the parliament would not regiſter the edict. He made attempts afterwards, but without ſucceſs.

It was not till Louis XIV. was diſtreſſed by the league of Augſburg, and by his own immenſe expences, that he had recourſe to the plans of Tonti, which, though long laid aſide, were not forgotten. By an edict in 1689 he created a Tontine royale of 1,400,000 livres annual rent, divided into 14 claſſes. The actions were 300 livres a piece, and the proprietors were to receive 10l. per cent. with benefit of ſurvivorſhip in every claſs. This ſcheme was executed but very imperfectly; for none of the claſſes roſe to above 25,000 livres, inſtead of 100,000, according to the original inſtitution; though the annuities were very regularly paid. A few years after, the people ſeeming in better humour for projects of this kind, another tontine was erected upon nearly the ſame terms, but this was never above half full. They both ſubſiſted in the year 1726, when the French king united the 13th claſs of the firſt tontine with the 14th of the ſecond; all the actions of which were poſſeſſed by Charlotte Bonnemay, widow of Lewis Barbier, a ſurgeon of Paris, who died at the age of 96. This gentlewoman had ventured 300 livres in each tontine; and in the laſt year of her life ſhe had for her annuity 73,500 livres, or about 3600l. a-year, for about 30l.

Tontine ‖ Top-Sails.

The nature of the tontine is this; there is an annuity, after a certain rate of intereſt, granted to a number of people; divided into claſſes, according to their reſpective ages; ſo that annually the whole fund of each claſs is divided among the ſurvivors of that claſs; till at laſt it falls to one, and upon the extinction of that life, reverts to the power by which the tontine was erected, and which becomes thereby ſecurity for the due payment of the annuities.

TOOL, among mechanics, denotes in general any inſtrument uſed for making other complex inſtruments and machines, or in other operations of the mechanic arts.

TOOTH, for a deſcription of, ſee ANATOMY, N° 27.

TOOTHACH. See MEDICINE, N° 210, and SURGERY *Index*.

TOOTHACH-Tree. See ZANTHOXYLUM, } BOTANY
TOOTHWORT. See PLUMBAGO, } *Index*.

TOP, a ſort of platform, ſurrounding the lower maſthead, from which it projects on all ſides like a ſcaffold.

The principal intention of the top is to extend the topmaſt ſhrouds, ſo as to form a greater angle with the maſt, and thereby give additional ſupport to the latter. It is ſuſtained by certain timbers fixed acroſs the hounds or ſhoulders of the maſts, and called the *treſtle-trees* and *croſs-trees*.

Beſides the uſe above mentioned, the top is otherwiſe extremely convenient to contain the materials neceſſary for extending the ſmall ſails, and for fixing or repairing the rigging and machinery with more facility and expedition. In ſhips of war it is uſed as a kind of redoubt, and is accordingly fortified for attack or defence; being furniſhed with ſwivels, muſketry, and other fire-arms, and guarded by a thick fence of corded hammocks. Finally, it is employed as a place for looking out, either in the day or night.

TOP-Maſt, the ſecond diviſion of a maſt, or that part which ſtands between the upper and lower pieces. See the article MAST.

TOP-Sails, certain large ſails extended acroſs the topmaſts by the topſail-yard above, and by the yard attached to the lower maſt beneath; being faſtened to the former by robands, and to the latter by means of two great blocks fixed on its extremities, through which the topſail-ſheets are inſerted, paſſing from thence to two other blocks fixed on the inner part of the yard cloſe-

Top-Sails || Tories.

close by the maſt; and from theſe latter the ſheets lead downwards to the deck, where they may be ſlackened or extended at pleaſure. See the article SAIL.

TOPAZ, a gem or precious ſtone. See MINERALOGY *Index*.

TOPE, a ſpecies of SQUALUS. See ICHTHYOLOGY *Index*.

TOPHET. See HINNOM and MOLOCH.

TOPHUS, in *Medicine*, denotes a chalky or ſtony concretion in any part of the body; as the bladder, kidney, &c. but eſpecially in the joints.

TOPIC, a general head or ſubject of diſcourſe.

TOPICS, in *Oratory*. See ORATORY, N° 10—13.

TOPICS, or *Topical Medicines*, are the ſame with external remedies, or thoſe applied outwardly to ſome diſeaſed and painful part: ſuch are plaſters, cataplaſms, unguents, &c.

TOPOGRAPHY, a deſcription or draught of ſome particular place, or ſmall tract of land, as that of a city or town, manor, or tenement, field, garden, houſe, caſtle, or the like; ſuch as ſurveyors ſet out in their plots, or make draughts of, for the information and ſatisfaction of the proprietors.

TOPSHAM, a town in Devonſhire, in England, ſeated on the river Exmouth, five miles ſouth-eaſt of Exeter, to which place the river was formerly navigable; but in time of war was choaked up deſignedly, ſo that ſhips are now obliged to load and unload at Topſham. W. Long. 3. 26. N. Lat. 50. 39.

TORBAY, a fine bay of the Engliſh channel, on the coaſt of Devonſhire, a little to the eaſt of Dartmouth, formed by two capes, called *Bury Points*, and *Bob's Noſe*.

TORDA, or RASOR-BILL. See ALCA, ORNITHOLOGY *Index*.

TORDYLIUM, HART-WORT, a genus of plants belonging to the claſs of pentandria, and in the natural ſyſtem arranged under the 45th order, *Umbellatæ*. See BOTANY *Index*.

TORIES, a political faction in Britain, oppoſed to the Whigs.

The name of *Tories* was given to a ſort of banditti in Ireland, and was thence transferred to the adherents of Charles I. by his enemies, under the pretence that he favoured the rebels in Ireland. His partiſans, to be even with the republicans, gave them the name of *Whigs*, from a word which ſignifies *whey*, in deriſion of their poor fare. The Tories, or *cavaliers*, as they were alſo called, had then principally in view the political intereſt of the king, the crown, and the church of England; and the round-heads, or Whigs, propoſed chiefly the maintaining of the rights and intereſts of the people, and of Proteſtantiſm. This is the moſt popular account; and yet it is certain the names *Whig* and *Tory* were but little known till about the middle of the reign of King Charles II. M. de Cize relates, that it was in the year 1678 that the whole nation was firſt obſerved to be divided into Whigs and Tories; and that on occaſion of the famous depoſition of Titus Oates, who accuſed the Catholics of having conſpired againſt the king and the ſtate, the appellation of *Whig* was given to ſuch as believed the plot real; and *Tory* to thoſe who held it fictitious.

Theſe parties may be conſidered either with regard to the ſtate or to religion. The ſtate Tories are either violent or moderate: the firſt would have the king to be abſolute, and therefore plead for paſſive obedience, non-reſiſtance, and the hereditary right of the houſe of Stuart. The moderate Tories would not ſuffer the king to loſe any of his prerogative; but then they would not ſacrifice thoſe of the people. The ſtate Whigs are either ſtrong republicans or moderate ones. The firſt (ſays Rapin) are the remains of the party of the long parliament, who attempted to change monarchy to a commonwealth: but theſe make ſo ſlender a figure, that they only ſerved to ſtrengthen the party of other Whigs. The Tories would perſuade the world, that all the Whigs are of this kind; as the Whigs would make us believe that all the Tories are violent. The moderate ſtate Whigs are much in the ſame ſentiments with the moderate Tories, and deſire that the government may be maintained on the ancient foundation: all the difference is, that the firſt bear a little more to the parliament and people, and the latter to that of the king. In ſhort, the old Whigs were always jealous of the encroachments of the royal prerogative, and watchful over the preſervation of the liberties and properties of the people.

Tories || Torricellian Experiment.

TORMENTILLA, TORMENTIL, a genus of plants belonging to the claſs of icoſandria, and in the natural ſyſtem ranging under the 35th order, *Senticoſæ*. See BOTANY *Index*.

TORNADO, a ſudden and vehement guſt of wind from all points of the compaſs, frequent on the coaſt of Guinea.

TORPEDO, the CRAMP-FISH. See RAJA, ICHTHYOLOGY *Index*.

TORPOR, a numbneſs, or defect of feeling and motion. Galen ſays it is a ſort of intermediate diſorder between palſy and health.

TORREFACTION, in *Chemiſtry*, is the roaſting or ſcorching of a body by the fire, in order to diſcharge a part either unneceſſary or hurtful in another operation. Sulphur is thus diſcharged from an ore before it can be wrought to advantage.

TORRENT, denotes a temporary ſtream of water falling ſuddenly from mountains, whereon there have been great rains, or an extraordinary thaw of ſnow.

TORRICELLI, EVANGELISTE, an illuſtrious Italian mathematician and philoſopher, born at Faenza in 1608. He was trained in Latin literature by his uncle a monk; and after cultivating mathematical knowledge for ſome time without a maſter, he ſtudied it under Father Benedict Caſtelli, profeſſor of mathematics at Rome. Having read Galileo's dialogues, he compoſed a treatiſe on motion, on his principles, which brought him acquainted with Galileo, who took him home as an aſſiſtant: but Galileo died in three months after. He became profeſſor of mathematics at Florence, and greatly improved the art of making teleſcopes and microſcopes: but he is beſt known for finding out a method of aſcertaining the weight of the atmoſphere by quickſilver; the barometer being called, from him, the *Torricellian tube*. He publiſhed *Opera Geometrica*, 4to, 1644; and died in 1647.

TORRICELLIAN EXPERIMENT, a famous experiment made by Torricelli, by which he demonſtrated the preſſure of the atmoſphere in oppoſition to the doctrines of ſuction, &c. finding that preſſure able to ſupport only

a certain length of mercury, or any other fluid, in an inverted glaſs tube. See BAROMETER.

TORSK, or TUSK. See GADUS, ICHTHYOLOGY *Index*.

TORTOISE. See TESTUDO, ERPETOLOGY *Index*.

TORTOISE-ſhell, the ſhell, or rather ſcales, of the teſtaceous animal called a *tortoiſe;* uſed in inlaying, and in various other works, as for ſnuff-boxes, combs, &c. Mr Cateſby obſerves, that the hard ſtrong covering which incloſes all ſorts of tortoiſes, is very improperly called a *ſhell;* being of a perfect bony contexture; but covered on the outſide with ſcales, or rather plates, of a horny ſubſtance; which are what the workmen call *tortoiſe-ſhell.*

There are two general kinds of tortoiſes, viz. the *land* and *ſea tortoiſe*, *teſtudo terreſtris* and *marina*. The ſea-tortoiſe, again, is of ſeveral kinds; but it is the caret, or teſtudo imbricata of Linnæus, alone which furniſhes that beautiful ſhell ſo much admired in Europe.

The ſhell of the caretta, or hawkſbill tortoiſe, is thick; and conſiſts of two parts, the upper, which covers the back, and the lower the belly: the two are joined together at the ſides by ſtrong ligaments, which yet allow of a little motion. In the fore-part is an aperture for the head and fore-legs, and behind for the hind-legs and tail. It is the under ſhell alone that is uſed: to ſeparate it, they make a little fire beneath it, and as ſoon as ever it is warm, the under ſhell becomes eaſily ſeparable with a point of a knife, and is taken off in laminæ or leaves.

The whole ſpoils of the caret conſiſt in 13 leaves or ſcales, eight of them flat, and five a little bent. Of the flat ones, there are four large ones, ſometimes a foot long, and ſeven inches broad. The beſt tortoiſe-ſhell is thick, clear, tranſparent, of the colour of antimony, ſprinkled with brown and white. When uſed in marquetry, &c. the workmen give it what colour they pleaſe by means of coloured leaves, which they put underneath it.

Working and joining of TORTOISE-ſhell.—Tortoiſe-ſhell and horn become ſoft in a moderate heat, as that of boiling water, ſo as to be preſſed, in a mould, into any form, the ſhell or horn being previouſly cut into plates of a proper ſize. Plumier informs us, in his *Art de Tourner*, that two plates are likewiſe united into one by heating and preſſing them; the edges being thoroughly cleaned, and made to fit cloſe to one another. The tortoiſe-ſhell is conveniently heated for this purpoſe by applying a hot iron above and beneath the juncture, with the interpoſition of a wet cloth to prevent the ſhell from being ſcorched by the irons: theſe irons ſhould be pretty thick, that they may not loſe their heat before the union is effected. Both tortoiſe-ſhell and horns may be ſtained of a variety of colours, by means of the colouring drugs commonly uſed in dyeing, and by certain metallic ſolutions.

TORTURE, a violent pain inflicted on perſons to force them to confeſs the crimes laid to their charge, or as a puniſhment for crimes committed.

Torture was never permitted among the Romans except in the examination of ſlaves: it would therefore appear, that it was a general opinion among them, that a ſlave had ſuch a tendency to falſehood, that the truth could only be extorted from him. To the diſgrace of the profeſſors of Chriſtianity, torture was long practiſed by thoſe who called themſelves Catholics, againſt thoſe whom they termed *heretics;* that is, thoſe who differed in opinion from themſelves. Finding that they could not bring over others to adopt their ſentiments by the force of argument, they judged it proper to compel them by the force of puniſhment. This practice was very general among orthodox Chriſtians, but eſpecially among Roman Catholics. See INQUISITION.

By the law of England, torture was at one period employed to compel thoſe criminals who ſtood obſtinately mute when brought to trial, and refuſed either to plead guilty or not guilty; but it is now aboliſhed (ſee ARRAIGNMENT, and RACK). A hiſtory of the machines which have been invented to torture men, and an account of the inſtances in which they have been employed, would exhibit a diſmal picture of the human character.

TORUS, in *Architecture*, a large round moulding uſed in the baſes of columns. See ARCHITECTURE.

TOUCAN. See RHAMPHASTOS, ORNITHOLOGY *Index*.

TOUCH-NEEDLE, among aſſayers, refiners, &c. little bars of gold, ſilver, and copper, combined together, in all the different proportions and degrees of mixture; the uſe of which is to diſcover the degree of purity of any piece of gold or ſilver, by comparing the mark it leaves on the touchſtone with thoſe of the bars.

The metals uſually tried by the touchſtone are gold, ſilver, and copper, either pure, or mixed with one another in different degrees and proportions, by fuſion. In order to find out the purity or quantity of baſer metal in theſe various admixtures, when they are to be examined they are compared with theſe needles, which are mixed in a known proportion, and prepared for this uſe. The metals of theſe needles, both pure and mixed, are all made into laminæ or plates, one-twelfth of an inch broad, and of a fourth part of their breadth in thickneſs, and an inch and half-long; theſe being thus prepared, you are to engrave on each a mark indicating its purity, or the nature and quantity of the admixture in it. The black rough marbles, the baſaltes, or the ſofter kinds of black pebbles, are the moſt proper for touchſtones.

The method of uſing the needles and ſtone is thus: The piece of metal to be tried ought firſt to be wiped well with a clean towel or piece of ſoft leather, that you may the better ſee its true colour; for from this alone an experienced perſon, will in ſome degree, judge beforehand what the principal metal is, and how and with what debaſed.

Then chooſe a convenient, not over large, part of the ſurface of the metal, and rub it ſeveral times very hardly and ſtrongly againſt the touchſtone, that in caſe a deceitful coat or cruſt ſhould have been laid upon it, it may be worn off by that friction: this, however, is more readily done by a grindſtone or ſmall file. Then wipe a flat and very clear part of the touchſtone, and rub againſt it, over and over, the juſt-mentioned part of the ſurface of the piece of metal, till you have, on the flat ſurface of the ſtone, a thin metallic cruſt, an inch long, and about an eighth of an inch broad: this done, look out the needle that ſeems moſt like to the metal under trial, wipe the lower part of this needle very

rricel- Experi- nent ‖ rture.

Transf. 438. 17.

Torture ‖ Touch-Needle.

Touch-Needle || Toulon.

very clean, and then rub it againſt the touchſtone, as you did the metal, by the ſide of the other line, and in a direction parallel to it.

When this is done, if you find no difference between the colours of the two marks made by your needle and the metal under trial, you may with great probability pronounce that metal and your needle to be of the ſame alloy, which is immediately known by the mark engraved on your needle. But if you find a difference between the colour of the mark given by the metal, and that by the needle you have tried, chooſe out another needle, either of a darker or lighter colour than the former, as the difference of the tinge on the touchſtone directs; and by one or more trials of this kind you will be able to determine which of your needles the metal anſwers, and thence what alloy it is of, by the mark of the needle; or elſe you will find that the alloy is extraordinary, and not to be determined by the compariſon of your needles,

Touchstone, a black, ſmooth, gloſſy ſtone, uſed to examine the purity of metals. The ancients called it *lapis Lydius*, the Lydian ſtone, from the name of the country whence it was originally brought.

Any piece of pebble or black flint will anſwer the purpoſes of the beſt lapis Lydius of Aſia. Even a piece of glaſs made rough with emery is uſed with ſucceſs, to diſtinguiſh true gold from ſuch as is counterfeit; both by the metallic colour and the teſt of aquafortis. The true touchſtone is of a black colour, and is not uncommon in many parts of the world.

TOUCHWOOD. See Boletus, Botany *Index*.

TOULON, a celebrated city and ſeaport of France, in that part of the late province of Provence which is now denominated the department of the *Var*. It is a very ancient place, having been founded, according to the common opinion, by a Roman general. It is the chief town of the department, and before the great revolution in 1789 was an epiſcopal ſee. The inhabitants are computed at 80,000. It is divided into the Old Quarter and the New Quarter. The firſt, which is very ill built, has nothing remarkable in it but the *Rue aux Arbres*, the Tree-Street, which is a kind of courſe or mall, and the town-houſe; the gate of this is ſurrounded by a balcony, which is ſupported by two termini, the maſterpieces of the famous Pujet. The New Quarter, which forms as it were a ſecond city, contains, beſide the magnificent works conſtructed in the reign of Louis XIV. many fine houſes (among which that of the late ſeminary merits beyond compariſon the preference) and a grand oblong ſquare, lined with trees, and ſerving as a parade.

The Merchants Haven, along which extends a noble quay, on which ſtands the town-houſe, is protected by two moles, begun by Henry IV. The New Haven was conſtructed by Louis XIV. as were the fortifications of the city. In the front of this haven is an arſenal, containing all the places neceſſary for the conſtruction and fitting out of veſſels: the firſt object that appears is a rope-walk, entirely arched, extending as far as the eye can reach, and built after the deſigns of Vauban: here cables are made, and above is a place for the preparation of hemp. Here likewiſe is the armoury for muſkets, piſtols, halberds, &c. In the park of artillery are cannons placed in piles, bombs, grenades, mortars, and balls of various kinds, ranged in wonderful order. The long ſail-room, the foundery for cannon, the dockyards, the baſons, &c. are all worthy of obſervation. Toulon, Toulouſe.

Both the Old and New Port have an outlet into the ſpacious outer road or harbour, which is ſurrounded by hills, and formed by nature almoſt circular. Its circuit is of very great extent, and the entrance is defended on both ſides by a fort with ſtrong batteries. In a word, the baſons, docks, and arſenal, at Toulon, warranted the remark of a foreigner that viſited them in the late reign, that "the king of France was greater there than at Verſailles." Toulon is the only mart in the Mediterranean for the re-exportation of the products of the Eaſt Indies.

This place was deſtroyed toward the end of the tenth century, and pillaged by the African pirates almoſt as ſoon as rebuilt. The conſtable of Bourbon, at the head of the Imperial troops, obtained poſſeſſion of it in 1524, as did Charles V. in 1536; but in the next century Charles Emanuel duke of Savoy could not enter it, and Prince Eugene in 1707 ineffectually laid ſiege to it. This city was ſurrendered by the inhabitants in September 1793 to the Britiſh admiral Lord Hood, as a condition and means of enabling them to effect the re-eſtabliſhment of monarchy in France, according to the conſtitution of 1789. Lord Hood accordingly, in conjunction with the Spaniſh land and naval forces, took poſſeſſion of the harbour and forts in truſt for Louis XVII. It was garriſoned for ſome time by the Britiſh troops, and their allies the Spaniards, Neapolitans, and Sardinians; but the French having laid ſiege to it, the garriſon was obliged to evacuate the place in the month of December following, after having deſtroyed the grand arſenal, two ſhips of 84 guns, eight of 74, and two frigates; and carried off the Commerce de Marſeilles, a ſhip of 120 guns, with an 80 and 74 gun ſhip. This exploit was moſt gallantly performed, after it was found impoſſible to defend the town, or to carry off the ſhips. Lord Hood entruſted the management of the affair to Sir Sydney Smith, ſo diſtinguiſhed for his intrepidity. Captain Hare commanded the fireſhip which was towed into the grand arſenal; and ſo eager was he to execute his orders, that inſtead of ſetting fire to the train in the uſual cautious manner, he fired a piſtol loaded with powder into the bowl of the train, compoſed of 36 pounds of powder and other combuſtibles. The conſequence was, he was blown into the water with ſuch violence, as to knock a lieutenant of the Victory's boat overboard, and narrowly eſcaped with his life. A Spaniſh captain was appointed to ſet fire to the ſmall arſenal, but cowardice prevented him from executing his orders; and this is the reaſon why the whole French ſhips were not deſtroyed. We have been favoured with this account by an officer of the Britiſh fleet.

Toulon is ſeated on a bay of the Mediterranean, 17 leagues ſouth-eaſt of Aix, 15 ſouth-eaſt of Marſeilles, and 217 ſouth-eaſt of Paris. E. Long. 5. 56. N. Lat. 43. 7.

TOULOUSE, a very ancient city of France, in the department of Upper Garonne, and late province of Languedoc, with an archbiſhop's ſee. It is the moſt conſiderable city in France next to Paris and Lyons, although its population bears no proportion to its extent. According to Mr Neckar's calculation, it contains 56,000 inhabitants. The ſtreets are very handſome,

houſe, ſome, and the walls of the city, as well as the houſes, are built with bricks. The town-houſe, a modern ſtructure, forms a perfect ſquare, 324 feet long and 66 high. The principal front occupies an entire ſide of the grand ſquare, lately called the *Place Royale*. In the great hall, called the *Hall of Illuſtrious Men*, is the ſtatue of the Chevalier Iſaure, and the buſts of all the great men to whom Toulouſe has given birth. Communicating with the ocean on one ſide by the river Garonne, and with the Mediterranean on the other by the canal of Languedoc, Toulouſe might have been a great commercial city; but the taſte of the inhabitants has been directed to the ſciences and belles-lettres. Of courſe, there are two colleges, two public libraries, and three academies. The little commerce of Toulouſe conſiſts in leather, drapery, blankets, mignionets, oil, iron, mercery, hardware, and books. The bridge over the Garonne is at leaſt equal to thoſe of Tours and Orleans; it forms the communication between the ſuburb of St Cyprian and the city. The quays extend along the banks of the Garonne; and it has been in contemplation to line them with new and uniform houſes. Toulouſe is 37 miles eaſt of Auch, 125 ſouth-eaſt of Bourdeaux, and 350 ſouth-by-weſt of Paris. E. Long. 1. 32. N. Lat. 43. 36.

TOUR, HENRY DE LA, Viſcount Turenne, a celebrated French general, was the ſecond ſon of Henry de la Tour duke of Bouillon, and was born at Sedan in 1611. He made his firſt campaigns in Holland, under Maurice and Frederic Henry princes of Orange; who were his uncles by the mother's ſide; and even then diſtinguiſhed himſelf by his bravery. In 1634 he marched with his regiment into Lorraine; and having contributed to the taking of La Mothe, was, though very young, made mareſchal de camp. In 1636 he took Saverne, and the year following the caſtles of Hirſon and Sole; on which occaſion he performed an action like that of Scipio's, with reſpect to a very beautiful woman whom he ſent back to her huſband. The viſcount Turenne continued to diſtinguiſh himſelf in ſeveral ſieges and battles, and in 1644 was made marſhal of France; but had the misfortune to be defeated at the battle of Mariendal in 1645. However, he gained the battle of Nortlingen three months after; reſtored the elector of Treves to his dominions; and the following year made the famous junction of the French army with that of Sweden commanded by General Wrangel, which obliged the duke of Bavaria to demand a peace. Afterwards that duke breaking the treaty he had concluded with France, he was defeated by the viſcount Turenne at the battle of Zumarſhauſen, and in 1648 driven entirely out of his dominions. During the civil wars in France he ſided with the princes, and was defeated at the battle of Rhetel in 1650; but ſoon after was reſtored to the favour of the king, who in 1652 gave him the command of his army. He acquired great honour at the battles of Jergeau, Gren, and the ſuburbs of St Anthony, and by the retreat he made before the army commanded by the princes at Ville Neuve St George. In 1654 he made the Spaniards raiſe the ſiege of Arras: the next year he took Conde, St Guilian, and ſeveral other places; gained the famous battle of Dunes; and made himſelf maſter of Dunkirk, Ondenarde, and almoſt all Flanders: this obliged the Spaniards to conclude the peace of the Pyrenees in 1660. Theſe important ſervices occaſioned his being made marſhal-general of the king's camps and armies. The war being renewed with Spain in 1667, Turenne commanded in Flanders; and took ſo many places, that in 1668 the Spaniards were obliged to ſue for peace. He commanded the French army in the war againſt the Dutch in 1672; took 40 towns in 22 days; purſued the elector of Brandenburg even to Berlin; gained the battles of Slintſheim, Ladenburg, Enſheim, Mulhauſen, and Turkeim; and obliged the Imperial army, which conſiſted of 70,000 men, to repaſs the Rhine. By this campaign the viſcount Turenne acquired immortal honour. He paſſed the Rhine to give battle to General Montecuculi, whom he followed as far as Saſpach; but mounting upon an eminence to diſcover the enemy's camp, he was killed by a cannon-ball in 1675. All France regretted the loſs of this great man, who, by his military exploits, had raiſed the admiration of Europe.

Tour || Tournament.

TOURAINE, a province of France, bounded on the north by Maine, on the eaſt by Orleanois, on the ſouth by Berris, and on the weſt by Anjou and Poitou. It is about 58 miles in length, and 55 in breadth where it is broadeſt. This country is watered by 17 rivers, beſides many brooks, which not only render it delightful, but keep up a communication with the neighbouring provinces. The air is temperate, and the ſoil is ſo fruitful that it is called the *garden of France*. It now forms the department of Indre and Loire, of which Tours is the capital.

TOURMALINE, a ſpecies of mineral belonging to the ſiliceous genus. See MINERALOGY *Index*.

TOURNAMENT, a martial ſport or exerciſe which the ancient cavaliers uſed to perform, to ſhow their bravery and addreſs. It is derived from the French word *tourner*, i. e. "to turn round," becauſe to be expert in theſe exerciſes, much agility both of horſe and man was requiſite, they riding round a ring in imitation of the ancient Circi.

The firſt tournaments were only courſes on horſeback, wherein the cavaliers tilted at each other with canes in manner of lances; and were diſtinguiſhed from juſts, which were courſes or careers, accompanied with attacks and combats, with blunted lances and ſwords. See JUST.

The prince who publiſhed the tournament, uſed to ſend a king at arms, with a ſafe-conduct, and a ſword, to all the princes, knights, &c. ſignifying that he intended a tournament and claſhing of ſwords, in the preſence of ladies and damſels; which was the uſual formula of invitation.

They firſt engaged man againſt man, and then troop againſt troop; and, after the combat, the judges allotted the prize to the beſt cavalier, and the beſt ſtriker of ſwords; who was accordingly conducted in pomp to the lady of the tournament; where, after thanking her very reverently, he ſaluted her and likewiſe her two attendants.

Theſe tournaments made the principal diverſion of the 13th and 14th centuries. Munſter ſays, it was Henry the Fowler, duke of Saxony, and afterwards emperor, who died in 936, that firſt introduced them; but it appears from the chronicle of Tours, that the true inventor of this famous ſport, at leaſt in France, was one Geoffry, lord of Preuilli, about the year 1066.

Inſtances of them occur among the Engliſh in the reign

Tournament || Tournefort.

reign of King Stephen, about the year 1140; but they were not much in uſe till Richard's time, towards the year 1149. After which period theſe diverſions were performed with extraordinary magnificence in the Tilt-yard near St James's, Smithfield, and other places.

The following is the account of a tournament, from Maitland. King Richard II. deſigning to hold a tournament at London on the Sunday after Michaelmas, ſent divers heralds to make proclamations of it in all the principal courts of Europe; and accordingly not a few princes, and great numbers of the prime nobility, reſorted hither from France, Germany, the Netherlands, &c. This ſolemnity began on Sunday afternoon, from the Tower of London, with a pompous cavalcade of 60 ladies, each leading an armed knight by a ſilver chain, being attended by their 'ſquires of honour, and, paſſing through Cheapſide, rode to Smithfield, where the juſts and tournaments continued ſeveral days with magnificent variety of entertainments; on which occaſion the king kept open houſe at the biſhop of London's palace for all perſons of diſtinction, and every night concluded with a ball.

At laſt, however, they were found to be productive of bad effects, and the occaſions of ſeveral fatal misfortunes—as in the inſtance of Henry II. of France, and of the tilt exhibited at Chalons, which, from the numbers killed on both ſides, was called the *little war of Chalons*. Theſe and other inconveniencies, reſulting from thoſe dangerous paſtimes, gave the popes occaſion to forbid them, and the princes of Europe gradually concurred in diſcouraging and ſuppreſſing them.

TOURNAY, a town of the Auſtrian Netherlands in Flanders, and capital of a diſtrict called *Tournaysis*, with a biſhop's ſee. It is divided into two parts by the river Scheldt; and is large, populous, well built, and carries on a great trade in woollen ſtuffs and ſtockings. The cathedral is a very handſome ſtructure, and contains a great many chapels, with rich ornaments, and ſeveral magnificent tombs of marble and braſs. The town was taken by the allies in 1709; but was ceded to the houſe of Auſtria by the treaty of Utrecht, though the Dutch had a right to put in a garriſon. It was taken by the French in June 1745, who demoliſhed the fortifications. In 1781 the emperor Joſeph II. obliged the Dutch to withdraw their garriſon. It was taken by the French in 1791, abandoned by them in 1793, and again conquered by them in 1794. It is 14 miles ſouth-eaſt of Liſle, 30 ſouth-weſt of Ghent, and 135 north-by-eaſt from Paris. E. Long. 3. 25. N. Lat. 50. 35.

TOURNEFORT, Joseph Pitton de, a famous French botaniſt, was born at Aix in Provence in 1656. He had a paſſion for plants from his childhood, which overcame his father's views in putting him to ſtudy philoſophy and divinity; therefore on his death he quitted theology, and gave himſelf up entirely to phyſic, natural hiſtory, and botany. He wandered over the mountains of Dauphiny, Savoy, Catalonia, the Pyrenees, and the Alps, in ſearch of new ſpecies of plants, which he acquired with much fatigue and danger. His fame in 1683 procured him the employment of botanic profeſſor, in the king's garden; and by the king's order, he travelled into Spain, Portugal, Holland, and England, where he made prodigious collections of plants. In 1700, Mr Tournefort, in obedience to another order, ſimpled over all the iſles of the Archipelago, upon the coaſts of the Black ſea, in Bithynia, Pontus, Cappadocia, Armenia, and Georgia; making obſervations on natural hiſtory at large, ancient and modern geography, religion, manners, and commerce. He ſpent three years in this learned voyage; and then reſuming his profeſſion, was made profeſſor of phyſic in the college-royal. He died in conſequence of an accidental cruſh of his breaſt by a cart-wheel, which brought on a ſpitting of blood and hydrothorax, that carried him off in 1708. He wrote Elements of Botany, both in French and Latin; A relation of his Voyage into the Levant; with other pieces of leſs conſideration.

Tournefort || Traditio

TOURNIQUET, in *Surgery*, an inſtrument formed with ſcrews, for compreſſing any part with rollers, &c. for the ſtopping of hæmorrhagies. See Surgery *Index*.

TOWER, a tall building conſiſting of ſeveral ſtories, uſually of a round form, though ſome are ſquare or polygonal. Towers are built for fortreſſes, &c. as the Tower of London. See London, N° 46.

TOWN, a place inhabited by a conſiderable number of people, being of a middle ſize between a city and a village.

TOXICODENDRON. See Rhus, Botany *Index*.

TRAAS. See Terras.

TRACHEA. See Anatomy, N° 119.

TRACHINUS, the Weever, a genus of fiſhes belonging to the order of jugulares. See Ichthyology *Index*.

TRACT, in *Geography*, an extent of ground, or a portion of the earth's ſurface.

Tract, in matters of literature, denotes a ſmall treatiſe or written diſcourſe upon any ſubject.

TRADE, in general, denotes the ſame with commerce, conſiſting in buying, ſelling, and exchanging of commodities, bills, money, &c. See Commerce, Coin, Money, Company, &c.

Trade-Winds, denote certain regular winds at ſea, blowing either conſtantly the ſame way, or alternately this way and that; thus called from their uſe in navigation, and the Indian commerce. See Meteorology.

Tradesmen's tokens, a term ſynonymous among medaliſts with provincial coins.

This is a ſubject curious enough to deſerve attention, though we will not go ſo far as Mr Pinkerton does, who ſays that it is a ſubject in which the perpetual glory of the nation is intereſted. Since the year 1789 provincial halfpence have been made and circulated in conſiderable quantity. As ancient medals and coins have been frequently of uſe to hiſtorians, it is to be regretted that many of theſe provincial halfpence are rendered uſeleſs in this reſpect by unmeaning figures and puerile devices. Utility and elegance ought to be ſtudied: for this view it has been propoſed by a gentleman of taſte on this ſubject, that all coins ſhould be diſtinguiſhed by one of the following five characteriſtics. 1. Fac ſimiles of magnificent beautiful buildings. 2. Repreſentations of great and uſeful undertakings. 3. Emblems of the induſtry and commerce of the age. 4. The illuſtrious men, &c. to whom the nation has given birth. 5. Important hiſtorical events.

TRADITION, ſomething handed down from one generation to another without being written. Thus the

Jews

addition || Tra-los-montes.

Jews pretended, that beſides their written law contained in the Old Teſtament, Moſes had delivered an oral law which had been conveyed down from father to ſon; and thus the Roman Catholics are ſaid to value particular doctrines ſuppoſed to have deſcended from the apoſtolic times by tradition.

TRAGACANTH. See ASTRAGALUS, MATERIA MEDICA *Index*.

TRAGEDY, a dramatic poem, repreſenting ſome ſignal action performed by illuſtrious perſons, and which has frequently a fatal iſſue or end. See POETRY, Part II. ſect. 1.

TRAGI-COMEDY, a dramatic piece, partaking both of the nature of tragedy and comedy; in which a mixture of merry and ſerious events is admitted.

TRAGOPOGON, GOAT'S-BEARD; a genus of plants belonging to the claſs of ſyngeneſia; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. See BOTANY *Index*.

TRAJAN, MARCUS ULPIUS, a celebrated Roman emperor, who gained many victories over the Parthians and Germans, puſhing the empire to its utmoſt extent on the eaſt and north ſides. He died at Silinunte, a city of Cilicia, which from him was called *Trajanopolis*, in the year 117.

TRAJAN'S Column, a famous hiſtorical column erected in Rome, in honour of the emperor Trajan. It is of the Tuſcan order, though ſomewhat irregular: its height is eight diameters, and its pedeſtal Corinthian: it was built in a large ſquare called *Forum Romanum*. Its baſe conſiſts of 12 ſtones of an enormous ſize, and is raiſed on a ſocle, or foot, of eight ſteps: withinſide is a ſtaircaſe illuminated with 44 windows. It is 140 feet high, which is 35 feet ſhort of the Antonine column, but the workmanſhip of the former is much more valued. It is adorned from top to bottom with baſſo relievos, repreſenting the great actions of the emperor againſt the Dacians.

TRAIN, a line of gunpowder laid to give fire to a quantity thereof, in order to do execution by blowing up earth, works, buildings, &c.

TRAIN of Artillery, includes the great guns and other pieces of ordnance belonging to an army in the field.

TRAIN-Oil, the oil procured from the blubber of a whale by boiling.

TRALLIAN, ALEXANDER, a Greek writer on phyſic, a native of Tralles in Lydia, who lived about the middle of the ſixth century. His works are divided into 12 books; in which he treats of diſtempers as they occur, from head to foot. He was the firſt who opened the jugular vein, and that uſed cantharides as a bliſter for the gout. Dr Freind, in his Hiſtory of Phyſic, ſtyles him one of the moſt valuable authors ſince the time of Hippocrates. Though he appears on the whole to have been a rational phyſician, yet there are things in his writings that favour of enthuſiaſm and ſuperſtition.

TRA-LOS-MONTES, a province of Portugal, called in Latin *Tranſmontana*, becauſe ſituated on the eaſt ſide of a chain of hills that ſeparate it from Entre Duero-e-Minho. It is bounded on the north by Galicia; on the ſouth by the provinces of Beira and Leon; by the laſt of which it is bounded alſo to the eaſt. Its length from north to ſouth is upwards of 120 miles, and its breadth about 80. It is full of mountains, and produces little corn, but plenty of wine, fruits of ſeveral ſorts, and abundance of game.

Tra-los-montes || Tranſuſion.

TRANSACTIONS, a name generally given to a collection of the papers read before literary or philoſophical ſocieties. The name of *Philoſophical Tranſactions* was firſt adopted by the Royal Society of London.

The Philoſophical Tranſactions to the end of the year 1700 were abridged in three volumes by Mr John Lowthorp: thoſe from the year 1700 to 1720 were abridged in two volumes by Mr Henry Jones: thoſe from 1719 to 1733 were abridged in two volumes by Mr John Eames and Mr John Martyn; Mr Martyn continued the abridgment of thoſe from 1732 to 1744 in two volumes, and of thoſe from 1743 to 1750 in two volumes.

They were for many years publiſhed in numbers, and the printing of them was always, from time to time, the ſingle act of the reſpective ſecretaries, till the year 1752, when the ſociety thought fit that a committee ſhould be appointed to conſider the papers read before them, and to ſelect out of them ſuch as they ſhould judge moſt proper for publication in the future Tranſactions. They are publiſhed annually in two parts at the expence of the ſociety, and each fellow is entitled to receive one copy *gratis* of every volume publiſhed after his admiſſion into the ſociety.

They were firſt ſet on foot in 1665, by Mr Oldenburg, ſecretary of the ſociety, and were continued by him till the year 1677. Upon his death, they were diſcontinued till January 1678, when Dr Grew reſumed the publication of them, and continued it for the months of December 1678, and January and February 1679, after which they were intermitted till January 1683. During this laſt interval they were ſupplied in ſome meaſure by Dr Hooke's Philoſophical Collections. They were alſo interrupted for three years, from December 1687 to January 1691, beſide other ſmaller interruptions, amounting to near one year and a half more, before October 1695, ſince which time the Tranſactions have been regularly carried on.

TRANSCENDENTAL, or TRANSCENDENT, ſomething elevated, or raiſed above other things; which paſſes and tranſcends the nature of other inferior things.

TRANSCRIPT, a copy of any original writing, particularly that of an act or inſtrument inſerted in the body of another.

TRANSFER, in commerce, an act whereby a perſon ſurrenders his right, intereſt, or property, in any thing moveable or immoveable, to another.

TRANSFORMATION, in general, denotes a change of form, or the aſſuming a new form different from a former one.

TRANSFUSION, the act of pouring a liquor out of one veſſel into another.

TRANSFUSION of Blood, an operation by which it was ſome time ago imagined that the age of animals would be renewed, and immortality, or the next thing to it, conferred on thoſe who had undergone it.

The method of transfuſing Dr Lower gives us to the following effect: take up the carotid artery of the dog, or other animal, whoſe blood is to be transfuſed into another of the ſame, or a different kind: ſeparate it from the nerve of the eighth pair, and lay it bare above

Transfuſion. an inch. Make a ſtrong ligature on the upper part of the artery; and an inch nearer the heart another ligature with a running knot, to be looſened and faſtened as occaſion requires. Draw two threads between the two ligatures, open the artery, put in a quill, and tie up the artery again upon the quill by the two threads, and ſtop the quill by a ſtick.

Then make bare the jugular vein of the other animal for about an inch and a half in length, and at each end make a ligature with a running knot; and in the ſpace between the two knots draw under the veins two threads, as in the other. Open the vein, and put into it two quills, one into the deſcending part of the vein, to receive the blood from the other dog, and carry it to the heart; the other quill put into the other part of the jugular, towards the head, through which the ſecond animal's own blood is to run into diſhes. The quills thus tied faſt, ſtop them up with ſticks till there be occaſion to open them.

Things thus diſpoſed, faſten the dogs on their ſides towards one another, in ſuch manner as that the quills may go into each other; then unſtop the quill that goes down into the ſecond dog's jugular vein, as alſo that coming out of the other dog's artery; and by the help of two or three other quills put into each other, as there ſhall be occaſion, inſert them into one another. Then ſlip the running knots, and immediately the blood runs through the quills as through an artery, very impetuouſly. As the blood runs into the dog, unſtop the quill in the upper part of his jugular, for his own blood to run out at, though not conſtantly, but as you perceive him able to bear it, till the other dog begins to cry and faint, and at laſt die. *Laſtly*, Take both quills out of the jugular, tie the running knot faſt, and cut the vein aſunder, and ſew up the ſkin: the dog, thus diſmiſſed, will run away as if nothing ailed him.

In the Philoſophical Tranſactions we have accounts of the ſucceſs of various tranſfuſions practiſed at London, Paris, in Italy, &c. Sir Edmund King tranſuſed forty-nine ounces of blood out of a calf into a ſheep; the ſheep, after the operation, appearing as well and as ſtrong as before.

M. Denis tranſuſed the blood of three calves into three dogs, which all continued briſk, and ate as well as before. The ſame perſon transfuſed the blood of four wethers into a horſe twenty-ſix years old, which thence received much ſtrength, and a more than ordinary appetite.

Soon after this operation was introduced at Paris, viz. in 1667 and 1668, M. Denis performed it on five human ſubjects, two of whom recovered of diſorders under which they laboured, one being in perfect health ſuffered no inconvenience from it; and two perſons who were ill, and ſubmitted to the operation, died; in conſequence of which the magiſtrates iſſued a ſentence, prohibiting the transfuſion on human bodies under pain of impriſonment.

Mr John Hunter, we are told, made many ingenious experiments to determine the effects of transfuſing blood, ſome of which are ſufficient to attract attention. But whether ſuch experiments can ever be made with ſafety on the human body, is a point not eaſily determined. They might be allowed in deſperate caſes proceeding from a corruption of the blood, from poiſon, &c. as in hydrophobia.

TRANSIT, from *tranſit*, "it paſſes over," ſignifies the paſſage of any planet over the ſun, moon, or ſtars. Transit

TRANSITION, the paſſage of any thing from one place to another. ‖ Tranſmutation.

Transition, in *Oratory*. See Oratory, N° 39.

TRANSITIVE, in *Grammar*, an epithet applied to ſuch verbs as ſignify an action which paſſes from the ſubject that does it, to or upon another ſubject which receives it. Under the head of verbs tranſitive come what we uſually call *verbs active* and *paſſive*; other verbs, whoſe action does not paſs out of themſelves, are called *neuters*.

TRANSLATION, the act of transferring or removing a thing from one place to another; as we ſay, the tranſlation of a biſhop's ſee, a council, a ſeat of juſtice, &c.

Translation is alſo uſed for the verſion of a book or writing out of one language into another.

The principles of tranſlation have been clearly and accurately laid down by Dr Campbell of Aberdeen in his invaluable Preliminary Diſſertations to his excellent tranſlations of the goſpels. The fundamental rules which he eſtabliſhes are three: 1. That the tranſlation ſhould give a complete tranſcript of the ideas of the original. 2. That the ſtyle and manner of the original ſhould be preſerved in the tranſlation. 3. That the tranſlation ſhould have all the eaſe of original compoſition. The rules deducible from theſe general laws are explained and illuſtrated with much judgment and taſte, in an Eſſay on the Principles of Tranſlation, by Mr Tytler, judge-advocate of Scotland.

TRANSMARINE, ſomething that comes from or belongs to the parts beyond ſea.

TRANSMIGRATION, the removal or tranſlation of a whole people into another country, by the power of a conqueror.

Transmigration is particularly uſed for the paſſage of the ſoul out of one body into another. See Metempsychosis.

TRANSMUTATION, the act of changing one ſubſtance into another.

Nature, ſays Sir Iſaac Newton, is delighted with tranſmutation: water, which is a fluid, volatile, taſteleſs, ſalt, is, by heat, tranſmuted into vapour, which is a kind of air; and by cold into ice, which is a cold, tranſparent, brittle ſtone, eaſily diſſolvable; and this ſtone is convertible again into water by heat, as vapour is by cold.—Earth, by heat, becomes fire, and, by cold, is turned into earth again: denſe bodies, by fermentation, are rarefied into various kinds of air; and that air, by fermentation alſo, and ſometimes without it, reverts into groſs bodies. All bodies, beaſts, fiſhes, inſects, plants, &c. with all their various parts, grow and increaſe out of water and aqueous and ſaline tinctures; and, by putrefaction, all of them revert into water, or an aqueous liquor again.

Transmutation, in alchemy, denotes the act of changing imperfect metals into gold or ſilver. This is alſo called the *grand operation*; and, they ſay, it is to be effected with the philoſopher's ſtone.

The trick of tranſmuting cinnabar into ſilver is thus: the cinnabar, being bruiſed groſsly, is ſtratified in a crucible with granulated ſilver, and the crucible placed in a great fire; and, after due time for calcination, taken off; then the matter, being poured out, is found to be cinnabar

Transmutation || Transylvania

cinnabar turned into real silver, though the silver grains appear in the same number and form as when they were put into the crucible; but the mischief is, coming to handle the grains of silver, you find them nothing but light friable bladders which will crumble to pieces between the fingers.

The transmutability of water into earth seems to have been believed by Mr Boyle; and Bishop Watson thinks that it has not yet been disproved. See his *Chemical Essays*.

Transmutation of Acids, or *of Metals*, is the change of one acid or of one metal into another.

TRANSOM, among builders, denotes the piece that is framed across a double-light window.

TRANSOMS, in a ship, certain beams or timbers extended across the sternpost of a ship, to fortify her afterpart, and give it the figure most suitable to the service for which she is calculated.

TRANSPARENCY, in *Physics*, a quality in certain bodies, whereby they give passage to the rays of light: in constradistinction to opacity, or that quality of bodies which renders them impervious to the rays of light.

It has been generally supposed by philosophers, that transparent bodies have their pores disposed in straight lines, by which means the rays of light have an opportunity of penetrating them in all directions; but some experiments in electricity have made it apparent, that by the action of this fluid the most opaque bodies, such as sulphur, pitch, and sealing-wax, may be rendered transparent as glass, while yet we cannot suppose the direction of their pores to be any way altered from what it originally was (see ELECTRICITY). There is a curious instance of an increase of transparency in rubbing a piece of white paper over one that has been written upon or printed: while the white paper is at rest, the writing or print will perhaps scarce appear through it; but when in motion, will be very easily legible, and continue so till the motion is discontinued.

TRANSPOSITION, in *Grammar*, a disturbing or dislocating the words of a discourse, or a changing their natural order of construction, to please the ear by rendering the contexture more smooth, easy, and harmonious.

TRANSUBSTANTIATION, in *Theology*, the conversion or change of the substance of the bread and wine in the eucharist, into the body and blood of Jesus Christ; which the Romish church suppose to be wrought by the consecration of the priest. See *Supper of the Lord*, N° 5.

TRANSVERSALIS, in *Anatomy*, a name given to several muscles. See ANATOMY, Part II.

TRANSVERSE, something that goes across another from corner to corner: thus bends and bars in heraldry are transverse pieces or bearings; the diagonals of a parallelogram or a square are transverse lines.

TRANSYLVANIA, a province of Europe, annexed to Hungary, and bounded on the north by Upper Hungary and Poland, on the east by Moldavia and Walachia, on the south by Walachia, and on the west by Upper and Lower Hungary. It is surrounded on all parts by high mountains, which, however, are not barren. The inhabitants have as much corn and wine as they want themselves; and there are rich mines of gold, silver, lead, copper, quicksilver, and alum. It has undergone various revolutions; but it now belongs to the house of Austria. The inhabitants are of several sorts of religions; as Papists, Lutherans, Calvinists, Socinians, Photinians, Arians, Greeks, and Mahometans. It is about 162 miles in length, and 150 in breadth. The administration of affairs is conducted by twelve persons; namely, three Roman Catholics, three Lutherans, three Calvinists, and three Socinians. The militia is commanded by the governor, whose commission is the more important, as Transylvania is the bulwark of Christendom. It is divided into several small districts, called *palatinates* and *counties*; and is inhabited by three different nations, Saxons, Silesians, and Hungarians. Hermanstadt is the capital town.

TRAPEZIUM, in *Geometry*, a plane figure contained under four unequal right lines.

TRAPEZIUS, a muscle. See ANATOMY, Part II.

TRAPP, a compound rock. See GEOLOGY.

TRAVELLERS JOY. See CLEMATIS, BOTANY *Index*.

TRAVERSE, or TRANSVERSE, in general, denotes something that goes athwart another; that is, crosses and cuts it obliquely.

TRAVERSE, in *Navigation*, implies a compound course, or an assemblage of various courses, lying at different angles with the meridian. See NAVIGATION.

Traverse Board, a thin circular piece of board, marked with all the points of the compass, and having eight holes bored in each, and eight small pegs hanging from the centre of the board. It is used to determine the different courses run by a ship during the period of the watch, and to ascertain the distance of each course.

TRAVESTY, a name given to a humorous translation of any author. The word is derived from the French *travester*, "to disguise."

TREACLE, or MELASSES. See SUGAR.

Treacle Beer. See SPRUCE.

Treacle Mustard. See CLYPEOLA, BOTANY *Index*.

TREASON, a general appellation, made use of by the law, to denote not only offences against the king and government, but also that accumulation of guilt which arises whenever a superior reposes a confidence in a subject or inferior, between whom and himself there subsists a natural, a civil, or even a spiritual relation; and the inferior so abuses that confidence, so forgets the obligations of duty, subjection, and allegiance, as to destroy the life of any such superior or lord. Hence treason is of two kinds, *high* and *petty*.

High Treason, or *Treason Paramount* (which is equivalent to the *crimen læsæ majestatis* of the Romans, as Glanvil denominates it also in our English law), is an offence committed against the security of the king or kingdom, whether by imagination, word, or deed. In order to prevent the inconveniences which arose in England from a multitude of constructive treasons, the statute 25 Edw. III. c. 2. was made; which defines what offences only for the future should be held to be treason; and this statute comprehends all kinds of high-treason under seven distinct branches.

"1. When a man doth compass or imagine the death of our lord the king, of our lady his queen, or of their eldest son and heir." Under this description it is held that a queen-regnant (such as Queen Elizabeth and Queen

Treaſon. Queen Anne) is within the words of the act, being inveſted with royal power, and intitled to the allegiance of her ſubjects: but the huſband of ſuch a queen is not compriſed within theſe words; and therefore no treaſon can be committed againſt him.

Let us next ſee what is a *compaſſing* or *imagining* the death of the king, &c. Theſe are ſynonymous terms: the word *compaſs* ſignifying the purpoſe or deſign of the mind or will; and not, as in common ſpeech, the carrying ſuch deſign to effect. And therefore an accidental ſtroke, which may mortally wound the ſovereign, *per infortuniam*, without any traitorous intent, is no treaſon: as was the caſe of Sir Walter Tyrrel, who, by the command of King William Rufus, ſhooting at a hart, the arrow glanced againſt a tree, and killed the king upon the ſpot. But as this compaſſing or imagination is an act of the mind, it cannot poſſibly fall under any judicial cognizance, unleſs it be demonſtrated by ſome open or overt act. The ſtatute expreſsly requires, that the accuſed "be thereof upon ſufficient proof attainted of ſome open act by men of his own condition." Thus, to provide weapons or ammunition for the purpoſe of killing the king, is held to be a palpable overt act of treaſon in imagining his death. To conſpire to impriſon the king by force, and move towards it by aſſembling company, is an overt act of compaſſing the king's death; for all force uſed to the perſon of the king, in its conſequence may tend to his death, and is a ſtrong preſumption of ſomething worſe intended than the preſent force, by ſuch as have ſo far thrown off their bounden duty to their ſovereign: it being an old obſervation, that there is generally but a ſhort interval between the priſons and the graves of princes. It ſeems clearly to be agreed, that by the common law and the ſtatute of Edw. III. words ſpoken amount only to a high miſdemeanor, and no treaſon. For they may be ſpoken in heat, without any intention; or be miſtaken, perverted, or miſremembered by the hearers; their meaning depends always on their connection with other words and things; they may ſignify differently even according to the tone of voice with which they are delivered; and ſometimes ſilence itſelf is more expreſſive than any diſcourſe. As therefore there can be nothing more equivocal and ambiguous than words, it would indeed be unreaſonable to make them amount to high treaſon. And accordingly, in 4 Car. I. on a reference to all the judges, concerning ſome very atrocious words ſpoken by one Pyne, they certified to the king, "that though the words were as wicked as might be, yet they were no treaſon; for unleſs it be by ſome particular ſtatute, no words will be treaſon." If the words be ſet down in writing, it argues more deliberate intention; and it has been held, that writing is an overt act of treaſon; for *ſcribere eſt agere*. But even in this caſe the bare words are not the treaſon, but the deliberate act of writing them.

2. The ſecond ſpecies of treaſon is, "if a man do violate the king's companion, or the king's eldeſt daughter unmarried, or the wife of the king's eldeſt ſon and heir." By the king's companion is meant his wife; and by violation is underſtood carnal knowledge, as well without force as with it: and this is high treaſon in both parties if both be conſenting; as ſome of the wives of Henry VIII. by fatal experience evinced.

3. The third ſpecies of treaſon is, "if a man do levy war againſt our lord the king in his realm." And this may be done by taking arms, not only to dethrone the king, but under pretence to reform religion, or the laws, or to remove evil counſellors, or other grievances whether real or pretended. For the law does not, neither can it permit any private man, or ſet of men, to interfere forcibly in matters of ſuch high importance; eſpecially as it has eſtabliſhed a ſufficient power for theſe purpoſes in the high court of parliament: neither does the conſtitution juſtify any private or particular reſiſtance for private or particular grievances; though, in caſes of national oppreſſion, the nation has very juſtifiably riſen as one man, to vindicate the original contract ſubſiſting between the king and his people. Treaſon.

4. "If a man be adherent to the king's enemies in his realm, giving to them aid and comfort in the realm or elſewhere," he is alſo declared guilty of high-treaſon. This muſt likewiſe be proved by ſome overt act; as by giving them intelligence, by ſending them proviſions, by ſelling them arms, by treacherouſly ſurrendering a fortreſs, or the like.

5. "If a man counterfeit the king's great or privy ſeal," this is alſo high-treaſon. But if a man takes wax bearing the impreſſion of the great ſeal off from one patent, and fixes it to another, this is held to be only an abuſe of the ſeal, and not a counterfeiting of it: as was the caſe of a certain chaplain, who in ſuch a manner framed a diſpenſation for non-reſidence. But the knaviſh artifice of a lawyer much exceeded this of the divine. One of the clerks in chancery glued together two pieces of parchment; on the uppermoſt of which he wrote a patent, to which he regularly obtained the great ſeal, the label going through both the ſkins. He then diſſolved the cement, and taking off the written patent, on the blank ſkin, wrote a freſh patent of a different import from the former, and publiſhed it as true. This was held no counterfeiting of the great ſeal, but only a great miſpriſion; and Sir Edward Coke mentions it with ſome indignation that the party was living at that day.

6. The ſixth ſpecies of treaſon under this ſtatute is, "if a man counterfeit the king's money; and if a man bring falſe money into the realm counterfeit to the money of England, knowing the money to be falſe, to merchandiſe and make payment withal." As to the firſt branch, counterfeiting the king's money; this is treaſon, whether the falſe money be uttered in payment or not. Alſo if the king's own minters alter the ſtandard or alloy eſtabliſhed by law, it is treaſon. But gold and ſilver money only are held to be within this ſtatute. With regard likewiſe to the ſecond branch, importing foreign counterfeit money in order to utter it here; it is held that uttering it, without importing it, is not within the ſtatute.

7. The laſt ſpecies of treaſon aſcertained by this ſtatute is, "if a man ſlay the chancellor, treaſurer, or the king's juſtices of the one bench or the other, juſtices in eyre, or juſtices of aſſize, and all other juſtices aſſigned to hear and determine, being in their places doing their offices." Theſe high magiſtrates, as they repreſent the king's majeſty during the execution of their offices, are therefore for the time equally regarded by the law. But this ſtatute extends only to the actual killing of them; and not to wounding, or a bare attempt to kill them. It extends alſo only to the officers therein ſpecified; and therefore the barons of the exchequer, as ſuch, are not within

Treaſon. within the protection of this act; but the lord keeper or commiſſioners of the great ſeal now ſeem to be within it, by virtue of the ſtatutes 5 Eliz. c. 18. and 1 W. and M. c. 21.

The new treaſons, created ſince the ſtatute 1 M. c. 1. and not comprehended under the deſcription of ſtatute 25 Edw. III. may be compriſed under three heads. The firſt ſpecies relates to Papiſts; the ſecond to falſifying the coin or other royal ſignatures, as falſely forging the ſign manual, privy ſignet, or privy ſeal, which ſhall be deemed high treaſon (1 M. ſtat. ii. c. 6.). The third new ſpecies of high treaſon is ſuch as was created for the ſecurity of the Proteſtant ſucceſſion in the houſe of Hanover. For this purpoſe, after the act of ſettlement was made, it was enacted by ſtatute 13 and 14 W. III. c. 3. that the pretended prince of Wales, aſſuming the title of King James III. ſhould be attainted of high treaſon; and it was made high-treaſon for any of the king's ſubjects to hold correſpondence with him or any perſon employed by him, or to remit money for his uſe. And by 17 Geo. II. c. 39. it is enacted, that if any of the ſons of the pretender ſhall land or attempt to land in this kingdom, or be found in the kingdom or any of its dominions, he ſhall be adjudged attainted of high-treaſon; and correſponding with them or remitting money to their uſe is made high treaſon. By 1 Ann. ſtat. 2. c. 17. the offence of hindering the next in ſucceſſion from ſucceeding to the crown is high-treaſon: and by 6 Ann. c. 7. if any perſon ſhall maliciouſly, adviſedly, and directly, by writing or printing, maintain, that any other perſon hath any right to the crown of this realm, otherwiſe than according to the act of ſettlement, or that the kings of this realm with the authority of parliament are not able to make laws to bind the crown and its deſcent; ſuch perſon ſhall be guilty of high-treaſon.

The puniſhment of high treaſon in general is very ſolemn and terrible. 1. That the offender be drawn to the gallows, and not be carried or walk; though uſually (by connivance, at length ripened by humanity into law) a ſledge or hurdle is allowed, to preſerve the offender from the extreme torment of being dragged on the ground or pavement. 2. That he be hanged by the neck, and then cut down alive. 3. That his entrails be taken out, and burned while he is yet alive. 4. That his head be cut off. 5. That his body be divided into four parts. 6. That his head and quarters be at the king's diſpoſal.

The king may, and often doth, diſcharge all the puniſhment except beheading, eſpecially where any of noble blood are attainted. For beheading being part of the judgment, that may be executed, though all the reſt be omitted by the king's command. But where beheading is no part of the judgment, as in murder or other felonies, it hath been ſaid that the king cannot change the judgment, although at the requeſt of the party, from one ſpecies of death to another.

In the caſe of coining, which is a treaſon of a different complexion from the reſt, the puniſhment is milder for male offenders; being only to be drawn and hanged by the neck till dead. But in treaſons of every kind the puniſhment of women is the ſame, and different from that of men. For as the natural modeſty of the ſex forbids the expoſing and publicly mangling their bodies, their ſentence (which is to the full as terrible to ſenſe as the other) is to be drawn to the gallows, and there to be burned alive. Treaſon ‖ Treaſurer.

For the conſequences of this judgment, ſee ATTAINDER, FORFEITURE, and *CORRUPTION of Blood*.

Petty or *Petit Treaſon*, according to the ſtatute 25 Edward III. c. 2. may happen three ways: by a ſervant killing his maſter, a wife her huſband, or an eccleſiaſtical perſon (either ſecular or regular) his ſuperior, to whom he owes faith and obedience. A ſervant who kills his maſter whom he has left, upon a grudge conceived againſt him during his ſervice, is guilty of petty treaſon: for the traitorous intention was hatched while the relation ſubſiſted between them, and this is only an execution of that intention. So if a wife be divorced *a menſa et thoro*, ſtill the *vinculum matrimonii* ſubſiſts; and if ſhe kills ſuch divorced huſband, ſhe is a traitreſs. And a clergyman is underſtood to owe canonical obedience to the biſhop who ordained him, to him in whoſe dioceſe he is beneficed, and alſo to the metropolitan of ſuch ſuffragan or dioceſan biſhop; and therefore to kill any of theſe is petit treaſon. As to the reſt, whatever has been ſaid with reſpect to wilful MURDER, is alſo applicable to the crime of petit treaſon, which is no other than murder in its moſt odious degree; except that the trial ſhall be as in caſes of high treaſon, before the improvements therein made by the ſtatutes of William III. But a perſon indicted of petit treaſon may be acquitted thereof, and found guilty of manſlaughter or murder: and in ſuch caſe it ſhould ſeem that two witneſſes are not neceſſary, as in caſes of petit treaſon they are. Which crime is alſo diſtinguiſhed from murder in its puniſhment.

The puniſhment of petit treaſon in a man, is to be drawn and hanged, and in a woman to be drawn and burned: the idea of which latter puniſhment ſeems to have been handed down to us from the laws of the ancient Druids, which condemned a woman to be burned for murdering her huſband; and it is now the uſual puniſhment for all ſorts of treaſons committed by thoſe of the female ſex. Perſons guilty of petit treaſon were firſt debarred the benefit of clergy by ſtatute 12 Henry VII. c. 7. which has ſince been extended to their aiders, abettors, and counſellors, by ſtatutes 23 Henry VIII. c. 1, 4, and 5 P. and M. c. 4.

TREASURE, in general, denotes a ſtore or ſtock of money in reſerve.

TREASURE-Trove, in *Law*, derived from the French word *trover*, "to find," called in Latin *theſaurus inventus*, is where any money or coin, gold, ſilver, plate, or bullion, is found hidden in the earth or other private place, the owner thereof being unknown; in which caſe the treaſure belongs to the king: but if he that had hid it be known, or afterwards found out, the owner and not the king is intitled to it.

TREASURER, an officer to whom the treaſure of a prince or corporation is committed to be kept and duly diſpoſed of, in payment of officers and other expences. See TREASURY. Treaſurer.

Of theſe there is great variety. His majeſty of Great Britain, in quality of elector of Hanover, is arch-treaſurer of the Roman empire. In England, the principal officers under this denomination are, the lord high-treaſurer, the treaſurer of the houſehold, treaſurer of the navy, of the king's chamber, &c.

The lord high-treaſurer of Great Britain, or firſt commiſſioner

Treasurer || Trebuchet.

missioner of the treasury, when in commission, has under his charge and government all the king's revenue which is kept in the exchequer. He holds his place during the king's pleasure; being instituted by the delivery of a white staff to him. He has the check of all the officers employed in collecting the customs and royal revenues: and in his gift and disposition are all the offices of the customs in the several ports of the kingdom; escheators in every county are nominated by him; he also makes leases of the lands belonging to the crown.

The office of lord-treasurer is now in commission. The number of lords-commissioners is five; one of whom is the first lord, whose annual salary was formerly 3831. but is now 4000l.; and who, unless he be a peer, is also chancellor of the exchequer, and prime minister in the government of this country; the other lords commissioners have an annual salary of 1600l. each.

TREASURER of the Household, is an officer who, in the absence of the lord-steward, has power, with the comptroller and other officers of the green-cloth and the steward of the Marshalsea, to hear and determine treasons, felonies, and other crimes committed within the king's palace. See HOUSEHOLD.

There is also a treasurer belonging to the establishment of her majesty's household, &c.

TREASURER of the Navy, is an officer who receives money out of the exchequer, by warrant from the lord high-treasurer, or the lords commissioners executing that place; and pays all charges of the navy, by warrant from the principal officers of the navy.

TREASURER of the County, he that keeps the county stock. There are two of them in each county, chosen by the major part of the justices of the peace, &c. at their general quarter session; under previous security given for the money entrusted with them, and the faithful execution of the trusts reposed in them.

TREASURY, the place wherein the revenues of a prince are received, preserved and disbursed. In England the treasury is a part of the exchequer; by some called the *lower exchequer*. The officers of his majesty's treasury, or the lower exchequer, are the lords commissioners, one of whom is chancellor, two joint secretaries, private secretary to the first lord, two chamberlains, an auditor, four tellers, a clerk of the pells, ushers of the receipt, a tally-cutter, &c. See each officer under his proper article, CHANCELLOR, TELLER, TALLY, &c.

Lords of the TREASURY. In lieu of one single director and administrator of his majesty's revenues under the title of *lord high treasurer*, it is at present thought proper to put that office in commission, i. e. to appoint several persons to discharge it with equal authority, under the title of *lords commissioners of the treasury*.

TREATISE, a set discourse in writing on any subject.

TREATY, a covenant between two or more nations; or the several articles or conditions stipulated and agreed upon by two sovereign powers.

TREBLE, in *Music*, the highest or most acute of the four parts in symphony, or that which is heard the clearest and shrillest in a concert.

TREBUCHET, TREBUCKET, *Tribuch (Terbichetum)*, a tumbrel or cucking stool. Also a great engine to cast stones to batter walls. Trebuchet Tree.

TREE, a large vegetable, rising with one woody stem to a considerable height.

Trees may be divided into two classes, *timber* and *fruit-trees*; the first including all those trees which are used in machinery, ship-building, &c. or, in general, for purposes of utility; and the second comprehending those trees valued only, or chiefly, for their fruit. It is not necessary to form a third class to include trees used for fuel, as timber is used for this purpose where it is abundant; and where it is not abundant the branches of the timber trees, or such of them as are dwarfish, unhealthy, or too small for mechanical purposes, are used as fuel.

The anatomy and physiology of trees have already been given under the generic name PLANT and SAP.

Certain trees, it is well known, are natives of particular districts; but many of them have been transplanted from their native soil, and now flourish luxuriantly in distant countries, so that it becomes a matter of very considerable difficulty to ascertain their original soil. The following rules are given for this purpose by the Honourable Daines Barrington.

1. They must grow in large masses, and cover considerable tracts of ground, the woods not ending abruptly, by a change to other trees, except the situation and strata become totally different. 2. They must grow kindly in copses, and shoot from the stool, so as to continue for ever, if not very carefully grubbed up. 3. The seed must ripen kindly; nature never plants but where a succession in the greatest profusion will continue. Lastly, trees that give names to many places are probably indigenous.

The growth of trees is a curious and interesting subject; yet few experiments have been made to determine what the additions are which a tree receives annually in different periods of its age. The only observations which we have seen on this subject worth repeating were made by the ingenious Mr Barker, to whom the Philosophical Transactions are much indebted for papers containing an accurate register of the weather, which he has kept for many years. He has drawn up a table to point out the growth of three kinds of trees, oaks, ashes, and elms; which may be seen in the Philosophical Transactions for 1788. We shall give his conclusions.

"I find (says he) the growth of oak and ash to be nearly the same. I have some of both sorts planted at the same time, and in the same hedges, of which the oaks are the largest; but there is no certain rule as to that. The common growth of an oak or an ash is about an inch in girth in a year; some thriving ones will grow an inch and a half; the unthriving ones not so much. Great trees grow more timber in a year than small ones; for if the annual growth be an inch, a coat of one-sixth of an inch is laid on all round, and the timber added to the body every year is its length multiplied into the thickness of the coat and into the girth, and therefore the thicker the tree is, the more timber is added."

We will present our readers with a table, showing the growth of 17 kinds of trees for two years. The trees grew at Cavenham in Suffolk.

Tree.

N°	July 1785. F.	In.	July 1786. F.	In.	July 1787. F.	In.
1 Oak	0	10½	0	11½	1	0½
2 Larch	1	0½	1	3	1	4
3 Scotch fir	1	3½	1	5½	1	7¾
4 Spruce fir	0	5¾	0	6½	0	7¼
5 Spaniſh cheſnut	0	7¼	0	7½	0	8
6 Elm	2	7½	2	9	2	11
7 Pinaſter	2	3½	2	4½	2	7½
8 Larch	1	5¼	1	6	1	7
9 Weymouth pine	0	5	0	6	0	7¾
10 Acacia	1	2¾	1	5¾	1	6½
11 Beech	0	6½	0	6½	0	7¼
12 Plane, occidental	0	6½	0	7¾	0	8¾
13 Lombardy poplar	1	8	2	0	2	3¾
14 Black poplar	1	2¼	1	4½	1	5¾
15 Willow	2	9½	3	2	3	3
16 Silver fir	0	7¾	0	8¾	0	9¼
17 Lime	1	8½	1	10¾	2	0

Trees ſometimes attain a very great ſize: this muſt depend in a great meaſure on the richneſs of ſoil, but no leſs on the degree of heat. Indeed heat is ſo eſſential to the growth of trees, that as we go from the place within the polar circles where vegetation begins, and advance to the equator, we find the trees increaſe in ſize. Greenland, Iceland, and other places in the ſame latitude, yield no trees at all; and the ſhrubs which they produce are dwarfiſh; whereas, in warm climates, they often grow to an immenſe ſize. Mr Marſham ſaw ſpruce and ſilver firs in the dock-yard in Venice above 40 yards long, and one of 39 yards was 18 inches diameter at the ſmall end. He was informed that they came from Switzerland.

The largeſt tree in Europe, mentioned by travellers, is the cheſnut tree on Mount Etna, already deſcribed under the article Etna, N° 18. It is a certain fact that trees acquire a very great ſize in volcanic countries. Beſide the multitude of fine groves in the neighbourhood of Albano in Italy, there are many detached oaks 20 feet in circumference, and many elms of the ſame ſize, eſpecially in the romantic way to Eaſtello, called the *Galleria*. In travelling by the ſide of the lake of Bolſena, the road leads through an immenſe number of oaks, ſpread upon beautiful hills. Where the lava has been ſufficiently ſoftened, they are clean and ſtraight, and of a conſiderable ſize; but where the lava has not been converted into a ſoil proper for ſtrong vegetation, they are round-headed, and of leſs ſize; however, taken all together, they make a magnificent appearance; and the ſpot itſelf ought to be ranked among the fine parts of Italy. The ſame may be obſerved of the ſmall lake of Vico, encompaſſed with gentle riſings, that are all clothed with foreſt-trees.

Some yews have been found in Britain 60 feet round. Palms in Jamaica attain the height of 200 feet; and ſome of the pines in Norfolk iſland are 280 feet high.

Of all the different kinds known in Europe, oak is beſt for building; and even when it lies expoſed to air and water, there is none equal to it. Fir-timber is the next in degree of goodneſs for building, eſpecially in England, where they build upon leaſes. It differs from oak in this, that it requires not much ſeaſoning, and therefore no great ſtock is required before-hand. Fir is uſed for flooring, wainſcoting, and the ornamental parts of building within doors. Elm is the next in uſe, eſpecially in England and France: it is very tough and pliable, and therefore eaſily worked: it does not readily ſplit; and it bears driving of bolts and nails better than any other wood; for which reaſon it is chiefly uſed by wheel-wrights and coach-makers, for ſhafts, naves, &c. Beech is alſo uſed for many purpoſes: it is very tough and white when young, and of great ſtrength; but liable to warp very much when expoſed to the weather, and to be worm eaten when uſed within doors; its greateſt uſe is for planks, bedſteads, chairs, and other houſehold goods. Aſh is likewiſe a very uſeful wood, but very ſcarce in moſt parts of Europe; it ſerves in buildings, or for any other uſe, when ſcreened from the weather; handſpikes and oars are chiefly made of it. Wild cheſnut timber is by many eſteemed to be as good as oak, and ſeems to have been much uſed in old buildings; but whether theſe trees are more ſcarce at preſent than formerly, or have been found not to anſwer ſo well as was imagined, it is certain that this timber is now but little uſed. Walnut-tree is excellent for the joiner's uſe, it being of a more curious brown colour than beech, and not ſo ſubject to the worms. The poplar, abele, and aſpen trees, which are very little different from each other, are much uſed inſtead of fir; they look well, and are tougher and harder.

Tree.

The goodneſs of timber not only depends on the ſoil and ſituation in which it ſtands, but likewiſe on the ſeaſon wherein it is felled. In this people diſagree very much; ſome are for having it felled as ſoon as its fruit is ripe, others in the ſpring, and many in the autumn. But as the ſap and moiſture of timber is certainly the cauſe that it periſhes much ſooner than it otherwiſe would do, it ſeems evident, that timber ſhould be felled when there is the leaſt ſap in it, viz. from the time that the leaves begin to fall till the trees begin to bud. This work uſually commences about the end of April in England, becauſe the bark then riſes moſt freely; for where a quantity of timber is to be felled, the ſtatute requires it to be done then, for the advantage of tanning. The ancients chiefly regarded the age of the moon in felling their timber; their rule was to fell it in the wane, or four days after the new moon, or ſometimes in the laſt quarter. Pliny adviſes it to be in the very inſtant of the change: which happening to be in the laſt day of the winter ſolſtice, the timber, ſays he, will be incorruptible.

Timber ſhould likewiſe be cut when of a proper age; for when it is either too young or too old, it will not be ſo durable as when cut at a proper age. It is ſaid that oak ſhould not be cut under 60 years old, nor above 200. Timber, however, ſhould be cut in its prime, when almoſt fully grown, and before it begins to decay; and this will be ſooner or later according to the dryneſs and moiſtneſs of the ſoil where the timber grows, as alſo according to the bigneſs of the trees; for there are no fixed rules in felling of timber, experience and judgment muſt direct here as in moſt other caſes.

Great attention is neceſſary in the ſeaſoning of timber;

Tree. ber. Some adviſe the planks of timber to be laid for a few days in ſome pool or running ſtream, in order to extract the ſap, and afterwards to dry them in the ſun or air. By this means, it is ſaid, they will be prevented from either chopping, caſting, or cleaving; but againſt ſhrinking there is no remedy. Some again are for burying them in the earth, others in a heat; and ſome for ſcorching and ſeaſoning them in fire, eſpecially piles, poſts, &c. which are to ſtand in water or earth. The Venetians firſt found out the method of ſeaſoning by fire; which is done after this manner: They put the piece to be ſeaſoned into a ſtrong and violent flame; in this they continually turn it round by means of an engine, and take it out when it is everywhere covered with a black coaly cruſt; the internal part of the wood is thereby ſo hardened, that neither earth nor water can damage it for a long time afterwards.

Dr Plott ſays, it is found by long experience, that the trunk or body of the trees, when barked in the ſpring, and left ſtanding naked all the ſummer expoſed to the ſun and wind, are ſo dried and hardened, that the ſappy part in a manner becomes as firm and durable as the heart itſelf. This is confirmed by M. Buffon, who, in 1738, preſented to the Royal Academy of Sciences at Paris a memoir entitled, "An eaſy method of increaſing the ſolidity, ſtrength, and duration of timber;" for which purpoſe he obſerves, "nothing more is neceſſary than to ſtrip the tree entirely of its bark during the ſeaſon of the riſing of the ſap, and to leave it to dry completely before it be cut down."

By many experiments, particularly deſcribed in that eſſay, it appears, that the tree ſhould not be felled till the third year after it has been ſtripped of the bark; that it is then perfectly dry, and the ſap become almoſt as ſtrong as the reſt of the timber, and ſtronger than the heart of any other oak tree which has not been ſo ſtripped; and the whole of the timber ſtronger, heavier, and harder; from which he thinks it fair to conclude, that it is alſo more durable. "It would no longer (he adds) be neceſſary, if this method were practiſed, to cut off the ſap; the whole of the tree might be uſed as timber; one of 40 years growth would ſerve all the purpoſes for which one of 60 years is now required; and this practice would have the double advantage of increaſing the quantity, as well as the ſtrength and ſolidity, of the timber."

The navy board, in anſwer to the inquiries of the commiſſioners of the land revenue, in May 1789, informed them, that they had then ſtanding ſome trees ſtripped of their bark two years before, in order to try the experiment of building one half of a ſloop of war with that timber, and the other half with timber felled and ſtripped in the common way. This very judicious mode of making the experiment, if it be properly executed, will undoubtedly go far to aſcertain the effects of this practice. We are ſorry that we are not able to inform our readers what was the reſult of the experiment.

After the planks of timber have been well ſeaſoned and fixed in their places, care is to be taken to defend or preſerve them; to which the ſmearing them with linſeed oil, tar, or the like oleaginous matter, contributes much. The ancients, particularly Heſiod and Virgil, adviſe the ſmoke-drying of all inſtruments made of wood, by hanging them up in the chimneys where wood fires are uſed. The Dutch preſerve their gates, portcullices, drawbridges, ſluices, &c. by coating them over with a mixture of pitch and tar, whereon they ſtrew ſmall pieces of cockle and other ſhells, beaten almoſt to powder, and mixed with ſea-ſand, which incruſts and arms them wonderfully againſt all aſſaults of wind and weather. When timber is felled before the ſap is perfectly at reſt, it is very ſubject to worms; but to prevent and cure this, Mr Evelyn recommends the following remedy as the moſt approved: Put common ſulphur into a cucurbit, with as much aquafortis as will cover it three fingers deep; diſtil it to dryneſs, which is performed by two or three rectifications. Lay the ſulphur that remains at bottom, being of a blackiſh or ſand-red colour, on a marble, or put it in a glaſs, and it will diſſolve into an oil; with this oil anoint the timber which is infected with worms. This, he ſays, will not only prevent worms, but preſerve all kinds of woods, and many other things, as ropes, nets, and maſts, from putrefaction, either in water, air, or ſnow. Tree.

An experiment to determine the comparative durability of different kinds of timber, when expoſed to the weather, was made by a nobleman in Norfolk; of which an account is given by Sir Thomas Beevor. This nobleman, in the year 1774, ordered three poſts, forming two ſides of a quadrangle, to be fixed in the earth on a riſing ground in his park. Into theſe poſts were mortiſed planks, an inch and a half thick, cut out of trees from 30 to 45 years growth. Theſe, after ſtanding 10 years, were examined, and found in the following ſtate and condition: *Annals of Agriculture*, vol. p. 256.

The cedar was perfectly ſound; larch, the heart ſound, but the ſap quite decayed; ſpruce fir, ſound; ſilver fir, in decay; Scotch fir, much decayed; pinaſter, quite rotten; cheſnut, perfectly ſound; abele, ſound; beech, ſound; walnut, in decay; ſycamore, much decayed; birch, quite rotten. Sir Thomas Beevor juſtly remarks, that the trees ought to have been of the ſame age; and Mr Arthur Young adds, they ought to have been cut out of the ſame plantation.

The immenſe quantity of timber conſumed of late years in ſhip-building and other purpoſes has diminiſhed in a very great degree the quantity produced in this country. On this account, many gentlemen who wiſh well to their country, alarmed with the fear of a ſcarcity, have ſtrongly recommended it to government to pay ſome attention to the cultivation and preſervation of timber.

We find, on the beſt authority, that of Mr Irving inſpector general of imports and exports, that the ſhipping of England in 1760 amounted to 6107 in number, the tonnage being 433,922; and the ſhipping in Scotland amounted to 976 in number, the tonnage being 52,818. In 1788 the whole ſhipping of Britain and Ireland and their colonies amounted to 13,800 being 1,359,752 tons burden, and employing 107,925 men. The tonnage of the royal navy in the ſame year was 413,667. We are informed alſo, on what we conſider as the beſt authority (the report of the commiſſioners of the land revenue), that the quantity of oak timber, of Engliſh growth, delivered into the dockyards from 1760 to 1788 was no leſs than 768,676 loads, and that the quantity uſed in the merchants yards in the ſame time was 516,630 loads; in all 1,285,306 loads. The foreign oak uſed in the ſame period was only 137,766 loads. *Eleventh Report.*

Tree. loads. So that, after deducting the quantity remaining in the dock-yards in 1760 and 1788, and the foreign oak, there will remain about 1,054,284 loads of Engliſh oak, conſumed in 28 years, which is at an average 37,653 loads per annum, beſides from 8300 to 10,000 loads expended annually by the Eaſt India Company within the ſame period (A).

The price of wood has riſen in proportion to the demand and to its diminution. At the conqueſt, woods were valued, not by the quantity of timber which they contained, but the number of ſwine which the acorns could ſupport. In 1608, oak in the foreſts was ſold at 10s. per load, and fir-wood for 2s. per load. In 1663 or 1665, in navy contracts from 2l. to 2l. 15s. 6d. per load was given. In 1756 it roſe to 4l. 5s. per load, and 3s. in addition, becauſe no tops are received. Plank four inch ſold in 1769 for 7l. a load, three inch 6l.; which prices were the ſame in 1792.

So great an expenditure of valuable timber within ſo ſhort a period, gives reaſon to fear that the foreſts of this country will ſoon be entirely diſmantled, unleſs ſomething is done to raiſe freſh ſupplies: The building of a 70 gun ſhip, it is ſaid, would take 40 acres of timber. This calculation is indeed ſo exceſſive, that it is ſcarcely credible. This, however, is no exaggeration. According to the prevailing opinion of experienced ſurveyors, it will require a good ſoil and good management to produce 40 trees on an acre, which, in a hundred years, may, at an average, be computed at two loads each. Reckoning, therefore, two loads at 8l. 16s. one acre will be worth 350l. and conſequently 40 acres will only be worth 14,200l. Now a 70 gun ſhip is generally ſuppoſed to coſt 70,000l.; and as ſhips do not laſt a great many years, the navy continually requires new ſhips, ſo that the foreſts muſt be ſtripped in a century or two, unleſs young trees are planted to ſupply their place.

Many plans have been propoſed for recruiting the foreſts. Premiums have been held forth to individuals; and it has been propoſed that the crown-lands ſhould be ſet apart for the ſpecial purpoſe of raiſing timber. With reſpect to individuals, as they muſt generally be diſpoſed to ſow or plant their lands with thoſe vegetables which will beſt reward their labours, it is not to be expected that they will ſet apart their fields for planting trees unleſs they have a greater return from them than other crops. But bad muſt that land be which will not yield much more than 350l. produce in 100 years. But though it be evident that good land will produce crops much more lucrative to the proprietor than timber, yet ſtill there are lands or pieces of land which might be applied with very great advantage to the production of wood. Uneven ground, or the ſides of fields where corn cannot be cultivated, might very properly be ſet apart for this purpoſe; barren lands, or ſuch as cannot be cultivated without great labour and expence, might alſo be planted. Hedge-rows and clumps of trees, and little woods ſcattered up and down, would ſhelter and defend the fields from deſtructive winds, would beautify the face of the country, render the climate warmer, improve barren lands, and furniſh wood for the arts and manufactures. Tree.

But to cultivate foreſt timber has alſo been thought of ſuch national importance, that it has been deemed worthy of the attention of government. It has been propoſed to appropriate ſuch part of the crown-lands as are fit for the purpoſe ſolely of producing timber for the navy. This appears a very proper ſcheme in ſpeculation; but it has been objected, that for government to attempt the farming of foreſts would be really to eſtabliſh groups of officers to pocket ſalaries for doing what, it is well known, will never be done at all. But to this objection we reply, that ſuch an agreement might be made with the inſpectors of foreſts, as to make it their own intereſt to cultivate trees with as much care as poſſible. Their ſalary might be fixed very low, and raiſed in proportion to the number of trees which they could furniſh of ſuch a ſize in a certain number of years. After all, we muſt acknowledge that we muſt depend greatly on Ruſſia, Sweden, Norway, and America, for ſupplying us with timber; and while theſe countries take our manufactures in exchange, we have no reaſon to complain. Still, however, we ought ſurely not to neglect the cultivation of what is of ſo much importance to our exiſtence as a nation, for it may often be impoſſible in time of war to obtain timber from foreign countries.

In the beginning of this article we mentioned the general diviſion of trees into timber or foreſt-trees and fruit trees. We have already ſaid all that our limits will permit reſpecting the former: we will now, therefore, ſay ſomething of the latter. Our obſervations ſhall be confined to the methods of preſerving fruit trees in bloſſom from the effects of froſt, and from other diſeaſes to which they are liable.

The Chevalier de Dienenberg of Prague, we are told, has diſcovered a method of effectually preſerving trees in bloſſom from the fatal effects of thoſe froſts which ſometimes in the ſpring deſtroy the moſt promiſing hopes of a plentiful crop of fruit. His method is extremely ſimple. He ſurrounds the trunk of the tree in bloſſom with a wiſp of ſtraw or hemp. The end of this he ſinks, by means of a ſtone tied to it, in a veſſel of ſpring water, at a little diſtance from the tree. One veſſel will conveniently ſerve two trees: or the cord may be lengthened ſo as to ſurround ſeveral, before its end is plunged into the water. It is neceſſary that the veſſel be placed in an open ſituation, and by no means ſhaded by the branches of the neighbouring trees, that the froſt may produce all its effect on the water, by means of the cord communicating with it.—This precaution is particularly neceſſary for thoſe trees the flowers of which appear nearly at the ſame time as the leaves; which trees are peculiarly expoſed to the ravages of the froſt. The proofs of its efficacy, which he had an opportunity of obſerving in the *European Magazine*, March 1791.

(A) A writer in the Bath Tranſactions ſays, that the aggregate of oaks felled in England and Wales for 30 years paſt has amounted to 320,000 loads a-year; and affirms that he has documents in his poſſeſſion founded on indiſputable facts. The difference between this account, and that which we have given in the text from the report of the commiſſioners, we leave to be reconciled by thoſe who have proper opportunities. We give the facts merely on the authority of others.

Tree. spring of 1787, were remarkably ſtriking. Seven apricot eſpaliers in his garden began to bloſſom in the month of March. Fearing that they would ſuffer from the late froſts, he ſurrounded them with cords as above directed. In effect, pretty ſharp froſts took place ſix or eight nights: the apricot-trees in the neighbouring gardens were all frozen, and none of them produced any fruit, whilſt each of the chevalier's produced fruit in abundance, which came to the greateſt perfection.

The following is the method propoſed by Mr William Forſyth for curing injuries and defects in trees; for which a reward was given to him by his majeſty, on condition that he ſhould make it public. It is equally applicable to foreſt as to fruit trees (B).

Take one buſhel of freſh cow-dung; half a buſhel of lime rubbiſh of old buildings (that from the ceilings of rooms is preferable); half a buſhel of wood aſhes; and a ſixteenth part of a buſhel of pit or river ſand. The three laſt articles are to be ſifted fine before they are mixed; then work them well together with a ſpade, and afterwards with a wooden beater, until the ſtuff is very ſmooth, like fine plaſter uſed for the ceilings of rooms. The compoſition being thus made, care muſt be taken to prepare the tree properly for its application, by cutting away all the dead, decayed, and injured parts, till you come to the freſh ſound wood, leaving the ſurface of the wood very ſmooth, and rounding off the edges of the bark with a draw-knife, or other inſtrument, perfectly ſmooth, which muſt be particularly attended to. Then lay on the plaſter about one-eighth of an inch thick all over the part where the wood or bark has been ſo cut away, finiſhing off the edges as thin as poſſible. Then take a quantity of dry powder of wood aſhes, mixed with a ſixth part of the ſame quantity of the aſhes of burnt bones; put it into a tin box, with holes in the top, and ſhake the powder on the ſurface of the plaſter, till the whole is covered over with it, letting it remain for half an hour to abſorb the moiſture: then apply more powder, rubbing it on gently with the hand, and repeating the application of the powder, till the whole plaſter becomes a dry ſmooth ſurface.

All trees cut down near the ground ſhould have the ſurface made quite ſmooth, rounding it off in a ſmall degree, as before mentioned; and the dry powder directed to be uſed afterwards ſhould have an equal quantity of powder of alabaſter mixed with it, in order the better to reſiſt the dripping of trees and heavy rains. If any of the compoſition be left for a future occaſion, it ſhould ke kept in a tub or other veſſel, and urine of any kind poured on it, ſo as to cover the ſurface; otherwiſe the atmoſphere will greatly hurt the efficacy of the application. Where lime rubbiſh of old buildings cannot be eaſily got, take powdered chalk, or common lime, after having been ſlaked a month at leaſt. As the growth of the tree will gradually affect the plaſter, by raiſing up its edges next the bark, care ſhould be taken, where that happens, to rub it over with the finger when occaſion may require (which is beſt done when moiſtened by rain), that the plaſter may be kept whole, to prevent the air and wet from penetrating into the wound. Tree ‖ Trent.

By this proceſs, ſome old worn-out pear trees, that bore only a few ſmall, hard fruit, of a kernelly texture, were made to produce pears of the beſt quality and fineſt flavour the ſecond ſummer after the operation; and in four or five years they bore ſuch plenteous crops, as a young healthy tree would not have produced in four times that period. *Forſyth's Obſervations on the Diſeaſes of Trees.*

By this proceſs, too, ſome large ancient elms, in a moſt decayed ſtate, having all their upper parts broken, and a ſmall portion only of the bark remaining, ſhot out ſtems from their tops, above thirty feet in height, in ſix or ſeven years from the firſt application of the compoſition.

Thus may valuable trees be renovated; and foreſt trees, which are uſeful or ornamental from their particular ſituation, be preſerved in a flouriſhing ſtate. But what is far more intereſting, a perfect cure has been made, and ſound timber produced, in oak trees, which had received very conſiderable damage from blows, bruiſes, cutting of deep letters, the rubbing off the bark by the ends of rollers, or wheels of carts, or from the breaking of branches by ſtorms.

TREFOIL. See TRIFOLIUM, BOTANY *Index*.

TREMELLA, a genus of plants belonging to the claſs of cryptogamia. See BOTANY *Index*.

TREMOR, an involuntary ſhaking, chiefly of the hands and head, ſometimes of the feet, and ſometimes of the tongue and heart.—Tremors ariſing from a too free uſe of ſpirituous liquors require the ſame treatment as palſies.

TRENCHES, in fortification, are ditches cut by the beſiegers, that they may approach the more ſecurely to the place attacked, whence they are alſo called *lines of approach*.

TRENT, BISHOPRIC OF, a province of Germany, in the circle of Auſtria, near the frontiers of Italy; is bounded on the north by Tirol; on the eaſt by the Feltrino and Belluneſe; on the ſouth, by Vincentino, the Veroneſe, Breſciano, and the lake de Garda; and on the weſt, by the Breſciano and the lake de Garda. The ſoil is ſaid to be very fruitful, and to abound in wine and oil.

TRENT, a city of Germany, and capital of the biſhopric of that name, is a very ancient place, and ſtands in a fertile and pleaſant plain, in the midſt of the high mountains of the Alps. The river Adige waſhes its walls, and creeping for ſome time among the hills, runs ſwiftly into Italy. Trent has three conſiderable churches, the principal of which is the cathedral: this is a very regular piece of architecture. The church of St Maria Major is all of red and white marble; and is remarkable for being the place where the famous council of Trent

(B) A paſte for covering the wounds of trees, and the place where grafts are inſerted, was diſcovered long ago. It is recommended in a Treatiſe on Fruit Trees, publiſhed by Thomas Hitt in 1755; a third edition of which, with additions, was publiſhed in 1768. It conſiſts of a mixture of clay and cow's dung diluted with water. This paſte he directs to be laid on the wound with a bruſh; it adheres firmly, he ſays, without cracking till the wound heals. We are informed by a gentleman, to whoſe opinion and experience we pay great reſpect, that this paſte anſwers every purpoſe which Mr Forſyth's can ſerve.

Trent was held, whoſe deciſions are now the ſtanding rule of the Romiſh church. E. Long. 11. 5. N. Lat. 46.

TRENT, one of the largeſt rivers in England, which riſes in the moorland of Staffordſhire, and runs ſouth-weſt by Newcaſtle-under-Line; and afterwards dividing the county in two parts, runs to Burton, then to Nottingham and Newark; and ſo continuing its courſe due north to Gainſborough on the confines of Lincolnſhire, it joins ſeveral rivers, and falls into the Humber.

TRENT, *Council of*, in *Eccleſiaſtical Hiſtory*, denotes the council aſſembled by Paul III. in 1545, and continued by 25 ſeſſions till the year 1563, under Julius III. and Pius IV. in order to correct, illuſtrate, and fix with perſpicuity, the doctrine of the church, to reſtore the vigour of its diſcipline, and to reform the lives of its miniſters. The decrees of this council, together with the creed of Pope Pius IV. contain a ſummary of the doctrines of the Roman Catholics. Theſe decrees were ſubſcribed by 255 clergy, conſiſting of four legates, 2 other cardinals, 3 patriarchs, 25 archbiſhops, 168 biſhops, beſides inferior clergy. Of theſe 150 came from Italy, of courſe the council was entirely under the influence of the pope. For a more particular account of the council of Trent, ſee Moſheim's Church Hiſtory, the Modern Univerſal Hiſtory, vol. xxiii. and Father Paul's Hiſtory of the Council of Trent.

TRENTON. See *New* JERSEY.

TREPANNING. See SURGERY *Index*.

TRES TABERNÆ, in *Ancient Geography*, a place in Latium, lying on the Via Appia, on the left or ſouth ſide of the river Aſtura, to the north of the Paludes Pomptinæ. Its ruins are now ſeen near Ciſterna, a village in the Campagna di Roma, 21 miles from Rome, whence the Chriſtians went out to meet St Paul.

TRESPASS, in *Law*, ſignifies any tranſgreſſion of the law, under treaſon, felony, or miſpriſion of either: but it is commonly uſed for any wrong or damage that is done by one private perſon to another, or to the king in his foreſt.

TRESSLE TREES, in *Ship-Building*, two ſtrong bars of timber fixed horizontally on the oppoſite ſides of the lower maſt head, to ſupport the frame of the top and the weight of the top-maſt.

TRESSURE, in *Heraldry*, a diminutive of an orle, uſually held to be half the breadth thereof.

TRET, in *Commerce*, an allowance made for the waſte or the dirt that may be mixed with any commodity; which is commonly four pounds in every 104 pounds weight.

TREVERI, or TREVIRI, in *Ancient Geography*, an ancient and a powerful people, both in horſe and foot, according to Cæſar; extending far and wide between the Meuſe and the Rhine. Their chief town was called *Treveris*. Now *Triers* or *Treves*.

TREVES, or TRIERS (in Latin *Trevere*, *Trevers*, *Treviris*, or *Auguſta Trevirorum*), the capital of the German archbiſhopric of the ſame name, ſtands 60 miles weſt of Mentz, 52 ſouth of Cologne, and 82 north of Straſburg. This city vies with moſt in Europe for antiquity, having been a large and noted town before Auguſtus ſettled a colony in it. It was free and imperial till the year 1560, when it was ſurpriſed and ſubjected by its archbiſhop James III. It ſtands on the Moſelle, over which it has a fair ſtone bridge. The cathedral is a large building; and near it ſtands the elector's palace, which not long ago was rebuilt. Here are three collegiate and five pariſh churches, three colleges of Jeſuits, thirteen monaſteries and nunneries, an univerſity founded in 1472, a houſe of the Teutonic order, and another of that of Malta, with ſome remains of the ancient Roman theatre. Roman coins and medals are often found in the ruins of the old city. In the cathedral they pretend to have our Saviour's coat and St Peter's ſtaff, to which they aſcribe miracles. The private houſes here are mean; and the city is neither well fortified nor inhabited. E. Long. 6. 41. N. Lat. 49. 45. Treves, Trial.

TRIAL, in *Law*, the examination of a cauſe according to the laws of the land before a proper judge; or it is the manner and order obſerved in the hearing and determining of cauſes.

Trials are either civil or criminal.

I. *Civil* TRIALS. The ſpecies of trials in civil caſes are ſeven: By *record*; by *inſpection* or examination; by *certificate*; by *witneſſes*; by wager of *battel*; by wager of *law*; and by *jury*. The firſt ſix are only had in certain ſpecial or eccentrical caſes, where the trial by jury would not be ſo proper or effectual: (See them explained under their reſpective titles). The nature of the laſt, that principal criterion of truth in the law of England, ſhall be explained in this article.

As trial by jury is eſteemed one of the moſt important privileges which members of ſociety can enjoy, and the bulwark of the Britiſh conſtitution, every man of reflection muſt be ſtimulated by the deſire of inquiring into its origin and hiſtory, as well as to be acquainted with the forms and advantages by which it is accompanied. We will therefore begin with tracing it to its origin. Its inſtitution has been aſcribed to our Saxon anceſtors by Sir William Blackſtone.

"Some authors (ſays that illuſtrious lawyer) have endeavoured to trace the original of juries up as high as the Britons themſelves, the firſt inhabitants of our iſland; but certain it is that they were in uſe among the earlieſt Saxon colonies, their inſtitution being aſcribed by Biſhop Nicholſon to Woden himſelf, their great legiſlator and captain. Hence it is, that we may find traces of juries in the laws of all thoſe nations which adopted the feodal ſyſtem, as in Germany, France, and Italy; who had all of them a tribunal compoſed of twelve good men and true, *boni homines*, uſually the vaſſals or tenants of the lord, being the equals or peers of the parties litigant; and, as the lord's vaſſals judged each other in the lord's courts, ſo the king's vaſſals, or the lords themſelves, judged each other in the king's court. In England we find actual mention of them ſo early as the laws of King Ethelred, and that not as a new invention. Stiernhook aſcribes the invention of the jury, which in the Teutonic language is denominated *nembda*, to Regner king of Sweden and Denmark, who was contemporary with our King Egbert. Juſt as we are apt to impute the invention of this, and ſome other pieces of juridical polity, to the ſuperior genius of Alfred the Great; to whom, on account of his having done much, it is uſual to attribute every thing: and as the tradition of ancient Greece placed to the account of their own Hercules whatever achievement was performed ſuperior to the ordinary proweſs of mankind. Whereas the truth ſeems to be, that this tribunal was univerſally eſtabliſhed among all the northern nations, and ſo interwoven in their very conſtitution, *Blackſt. Comment.* vol. iii. p. 349.

Trial. conſtitution, that the earlieſt accounts of the one give us alſo ſome traces of the other."

This opinion has been controverted with much learning and ingenuity by Dr Pettingal in his Inquiry into the Uſe and Practice of Juries among the Greeks and Romans, who deduces the origin of juries from theſe ancient nations.

He begins with determining the meaning of the word δικαζαι in the Greek, and *judices* in the Roman, writers. "The common acceptation of theſe words (ſays he), and the idea generally annexed to them, is that of *preſidents of courts*, or, as we call them, *judges;* as ſuch they are underſtood by commentators, and rendered by critics. Dr Middleton, in his life of Cicero, expreſsly calls the judices, *judges of the bench:* and Archbiſhop Potter, and in ſhort all modern writers upon the Greek or Roman orators, or authors in general, expreſs δικαζαι and *judices* by ſuch terms as convey the idea of *preſidents in courts of juſtice.* The propriety of this is doubted of, and hath given occaſion for this inquiry; in which is ſhown, from the beſt Greek and Roman authorities, that neither the δικαζαι of the Greeks, or the *judices* of the Romans, ever ſignified *preſidents in courts of judicature*, or *judges of the bench;* but, on the contrary, they were diſtinguiſhed from each other, and the difference of their duty and function was carefully and clearly pointed out by the orators in their pleadings, who were the beſt authorities in thoſe caſes, where the queſtion related to forms of law, and methods of proceeding in judicial affairs and criminal proceſs.

The preſidents of the courts in criminal trials at Athens were the nine archons, or chief magiſtrates, of which whoever preſided was called ηγεμων δικαστηριε, or preſident of the court. Theſe nine preſided in different cauſes peculiar to each juriſdiction. The archon, properly ſo called, had belonging to his department all pupillary and heritable caſes; the βασιλευς or *rex ſacrorum*, the chief prieſt, all caſes where religion was concerned; the polemarchus, or general, the affairs of the army and all military matters; and the ſix theſmothetæ, the other ordinary ſuits.

Wherever then the ανδρες δικαζαι, or judicial men, are addreſſed by the Greek orators in their ſpeeches, they are not to be underſtood to be the preſiding magiſtrates, but another claſs of men, who were to inquire into the ſtate of the cauſe before them, by witneſſes and other methods of coming at truth; and after inquiry made and witneſſes heard, to report their opinion and verdict to the preſident, who was to declare it.

The ſeveral ſteps and circumſtances attending this judicial proceeding are ſo ſimilar to the forms obſerved by our jury, that the learned reader, for ſuch I muſt ſuppoſe him, cannot doubt but that the nature, intent, and proceedings of the δικαστηριον among the Greeks were the ſame with the Engliſh jury; namely, for the protection of the lower people from the power and oppreſſion of the great, by adminiſtering equal law and juſtice to all ranks; and therefore when the Greek orators directed their ſpeeches to the ανδρες δικαζαι, as we ſee in Demoſthenes, Æſchines, and Lyſias, we are to underſtand it in the ſame ſenſe as when our lawyers at the bar ſay, *Gentlemen of the jury.*

So likewiſe among the Romans, the *judices*, in their pleadings at the bar, never ſignified judges of the bench, or preſidents of the court, but a body or order of men, whoſe office in the courts of judicature was diſtinct from that of the prætor or *judex queſtionis*, which anſwered to our judge of the bench, and was the ſame with the archon, or ηγεμων δικαστηριε, of the Greeks: whereas the duty of the judices conſiſted in being impannelled, as we call it, challenged, and ſwore to try uprightly the caſe before them; and when they had agreed upon their opinion or verdict, to deliver it to the preſident who was to pronounce it. This kind of judicial proceſs was firſt introduced into the Athenian polity by Solon, and thence copied into the Roman republic, as probable means of procuring juſt judgment, and protecting the lower people from the oppreſſion or arbitrary deciſions of their ſuperiors. Trial.

When the Romans were ſettled in Britain as a province, they carried with them their *jura* and *inſtituta*, their laws and cuſtoms, which was a practice eſſential to all colonies; hence the Britons, and other countries of Germany and Gaul, learned from them the Roman laws and cuſtoms; and upon the irruption of the northern nations into the ſouthern kingdoms of Europe, the laws and inſtitutions of the Romans remained, when the power that introduced them was withdrawn: and Monteſquieu tells us, that under the firſt race of kings in France, about the fifth century, the Romans that remained, and the Burgundians their new maſters, lived together under the ſame Roman laws and police, and particularly the ſame forms of judicature. How reaſonable then is it to conclude, that in the Roman courts of judicature continued among the Burgundians, the form of a jury remained in the ſame ſtate it was uſed at Rome. It is certain, Monteſquieu, ſpeaking of thoſe times, mentions the *pairs* or *hommes de fief*, homagers or peers, which in the ſame chapter he calls *juges*, *judges* or *jurymen*: ſo that we hence ſee how at that time the *hommes de fief*, or "men of the fief," were called *peers*, and thoſe peers were *juges* or jurymen. Theſe were the ſame as are called in the laws of the Confeſſor *pers de la tenure*, the "peers of the tenure, or homagers," out of whom the jury of peers were choſen, to try a matter in diſpute between the lord and his tenant, or any other point of controverſy in the manor. So likewiſe in all other parts of Europe, where the Roman colonies had been, the Goths ſucceeding them, continued to make uſe of the ſame laws and inſtitutions, which they found to be eſtabliſhed there by the firſt conquerors. This is a much more natural way of accounting for the origin of a jury in Europe, than having recourſe to the fabulous ſtory of Woden and his ſavage Scythian companions, as the firſt introducers of ſo humane and beneficent an inſtitution."

Trials by jury in civil cauſes are of two kinds; *extraordinary* and *ordinary*.

1. The firſt ſpecies of *extraordinary* trial by jury is that of the grand aſſize, which was inſtituted by King Henry II. in parliament, by way of alternative offered to the choice of the tenant or defendant in a writ of right, inſtead of the barbarous and unchriſtian cuſtom of duelling. For this purpoſe a writ *de magna aſſiſa eligenda* is directed to the ſheriff, to return four knights, who are to elect and chooſe 12 others to be joined with them; and theſe all together form the grand aſſize, or great jury, which is to try the matter of right, and muſt now conſiſt of 16 jurors. Another ſpecies of extraordinary juries is the jury to try an attaint; which is a proceſs commenced againſt a former jury for bringing a falſe verdict. See the article ATTAINT.

2. With

Trial.

2. With regard to the *ordinary* trial by jury in civil cases, the most clear and perspicuous way of treating it will be by following the order and course of the proceedings themselves.

When therefore an issue is joined by these words, "And this the said A prays may be inquired of by the country;" or, "And of this he puts himself upon the country, and the said B does the like;" the court awards a writ of *venire facias* upon the roll or record, commanding the sheriff "that he cause to come here, on such a day, twelve free and lawful men, *liberes et legales homines*, of the body of his country, by whom the truth of the matter may be better known, and who are neither of kin to the aforesaid A nor the aforesaid B, to recognise the truth of the issue between the said parties." And such writ is accordingly issued to the sheriff. It is made returnable on the last return of the same term wherein issue is joined, viz. hilary or trinity terms; which, from the making up of the issues therein, are usually called *issuable terms*. And he returns the names of the jurors in a panel (a little pane or oblong piece of parchment) annexed to the writ. This jury is not summoned, and therefore not appearing at the day must unavoidably make default. For which reason a compulsive process is now awarded against the jurors, called in the common pleas a writ of *habeas corpora juratorum*, and in the King's Bench *distringas*, commanding the sheriff to have their bodies, or to distrain them by their lands and goods, that they may appear upon the day appointed. The entry therefore on the roll of record is, "That the jury is respited, through defect of the jurors, till the first day of the next term, then to appear at Westminster; unless before that time, viz. on Wednesday the fourth of March, the justices of our lord the king appointed to take assizes in that county shall have come to Oxford, that is, to the place assigned for holding the assizes. Therefore the sheriff is commanded to have their bodies at Westminster on the said first day of next term, or before the said justice of assize, if before that time they come to Oxford, viz. on the fourth of March aforesaid." And as the judges are sure to come and open the circuit commissions on the day mentioned in the writ, the sheriff returns and summons this jury to appear at the assizes: and there the trial is had before the justices of assize and *nisi prius:* among whom (as hath been said *) are usually two of the judges of the courts at Westminster, the whole kingdom being divided into six circuits for this purpose. And thus we may observe, that the trial of common issues, at *nisi prius*, was in its original only a collateral incident to the original business of the justices of assize; though now, by the various revolutions of practice, it is become their principal civil employment; hardly any thing remaining in use of the real assizes but the name.

If the sheriff be not an indifferent person, as if he be a party in the suit, or be related by either blood or affinity to either of the parties, he is not then trusted to return the jury; but the *venire* shall be directed to the coroners, who in this, as in many other instances, are the substitutes of the sheriff to execute process when he is deemed an improper person. If any exception lies to the coroners, the *venire* shall be directed to two clerks of the court, or two persons of the county named by the court, and sworn. And these two, who are called *elisors*, or electors, shall indifferently name the jury, and their return is final; no challenge being allowed to their array. Trial.

Let us now pause a while, and observe (with Sir Matthew Hale *), in these first preparatory stages of the trial, how admirably this constitution is adapted and framed for the investigation of truth beyond any other method of trial in the world. For, first, the person returning the jurors is a man of some fortune and consequence; that so he may be not only the less tempted to commit wilful errors, but likewise be responsible for the faults of either himself or his officers: and he is also bound by the obligation of an oath faithfully to execute his duty. Next, as to the time of their return: the panel is returned to the court upon the original *venire*, and the jurors are to be summoned and brought in many weeks afterwards to the trial, whereby the parties may have notice of the jurors, and of their sufficiency or insufficiency, characters, connections, and relations, that so they may be challenged upon just cause; while, at the same time, by means of the compulsory process (of *distringas*, or *habeàs corpora*) the cause is not like to be retarded through defect of jurors. Thirdly, As to the place of their appearance: which in causes of weight and consequence is at the bar of the court; but in ordinary cases at the assizes, held in the county where the cause of action arises, and the witnesses and jurors live: a provision most excellently calculated for the saving of expence to the parties. For though the preparation of the causes in point of pleading is transacted at Westminster, whereby the order and uniformity of proceeding is preserved throughout the kingdom, and multiplicity of forms is prevented; yet this is no great charge or trouble, one attorney being able to transact the business of 40 clients. But the troublesome and most expensive attendance is that of jurors and witnesses at the trial; which therefore is brought home to them, in the county where most of them inhabit. Fourthly, The persons before whom they are to appear, and before whom the trial is to be held, are the judges of the superior court, if it be a trial at bar; or the judges of assize, delegated from the courts at Westminster by the king, if the trial be held in the country: persons, whose learning and dignity secure their jurisdiction from contempt, and the novelty and very parade of whose appearance have no small influence upon the multitude. The very point of their being strangers in the county is of infinite service, in preventing those factions and parties which would intrude in every cause of moment, were it tried only before persons resident on the spot, as justices of the peace, and the like. And the better to remove all suspicion of partiality, it was wisely provided by the statutes 4 Edw. III. c. 2. 8 Ric. II. c. 2. and 33 Hen. VIII. c. 24. that no judge of assize should hold pleas in any county wherein he was born or inhabits. And as this institution prevents party and faction from intermingling in the trial of right, so it keeps both the rule and the administration of the laws uniform. These justices, though thus varied and shifted at every assizes, are all sworn to the same laws, have had the same education, have pursued the same studies, converse and consult together, communicate their decisions and resolutions, and preside in those courts which are mutually connected, and their judgments blended together, as they are interchangeably courts of appeal or advice to each other. And hence their administration of justice, and conduct

* *Hist.* C. L. c. 12.

Trial. conduct of trials, are consonant and uniform; whereby that confusion and contrariety are avoided, which would naturally arise from a variety of uncommunicating judges, or from any provincial establishment. But let us now return to the assizes.

When the general day of trial is fixed, the plaintiff or his attorney must bring down the record to the assizes, and enter it with the proper officer, in order to its being called on in course.

These steps being taken, and the cause called on in court, the record is then handed to the judge, to peruse and observe the pleadings, and what issues the parties are to maintain and prove, while the jury is called and sworn. To this end the sheriff returns his compulsive process, the writ of *habeas corpora* or *distringas*, with the panel of jurors annexed, to the judge's officer in court.

The jurors contained in the panel are either special or common jurors. Special juries were originally introduced in trials at bar, when the causes were of too great nicety for the discussion of ordinary freeholders; or where the sheriff was suspected of partiality, though not upon such apparent cause as to warrant an exception to him. He is in such cases, upon motion in court, and a rule granted thereupon, to attend the prothonotary or other proper officer with his freeholder's book; and the officer is to take indifferently 48 of the principal freeholders in the presence of the attorneys on both sides: who are each of them to strike off 12, and the remaining 24 are returned upon the panel. By the statute 3 Geo. II. c. 25. either party is entitled upon motion to have a special jury struck upon the trial of any issue, as well at the assizes as at bar, he paying the extraordinary expence, unless the judge will certify (in pursuance of the statute 24 Geo. II. c. 18.) that the cause required such special jury.

A common jury is one returned by the sheriff according to the directions of the statute 3 Geo. II. c. 25. which appoints that the sheriff or officer shall not return a separate panel for every separate cause, as formerly; but one and the same panel for every cause to be tried at the same assizes, containing not less than 48, nor more than 72, jurors: and that their names being written on tickets, shall be put into a box of glass; and when each cause is called, 12 of these persons, whose names shall be first drawn out of the box, shall be sworn upon the jury, unless absent, challenged, or excused; or unless a previous view of the messuages, lands, or place in question, shall have been thought necessary by the court; in which case, six or more of the jurors returned, to be agreed on by the parties, or named by a judge or other proper officer of the court, shall be appointed by special writ of *habeas corpora* or *distringas*, to have the matters in question shown to them by two persons named in the writ; and then such of the jury as have had the view, or so many of them as appear, shall be sworn on the inquest previous to any other jurors. These acts are well calculated to restrain any suspicion of partiality in the sheriff, or any tampering with the jurors when returned.

As the jurors appear when called, they shall be sworn, unless challenged by either party. See the article CHALLENGE.

If by means of challenges or other cause, a sufficient number of unexceptionable jurors doth not appear at the trial, either party may pray a *tales*.

A *tales* is a supply of such men as are summoned upon the first panel, in order to make up the deficiency. For this purpose a writ of *decem tales*, *octo tales*, and the like, was wont to be issued to the sheriff at common law, and must be still so done at a trial at bar, if the jurors make default. But at the assizes, or *nisi prius*, by virtue of the statute 55 Hen. VIII. c. 6. and other subsequent statutes, the judge is empowered at the prayer of either party to award a *tales de circumstantibus* of persons present in court, to be joined to the other jurors to try the cause; who are liable, however, to the same challenges as the principal jurors. This is usually done till the legal number of 12 be completed; in which patriarchal and apostolical number Sir Edward Coke hath discovered abundance of mystery. Tri

When a sufficient number of persons impanelled, or talesmen appear, they are then separately sworn, well and truly to try the issue between the parties, and a true verdict to give according to the evidence; and hence they are denominated "the jury," *jurata*, and "jurors," *sc. juratores*.

The jury are now ready to hear the merits; and to fix their attention the closer to the facts which they are impanelled and sworn to try, the pleadings are opened to them by counsel on that side which holds the affirmative of the question in issue. For the issue is said to lie, and proof is always first required upon that side which affirms the matter in question: in which our law agrees with the civil, *ei incumbit probatio qui dicit, non qui negat; cum per rerum naturam factum-negantis probatio nulla sit.* The opening counsel briefly informs them what has been transacted in the court above; the parties, the nature of the action, the declaration, the plea, replication, and other proceedings; and lastly, upon what point the issue is joined, which is there sent down to be determined. Instead of which, formerly the whole record and process of the pleadings were read to them in English by the court, and the matter of issue clearly explained to their capacities. The nature of the case, and the evidence intended to be produced, are next laid before them by counsel also on the same side; and when their evidence is gone through, the advocate on the other side opens the adverse case, and supports it by evidence; and then the party which began is heard by way of reply. See PLEADINGS.

Evidence in the trial by jury is of two kinds; either that which is given in proof, or that which the jury may receive by their own private knowledge. The former, or *proofs*, (to which in common speech the name of evidence is usually confined) are either written or parol; that is, by word of mouth. Written proofs, or evidence, are, 1. Records; and, 2. Ancient deeds of 30 years standing, which prove themselves: but, 3. Modern deeds; and, 4. Other writings, must be attested and verified by parol evidence of witnesses. With regard to parol evidence or witnesses; it must first be remembered that there is a process to bring them in by writ of *subpœna ad testificandum;* which commands them, laying aside all pretences and excuses, to appear at the trial on pain of 100l. to be forfeited to the king; to which the statute 5 Eliz. c. 9. has added a penalty of 10l. to the party aggrieved, and damages equivalent to the loss sustained by want of his evidence. But no witness, unless his reasonable expences be tendered him, is bound to appear at all; nor, if he appear, is he bound

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Trial. to give evidence till ſuch charges are actually paid him; except he reſides within the bills of mortality, and is ſummoned to give evidence within the ſame. This compulſory proceſs, to bring in unwilling witneſſes, and the additional terrors of an attachment in caſe of diſobedience, are of excellent uſe in the thorough inveſtigation of truth: and, upon the ſame principle, in the Athenian courts, the witneſſes who were ſummoned to attend the trial had their choice of three things: either to ſwear to the truth of the fact in queſtion, to deny or abjure it, or elſe to pay a fine of 1000 drachmas.

All witneſſes, of whatever religion or country, that have the uſe of their reaſon, are to be received and examined, except ſuch as are infamous, or ſuch as are intereſted in the event of the cauſe. All others are competent witneſſes; though the jury from other circumſtances will judge of their credibility. Infamous perſons are ſuch as may be challenged as jurors, *propter delictum:* and therefore never ſhall be admitted to give evidence to inform that jury, with whom they were too ſcandalous to aſſociate. Intereſted witneſſes may be examined upon a *voir dire*, if ſuſpected to be ſecretly concerned in the event; or their intereſt may be proved in court. Which laſt is the only method of ſupporting an objection to the former claſs; for no man is to be examined to prove his own infamy. And no counſel, attorney, or other perſon, intruſted with the ſecrets of the cauſe by the party himſelf, ſhall be compelled, or perhaps allowed, to give evidence of ſuch converſation or matters of privacy as came to his knowledge by virtue of ſuch truſt and confidence: but he may be examined as to mere matters of fact, as the execution of a deed or the like, which might have come to his knowledge without being intruſted in the cauſe.

One witneſs (if credible) is ſufficient evidence to a jury of any ſingle fact: though undoubtedly the concurrence of two or more corroborates the proof. Yet our law conſiders that there are many tranſactions to which only one perſon is privy; and therefore does not always demand the teſtimony of two. Poſitive proof is always required, where, from the nature of the caſe, it appears it might poſſibly have been had. But, next to poſitive proof, circumſtantial evidence, or the doctrine of preſumptions, muſt take place: for when the fact itſelf cannot be demonſtratively evinced, that which comes neareſt to the proof of the fact is the proof of ſuch circumſtances which either neceſſarily or uſually attend ſuch facts; and theſe are called *preſumptions*, which are only to be relied upon till the contrary be actually proved.

The oath adminiſtered to the witneſs is not only that what he depoſes ſhall be true, but that he ſhall alſo depoſe the whole truth: ſo that he is not to conceal any part of what he knows, whether interrogated particularly to that point or not. And all this evidence is to be given in open court, in the preſence of the parties, their attorneys, the counſel, and all byſtanders: and before the judge and jury: each party having liberty to except to its competency, which exceptions are publicly ſtated, and by the judge are openly and publicly allowed or diſallowed, in the face of the country: which muſt curb any ſecret bias or partiality that might ariſe in his own breaſt.

When the evidence is gone through on both ſides, the judge, in the preſence of the parties, the counſel, and all others, ſums up the whole to the jury; omitting all ſuperfluous circumſtances, obſerving wherein the main queſtion and principal iſſue lies, ſtating what evidence has been given to ſupport it, with ſuch remarks as he thinks neceſſary for their direction, and giving them his opinion in matters of law ariſing upon that evidence. Trial.

The jury, after the proofs are ſummed up, unleſs the caſe be very clear, withdraw from the bar to conſider of their verdict; and in order to avoid intemperance and cauſeleſs delay, are to be kept without meat, drink, fire, or candle, unleſs by permiſſion of the judge, till they are unanimouſly agreed. A method of accelerating unanimity not wholly unknown in other conſtitutions of Europe, and in matters of greater concern. For by the golden bull of the empire, if, after the congreſs is opened, the electors delay the election of a king of the Romans for 30 days, they ſhall be fed only with bread and water till the ſame is accompliſhed. But if our juries eat or drink at all, or have any eatables about them, without conſent of the court, and before verdict, it is finable; and if they do ſo at his charge for whom they afterwards find, it will ſet aſide the verdict. Alſo, if they ſpeak with either of the parties or their agents after they are gone from the bar, or if they receive any freſh evidence in private, or if, to prevent diſputes, they caſt lots for whom they ſhall find, any of theſe circumſtances will entirely vitiate the verdict. And it has been held, that if the jurors do not agree in their verdict before the judges are about to leave the town, though they are not to be threatened or impriſoned, the judges are not bound to wait for them, but may carry them round the circuit from town to town in a cart. This neceſſity of a total unanimity ſeems to be peculiar to our own conſtitution; or at leaſt, in the *nembda* or jury of the ancient Goths, there was required (even in criminal caſes) only the conſent of the major part; and in caſe of an equality, the defendant was held to be acquitted.

When they are all unanimouſly agreed, the jury return back to the bar; and before they deliver their verdict, the plaintiff is bound to appear in court, by himſelf, attorney, or counſel, in order to anſwer the amercement to which by the old law he is liable, in caſe he fails in his ſuit, as a puniſhment for his falſe claim. To be amerced, or *a mercie*, is to be at the king's mercy with regard to the fine to be impoſed; in *miſericordia domini regis pro falſo clamore ſuo*. The amercement is diſuſed, but the form ſtill continues; and if the plaintiff does not appear, no verdict can be given; but the plaintiff is ſaid to be nonſuit, *non ſequitur clamorem ſuum*. Therefore it is uſual for a plaintiff, when he or his counſel perceives that he has not given evidence ſufficient to maintain his iſſue, to be voluntarily nonſuited, or withdraw himſelf: whereupon the crier is ordered to call the plaintiff; and if neither he, nor any body for him, appears, he is nonſuited, the jurors are diſcharged, the action is at an end, and the defendant ſhall recover his coſts. The reaſon of this practice is, that a nonſuit is more eligible for the plaintiff than a verdict againſt him: for after a nonſuit, which is only a default, he may commence the ſame ſuit again for the ſame cauſe of action; but after a verdict had, and judgment conſequent thereupon, he is for ever barred from attacking

Trial.

the defendant upon the ſame ground of complaint. But in caſe the plaintiff appears, the jury by their foreman deliver in their verdict.

A verdict, *vere dictum*, is either privy or public. A privy verdict is when the judge hath left or adjourned the court: and the jury, being agreed, in order to be delivered from their confinement, obtain leave to give their verdict privily to the judge out of court: which privy verdict is of no force, unleſs afterwards affirmed by a public verdict given openly in court; wherein the jury may, if they pleaſe, vary from their privy verdict. So that the privy verdict is indeed a mere nullity; and yet it is a dangerous practice, allowing time for the parties to tamper with the jury, and therefore very ſeldom indulged. But the only effectual and legal verdict is the public verdict: in which they openly declare to have found the iſſue for the plaintiff, or for the defendant; and if for the plaintiff, they aſſeſs the damages alſo ſuſtained by the plaintiff, in conſequence of the injury upon which the action is brought.

When the jury have delivered in their verdict, and it is recorded in court, they are then diſcharged; and ſo ends the trial by jury: a trial which ever has been, and it is hoped ever will be, looked upon as the glory of the Engliſh law. It is certainly the moſt tranſcendant privilege which any ſubject can enjoy or wiſh for, that he cannot be affected either in his property, his liberty, or his perſon, but by the unanimous conſent of 12 of his neighbours and equals. A conſtitution that we may venture to affirm has, under providence, ſecured the juſt liberties of this nation for a long ſucceſſion of ages. And therefore a celebrated French writer *, who concludes, that becauſe Rome, Sparta, and Carthage, have loſt their liberties, therefore thoſe of England in time muſt periſh, ſhould have recollected that Rome, Sparta, and Carthage, at the time when their liberties were loſt, were ſtrangers to the trial by jury.

* *Monteſquieu, Spir. L.* xi. 6.

Great as this eulogium may ſeem, it is no more than this admirable conſtitution, when traced to its principles, will be found in ſober reaſon to deſerve.

The impartial adminiſtration of juſtice, which ſecures both our perſons and our properties, is the great end of civil ſociety. But if that be entirely entruſted to the magiſtracy, a ſelect body of men, and thoſe generally ſelected by the prince or ſuch as enjoy the higheſt offices in the ſtate, their deciſions, in ſpite of their own natural integrity, will have frequently an involuntary bias towards thoſe of their own rank and dignity: it is not to be expected from human nature, that the few ſhould be always attentive to the intereſts and good of the many. On the other hand, if the power of judicature were placed at random in the hands of the multitude, their deciſions would be wild and capricious, and a new rule of action would be every day eſtabliſhed in our courts. It is wiſely therefore ordered, that the principles and axioms of law, which are general propoſitions flowing from abſtracted reaſon, and not accommodated to times or to men, ſhould be depoſited in the breaſts of the judges, to be occaſionally applied to ſuch facts as come properly aſcertained before them. For here partiality can have little ſcope; the law is well known, and is the ſame for all ranks and degrees: it follows as a regular concluſion from the premiſſes of fact pre-eſtabliſhed. But in ſettling and adjuſting a queſtion of fact, when intruſted to any ſingle magiſtrate, partiality and injuſtice have an ample field to range in, either by boldly aſſerting that to be proved which is not ſo, or more artfully by ſuppreſſing ſome circumſtances, ſtretching and warping others, and diſtinguiſhing away the remainder. Here therefore a competent number of ſenſible and upright jurymen, choſen by lot from among thoſe of the middle rank, will be found the beſt inveſtigators of truth, and the ſureſt guardians of public juſtice. For the moſt powerful individual in the ſtate will be cautious of committing any flagrant invaſion of another's right, when he knows that the fact of his oppreſſion muſt be examined and decided by 12 indifferent men not appointed till the hour of trial; and that when once the fact is aſcertained, the law muſt of courſe redreſs it. This therefore preſerves in the hands of the people that ſhare which they ought to have in the adminiſtration of public juſtice, and prevents the encroachments of the more powerful and wealthy citizens.

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Criminal TRIALS. The regular and ordinary method of proceeding in the courts of criminal juriſdiction may be diſtributed under 12 general heads, following each other in a progreſſive order: viz. 1. Arreſt; 2. Commitment and bail; 3. Proſecution; 4. Proceſs; 5. Arraignment, and its incidents; 6. Plea, and iſſue; 7. Trial, and conviction; 8. Clergy; 9. Judgment, and its conſequences; 10. Reverſal of judgment; 11. Reprieve, or pardon; 12. Execution. See ARREST, COMMITMENT, PRESENTMENT, INDICTMENT, INFORMATION, APPEAL, *PROCESS upon an Indictment*, ARRAIGNMENT, and PLEA; in which articles all the forms which precede the trial are deſcribed, and are here enumerated in the proper order.

The ſeveral methods of trial and conviction of offenders, eſtabliſhed by the laws of England, were formerly more numerous than at preſent, through the ſuperſtition of our Saxon anceſtors; who, like other northern nations, were extremely addicted to divination; a character which Tacitus obſerves of the ancient Germans. They therefore invented a conſiderable number of methods of purgation or trial, to preſerve innocence from the danger of falſe witneſſes, and in conſequence of a notion that God would always interpoſe miraculouſly to vindicate the guiltleſs; as, 1. By ORDEAL; 2. By CORSNED; 3. By BATTEL. See theſe articles.

4. A fourth method is that by the *peers of Great Britain*, in the *Court of* PARLIAMENT; or the *Court of the Lord High* STEWARD, when a peer is capitally indicted; for in caſe of an appeal, a peer ſhall be tried by jury. This differs little from the trial *per patriam*, or by jury; except that the peers need not all agree in their verdict; and except alſo, that no ſpecial verdict can be given in the trial of a peer; becauſe the lords of parliament, or the lord high ſteward (if the trial be had in his court), are judges ſufficiently competent of the law that may ariſe from the fact; but the greater number, conſiſting of 12 at the leaſt, will conclude, and bind the minority.

The trial by jury, or the country, *per patriam*, is alſo that trial by the peers of every Briton, which, as the great bulwark of his liberties, is ſecured to him by the great charter: *nullus liber homo capitatur, vel impriſonetur, aut exulet, aut aliquo alio modo deſtruatur, niſi per legale judicium parium ſuorum, vel per legem terræ.*

When therefore a priſoner on his ARRAIGNMENT has pleaded not guilty, and for his trial hath put himſelf upon

Trial. upon the country, which country the jury are, the ſheriff of the county muſt return a panel of jurors, *liberos et legales homines, de viceneto;* that is, freeholders without juſt exception, and of the *viſne* or neighbourhood; which is interpreted to be of the county where the fact is committed. If the proceedings are before the court of king's bench, there is time allowed between the arraignment and the trial, for a jury to be impanelled by writ of *venire facias* to the ſheriff, as in civil cauſes; and the trial in caſe of a miſdemeanor is had at *niſi prius*, unleſs it be of ſuch conſequence as to merit a trial at bar; which is always invariably had when the priſoner is tried for any capital offence. But, before commiſſioners of oyer and terminer and gaol-delivery, the ſheriff, by virtue of a general precept directed to him beforehand, returns to the court a panel of 48 jurors, to try all felons that may be called upon their trial at that ſeſſion; and therefore it is there uſual to try all felons immediately or ſoon after their arraignment. But it is not cuſtomary, nor agreeable to the general courſe of proceedings, unleſs by conſent of parties, to try perſons indicted of ſmaller miſdemeanors at the ſame court in which they have pleaded not guilty, or traverſed the indictment. But they uſually give ſecurity to the court to appear at the next aſſizes or ſeſſion, and then and there to try the traverſe, giving notice to the proſecutor of the ſame.

In caſes of high-treaſon, whereby corruption of blood may enſue (except treaſon in counterfeiting the king's coin or ſeals), or miſpriſion of ſuch treaſon, it is enacted by ſtatute 7 W. III. c. 3. firſt, that no perſon ſhall be tried for any ſuch treaſon, except an attempt to aſſaſſinate the king, unleſs the indictment be found within three years after the offence committed: next, that the priſoner ſhall have a copy of the indictment (which includes the caption), but not the names of the witneſſes, five days at leaſt before the trial, that is, upon the true conſtruction of the act, before his arraignment; for then is his time to take any exceptions thereto, by way of plea or demurrer; thirdly, that he ſhall alſo have a copy of the panel of jurors two days before his trial: and, laſtly, that he ſhall have the ſame compulſive proceſs to bring in his witneſſes for him, as was uſual to compel their appearance againſt him. And by ſtatute 7 Ann. c. 21. (which did not take place till after the deceaſe of the late pretender) all perſons indicted for high-treaſon, or miſpriſions thereof, ſhall have not only a copy of the indictment, but a liſt of all the witneſſes to be produced, and of the jurors impanelled, with their profeſſions and places of abode, delivered to him ten days before the trial, and in the preſence of two witneſſes, the better to prepare him to make his challenges and defence. And no perſon indicted for felony is, or (as the law ſtands) ever can be, entitled to ſuch copies before the time of his trial.

When the trial is called on, the jurors are to be ſworn as they appear, to the number of 12, unleſs they are challenged by the party.

Challenges may here be made, either on the part of the king, or on that of the priſoner; and either to the whole array, or to the ſeparate polls, for the very ſame reaſons that they may be made in civil cauſes. But in criminal cauſes, or at leaſt in capital ones, there is, *in favorem vitæ*, allowed to the priſoner an arbitrary and capricious ſpecies of challenge, to a certain number of jurors, without ſhowing any cauſe at all; which is called a *peremptory* challenge; a proviſion full of that tenderneſs and humanity to priſoners for which our Engliſh laws are juſtly famous. This is grounded on two reaſons. 1. As every one muſt be ſenſible what ſudden impreſſions and unaccountable prejudices we are apt to conceive upon the bare looks and geſtures of another; and how neceſſary it is that a priſoner) when put to defend his life) ſhould have a good opinion of his jury, the want of which might totally diſconcert him; the law wills not that he ſhould be tried by any one man againſt whom he has conceived a prejudice, even without being able to aſſign a reaſon for ſuch his diſlike. 2. Becauſe, upon challenges for cauſe ſhown, if the reaſon aſſigned prove inſufficient to ſet aſide the juror, perhaps the bare queſtioning his indifference may ſometimes provoke a reſentment; to prevent all ill conſequences from which, the priſoner is ſtill at liberty, if he pleaſes, peremptorily to ſet him aſide. Trial.

The peremptory challenges of the priſoner muſt, however, have ſome reaſonable boundary; otherwiſe he might never be tried. This reaſonable boundary is ſettled by the common law to be the number of 35; that is, one under the number of three full juries.

If by reaſon of challenges or the default of the jurors, a ſufficient number cannot be had of the original panel, a tales may be awarded as in civil cauſes, till the number of 12 is ſworn, "well and truly to try, and true deliverance make, between our ſovereign lord the king and the priſoner whom they have in charge; and a true verdict to give, according to their evidence."

When the jury is ſworn, if it be a cauſe of any conſequence, the INDICTMENT is uſually opened, and the evidence marſhalled, examined, and enforced by the counſel for the crown or proſecution. But it is a ſettled rule at common law, that no counſel ſhall be allowed a priſoner upon his trial upon the general iſſue, in any capital crime, unleſs ſome point of law ſhall ariſe proper to be debated. A rule which (however it may be palliated under cover of that noble declaration of the law, when rightly underſtood, that the judge ſhall be counſel for the priſoner; that is, ſhall ſee that the proceedings againſt him are legal and ſtrictly regular) ſeems to be not at all of a piece with the reſt of the humane treatment of priſoners by the Engliſh law. For upon what face of reaſon can that aſſiſtance be denied to ſave the life of a man, which yet is allowed him in proſecutions for every petty treſpaſs? Nor indeed is it, ſtrictly ſpeaking, a part of our ancient law; for the Mirrour, having obſerved the neceſſity of counſel in civil ſuits, "who know how to forward and defend the cauſe by the rules of law, and cuſtoms of the realm," immediately afterwards ſubjoins, "and more neceſſary are they for defence upon indictments and appeals of felony, than upon other venial cauſes." And, to ſay the truth, the judges themſelves are ſo ſenſible of this defect in our modern practice, that they ſeldom ſcruple to allow a priſoner counſel to ſtand by him at the bar, and to inſtruct him what queſtions to aſk, or even to aſk queſtions for him, with regard to matters of fact; for as to matters of law ariſing on the trial, they are entitled to the aſſiſtance of counſel. But ſtill this is a matter of too much importance to be left to the good pleaſure of any judge, and is worthy the interpoſition of the legiſlature; which has ſhown its inclination to indulge

Trial || Tributary.

prisoners with this reasonable assistance, by enacting, in statute 7 W. III. c. 3. that persons indicted for such high treason as works a corruption of the blood or misprisonment thereof (except treason in counterfeiting the king's coins or seals), may make their full defence by counsel, not exceeding two, to be named by the prisoner, and assigned by the court or judge; and this indulgence, by statute 20 Geo. II. c. 30. is extended to parliamentary impeachments for high-treason, which were excepted in the former act.

When the evidence on both sides is closed, the jury cannot be discharged (unless in cases of evident necessity) till they have given in their VERDICT. If they find the prisoner not guilty, he is then for ever quit and discharged of the accusation, except he be appealed of felony within the time limited by law. And upon such his acquittal, or discharge for want of prosecution, he shall be immediately set at large without payment of any fee to the gaoler. But if the jury find him guilty, he is then said to be convicted of the crime whereof he stands indicted. See the article CONVICTION; and subsequent thereto, the articles JUDGMENT, ATTAINDER, FORFEITURE, EXECUTION, also *Benefit of* CLERGY, REPRIEVE, PARDON.

TRIAL, in *Scotland*. See *Scots* LAW.

TRIANDRIA, (from τρεις, "three," and ανηρ, "a man or husband)," the name of the third class in Linnæus's sexual system, consisting of plants with hermaphrodite flowers, which have three stamina or male organs.

TRIANGLE, in *Geometry*, a figure of three sides and three angles.

TRIBE, in antiquity, a certain quantity or number of persons, when a division was made of a city or people into quarters or districts.

TRIBRACHYS, in *Ancient Poetry*, a foot consisting of three syllables, and these all short; as, *melius*.

TRIBUNAL, in general, denotes the seat of a judge, called in our courts *bench*.

TRIBUNE, among the ancient Romans, a magistrate chosen out of the commons, to protect them against the oppressions of the great, and to defend the liberty of the people against the attempts of the senate and consuls.

The tribunes of the people were first established in the year of Rome 259. The first design of their creation was to shelter the people from the cruelty of usurers, and to engage them to quit the Aventine mount, whither they had retired in displeasure.

Their number at first was but two; but the next year, under the consulate of A. Posthumius Aruncius and Cassius Viscellinus, there were three more added; and this number of five was afterwards increased by L. Trebonius to ten.

Military TRIBUNE, an officer in the Roman army, commander in chief over a body of forces, particularly the division of a legion; much the same with our colonel, or the French maitre de camp.

TRIBUTARY, one who pays tribute to another in order to live in peace with or share in his protection.

Trib. || Trigon.

TRIBUTE, a tax or impost which one prince or state is obliged to pay to another as a token of dependence, or in virtue of a treaty, and as a purchase of peace.

TRICEPS, in *Anatomy*. See there, *Tables of the Muscles*.

TRICHECUS, WALRUS; a genus of aquatic animals belonging to the class of *mammalia*, and order of *bruta*. See MAMMALIA *Index*.

TRICHOMANES, a genus of plants belonging to the class of *cryptogamia*, and order of *filices*. See BOTANY *Index*.

TRICOCCEÆ, (τρεις, "three," and κοκκος, "a grain"), the name of the 38th order in Linnæus's Fragments of a Natural Method, consisting of plants with a single three-cornered capsule, having three cells, or internal divisions, each containing a single seed. See BOTANY.

TRICOSANTHES, a genus of plants belonging to the class of *monœcia*, and in the natural system ranging under the 34th order, *Cucurbitaceæ*. See BOTANY *Index*.

TRIDENT, an attribute of Neptune, being a kind of sceptre which the painters and poets put into the hands of that god, in form of a spear or fork with three teeth; whence the word.

TRIENNIAL, an epithet applied chiefly to offices or employments which last for three years.

TRIENS, in antiquity, a copper money of the value of one third of an *as*, which on one side bore a Janus's head, and on the other a water rat.

TRIENTALIS, CHICKWEED WINTER-GREEN, a genus of plants belonging to the class of *heptandria*, and in the natural system ranging under the 20th order, *Rotaceæ*. See BOTANY *Index*.

TRIERS, or TREVES. See TREVES.

TRIFOLIUM, TREFOIL, or *Clover*, a genus of plants belonging to the class of *diadelphia*, and in the natural system ranging under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

TRIGA, in antiquity, denotes a kind of car or chariot drawn by three horses; whence the name.

TRIGLA, a genus of fishes belonging to the order of thoracici. See ICHTHYOLOGY *Index*.

TRIGLOCHIN, a genus of plants belonging to the class of *hexandria*, and in the natural system ranging under the fifth order, *Tripetaloideæ*. See BOTANY *Index*.

TRIGLYPHS, in *Architecture*, a sort of ornament repeated at equal intervals, in the Doric freeze.

Dialing TRIGON. See DIALING.

TRIGONALIS. See PILA.

TRIGONELLA, FENUGREEK, a genus of plants belonging to the class of *diadelphia*, and in the natural system arranged under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

TRIGONOMETRY.

Nature and Conſtruction of Trigonometrical Tables.

TRIGONOMETRY is the application of arithmetic to geometry. It conſiſts of two principal parts, viz. PLANE TRIGONOMETRY and SPHERICAL TRIGONOMETRY.

Plane trigonometry treats of the application of numbers to determine the relations of the ſides and angles of a plane triangle to one another.

Spherical trigonometry treats of the application of numbers in like manner to ſpherical triangles; the nature of theſe will be explained in the courſe of this article.

Both branches of the ſubject depend eſſentially upon certain numerical tables, the nature and conſtruction of which we ſhall now proceed to explain.

SECTION I.

NATURE AND CONSTRUCTION OF TRIGONOMETRICAL TABLES.

IT has been demonſtrated in GEOMETRY (Theor. 31. Sect. IV.) that any angles at the centre of a circle have to one another the ſame proportion as the arches intercepted between the lines which contain the angles. Hence it is eaſy to infer, that an angle at the centre of a circle has the ſame ratio to four right angles, that the arch intercepted between the lines which contain the angle has to the whole circumference. It alſo follows that we may employ arches of a circle as *meaſures* of angles, and thus the compariſon of angles is reduced to the compariſon of arches of a circle. From this principle we infer the conſiſtency of the firſt of the following ſeries of definitions.

DEFINITIONS.

I. If two ſtraight lines interſect one another in the centre of a circle, the arch of the circumference intercepted between them is called the *Meaſure* of the angle which they contain. Thus, (Plate DXXXVII. fig. 1.) the arch AB is the meaſure of the angle contained by the lines CA and CH.

Plate DXXVII fig. 1.

II. If the circumference of a circle be divided into 360 equal parts, each of theſe is called a *Degree;* and if a degree be divided into 60 equal parts, each of theſe is called a *Minute;* and if a minute be divided into 60 equal parts, each of theſe is called a *Second*, and ſo on; and as many degrees, minutes, ſeconds, &c. as are in any arch, ſo many degrees, minutes, ſeconds, &c. are ſaid to be in the angle meaſured by that arch.

COR. 1. Any arch is to the whole circumference of which it is a part, as the number of degrees and parts of a degree in it is to the number 360. And any angle is to four right angles as the number of degrees, &c. in the arch which is the meaſure of the angle to 360.

COR. 2. Hence alſo it appears that the arches which meaſure the ſame angle, whatever be the radii with which they are deſcribed, contain the ſame number of degrees and parts of a degree.

Nature and Conſtruction of Trigonometrical Tables.

The degrees, minutes, ſeconds, &c. contained in an arch or angle are commonly written thus, $23^{\circ}\ 29'\ 32''\ 20'''$, which expreſſion means 23 degrees 29 minutes 32 ſeconds, and 20 thirds.

III. Two angles which make together two right angles, alſo two arches which make together a ſemicircle, are called the *Supplements* of one another.

IV. A ſtraight line BG drawn through B, one of the extremities of the arch AB, perpendicular to the diameter paſſing through the other extremity A, is called the *Sine* of the arch AC, or of the angle ACB, having arch AB for its meaſure.

COR. 1. The ſine of a quadrant or of a right angle is equal to the radius.

COR. 2. The ſine of an arch is half the chord of twice the arch.

V. The ſegment AG of the diameter intercepted between its extremity and the ſine BG is called the *Verſed Sine* of the arch AB, or of the angle ACB.

VI. A ſtraight line AH touching the circle at A, one extremity of the arch AB, and meeting the diameter CB which paſſes through B the other extremity, is called the *Tangent* of the arch AB, or of the angle ACB.

COR. The tangent of half a right angle is equal to the radius.

VII. The ſtraight line CH between the centre and the extremity of the tangent AH is called the *Secant* of the arch AB or of the angle ACB.

COR. to Def. 4, 6, 7. The ſine, tangent, and ſecant of any angle ACB, are alſo the ſine, tangent, and ſecant of its ſupplement BCE. For by the definition, BG is the ſine of the angle BCE; and if BC be produced to meet the circle in I, then AH is the tangent and CH the ſecant of the angle ACI or BCE.

COR. to Def. 4, 5, 6, 7. The ſine, verſed ſine, tangent, and ſecant of an arch which is the meaſure of the angle ACB is to the ſine, verſed ſine, and ſecant of any other arch which is the meaſure of the ſame angle, as the radius of the firſt arch is to the radius of the ſecond.

Let BG, fig. 2. be the ſine, AG the verſed ſine, AH the tangent, and CH the ſecant of the arch AB to the radius CA; and bg, ag, ah, ch the ſame things to the radius Ca. From ſimilar triangles BG : bg :: BC : bC; and becauſe CG : Cg (:: CB : Cb) :: CA : Ca; therefore, by diviſion AG : ag :: CA : Ca. Alſo AH : ah :: CH : Ch :: CA : Ca. Fig. 2.

Hence it appears that if tables be conſtructed exhibiting in numbers the ſines, tangents, and verſed ſines of certain angles to a given radius, they will exhibit the ratios of the ſines, tangents, and verſed ſines of the ſame angles to any radius whatever. In ſuch tables, which are called trigonometrical tables, the radius is either ſuppoſed 1, or ſome number in the ſeries 10, 100, 1000, &c.

Nature and Conſtruction of Trigonometrical Tables.

&c. The conſtruction and uſe of theſe tables we ſhall preſently explain.

VIII. The difference between any angle and a right angle, or between any arch and a quadrant, is called the *Complement* of that angle, or of that arch. Thus, if the angle ACD, fig. 1. be a right angle, and conſequently the arch AD, which is its meaſure, a quadrant, the angle BCD is the complement of the angle BCA, and the arch BD is the complement of the arch AB. Alſo the complement of the obtuſe angle BCE is BCD, its exceſs above a right angle; and the complement of the arch BDE is the arch BD.

Fig. 1.

IX. The ſine, tangent, or ſecant of the complement of any angle is called the coſine, cotangent, or coſecant of that angle. Thus, ſuppoſing the angle ACD to be a right angle, then BF=CG, the ſine of the angle BCD, is the coſine of the angle BCA; DK, the tangent of the angle BCD, is the cotangent of the angle BCA, and CK, the ſecant of the angle BCD, is the coſecant of the angle BCA.

The following properties of the lines which have been defined flow immediately from their poſition.

1. The ſum of the ſquares of the ſine and coſine of any angle is equal to the ſquare of the radius. For, in the right-angled triangle BGC, $BC^2=BG^2+GC^2$, (GEOMETRY, Sect. IV. theor. 13.). Now BG is the ſine, and CG=BF is the coſine of the angle BCA.

2. The radius is a mean proportional between the tangent of any angle and its cotangent, or tan. ACB × cot. ACB=rad.^{2}. For ſince DK, CA are parallel, the angles DKC, HCA are equal; now CDK, CAH are right angles, therefore the triangles CDK, HCA are ſimilar, and therefore AH : AC :: CD or AC : DK, and $AC^2=AH\times DK$.

3. The radius is a mean proportional between the coſine and ſecant of any angle. Or cof. ACB × ſec. ACB =rad.^{2}. For the triangles CGB, CAH are ſimilar; therefore CG : CB or CA :: CA : CH.

4. The tangent of an arch is a fourth proportional to its coſine, its ſign and the radius, or tan. $ACB=\frac{\text{ſin. ACB}}{\text{cof. ACB}}\times$rad. For, from ſimilar triangles CG : GB :: CA : AH.

Trigonometrical tables uſually exhibit the ſines, tangents, and ſecants of all angles which can be expreſſed by an exact number of degrees and minutes from 1 minute to 90 degrees, or a right angle. Theſe may be computed in various ways, the moſt elementary is to calculate them by the help of principles deducible immediately from the elements of geometry.

It has been demonſtrated in GEOMETRY, (Sect. V. prob. 22.) that the chord of one-ſixth of the circumference, or an arch of 60°, is equal to the radius; therefore, if BD be an arch of 30°, its ſine BF will be half the radius (cor. 2. def. 4.). Let us ſuppoſe the radius to be expreſſed by unity, or 1, then ſin. $30^\circ=\frac{1}{2}$; now ſince a being put for any arch, cof.^{2} a + ſin.^{2} a=rad.^{2} (where by cof.^{2} a is meant the ſquare of the number expreſſing the coſine of the arch a, &c.) and as ſin.^{2} $30^\circ=\frac{1}{4}$, therefore cof.^{2} $30^\circ=1-\frac{1}{4}=\frac{3}{4}$, &c. Cof. $30^\circ=\frac{1}{2}\sqrt{3}=.8660254038$.

It has been demonſtrated in the arithmetic of ſines (ALGEBRA, § 356.) that $2\text{ cof.}^2a=1+\text{cof.}2a$; hence we have the following formula for finding the coſine of an arch, having given the coſine of its double; cof. $a=\sqrt{\frac{1+\text{cof. }2a}{2}}$. By this formula from the coſine of 30° we may find that of 15°, and again from cof. 15° we may find cof. 7° 30′, and proceeding in this way we may find the coſines of 3° 45′, 1° 52′ 30″, and ſo on, till after 11 biſections the coſine of $52''\,44'''\,3^{iv}\,45^{v}$ is found; we may then find the ſine of this arch by the formula ſin. $a=\sqrt{(1-\text{cof.}^2a)}$. Now, as from the nature of a circle the ratio of an arch to its ſine approaches continually to that of equality, when the arch is continually diminiſhed, it follows that the ſines of very ſmall arches will be very nearly to one another as the arches themſelves: Therefore, as $52''\,44'''\,3^{iv}\,45^{v}$ to 1′ ſo is the ſine of the former arch to the ſine of the latter. By performing all the calculations which we have here indicated, it will be found that the ſine of 1′ is .0002908882.

Nature and Conſtruction of Trigonometrical Tables.

It has been ſhewn in the arithmetic of ſines (ALGEBRA, § 355.) that a and b being put for any two arches, ſin. $(a+b)=2$ cof. b ſin. a—ſin. $(a-b)$, hence putting 1′ for b, and 1′, 2′, 3′, &c. ſucceſſively for a, we have,

ſin. $2'=2$ cof. $1'\times$ ſin. $1'$,
ſin. $3'=2$ cof. $1'\times$ ſin. $2'$—ſin. $1'$,
ſin. $4'=2$ cof. $1'\times$ ſin. $3'$—ſin. $2'$,
&c.

In this way the ſines for every minute of the quadrant may be computed, and as the multiplier cof. 1′ remains always the ſame, the calculation is eaſy. If inſtead of 1′, the common difference of the ſeries of arches were any other angle, the very ſame formula would apply.

The ſines, and conſequently the coſines of any number of arches being ſuppoſed found, their tangents may be found by conſidering that tan. $a=\frac{\text{ſin. }a}{\text{cof. }a}$; and their ſecants from the formula ſec. $a=\frac{1}{\text{cof. }a}$.

We have here very briefly indicated the manner of conſtructing the trigonometrical *canon*, as it is ſometimes called. There are, however, various properties of ſines, tangents, &c. which greatly facilitate the actual calculation of the numbers, theſe the reader will find detailed in ALGEBRA, Sect. XXV. which treats expreſsly of the *Arithmetic of Sines*.

The moſt expeditious mode of computing the ſine or coſine of a ſingle angle is by means of infinite ſeries: The inveſtigation of theſe is given in FLUXIONS, § 70.; and it is there ſhewn that if a denote any arch, then, the radius being expreſſed by 1,

$$\text{ſin. } a=a-\frac{a^3}{1\cdot2\cdot3}+\frac{a^5}{1\cdot2\cdot3\cdot4\cdot5}-\text{&c.}$$

$$\text{cof. } a=1-\frac{a^2}{1\cdot2}+\frac{a^4}{1\cdot2\cdot3\cdot4}-\text{&c.}$$

To apply theſe we muſt have the arch expreſſed in parts of the radius, which requires that we know the proportion of the diameter of the circle to its circumference. We have inveſtigated this proportion in GEOMETRY, Prop. 6. Sect. vi.; alſo in FLUXIONS, § 137.; and ſubſequently in the article entitled SQUARING THE CIRCLE.

From theſe ſeries others may be found which ſhall expreſs the tangent and ſecant. Thus becauſe tan. $a=$

Nature and Construction of Trigonometrical Tables.

$a = \frac{\text{fin. } a}{\text{cof. } a}$, we get, after dividing the ſeries for the ſine by that for the coſine,

$$\text{tan. } a = a + \frac{a^3}{3} + \frac{2a^5}{15} + \frac{17a^7}{315} + \&c.$$

And in like manner, dividing unity by the ſeries for cof. a, becauſe ſec. $a = \frac{1}{\text{cof. } a}$, we get

$$\text{ſec. } a = 1 + \frac{a^2}{2} + \frac{5a^4}{24} + \frac{61a^6}{720} + \&c.$$

We ſhall conclude what we propoſed to ſay on the conſtruction of the tables, by referring ſuch of our readers as wiſh for more extenſive information on this ſubject to Dr Hutton's Introduction to his excellent Mathematical tables; alſo to the treatiſes which treat expreſsly of trigonometry, among which are thoſe of *Emerſon*, *Simpſon*, *Bonnycaſtle*, *Cagnoli*, *Mauduit*, *Lacroix*, *Legendre*. In particular we refer to an excellent treatiſe on the ſubject by *Mr R. Woodhouſe* of Caius college, Cambridge.

Deſcription of the Table of Logarithmic Sines, &c.

That trigonometrical tables may be extenſively uſeful, they ought to contain not only the ſine, tangent, and ſecant to every minute of the quadrant, but alſo the logarithms of theſe numbers; and theſe are given in Dr Hutton's Mathematical Tables, a work which we have already mentioned; as, however, the ſines, &c. or the *natural* ſines, &c. as they are called, are much leſs frequently wanted than their logarithms, we have only given a table of the latter. See LOGARITHMS.

This table contains the logarithms of the ſines and tangents, or the *logarithmic ſines* and *tangents*, to every minute of the quadrant, the degrees at top and minutes deſcending down the left-hand ſide, as far as 45°, and from thence returning with the degrees at the bottom and the minutes aſcending by the right hand ſide to 90°, in ſuch a manner that any arch on the one ſide is in the ſame line with its complement on the other, the reſpective ſines, coſines, tangents, and cotangents, being in the ſame line with the minutes, and on the columns figured with their reſpective names at top when the degrees are at top, but at the bottom when the degrees are at the bottom. The differences of the ſines and coſines are placed in columns to the right-hand, marked D; and the differences of the tangents and cotangents are placed in a column between them, each difference belonging equally to the columns on both ſides of it. Alſo each differential number is ſet oppoſite the ſpace between the numbers whoſe difference it is. All this will be evident by inſpecting the table itſelf.

There are no logarithmic ſecants in the table, but theſe are eaſily had from the coſines; for ſince ſec. $a = \frac{\text{rad.}^2}{\text{cof. } a}$, therefore, log. ſec. a = 2 log. rad.—log. cof. a; now log. rad. = 10, therefore the log. ſecant of any arch is had by ſubtracting its log. coſine from 20.

The log. ſine, log. tangent, or log. ſecant of any angle is expreſſed by the ſame numbers as the log. ſine, log. tangent, or log. ſecant of its ſupplement; therefore, when an angle exceeds 90°, ſubtract it from 180° and take the log. ſine, &c. of the remainder for that of the angle.

Nature and Construction of Trigonometrical Tables.

To find the log. ſine of any angle expreſſed by degrees and minutes. If the angle be leſs than 45°, look for the number of degrees at the top, and oppoſite to the minutes on the left hand will be found the ſine required; thus the log. ſine of 8° 10′ is 9.15245. But if the angle be 45° or more than 45°, look for the degrees at the bottom and the minutes on the right hand, and oppoſite will be found the log. ſine required. Thus the log. ſine of 58° 12′ is 9.92936. The very ſame directions apply for the coſine, tangent, and cotangent; and from what has been ſaid, the manner of finding the angle to degrees and minutes, having given its ſine, &c. muſt be obvious.

If the angle conſiſts of degrees, minutes, and ſeconds, find the ſine or tangent to the degrees and minutes, and add to this a proportional part of the difference given in the column of differences for the ſeconds, obſerving that the whole difference correſponds to 1′ or 60″. Thus to find the log. ſine of 30° 23′ 28″; firſt the ſine of 30° 23′ is 9.70396. The difference is 21. As 60″: 28″ :: 21 : $\frac{28 \times 21}{60}$ = 10 nearly, the part of the difference to be added, therefore the ſine of 30° 23′ 28″ is 9.70406.

On the contrary, let it be required to find the angle correſponding to the tangent 10.14152.

The next leſs tangent in the table is 10.14140, which correſponds to 54° 10′; the difference between the propoſed tangent and next leſs is 12; and the difference between the next leſs and next greater, as given in the table, is 26; therefore, 26 : 12 :: 60″ : $\frac{12 \times 60}{26}$: 28″ nearly, hence the angle correſponding to the propoſed log. tangent is 34° 10′ 28″.

SECTION II.

PLANE TRIGONOMETRY.

THE following propoſitions expreſs as many of the properties of plane triangles as are eſſentially neceſſary in plane trigonometry.

THEOR. I.

In a right-angled plane triangle, as the hypothenuſe is to either of the ſides, ſo is the radius to the ſine of the angle oppoſite to that ſide; and as either of the ſides to the other ſide, ſo is the radius to the tangent of the angle oppoſite to that ſide.

Let ABC be a right-angled plane triangle (fig. 3.), of which AC is the hypothenuſe. On A as a centre with any radius, deſcribe the arch DE; draw EG at right angles to AB, and draw DF touching the circle at D, and meeting AC in F. Then EG is the ſine of the angle A to the radius AD or AE, and DF is its tangent. Fig. 3.

The triangles AGE, ADF are manifeſtly ſimilar to the triangle ABC. Therefore AC : CB :: AE : EG; that is, AC : CB :: rad. : ſin. A.

Again,

Plane Trigonometry.

Again, AB : BC :: AD : DF; that is AB : BC :: rad. : tan. A.

Cor. In a right-angled triangle, as the hypothenuſe to either of the ſides, ſo is the ſecant of the acute angle adjacent to that ſide to the radius. For AF is the ſecant of the angle A to the radius AD; and AC : AB :: AF : AD, that is, AC : AB :: ſec. A : rad.

Note. This propoſition is moſt eaſily remembered when ſtated thus. *If in a right-angled triangle the hypothenuſe be made the radius, the ſides become the ſines of the oppoſite angles; and if one of the ſides be made the radius, the other ſide becomes the tangent of the oppoſite angle, and the hypothenuſe its ſecant.*

Theor. II.

The ſides of a plane triangle are to one another as the ſines of the oppoſite angles.

Fig. 4. From B any angle of the triangle ABC (fig. 4.), draw BD perpendicular to AC. Then, by laſt theorem,

AB : BD :: rad. : ſin. A,
alſo BD : BC :: ſin. C : rad.

therefore *ex æquo* inverſely (Geometry, Sect. III. Theor. 7.), AB : BC :: ſin. C : ſin. A.

Theor. III.

The ſum of any two ſides of a triangle is to their difference as the tangent of half the ſum of the angles oppoſite to theſe ſides to the tangent of half their difference.

Fig. 5. Let ABC, fig. 5. be a triangle; AB+BC : AB—BC :: tan. $\frac{1}{2}$ (∠BCA+∠BAC) : tan. $\frac{1}{2}$ (∠BCA—∠BAC).

In AB produced take BE=BC, and on B as a centre with BC or BE as a radius, deſcribe the ſemicircle ECF meeting AC in D; join BD, CF, and CE, and from F draw FG parallel to AC, meeting CE in G.

Becauſe the angles CFE, CBE, ſtand on the ſame arch CE, and the former is at the circumference of the circle, and the latter at the centre; therefore, the angle CFE is half the angle CBE (Geometry, Sect. II. Theor. XIV.); but the angle CBE is the ſum of the angles BAC, BCA (Geometry, Sect. I. Theor. XXIII.); therefore the angle CFE is half the ſum of the angles BCA, BAC.

Becauſe the angle BDC is the ſum of the angles BAC, ABD, therefore the angle ABD is the difference between the angles BDC, BAD; but ſince BD=BC, the angle BDC is equal to BCD or BCA, therefore ABD is the difference of the angles BCA, BAC; but ABD, or FBD, being an angle at the centre of the circle, is double the angle FCD at the circumference, which laſt is equal to the alternate angle CFG; therefore the angle CFG is half the difference of the angles BCA, BAC.

Becauſe CE is manifeſtly the tangent of the angle CFE to the radius CF, and CG the tangent of the angle CFG to the ſame radius; therefore CE : CG :: tan. CFE : tan. CFG, that is, CE : CG :: tan. $\frac{1}{2}$ (BCA+BAC) : tan. $\frac{1}{2}$ (BCA—BAC); but becauſe FG is parallel to AC, CE : CG :: AE : AF, that is, CE : CG :: AB+BC : AB—BC, therefore AB+BC : AB—BC :: tan. $\frac{1}{2}$ (BCA+BAC) tan. $\frac{1}{2}$ (BCA—BAC).

Theor. IV.

Plane Trigonometry.

If a perpendicular be drawn from any angle of a triangle to the oppoſite ſide or baſe; the ſum of the ſegments of the baſe is to the ſum of the other two ſides as the difference of theſe ſides to the difference of the ſegments of the baſe.

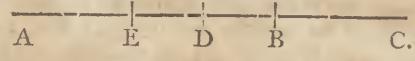
Let ABC be a triangle (fig. 6.), and BD a perpendicular drawn to the baſe from the oppoſite angle; AD+DC : AB+BC :: AB—BC : AD—DB. Fig. 6.

On, B as a centre with the radius BC, deſcribe a circle meeting AC in E, and AB in G, and the ſame line produced in F. Then AC : AF :: AG : AE; now AF = AB+BC, and AG = AB—BC, and becauſe ED = DC, AE (or AD—DE) = AD—DC, therefore AC : AB+BC :: AB—BC : AD—DC.

Problem.

Having given the ſum of any two quantities and alſo their difference, to find each of the quantities.

Solution. To half the ſum add half the difference of the quantities, and it will give the greater; and from half the ſum ſubtract half the difference, and it will give the leſs.



For let the greater of the two quantities be expreſſed by the line AB, and the leſs by BC; biſect AC in D, and take DE equal to DB, then AE=BC, and AB—BC=AB—AE=EB, and $\frac{1}{2}$ (AB—BC)=DB; alſo $\frac{1}{2}$ (AB+BC)=AD; now AB=AD+DB and BC=AD—DB, therefore the truth of the ſolution is evident.

In a plane triangle there are five diſtinct parts, which are ſo connected with one another, that any three of them being given, the remaining two may be found; theſe are, the three ſides and any two of the three angles; as to the remaining angle, that depends entirely upon the other two, and may be found from them independent of the ſides.

If one of the angles be a right angle, then the number of parts is reduced to four, and of theſe, any two being given, the remaining two may be found.

Solution of the Caſes of Right-angled Plane Triangles.

In right-angled triangles there are four caſes which may be reſolved by the firſt theorem.

Case 1. The hypothenuſe AC (fig. 7.) and an angle A being given, to find the ſides AB, BC about the right angle. Fig. 7.

Solution. { Rad. : ſin. A :: AC : BC,
Rad. : coſ. A :: AC : AB.

Example. In the triangle ABC, let the hypothenuſe AC be 144, and the angle A 39° 22′. Required the ſides AB and BC.

To find AB.	Logarithms.	To find BC	Log.
Rad. - -	10.00000	Rad. -	10.00000
Sin. A 39° 22′	9.80228	Coſ. A 39° 22′	9.88824
AC 144 -	2.15836	AC 144	2.15836
BC=91.3	1.96064	AB=111.3	2.04660

Here

Plane Trigonometry. Here the logarithms of the second and third terms are added, and the logarithm of the first term subtracted or rejected from the sum.

CASE 2. A side AB, and an acute angle A (and consequently the other angle C) being given, to find the hypothenuse AC, and remaining side BC.

SOLUTION. { Cos. A : rad. :: AB : AC,
Rad. : tan. A :: AB : BC.

Example. In the triangle ABC are given AB 208, and the angle A 35° 16′, to find AC and BC.

To find AC.		To find BC.	
Cos. A 35° 16′	9.91194	Rad. - - -	10.00000
Rad. - - -	10.00000	Tan. A 35° 16′	9.84952
AB 208 -	2.31806	AB 208 -	2.31806
	12.31806	BC=147.1	2.16758
AC=254.7	2.40612		

CASE 3. The hypothenuse AC and a side AB being given, to find the angle A (and consequently C) and the side BC.

SOLUTION. { AC : AB :: rad. : cos. A,
Rad. : sin. A :: AC : BC.

Example. Let the hypothenuse AC be 272, and the side AB 232. Required the angle A and the side BC.

To find A.		To find BC.	
AC 272 -	2.43457	Rad. - -	10.00000
AB 232 -	2.36549	Sin. A 31° 28′	9.71767
Rad. - -	10.00000	AC 272 - -	2.43457
	12.36549	BC 142 - -	2.15224
Cos. A=31° 28′	9.93092		

CASE 4. The sides AB and BC about the right angle being given, to find the angle A (and thence C) and the hypothenuse AC.

SOLUTION. { AB : BC : rad. : tan. A,
Cos. A : rad. : AB : AC.

Example. Let the side AB be 186, the side BC 152. Required the angle A, and the hypothenuse AC.

To find A.		To find AC.	
AB 186 -	2.26951	Cos. A 39° 15′	9.88896
BC 152 -	2.18184	Rad. - -	10.00000
Rad. - -	10.00000	AB 186 -	2.26951
	12.18184		12.26951
Tan. A=39° 15′	9.91233	AC=240.2	2.38055

Solution of the Cases of Oblique-angled Triangles.

In oblique-angled triangles there are also four cases, which, with their solutions, are as follows.

CASE 1. Two angles A and B, and a side AB, being given, to find the other sides AC, BC.

SOLUTION. First subtract the sum of the angles A and B from 180°, and the remainder is the angle C; then AC and BC are to be found from these proportions. Plane Trigonometry.

Sin. C : Sin. B :: AB : AC,
Sin. C : Sin. A :: AB : BC.

The truth of this solution is obvious from Theor. II.

Example. In the triangle ABC are given the side AB=266, the angle A 38° 40′, the angle B 72° 16′; to find the sides AC and BC.

First, A+B=110° 56′, and 180°—110° 56′=69° 4′=C.

Sin. C 69° 4′	9.97035	Sin. C 69° 4′	9.97035
Sin. B 72° 16′	9.97886	Sin. A 38° 40′	9.79573
AB 266 -	2.42488	AB 266 -	2.42488
	12.40374		12.22061
AC=271.3	2.43339	BC=177.9	2.25026

CASE 2. Two sides AC, CB (fig. 9.), and the angle A opposite to one of them, being given; to find the other angles B, C, and also the other side AB. Fig. 9.

SOLUTION. The angle B is found by this proportion.

CB : AC :: sin. A : sin. B.

When CB is less than CA, the angle B admits of two values, one of which is the supplement of the other; because, corresponding to the same value of the side AC, and the angle A, the side BC may evidently have two distinct positions, viz. CB, C*b*. The angle CBA and its supplement C*b*A being found, the angle ACB, also the angle AC*b* may be found, by subtracting the sum of the two known angles from 180°, and then AB and A*b* may be found by these proportions.

Sin. A : Sin. ACB :: CB : AB,
Sin. A : Sin. AC*b* :: CB or C*b* : A*b*.

This is called the *ambiguous* case, on account of the angle B and the side AB having sometimes two values.

This solution, like the last, is deduced from Theorem II.

Example. Suppose AC 225, BC 180, and the angle A 42° 20′; to find the remaining parts.

CB 180 -	2.25527
AC 225 - -	2.35218
Sin. A 42° 20′ -	9.82830
	12.18048
Sin. ABC=57° 20′ Or sin. A*b*C=122.40	9.92521

In the triangle ACB we have now the side AC and the angles CAB, CBA, therefore the remaining angle ACB and side AB may be found by Case 1.; and the same is true of the triangle AC*b*.

Plane Trigonometry.

CASE 3. Two sides CA, CB and the included angle C being given, to find the remaining angles B, A, and side AB.

SOLUTION. Find AC+CB, the sum of the sides, and AC—CB their difference; also find the sum of the angles A and B (that sum is the supplement of C), and half that sum; then half the difference of the angles will be got from this proportion. (See Theor. III.).

$$AC+CB : AC-CB :: \tan.\tfrac{1}{2}(B+A) : \tan.\tfrac{1}{2}(B-A).$$

Having now the sum and difference of the angles B and A, the angles will be found by the rule given in the problem following Theor. IV.

The remaining side may be found by either of these proportions.

$$\text{Sin. } B : \text{sin. } C :: AC : AB; \text{ or sin. } A : \text{sin. } C :: BC : AB.$$

Example. Let AC be 128, CB 90, and the angle C 48° 12′. Required the remaining parts of the triangle.

AC+CB 218	-	2.33846
AC—CB 38	-	1.57978
tan. ½ (B+A) 65° 54′	-	10.34938
		11.92916
tan. ½ (B—A) 21° 17′	-	9.59070

Hence by the given rule in the above-mentioned problem, B=87° 11′, A=43° 37′. As we now know all the angles and two sides, the remaining side may be found by Case 1.

Fig. 10.

CASE 4. The three sides AB, BC and AC (fig. 10.) being given, to find the three angles A, B, C.

SOLUTION. Let fall a perpendicular CD upon the greatest of the three sides from the opposite angle. Then find the difference between AD and DB by this proportion.

$$AB : AC+CB :: AC-CB : AD-DB.$$

The segments AD, DB may now be found severally by the rule given for finding each of the quantities whose sum and difference is given, and then the angles A and B may be found by the following proportions.

$$CA : AD :: \text{rad.} : \text{cos. } A,$$
$$CB : BD :: \text{rad.} : \text{cos. } B.$$

The angles A, B being found, C of course is known. The first part of this solution follows from Theor. IV. the latter part from Theor. I.

Example. Let AB be 125, AC 105, and BC 95. Required the angles.

In this case AC+BC=200, AC—BC=10, therefore we have

$$125 : 200 :: 10 : AD-DB = \frac{200 \times 10}{125} = 16.$$

Now AD+DB=125, therefore AD=70.5 DB=54.5.

To find A.			To find B.		
AC 105	-	2.02119	BC 95	-	1.97772
AD 70.5	-	1.84819	BD 54.5	-	1.73640
Rad.	-	10.00000	Rad.	-	10.00000
		11.84819			11.73640
Cos. A 47° 49′		9.82700	Cos. B 55°	-	9.75868

Spher Trigonometry.

For the application of plane trigonometry, see MENSURATION, Sect. I.

SECTION III.

SPHERICAL TRIGONOMETRY.

THEOR. I.

If a sphere be cut by a plane through the centre, the section is a circle.

THE truth of this proposition is evident from the definition of a sphere. See GEOMETRY, Sect. IX. Def. 3.

DEFINITIONS.

I. Any circle which is a section of a sphere by a plane passing through its centre, is called a *great circle* of the sphere.

COR. All great circles of a sphere are equal, and the centre of the sphere is their common centre, and any two of them bisect one another.

II. The *pole* of a great circle of the sphere is a point in the superficies of the sphere from which all straight lines drawn to the circumference of the circle are equal.

III. A *spherical angle* is that which on the superficies of a sphere is contained by two arches of great circles, and is the same with the inclination of the planes of these great circles.

IV. A *spherical triangle* is a figure upon the superficies of a sphere comprehended by three arches of three great circles, each of which is less than a semicircle.

THEOR. II.

The arch of a great circle between the pole and the circumference of another circle is a quadrant.

Let ABC be a great circle (fig. 11.), and D its pole; let the great circle ADC pass through D, and let AEC be the common section of the planes of the two circles, which will pass through E the centre of the circle, join DA, DC. Because the chord DA is equal to the chord DC, (Def. 2.) the arch DA is equal to the arch DC; now ADC is a semicircle, therefore the arches AD and DC are quadrants. Fig. 11.

COR. 1. If DE be drawn, the angle AED is a right angle, and DE being therefore at right angles to every line it meets with in the plane of the circle ABC, is at right angles to that plane. Therefore the straight line drawn from the pole of any great circle to the centre of the sphere is at right angles to the plane of that circle.

COR. 2. The circle has two poles D, D′, one on each

Spherical Trigonometry.

ical each side of its plane, which are the extremities of a diameter of the sphere perpendicular to the plane ABC.

THEOR. III.

A spherical angle is measured by the arch of a great circle intercepted between the great circles containing the angle, and having the angular point for its pole.

Fig. Let AB, AC be two arches of great circles containing the spherical angle BAC; let BC be an arch of a great circle intercepted between them, and having A for its pole, and let BD, CD, AD be drawn to D the centre of the sphere. The arches AB, AC are quadrants, (Theor. II.), and therefore the angles ADB, ADC right angles; therefore (GEOMETRY, Sect. VII. Def. 4.), the angle BDC (which is measured by the arch BC) is the inclination of the planes of the circles BDA, CDA, and is equal to the spherical angle BAC (Def. 3.).

COR. If AB, AC two arches of great circles meet in A, then A shall be the pole of a great circle passing through B and C.

THEOR. IV.

Two great circles whose planes are perpendicular pass through each others poles.

Fig 3. Let ACBD, AEBF be two great circles, the planes of which are at right angles to one another; from G the centre of the sphere, draw GC in the plane ABCD perpendicular to AB, then GC is also perpendicular to the plane AEBF, (GEOMETRY, Sect. VII. Theor. 12.); therefore C is the pole of the circle AEBF, and if CG be produced to D, D is the other pole of the circle AEBF.

In the same manner, by drawing GE in the plane AEBF perpendicular to AB, and producing it to F, it is shewn that E and F are the poles of the circle ABCD.

COR. 1. If two great circles pass through each others poles, their planes are perpendicular to one another.

COR. 2. If of two great circles the first passes through the poles of the second, the second also passes through the poles of the first.

THEOR. V.

If the angular points of any spherical triangle be made the poles of three great circles, another triangle will be formed by their intersections, such, that the sides of the one triangle will be respectively the supplements of the measures of the angles opposite to them in the other.

Fig 4. Let the angular points of the triangle ABC be the poles of three great circles; which by their intersections form the three lunary surfaces DQ, FR, and EO; A being the pole of EF, B the pole of DF, and C the pole of ED. Then the triangle DEF which is common to three lunary surfaces will be in every respect supplemental to the triangle ABC.

For let each side of ABC be produced to meet the sides that contain the angle opposite to it, in the triangle DEF; then, because BC passes through the poles of ED, DF, ED, DF must also pass through the poles of BC. (Theor. II. Cor. 2.). Therefore the points D, Q are the poles of BC. In like manner R, F are the poles of AB, and E, O the poles of AC. Hence EL, FK are quadrants, (Theor. II.); and therefore EF is the supplement of KL, but since A is the pole of EF, KL is the measure of the angle at A; thus EF is the supplement of the measure of the angle at A. In like manner FD is the supplement of the measure of the angle at B, and DE the supplement of the measure of the angle at C.

Further, it will appear in the same manner that BC is the supplement of HM, the measure of the angle at D; that AB is the supplement of NK the measure of the angle at F; and that AC is the supplement of GL, the measure of the angle at E.

THEOR. VI.

If from any point E, which is not the pole of the great circle ABC, there be drawn arches of great circles EA, EK, EB, &c. the greatest of these is EGA, which passes through G the pole of ABC, and EC the remainder of the semicircle is the least, and of the other, EK, EB, &c. EK which is nearer to EA is greater than EB, which is more remote.

Let AC be the common section of the planes of the great circles AEC, ABC; draw EH perpendicular to AC, which will be perpendicular to the plane of the circle ABC (GEOMETRY, Sect. VII. Theor. XII.), and join AE, KE, BE, KH, BH. Then of all the straight lines drawn from H to the circumference, HA is the greatest, HC the least, and HK greater than HB: Therefore in the right-angled triangles EHA, EHK, EHB, EHC, which have the side EH common, EA is the greatest hypothenuse, EC the least, and EK greater than EB, consequently the arch EGA is the greatest, EC the least, and EK greater than EB. Fig. 15.

THEOR. VII.

Any two sides of a spherical triangle are together greater than the third, and all the three sides are together less than a circle.

Let ABC be a spherical triangle, let D be the centre of the sphere, join DA, DB, DC. The solid angle at D is contained by three plane angles ADB, BDC, ADC, any two of which are greater than the third, (GEOMETRY, Sect. VII. Theor. XV.); and therefore any two of the arches AB, BC, AC which measure these angles must be greater than the third arch. Fig. 16.

To prove the second part of the proposition, produce the sides AB, AC until they meet again in E; then ECA and EBA are semicircles; now CB is less than CE+EB, therefore CB+CA+BA is less than CE+EB+CA+BA, but these four arches make up two semicircles; therefore CB+CA+BA is less than a circle.

Spherical Trigonometry.

THEOR. VIII.

If two sides of a spherical triangle be equal, the angles opposite to them are equal, and conversely.

Fig. 17. In the triangle ABC, if the sides AB, AC be equal, the angles ABC, ACB are also equal. If AB, AC be quadrants, ABC, ACB are right angles. If not, let the tangent to the side AB at B meet EA the line of common section of the planes AB, AC in F, and let the tangents to the base BC at its extremities meet each other in G; also, let FC, FG, EC, and EB be joined. Then the triangles FEB, FEC have FE common, EB=EC, and the angle AEB=AEC, therefore FB =FC, and the angle FCE=FBE a right angle: hence FC is a tangent, and the triangles FGB, GCF are mutually equilateral, therefore the angle FBG=FCG, and consequently the spherical angle ABC=ACB.

Again, if the angles ABC, ACB be equal, the side AB=AC. For if in fig. 14. the angle ABC be equal to ACB, the side DF of the supplemental triangle DEF will be equal to the side DE (Theor. V.); therefore the angle DEF=DFE, and consequently in the triangle ABC, the side AC=AB by Theorem V.

COR. In any triangle the greater angle is subtended by the greater side; and conversely. For if the angle Fig. 18. ACB be greater than ABC (fig. 18.) let BCD=ABC, then BD=DC, and AB=AD+DC, which is greater than AC (Theor. VII.). The converse is demonstrated in the same manner as the like property of plane triangles, (GEOMETRY, Sect. I. Theor. XIII.).

THEOR. IX.

All the angles of a spherical triangle are together greater than two, and less than six right angles.

Fig. 14. In the triangle ABC (fig. 14.) the three angles are together less than six right angles, because when added to the three exterior angles they only make six; and they are greater than two right angles, because their measures GH, KL, MN, added to DE, EF, FD, are equal to three semicircles; and DE, EF, FD being less than two semicircles (Theor. VII.) GH, KL, MN must be greater than one.

THEOR. X.

Any two angles of a spherical triangle are together greater, equal, or less than two right angles, according as the sum of the opposite sides is greater, equal, or less than a semicircle; and conversely.

Fig. 19. Let the sides AB, AC (fig. 19.) of the spherical triangle ABC be produced to meet in D; then it is evident, that according as the sum of AB, BC is greater, equal, or less than the semicircle ABD, the side BC will be greater, equal, or less than BD; the angle D or A will be greater, equal, or less than BCD, and the sum of the angles BAC, BCA greater, equal, or less than the sum of BCA, BCD, which is two right angles.

COR. According as half the sum of any two sides of a spherical triangle is greater, equal, or less than a quadrant, half the sum of the opposite angles will be greater, equal, or less than a right angle. Spherical Trigonometry.

THEOR. XI.

In a right-angled triangle, according as either of the sides about the right angles is greater, equal, or less than a quadrant, its opposite angle is greater, equal, or less than a right angle; and conversely.

Let ABC (fig. 20.) be a triangle right-angled at B, Fig. 20. and let the sides AB, BC be produced to meet in D; then, because they pass through each others poles, E the middle point of BAD will be the pole of BCD; let a great circle pass through the points CE. The arch EC is a quadrant, and the angle ECB a right angle. Now it is plain, that according as AB is greater, equal, or less than the quadrant EB, the opposite angle ACB will be greater, equal, or less than the right angle ECB, and conversely.

COR. 1. If the two sides be both greater, or both less than quadrants, the hypothenuse will be less than a quadrant; but if the one be greater and the other less, the hypothenuse will be greater than a quadrant, and conversely.

For in the triangles ABC, ADC, right-angled at B, D, in which the sides AB, BC are less, and consequently AD, DC greater than quadrants, the hypothenuse AC is less than a quadrant, because it is nearer to CB than the quadrant CE. But in the triangle aBC, of which the side aB is greater, and BC less than a quadrant, the hypothenuse aC is greater than a quadrant, because it is further from CB than CE is.

COR. 2. In every spherical triangle, of which the two sides are not both quadrants, if the perpendicular from the vertex fall within, the angles at the base will be both acute, or both obtuse; but if it fall without, the one will be obtuse, and the other acute, and conversely.

THEOR. XII.

In any right-angled spherical triangle, as radius is to the sine of the hypothenuse, so is the sine of one of the oblique angles to the sine of its opposite side.

Let ABC (fig. 21.) be a spherical triangle, having Fig. 21. a right angle at B; and let AD, BD, CD be drawn to the centre of the sphere. From C, in the plane DCA, let CE be drawn perpendicular to DA, and from E, in the plane DBA, draw EF perpendicular to the same line, and let CF be joined. Then because DA is perpendicular to the two lines CE, EF, it is perpendicular to the plane CEF, and consequently the plane CEF is perpendicular to the plane DBA; but the plane DCB is also perpendicular to DBA; therefore their line of common section CF is perpendicular to the same: Hence CFD, CFE are right angles. Now in the right-angled triangle CFE, rad. : CE :: sin. E : CF; but the angle CEF, being the inclination of the planes DCA, DBA, is the same with the spherical angle CAB, CE is the sine of AC, and CF the sine of BC; therefore rad. : sin. AC :: sin. A : sin. BC.

COR.

Spherical Trigonometry.

Cor. 1. As radius to the cosine of either of the sides, so is the cosine of the other to the cosine of the hypothenuse.

Fig. 22. For let the great circle of which A is the pole, meet the three sides in D, E, F; then F is the pole of AD; and applying this proposition to the complemental triangle FCE, rad. : sin. FC :: sin. F : sin. CE; that is, rad. : cos. BC :: cos. AB : cos. AC.

Cor. 2. As radius to the cosine of one of the sides, so is the sine of its adjacent angle to the cosine of the other angle.

Theor. XIII.

In any right-angled triangle, as radius to the sine of one of the sides, so is the tangent of the adjacent angle to the tangent of the other side.

Fig. 23. From B let BE be drawn perpendicular to DA, and from E, EF also perpendicular to DA, in the plane DCA, to meet DC in F, and let BF be joined. It may be shown as in the preceding proposition, that FB is perpendicular to the plane DBA; hence FB is the tangent of BC, and FBE is a right-angled triangle; therefore rad. : EB :: tan. E : FB; that is rad. : sin. AB :: tan. A : tan. BC.

Cor. 1. As radius to the cosine of the hypothenuse, so is the tangent of one of the angles to the cotangent of the other. For, in the complemental triangle FCE, (fig. 22.) rad. : sin. CE :: tan. C : tan. FE, that is, rad. : cos. AC :: tan. C : cot. A, or, rad. : cos. AC :: tan. A : cot. C.

Cor. 2. As radius is to the cosine of one of the angles, so is the tangent of the hypothenuse to the tangent of the side adjacent to that angle.

For rad. : sin. FE :: tan. F : tan. CE; that is, rad. : cos. A :: cot. AB : cot. AC, or rad. : cos. A :: tan. AC : tan. AB.

Napier's Rule for Circular Parts.

Let the hypothenuse, the two angles, and the complements of the two sides of any right-angled spherical triangle be called the *five circular parts* of the triangle. Any one of these being considered as the *middle* part, let the two which are next to it be called the *adjacent* parts, and the remaining two the *opposite* parts. Then the two preceding theorems, with their corollaries, may be all expressed in one proposition adapted to practice, as follows.

In any right-angled spherical triangle, the rectangle under radius, and the cosine of the middle part, is equal to the rectangle under the cotangents of the adjacent parts, or to the rectangle under the sines of the opposite parts.

Fig. 24. Case 1. Let the hypothenuse AC be the middle part.

Then, rad. : cos. AC :: tan. C : cot. A (Theor. 13. Cor. 1.).

Therefore (rad. : tan. C ::) cot. C : rad. :: cos. AC : cot. A.

And rad. : cos. AB :: cos. BC : cos. AC (Theor. 12. Cor. 1.).

Case 2. Let the angle A be the middle part.

Then (Theor. 13. Cor. 2.) rad. : cos. A :: tan. AC : tan. AB.

Therefore, (rad. : tan. AC ::) cot. AC : rad. :: cos. A : tan. AB,

And (Theor. 12. Cor. 2.) rad. : cos. BC :: sin. C : cos. A.

Case 3. Let the complement of the side AB be the middle part.

Then (Theor. 13.) rad. : sin. AB :: tan. A : tan. BC.

Therefore (rad. : tan. A ::) cot. A : rad. :: sin. AB : tan. BC.

And (Theor. 12.) rad. : sin. AC :: sin. C : sin. AB.

We are indebted for the foregoing rule to Napier, the celebrated inventor of logarithms. It comprehends all the propositions which are necessary for the resolution of right-angled triangles, and being easily remembered, is perhaps one of the happiest instances of artificial memory that is known.

Theor. XIV.

In any spherical triangle, the sines of the sides are proportional to the sines of the opposite angle.

This proposition has been demonstrated in the case of right-angled triangles. Let ABC be any oblique-angled triangle, divided into two right-angled triangles, ABD, CBD, by the perpendicular BD, falling from the vertex upon the base AC. In the former, the complement of BD being the middle part, rad. × sin. BD = sin. AB × sin. A, (Napier's Rule). In the latter, the complement of BD being the middle part, rad. × sin. BD = sin. BC × sin. C. Hence sin. AB × sin. A = sin. BC × sin. C, and sin. AB : sin. BC :: sin. C : sin. A. Fig. 25.

Cor. 1. The cosines of the two sides are to one another directly as the cosines of the segments of the base. This is proved by making AB, BC the middle part.

Cor. 2. The tangents of the two sides are to one another inversely as the cosines of the vertical angles. This will follow from making the angles ABD, CBD the middle parts.

Lemma 1. *The sum of the tangents of two arches is to their difference, as the rectangle under the sine and cosine of half their sum to the rectangle under the sine and cosine of half their difference.*

For, putting a and b for any two arches, by the arithmetic of sines (Algebra, § 353.),

$$\text{Sin } a \text{ cos. } b + \text{cos. } a \text{ sin. } b = \text{sin. } (a+b).$$

Let each side of this equation be divided by cos. a cos. b, and we get

$$\frac{\text{sin. } a}{\text{cos. } a} + \frac{\text{sin. } b}{\text{cos. } b} = \frac{\text{sin. } (a+b)}{\text{sin. } a \text{ cos. } b}$$

that is, $\text{tan. } a + \text{tan. } b = \dfrac{\text{sin. } (a+b)}{\text{sin. } a \text{ cos. } b}$.

In like manner, from the formula $\text{sin. } (a-b) = \text{sin. } a \text{ cos. } b - \text{cos. } a \text{ sin. } b$, we get

$$\text{tan. } a - \text{tan. } b = \frac{\text{sin. } (a-b)}{\text{sin. } a \text{ cos. } b};$$

therefore $\text{tan. } a + \text{tan. } b : \text{tan. } a - \text{tan. } b : \text{sin. } (a+b) : \text{sin. } (a-b)$, and remarking that $\text{sin. } (a+b) = 2 \text{ sin. } \frac{1}{2}(a+b)$

Spherical Trigonometry.

$\frac{1}{2}(a+b)$ cof. $\frac{1}{2}(a+b)$, and fin. $(a-b) = 2$ fin. $\frac{1}{2}(a-b)$ cof. $\frac{1}{2}(a-b)$, (ALGEBRA, § 358) it follows that tan. a + tan. b : tan. a — tan. b :: fin. $\frac{1}{2}(a+b)$ cof. $\frac{1}{2}(a+b)$: fin. $\frac{1}{2}(a-b)$ cof. $\frac{1}{2}(a-b)$.

LEMMA 2. *The ſum of the ſines of two arches is to their difference, as the rectangle under the ſine of half the ſum and coſine of half the difference of theſe arches is to the rectangle under the ſine of half the difference and coſine of half the ſum.*

For it has been ſhown in the arithmetic of ſines (ALGEBRA, § 355), that

$$\text{Sin. } (p+q) + \text{fin. } (p-q) = 2 \text{ fin. } p \text{ cof. } q,$$
$$\text{Sin. } (p+q) - \text{fin. } (p-q) = 2 \text{ cof. } p \text{ fin. } q.$$

Let $p = \frac{1}{2}a + \frac{1}{2}b$, and $q = \frac{1}{2}a - \frac{1}{2}b$, ſo that $p+q$, $= a$ and $p-q = b$, then theſe formulas become

$$\text{Sin. } a + \text{fin. } b = 2 \text{ fin } \tfrac{1}{2}(a+b) \text{ cof. } \tfrac{1}{2}(a-b)$$
$$\text{Sin. } a - \text{fin. } b = 2 \text{ cof. } \tfrac{1}{2}(a+b) \text{ fin. } \tfrac{1}{2}(a-b).$$

Therefore, fin. a + fin. b : fin. a — fin. b :: fin. $\frac{1}{2}(a+b)$ cof. $\frac{1}{2}(a-b)$: cof. $\frac{1}{2}(a+b)$ fin. $\frac{1}{2}(a-b)$.

LEMMA 3. *The ſum of the ſines of two arches is to their difference, as the tangent of half the ſum of theſe arches is to the tangent of half their difference.*

For, dividing the latter antecedent and conſequent of the proportion in the foregoing lemma by cof. $\frac{1}{2}(a+b) \times$ cof. $\frac{1}{2}(a-b)$, we have fin. a + fin. b : fin. a — fin. b :: $\frac{\text{fin. } \frac{1}{2}(a+b)}{\text{cof. } \frac{1}{2}(a+b)} : \frac{\text{fin. } \frac{1}{2}(a-b)}{\text{cof. } \frac{1}{2}(a-b)}$, that is, becauſe $\frac{\text{fin.}}{\text{cof.}} =$ tan. fin. a + fin. b : fin. a — fin. b :: tan. $\frac{1}{2}(a+b)$: tan. $\frac{1}{2}(a-b)$.

LEMMA 4. *The ſum of the coſines of two arches is to their difference, as the cotangent of half the ſum of theſe arches is to the tangent of half their difference.*

By Arithmetic of ſines (ALGEBRA, § 355.),

$$\text{cof. } (p-q) + \text{cof. } (p+q) = 2 \text{ cof. } p \text{ cof. } q,$$
$$\text{cof. } (p-q) - \text{cof. } (p+q) = 2 \text{ fin. } p \text{ fin. } q.$$

Let $p = \frac{1}{2}(b+a)$ and $q = \frac{1}{2}(b-a)$, then $p-q = a$ and $p+q = b$, and the two formulas become

$$\text{cof. } a + \text{cof. } b = 2 \text{ cof. } \tfrac{1}{2}(b+a) \text{ cof. } \tfrac{1}{2}(b-a),$$
$$\text{cof. } a - \text{cof. } b = 2 \text{ fin. } \tfrac{1}{2}(b+a) \text{ fin. } \tfrac{1}{2}(b-a);$$

Hence, cof. a + cof. b : cof. a — cof. b :: cof. $\frac{1}{2}(b+a)$ cof. $\frac{1}{2}(b-a)$: fin. $\frac{1}{2}(b+a)$ fin. $\frac{1}{2}(b-a)$;

and dividing the latter antecedent and conſequent by fin. $\frac{1}{2}(b+a)$ cof. $\frac{1}{2}(b-a)$,

$$\text{cof. } a + \text{cof. } b : \text{cof. } a - \text{cof. } b :: \frac{\text{cof. } \frac{1}{2}(b+a)}{\text{fin. } \frac{1}{2}(b+a)} : \frac{\text{fin. } \frac{1}{2}(b-a)}{\text{cof. } \frac{1}{2}(b-a)},$$

that is, becauſe $\frac{\text{cof.}}{\text{fin.}} = \text{cot.}$ and $\frac{\text{fin.}}{\text{cof.}} = \text{tan.}$ we have cof. a + cof. b : cof. a — cof. b :: cot. $\frac{1}{2}(b+a)$: tan. $\frac{1}{2}(b-a)$.

Fig. 26.

IN the demonſtration of the remaining theorems, we ſhall put A, B for the angles A and B at the baſe of the ſpherical triangle ACB (fig. 26), a and b for the ſides oppoſite to theſe angles, p and q for the ſegments of the baſe BD, AD made by the perpendicular arch CD, P and Q for the vertical angles BCD, ACD; we ſhall alſo put s for $\frac{1}{2}(a+b)$, d' for $\frac{1}{2}(a-b)$, s' for $\frac{1}{2}(p+q)$, d' for $\frac{1}{2}(p-q)$, S for $\frac{1}{2}$(A+B), D for $\frac{1}{2}$(A—B), S′ for $\frac{1}{2}$(P+Q), and D′ for $\frac{1}{2}$(P—Q). Spherical Trigonometry.

THEOR. XV.

In any ſpherical triangle, the tangent of half the ſum of the ſegments of the baſe is to the tangent of half the ſum of the two ſides, as the tangent of half their difference to the tangent of half the difference of the ſegments of the baſe.

For by Theor. XIV. Cor. 1. cof. a : cof. b :: cof. p : cof. q; therefore, cof. a + cof. b : cof. a — cof. b :: cof. p + cof. q : cof. p — cof. q, hence (Lemma 4.) cot. s : tan. d' :: cot. s' : tan. d', or cot. s : cot. s' :: tan. d : tan. d'; but cot. s : cot. s' :: tan. s' : tan. s, therefore, tan. s' : tan s :: tan. d : tan. d'. This propoſition expreſſed in words at length is the theorem to be demonſtrated.

THEOR. XVI.

The cotangent of half the ſum of the vertical angles and the tangent of half their difference, or the cotangent of half their difference and the tangent of half their ſum, according as the perpendiculars fall within or without, are reciprocally proportional to the tangents of half the ſum and half the difference of the angles at the baſe.

For, taking the caſe in which the perpendicular CD (fig. 27.) falls within, let EFG be the ſupplemental triangle, let the arches GE, GF meet again in L, and produce CA, CB to meet EF in H and K. Becauſe G and L are the poles of AB, the perpendicular CD, if produced, will paſs through G and L; let it meet EF in I; then, becauſe C is the pole of EF, the arch GCI is perpendicular to EF, and ſince E is the pole of BC, KE = a quadrant = FH, and EH = KF, and IF — IE = IK — IH. In the triangle LEF, by the preceding propoſition, tan. $\frac{1}{2}$(FI+IE) : tan. $\frac{1}{2}$(FL+LE) :: tan. $\frac{1}{2}$(FL—LE) : tan. $\frac{1}{2}$(FI—IE) or tan. $\frac{1}{2}$(KI—IH). Now FI+IE, or FE, being the ſupplement of C, (Theor. 5.), tan. $\frac{1}{2}$FE = cot. $\frac{1}{2}$C; and FL, LE being the ſupplements of FG and GE, FL and LE are the meaſures of the angles A, B; moreover, IK, IH are the meaſures of the angles BCD, ACD, therefore, cot. $\frac{1}{2}$C, or cot. $\frac{1}{2}$(P+Q) : tan. $\frac{1}{2}$(A+B) : tan. $\frac{1}{2}$(A—B) : tan. $\frac{1}{2}$(P—Q). In the very ſame way it may be proved, when the perpendicular falls without the triangle, that cot. $\frac{1}{2}$(P—Q) : tan. $\frac{1}{2}$(A+B) :: tan. $\frac{1}{2}$(A—B) : tan. $\frac{1}{2}$(P+Q). Fig. 27.

THEOR. XVII.

In any ſpherical triangle, the ſine of half the ſum of the ſides is to the ſine of half their difference, as the cotangent of half the vertical angle to the tangent of half the difference of the angles at the baſe.

For ſince tan. a : tan. b :: cof. Q : cof. P, therefore,

tan.

tan. a + tan. b : tan. a — tan. b :: cof. Q + cof. P : cof. Q — cof. P; hence, by Lemma 2 and 4.

fin. s cof. s : fin. d cof. d :: cot. S′ : tan. D′ . . . (1).

Again, becauſe (by Theor. XIV.) fin. a : fin. b :: fin. A : fin. B, therefore, fin. a + fin. b : fin. a — fin. b :: fin. A + fin. B : fin. A — fin. B; hence, (by Lemma 2. and 3.).

fin. s cof. d : fin. d cof. s :: tan. S : tan. D . . . (2).

Taking now the product of the correſponding terms of the proportions (1) and (2), and rejecting the factor cof. s cof. d, which is common to the firſt antecedent and conſequent of the reſulting proportion, we have,

fin.^{2} s : fin.^{2} d :: cot. S′ tan. S : tan. D′ tan. D.

But ſince by Theor. XVI. tan. S : tan. D′ :: cot. S′ : tan. D, therefore cot. S′ tan. S : tan. D′ tan. D :: cot.^{2} S′ : tan.^{2} D; therefore, fin.^{2} s : fin.^{2} d :: cot.^{2} S′ : tan.^{2} D, and fin. s : fin. d :: cot. S′ : tan. D, this proportion when expreſſed in words is the proportion to be demonſtrated.

Theor. XVIII.

In any ſpherical triangle, the coſine of half the ſum of the two ſides is to the coſine of half their difference, as the cotangent of half the vertical angle to the tangent of half the ſum of the angles at the baſe.

For it has been proved in laſt theorem that

fin. s cof. s : fin. d cof. d :: cot. S′ : tan. D′
fin. s cof. d : fin. d cof. s :: tan. S : tan. D;

therefore, dividing the terms of the firſt of theſe two proportions by the correſponding terms of the ſecond, we get

$$\frac{\text{cof. } s}{\text{cof. } d} : \frac{\text{cof. } d}{\text{cof. } s} :: \frac{\text{cot. S}'}{\text{tan. S}} : \frac{\text{tan. D}'}{\text{tan. D}}.$$

Hence, multiplying the firſt and ſecond terms by cof. s × cof. d, and the third and fourth by tan. S tan. D, we have

cof.^{2} s : cof.^{2} d :: cot. S′ tan. D : tan. S tan. D′.

But ſince by Theor. XVI. tan. D : tan. D′ :: cot. S′ : tan. S, therefore, cot. S′ tan. D : tan. S tan. D′ :: cot.^{2} S′ : tan.^{2} S; therefore, cof.^{2} s : cof.^{2} d :: cot.^{2} S′ : tan.^{2} S, and cof. s : cof. d :: cot. S′ : tan. S.

Theor. XIX.

In any ſpherical triangle, the ſine of half the ſum of the angles at the baſe is to the ſine of half their difference, as the tangent of half the baſe to the tangent of half the difference of the two ſides.

For the ſame conſtruction being made as in Theor. XVI. in the triangle ELF (fig. 27.) fin. $\frac{1}{2}$ (FL + LE) : fin. $\frac{1}{2}$ (FL — LE) :: cot. $\frac{1}{2}$ L : tan. $\frac{1}{2}$ (E — F) (Theor. XVII.); but EFG being the ſupplemental triangle of ABC, LF and LE are the meaſures of A and B, L is the ſupplement of AB, and LFE, LEF are the meaſures of the ſides AC, BC (Theor. V.); therefore fin. $\frac{1}{2}$ (A + B) : fin. $\frac{1}{2}$ (A — B) :: tan. $\frac{1}{2}$ AB : tan. $\frac{1}{2}$ (BC — AC).

Theor. XX.

In any ſpherical triangle, the coſine of half the ſum of the angles at the baſe is to the coſine of half their difference, as the tangent of half the baſe to the tangent of half the ſum of the two ſides.

For in the triangle ELF, cof. $\frac{1}{2}$ (LF + LE) : cof. $\frac{1}{2}$ (LF — LE) :: cot. $\frac{1}{2}$ L : tan. $\frac{1}{2}$ (E + F) (Th. XVIII.) that is, becauſe of the relation of the triangle FLE to ABC, as expreſſed in laſt theorem, cof. $\frac{1}{2}$ (A + B) : cof. $\frac{1}{2}$ (A — B) :: tan. $\frac{1}{2}$ AB : tan. $\frac{1}{2}$ (BC + AC). Fig. 27.

Scholium.

Let one of the ſix parts of any ſpherical triangle be neglected; let the one oppoſite to it, or its ſupplement, if an angle, be called the *middle part*, the two next to it the *adjacent parts*, and the remaining two the *oppoſite parts*. Then the four preceding propoſitions, which are called *Napier's Analogies*, becauſe firſt invented by him, may be included in one, as follows.

In any ſpherical triangle, the ſine or coſine of half the ſum of the adjacent parts, is to the ſine or coſine of half their difference, as the tangent of half the middle part to the tangent of half the difference or half the ſum of the oppoſite parts, that is,

Sin. $\frac{1}{2}$ (A + a) : fin. $\frac{1}{2}$ (A — a) :: tan. $\frac{1}{2}$ M : tan. $\frac{1}{2}$ (O — o).
Cof. $\frac{1}{2}$ (A + a) : cof. $\frac{1}{2}$ (A — a) :: tan. $\frac{1}{2}$ M : tan. $\frac{1}{2}$ (O + o).

When A, a and M are given, by the firſt proportion, $\frac{1}{2}$ (O — o) is found, and by the ſecond $\frac{1}{2}$ (O + o); thence O and o may be had immediately by the problem following Theor. IV. Plane Trigonometry.

The Caſes of Right-angled Spherical Triangles.

In a right-angled triangle, let c denote the ſide oppoſite the right angle, a, b the ſides containing it, and A, B the oppoſite angles, A being oppoſite to a, and B to b. Then, combining theſe quantities two by two, there will be found to be ſix diſtinct combinations, or caſes. Fig. 28.

Case 1. When c, A, the hypothenuſe and one of the angles are given; to find a, b, B.

a is found by Theor. XII.; b by Theor. XIII. Cor. 2. and B by Theor. XIII. Cor. 1.

Case 2. Given a, B, a ſide and its adjacent angle. Sought, A, b, c.

A is found by Theor. XII. Cor. 2.; b by Theor. XIII.; c by Theor. XIII. Cor. 2.

Case 3. Given a, A, a ſide and its oppoſite angle; to find b B, c.

b is found by Theor. XIII.; B by Theor. XII. Cor. 2.; c by Theor. XII.

Case 4. Given c, a, the hypothenuſe, and one of the ſides; to find A, b, B.

A is found by Theor. XII.; b by Theor. XII. Cor. 1.; B by Theor. XIII. Cor. 2.

Case

Spherical Trigonometry.

Case 5. Given *a*, *b*, the two sides. Sought A, B, *c*.
A is found by Theor. XIII.; B by the same; *c* by Theor. XII. Cor. 1.

Case 6. Given A, B, the two angles. Sought *a*, *b*, *c*.
a and *b* are found by Theor. XII. Cor. 2.; *c* by Theor. XIII. Cor. 1.

The cases may be all resolved also by *Napier's Rule*, observing to make each of the things given the middle part; then two of the required parts will be found, and the remaining part is found by making it the middle part.

By Theor. II. and Cor. 1. each of the unknown parts is, in every case except the third, limited to one value.

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In any spherical triangle let the sides be denoted by *a*, *b*, *c*, and the opposite angles by A, B, C respectively.

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Case 1. Given *a*, A, *b*, two sides and an angle opposite to one of them. Sought *c*, B, C.
B is found by Theor. XIV.; *c* by either Theor. XIX. or Theor. XX.; C by Theor. XVII. or Theor. XVIII.

Case 2. Given A, *a*, B, two angles and a side opposite to one of them. Sought *b*, *c*, C.
b is found by Theor. XIV.; *c* and C as in Case 1.

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Find $\frac{1}{2}$ (A—B) by Theor. XVII. and $\frac{1}{2}$ (A+B) by Theor. XVIII. and thence A and B by the rule Sect. II. for finding each of two quantities whose sum and difference are given. All the angles being known, also two sides, *c* is found by Theor. XIV. Spherical Trigonometry.

Case 4. Given A, *c*, B, two angles and a side between them. Sought *a*, C, *b*.

Find $\frac{1}{2}$ (*a*—*b*) by Theor. XIX. and $\frac{1}{2}$ (*a*+*b*) by Theor. XX. and thence *a*, *b*. All the sides and two angles being now known, C is found by Theor. XIV.

Case 5. Given *a*, *b*, *c*, the three sides. Sought A, B, C.

Draw a perpendicular from any one of the angles, dividing the opposite side into the segments *p*, *q*. Find $\frac{1}{2}$ (*p*—*q*) by Theor. XV. and then, from $\frac{1}{2}$ (*p*+*q*) and $\frac{1}{2}$ (*p*—*q*), find *p*, *q*. The triangle being now resolved into two right-angled triangles, the angles may be found by Case 4. of right angled triangles.

Case 6. Given A, B, C, the three angles. Sought *a*, *b*, *c*.

Draw a perpendicular, dividing any one of the angles into the parts P, Q. Find $\frac{1}{2}$ (P—Q) by Theor. XVI. and then P, Q. The triangle being now resolved into two right-angled triangles, the sides may be found by Case 6. of right-angled triangles.

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Trihilatæ ‖ Tringa.

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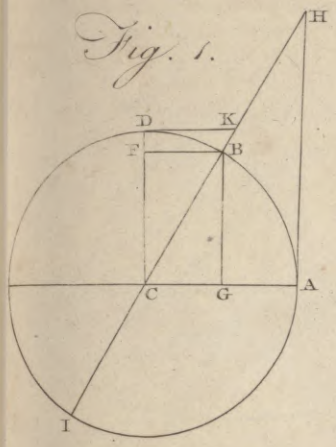
TRINITARIANS, those who believe in the Trinity; those who do not believe therein being called *Anti-trinitarians*.

TRINITY,

Fig. 1.



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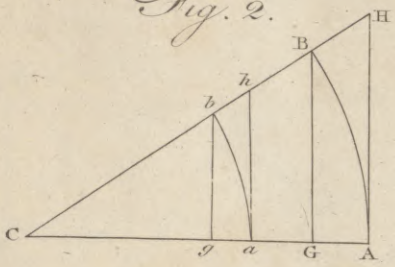

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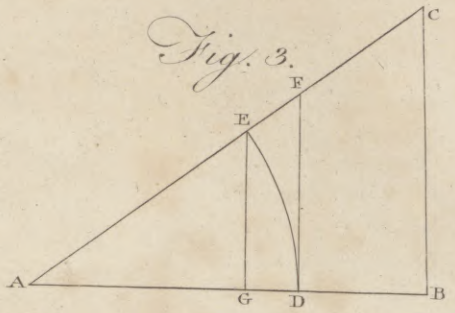
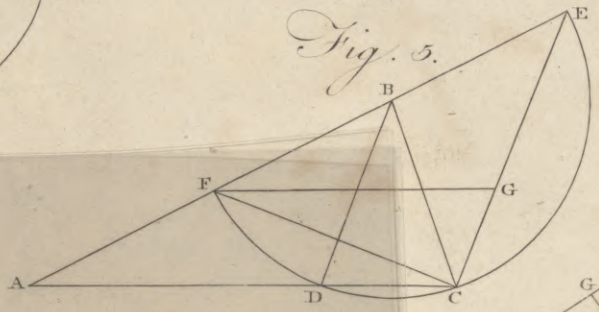


Fig. 4.

Fig. 5.



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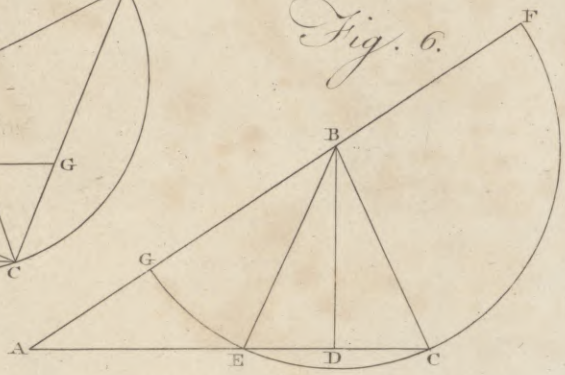
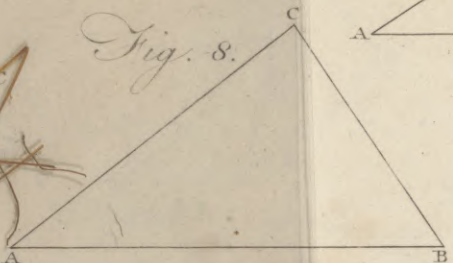


Fig. 7.

Fig. 8.



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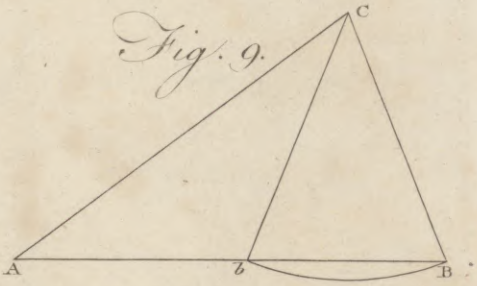

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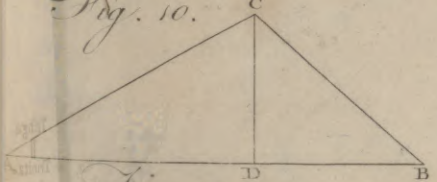

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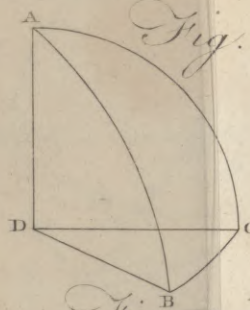

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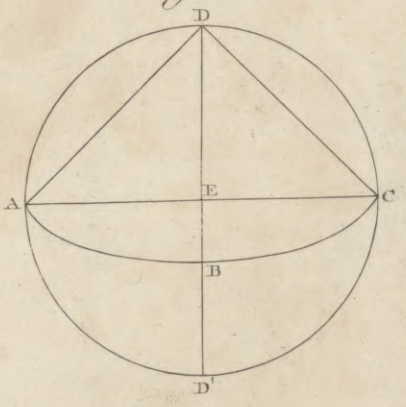

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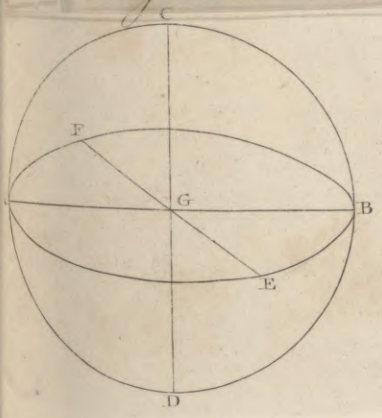

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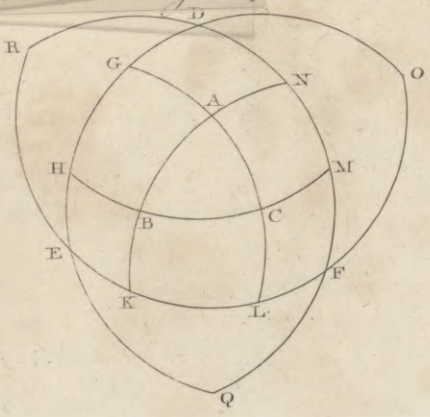

W. Train Sculpt.

Spherical Trigonometry.

Case 5. Given a, b, the two sides. Sought A, B, c. A is found by Theor. XIII.; B by the same; c by Theor. XII. Cor. 1.

Case 6. Given A, B, the two angles. Sought a, b, c.

a and b are found by Theor. XII. Cor. 2.; c by Theor. XIII. Cor. 1.

The cases may be all resolved also by *Napier's Rule*, observing to make each of the things given the middle part; then two of the required parts will be found, and the remaining part is found by making it the middle part.

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Case 2. Given A, a, B, two angles and a side opposite to one of them. Sought b, c, C.

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Find $\frac{1}{2}(A-B)$ by Theor. XVII. and $\frac{1}{2}(A+B)$ by Theor. XVIII. and thence A and B by the rule Sect. II. for finding each of two quantities whose sum and difference are given. All the angles being known, also two sides, c is found by Theor. XIV. Spherical Trigonometry.

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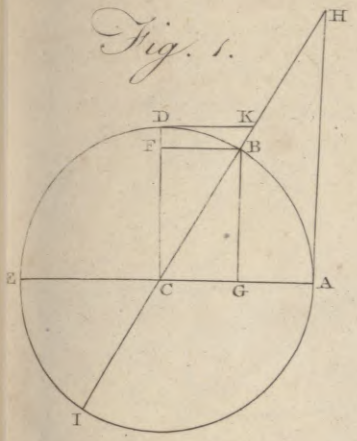

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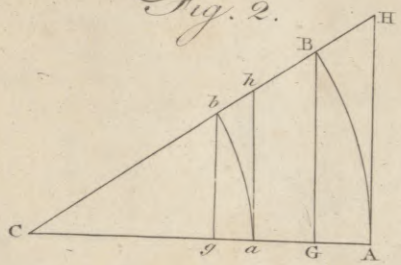

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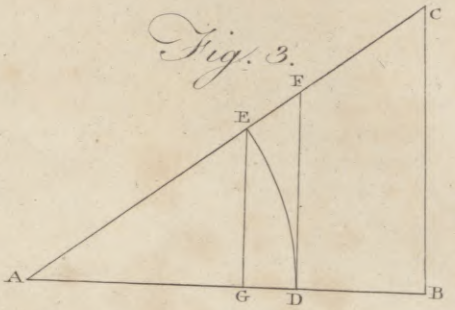

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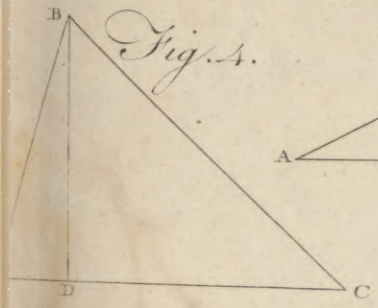

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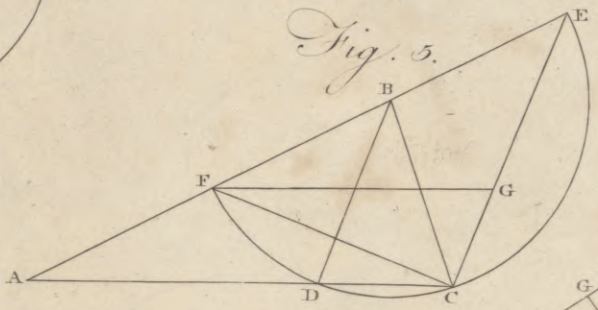

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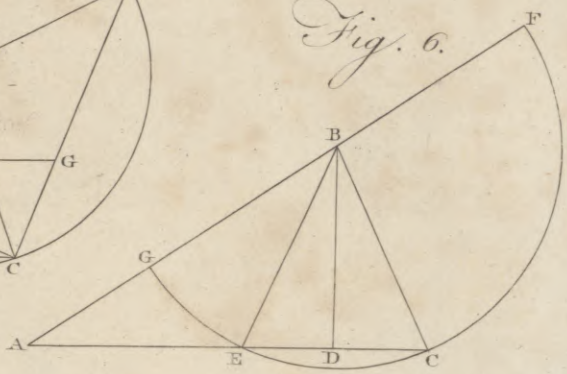

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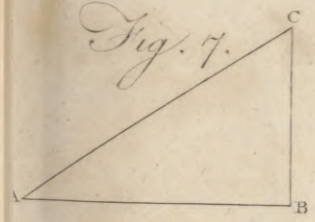

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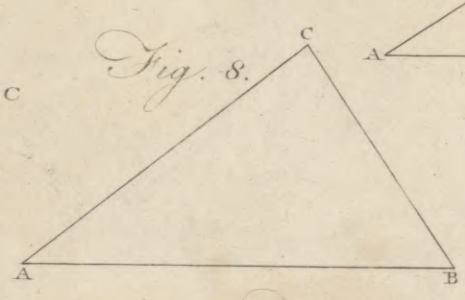

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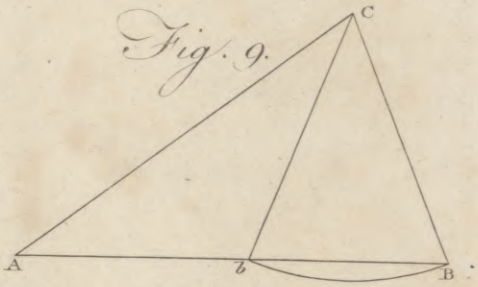

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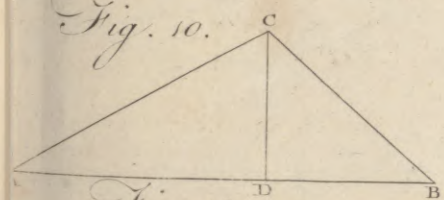

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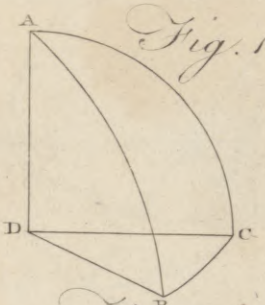

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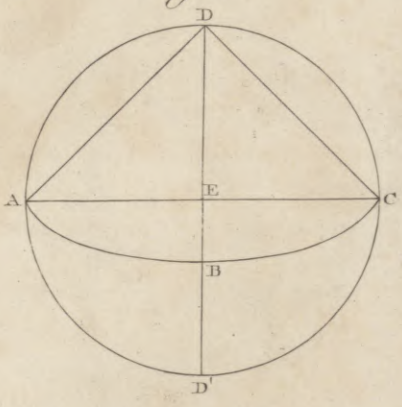

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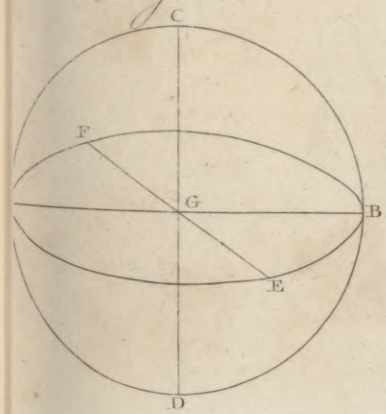

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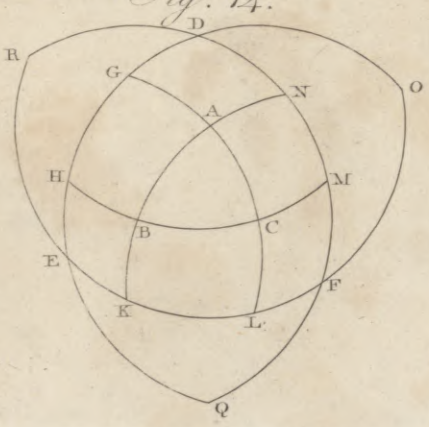
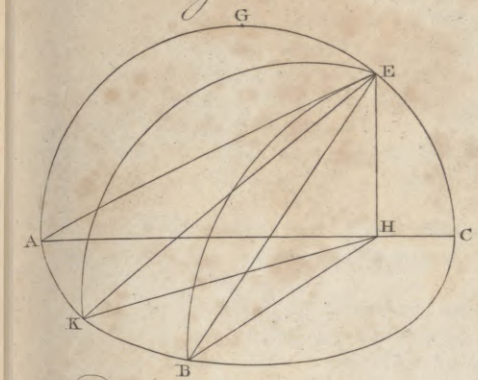


W. Train Sculpt.

Fig. 15.



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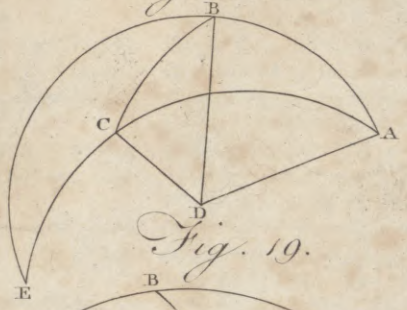

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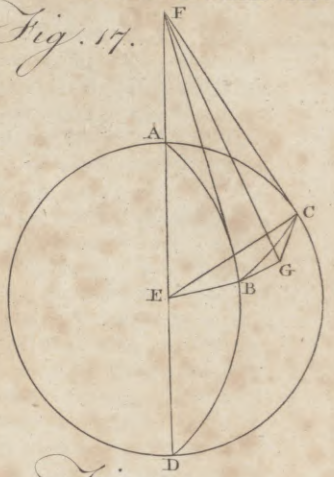

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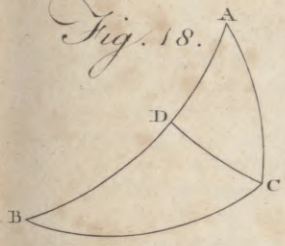

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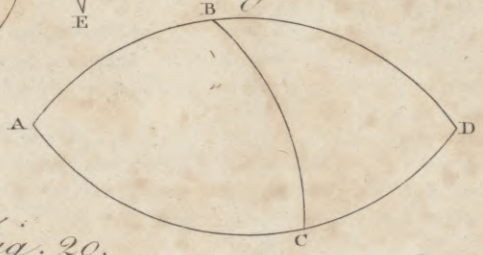

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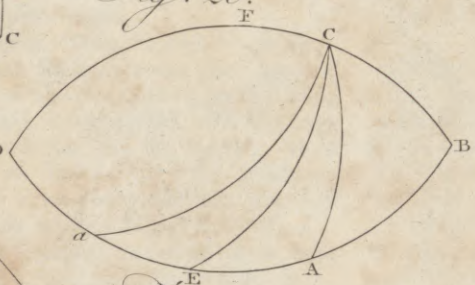

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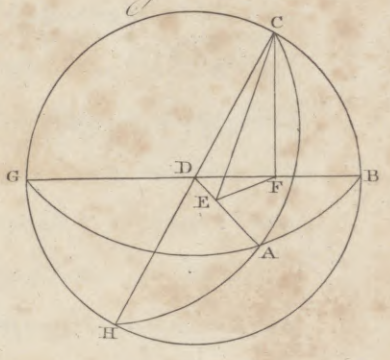

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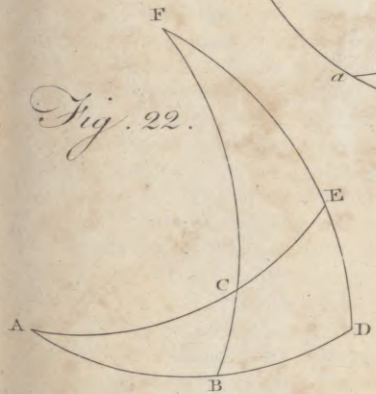

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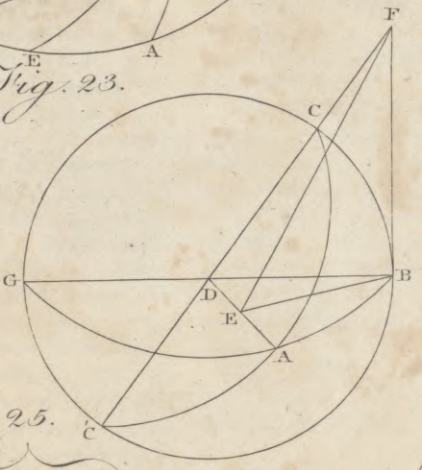

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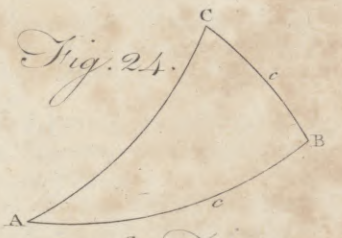

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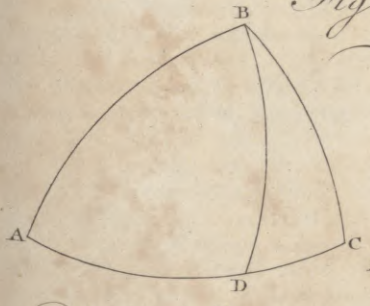

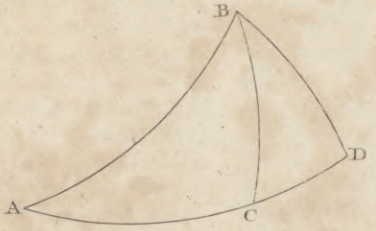

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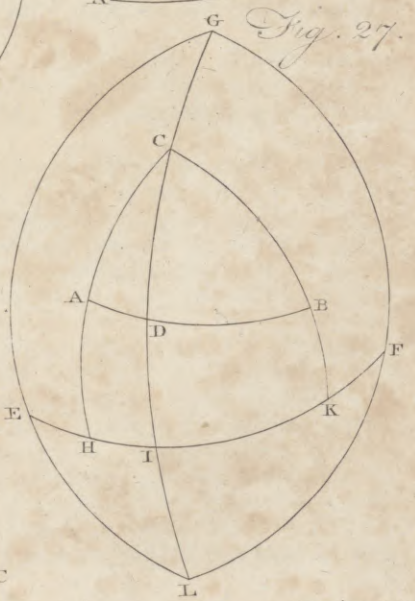


Fig. 26.

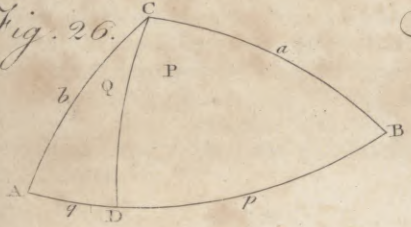
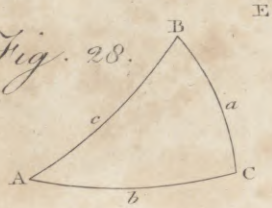


Fig. 28.



W. Tratin Sculpt.

Trinity Tripoli.

TRINITY, in *Theology*, the ineffable myſtery of three perſons in one God; Father, Son, and Holy Spirit. See THEOLOGY.

TRINITY-Houſe. See LONDON, N° 49.

TRINITY-Sunday, a feſtival obſerved on the Sunday next after Whitſunday, in honour of the holy Trinity. The obſervation of this feſtival was firſt enjoined in the council of Arles, anno 1260.

TRINOBANTES, in *Ancient Geography*, a people of Britain, ſuppoſed to have occupied Middleſex and Eſſex.

TRIO, in *Muſic*, a part of a concert wherein three perſons ſing; or, more properly, a muſical compoſition conſiſting of three parts.

TRIPHTHONG, in *Grammar*, an aſſemblage or concourſe of three vowels in one ſyllable; as *quæ*.

TRIPLE, in *Muſic*, is one of the ſpecies of meaſure or time. See MUSIC.

TRIPOD, in antiquity, a famed ſacred ſeat or ſtool, ſupported by three feet, whereon the prieſts and ſibyls were placed to render oracles. It was on the tripod that the gods were ſaid to inſpire the Pythias with that divine fury and enthuſiaſm wherewith they were ſeized at the delivery of their predictions.

TRIPOLI, a country of Africa, in Barbary; bounded on the north by the Mediterranean ſea; on the ſouth, by the country of the Beriberies; on the weſt, by the kingdom of Tunis, Biledulgerid, and territory of the Gadamis; and on the eaſt, by Egypt. It is about 925 miles along the ſea coaſt; but the breadth is various. Some parts of it are pretty fruitful; but that towards Egypt is a ſandy deſert. It had the title of a *kingdom*; but is now a republic, governed by a dey. He is not abſolute; for a Turkiſh baſhaw reſides here, who receives his authority from the grand ſeignior, and has a power of controuling the dey, and levying taxes on the people. The dey is elected by the ſoldiers, who make no ſcruple of depoſing him when they pleaſe.

TRIPOLI, a conſiderable town of Africa, and capital of a republic of the ſame name in Barbary, and under protection of the grand ſeignior, with a caſtle and a fort. It is pretty large, and the inhabitants are noted pirates. It was taken by Charles V. who ſettled the knights of Malta there; but they were driven away by the Turks in 1551. It was formerly very flouriſhing; and has now ſome trade in ſtuffs, ſaffron, corn, oil, wool, dates, oſtrich feathers, and ſkins: but they make more of the Chriſtian ſlaves which they take at ſea; for they either ſet high ranſoms upon them, or make them perform all ſorts of work. It is ſeated on the coaſt of the Mediterranean, in a ſandy ſoil, and ſurrounded by a wall, ſtrengthened by other fortifications. E. Long. 13. 12. N. Lat. 32. 34.

TRIPOLI, called *Tripolis* of *Syria*, to diſtinguiſh it from Tripoli in *Barbary*, received its name from its being anciently formed of three cities at a ſmall diſtance from each other, one of which belonged to the Aradians, or ancient kingdom of Arad, the ſecond to the Sidonians, and the third to the Tyrians, perhaps as a common mart to thoſe maritime powers. The preſent town of Tripoli is built at the diſtance of a mile and a half from the other, upon the declivity of a hill facing the ſea, in 34° 20′ north latitude, and in 35° 50′ eaſt longitude from Greenwich. It is ſurrounded with walls, fortified with ſeven high ſtrong towers, and a caſtle, all of Gothic architecture; but the ſtreets are narrow, and the houſes low. The city contains about 8000 houſes, and near 60,000 inhabitants, conſiſting of Turks, Chriſtians, and Jews. The baſha, or pacha, who reſides in the caſtle, where there is a garriſon of 200 janizaries, governs the adjacent territory, in which there is plenty of fruit, and a great number of mulberry trees, which enable the inhabitants to carry on a ſilk manufacture, from which they draw conſiderable profit. Tripoli ‖ Triumph.

All the environs of Tripoli are laid out in orchards, where the nopal grows ſpontaneouſly, and the white mulberry is cultivated for the ſilk-worm; the pomegranate, orange, and lemon trees for their fruit, which is here very fine. The country, though delightful to the eye, is unhealthy; from July to September, epidemic fevers, like thoſe of Scanderoon and Cyprus, prevail, and are principally cauſed by the artificial inundations made for the purpoſe of watering the mulberry trees, to enable them to throw out their ſecond leaves, and from a want of free circulation of air, the city being open only to the weſtward.

TRIPOLI, a ſpecies of argillaceous earth, much uſed in the poliſhing of metals. See MINERALOGY *Index*.

TRIPTOLEMUS, LAWS OF. See MYSTERIES, N° 74.

TRIQUETROUS, among botaniſts, denotes a fruit or leaf that has three flat ſides or faces.

TRIREMIS, in antiquity, a galley with three ranks of oars on a ſide.

TRISMEGISTUS, an epithet or ſurname given to one of the two Hermeſes. See THOTH.

TRISMUS, the LOCKED JAW. See MEDICINE, N° 280.

TRISYLLABLE, in *Grammar*, a word conſiſting of three ſyllables.

TRITICUM, WHEAT; a genus of plants belonging to the claſs of triandria; and in the natural ſyſtem ranging under the 4th order, *Gramina*. See BOTANY and AGRICULTURE *Index*.

TRITON, a ſea demigod, held by the ancients to be an officer or trumpeter of Neptune, attending on him, and carrying his orders from ſea to ſea.

TRITURATION, the act of reducing a ſolid body into a ſubtile powder; called alſo *pulveriſation* and *leviigation*.

TRIUMPH, in Roman antiquity, a public and ſolemn honour conferred by the Romans on a victorious general, by allowing him a magnificent entry into the city.

The greater triumph, called alſo *curulis*, or ſimply the *triumph*, was decreed by the ſenate to a general, upon the conquering of a province or gaining a ſignal victory. The day appointed for the ceremony being arrived, ſcaffolds were erected in the forum and circus, and all the other parts of the city where they could beſt behold the pomp: the ſenate went to meet the conqueror without the gate called *Capena* or *Triumphalis*, and marched back in order to the Capitol; the ways being cleared and cleanſed by a number of officers and tipſtaffs, who drove away ſuch as thronged the paſſage or ſtraggled up and down. The general was clad in a rich purple robe, interwoven with figures of gold, ſetting forth his great exploits; his buſkins were beſet with pearl; and he wore a crown, which at firſt was only laurel, but afterwards gold; in one hand he bore

Triumph ‖ Troja.

a branch of laurel, and in the other a truncheon. He was carried in a magnificent chariot, adorned with ivory and plates of gold, drawn uſually by two white horſes; though ſometimes by other animals, as that of Pompey, when he triumphed over Africa, by elephants; that of Mark Antony by lions; that of Heliogabalus by tygers; that of Aurelian by deer, &c. His children were at his feet, and ſometimes on the chariot-horſes. The proceſſion was led by the muſicians, who played triumphal pieces in praiſe of the general: theſe were followed by young men, who led the victims to the ſacrifice, with their horns gilded, and their heads adorned with ribbands and garlands; next came the carts and waggons, loaded with all the ſpoils taken from the enemy, with their horſes, chariots, &c.; theſe were followed by the kings, princes, and generals, who had been taken captives, loaded with chains: after theſe appeared the triumphal chariot, before which, as it paſſed, they all along ſtrewed flowers, and the people with loud acclamations called out *Io triumphe!* The chariot was followed by the ſenate, clad in white robes; and the ſenate by ſuch citizens as had been ſet at liberty or ranſomed; and the proceſſion was cloſed by the prieſts and their officers and utenſils, with a white ox led along for the chief victim. In this order they proceeded through the triumphal gate, along the Via Sacra, to the Capitol, where the victims were ſlain. In the mean time all the temples were open, and all the altars loaded with offerings and incenſe; games and combats were celebrated in the public places, and rejoicings appeared everywhere.

TRIUMVIR, one of three perſons who govern abſolutely, and with equal authority, in a ſtate. It is chiefly applied to the Roman government: Cæſar, Pompey, and Craſſus, were the firſt triumvirs who divided the government among them. There were alſo other officers ſo called; as the triumviri or treſviri capitales, who were the keepers of the public gaol: they had the office of puniſhing malefactors; for which purpoſe they kept eight lictors under them.

TROAS, a country of Phrygia in Aſia Minor, of which Troy was the capital. When Troas is taken for the whole kingdom of Priam, it may be ſaid to contain Myſia and Phrygia Minor: but if only applied to that part of the country where Troy was ſituated, its extent is confined within very narrow limits. Troas was anciently called Dardania. See TROJA.

TROCHÆUS, in proſody, a foot conſiſting of a long and ſhort ſyllable.

TROCHANTER, in *Anatomy*. See there, N° 58.

TROCHE, in *Pharmacy*, a ſort of medicine made of glutinous ſubſtances into little cakes, and afterwards exſiccated. See MATERIA MEDICA *Index*.

TROCHILUS, HUMMING BIRD, a genus of birds belonging to the order of picæ. See ORNITHOLOGY *Index*.

TROGLODYTES, in the *Ancient Geography*, a people of Ethiopia, ſaid to have lived in caves under ground. Pomponius Mela gives a ſtrange account of the Troglodytes: he ſays, they did not ſo properly ſpeak as ſhriek; and that they lived on ſerpents.

TROGUS POMPEIUS, a Latin univerſal hiſtorian to the time of Auguſtus Cæſar, of whom we have only an abridgement by Juſtin, flouriſhed about 41 B. C.

TROJA, the capital city of Troas, or, according to others, a country of which Ilium was the capital. It was built on a ſmall eminence near Mount Ida, and the promontory of Sigæum, at the diſtance of about four miles from the ſea-ſhore. Dardanus the firſt king of the country built it, and called it *Dardania*, and from Tros one of his ſucceſſors it was called *Troja*, and from Ilus *Ilion*. This city has been celebrated by the poems of Homer and Virgil; and of all the wars which have been carried on among the ancients, that of Troy is the moſt famous. Troja ‖ Tromp.

A deſcription of the plain of Troy has been publiſhed in French in the 3d volume of the Philoſophical Tranſactions of The Royal Society of Edinburgh, written by M. Chevalier. The city of Troy, according to him, ſtood on the preſent ſite of the modern village of Bounarbachi, diſtant four leagues from the ſea, and which is the reſidence of an aga, ruling with abſolute ſway the inhabitants of the Trojan plain and the inferior agas, to whom they are immediately ſubject. Bounarbachi is ſituated on the ſide of an eminence, expoſed to every wind, at the termination of a ſpacious plain, the ſoil of which is rich and of a blackiſh colour. Cloſe to the village is to be ſeen a marſh covered with tall reeds; and the ſituation is impregnable on all ſides except at Erin (Homer's ερινεος), the *hill of wild fig-trees*, which extended between the Scæan gate and the ſources of the Scamander. Theſe circumſtances, agreeing with Homer's deſcriptions, ſtrongly ſupport M. Chevalier's opinion concerning the ſituation of Troy. A very intereſting part of this work is the account of conical mounds or barrows, ſeveral of them 100 feet in diameter at the baſe; and which the author maintains to be the identical tombs raiſed over the aſhes of the heroes of the Trojan war; ſome of them he deems more ancient. He deſcribes particularly the tombs of Eſyetes, Ilus, Ajax, Hector, Achilles, Patroclus, and Antilochus.

This diſſertation, which runs to the length of 92 quarto pages, is replete with erudition and ingenious reaſoning, and is illuſtrated and embelliſhed by maps of the plain of Troy and ſeveral tables of inſcriptions. It has been tranſlated with much accuracy and care by Mr Dalzel profeſſor of Greek in the Univerſity of Edinburgh, and accompanied with large notes and illuſtrations.

TROLLIUS, GLOBE-FLOWER, or *Lucken Gowan*, a genus of plants belonging to the claſs of polyandria; and in the natural ſyſtem ranging under the 26th order, *Multiſiliquæ*. See BOTANY *Index*.

TROMP, MARTIN HAPPERTZ VAN, a celebrated Dutch admiral, was born at the Baille, in Holland. He raiſed himſelf by his merit, after having diſtinguiſhed himſelf on many occaſions, eſpecially at the famous engagement near Gibraltar in 1607. He paſſed for one of the greateſt ſeamen that had till that time appeared in the world; and was declared admiral of Holland, even by the advice of the prince of Orange. He in that character defeated a large Spaniſh fleet in 1630, and gained 32 other victories at ſea; but was killed when under deck, in an engagement with the Engliſh in 1653. The ſtates-general cauſed medals to be ſtruck to his honour, and lamented him as one of the greateſt heroes of their republic. Van Tromp, in the midſt of the greateſt glory, conſtantly diſcovered a remarkable modeſty; for he never aſſumed a higher cha-

racter

romp || rover.

racter than that of a burgher, and that of being the father of the ſailors.

TRONAGE, an ancient cuſtomary duty or toll, for weighing of wool. According to Fleta, *trona* is a beam to weigh with, mentioned in the ſtat. Weſtm. 2. cap. 25. And tronage was uſed for the weighing wool in a ſtaple or public mart, by a common trona or beam; which, for the tronage of wool in London, was fixed at Leaden-Hall. The mayor and commonalty of London are ordained keepers of the beams and weights for weighing merchants commodities, with power to aſſign clerks and porters, &c. of the great beam and balance; which weighing of goods and wares is called *tronage*; and no ſtranger ſhall buy any goods in London before they are weighed at the king's beam, on pain of forfeiture.

TRONE-WEIGHT, the moſt ancient of the different weights uſed in Scotland; and, though now forbidden by ſeveral ſtatutes, is ſtill uſed by many for home commodities, and that in a very irregular manner; for the pound varies in different places, and for different purpoſes, from 20 to 24 Dutch ounces. The common allowance is $21\frac{1}{2}$ ounces for wool, $20\frac{1}{2}$ for butter and cheeſe, 20 for tallow, lint, hemp, and hay. It is divided into 16 of its own ounces, and 16 pounds make a ſtone.

TROOP, a ſmall body of horſe or dragoons, about 50 or 60, ſometimes more, ſometimes leſs, commanded by a captain, lieutenant, cornet, quarter-maſter, and three corporals, who are the loweſt officers of a troop.

TROPE. See ORATORY, N° 52—66.

TROPHONIUS's CAVE, or *Oracle*, in *Ancient Geography*, a cave near Lebadia in Bœotia, between Helicon and Chæronea (Strabo): ſo called from Trophonius, an enthuſiaſtic diviner; who, deſcending into this cave, pretended to give anſwers and pronounce oracles; and was hence called *Jupiter Trophonius*. Such as went down to this cave never after ſmiled; hence the proverbial ſaying of a man who has loſt his mirth, That he is come out of Trophonius's cave. Though Pauſanias, who writes from experience, contradicts this; affirming that perſons came out of the cave affected indeed with a ſtupor, but that they ſoon after recovered themſelves. See ORACLE.

TROPHY (*Tropæum*), among the ancients, a monument of victory.

TROPIC-BIRD. See PHAETON, ORNITHOLOGY *Index*.

TROPICS. See GEOGRAPHY.

TROUBADOURS, poets that flouriſhed in Provence during the 12th century.

They wrote poems on love and gallantry; on the illuſtrious characters and remarkable events of the times; ſatires which were chiefly directed againſt the clergy and monks; and a few didactic pieces. The troubadours were great favourites in different courts, diffuſed a taſte for their language and for poetry over Europe, which was about that time ſunk in ignorance and rudeneſs; they diſappeared in the 14th century. A hiſtory of the troubadours in 3 vols 12mo, was begun by M. de Sainte Palaie, and finiſhed by the abbé Millot. See MUSIC.

TROUGH, GALVANIC. See GALVANISM. For later diſcoveries in galvanic electricity, ſee ZINC.

TROVER, in *Law*, an action that a man hath againſt one that, having found any of his goods, refuſeth to deliver them upon demand.

Trover || Trumpet.

TROUT. See SALMO, ICHTHYOLOGY *Index*.

TROY. See TROJA.

TROY-Weight, one of the moſt ancient of the different kinds uſed in Britain. The ounce of this weight was brought from Grand Cairo in Egypt, about the time of the cruſades, into Europe, and firſt adopted in *Troyes*, a city of Champagne; whence the name.

The pound *Engliſh* Troy contains 12 ounces, or 5760 grains. It was formerly uſed for every purpoſe; and is ſtill retained for weighing gold, ſilver, and jewels; for compounding medicines; for experiments in natural philoſophy; and for comparing different weights with each other.

Scots TROY-Weight was eſtabliſhed by James VI. in the year 1618, who enacted, that only one weight ſhould be uſed in Scotland, viz. the French Troy ſtone of 16 pounds, and 16 ounces in the pound. The pound contains 7600 grains, and is equal to 17 oz. 6 dr. avoirdupois. The cwt. or 112 lb. avoirdupois, contains only 103 lb. $2\frac{1}{2}$ oz. of this weight, though generally reckoned equal to 104 lb. This weight is nearly, if not exactly, the ſame as that of Paris and Amſterdam; and is generally known by the name of *Dutch weight*. Though prohibited by the articles of union, it is ſtill uſed in weighing iron, hemp, flax, moſt Dutch and Baltic goods, meal, butcher-meat, unwrought pewter and lead, and ſome other articles.

TRUE-LOVE. See PARIS, BOTANY *Index*.

TRUFFLES, See LYCOPERDON, BOTANY *Index*.

TRUMPET, a muſical inſtrument, the moſt noble of all portable ones of the wind kind; uſed chiefly in war, among the cavalry to direct them in the ſervice. Each troop of cavalry has one. The cords of the trumpets are of crimſon, mixed with the colours of the facings of the regiments.

As to the invention of the trumpet, ſome Greek hiſtorians aſcribe it to the Tyrrhenians; but others, with greater probability, to the Egyptians; from whom it might have been tranſmitted to the Iſraelites. The trumpet was not in uſe among the Greeks at the time of the Trojan war; though it was in common uſe in the time of Homer. According to Potter (*Arch. Græc.* vol. ii. cap. 9.), before the invention of trumpets, the firſt ſignals of battle in primitive wars were lighted torches; to theſe ſucceeded ſhells of fiſhes, which were ſounded like trumpets. And when the trumpet became common in military uſe, it may well be imagined to have ſerved at firſt only as a rough and noiſy ſignal of battle, like that at preſent in Abyſſinia and New Zealand, and perhaps with only one ſound. But, even when more notes were produced from it, ſo noiſy an inſtrument muſt have been an unfit accompaniment for the voice and poetry; ſo that it is probable the trumpet was the firſt ſolo inſtrument in uſe among the ancients.

TRUMPET, Articulate, comprehends both the *ſpeaking* and the *hearing* trumpet, is by much the moſt valuable inſtrument, and has, in one of its forms, been uſed by people among whom we ſhould hardly have expected to find ſuch improvements.

That the *ſpeaking trumpet*, of which the object is to increaſe the force of articulate ſounds, ſhould have been known to the ancient Greeks, can excite no wonder;

Trumpet. and therefore we eaſily admit the accounts which we read of the horn or trumpet, with which Alexander addreſſed his army, as well as of the whiſpering caverns of the Syracuſan tyrant. But that the natives of Peru were acquainted with this inſtrument, will probably ſurpriſe many of our readers. The fact, however, ſeems incontrovertible.

In the Hiſtory of the Order of Jeſuits, publiſhed at Naples in 1601 by Beritaria, it is ſaid, that in the year 1595 a ſmall convent of that order in Peru, ſituated in a remote corner, was in danger of immediate deſtruction by famine. One evening the ſuperior Father Samaniac implored the help of the cacique; next morning, on opening the gate of the monaſtery, he found it ſurrounded by a number of women each of whom carried a ſmall baſket of proviſions. He returned thanks to heaven for having miraculouſly interpoſed, by inſpiring the good people with pity for the diſtreſs of his friars. But when he expreſſed to them his wonder how they came all to be moved as if by mutual agreement with theſe benevolent ſentiments, they told him it was no ſuch thing; that they looked upon him and his countrymen as a pack of infernal magicians, who by their ſorceries had enſlaved the country, and had bewitched their good cacique, who hitherto had treated them with kindneſs and attention, as became a true worſhipper of the ſun; but that the preceding evening at ſunſet he had ordered the inhabitants of ſuch and ſuch villages, about ſix miles off, to come that morning with proviſions to this neſt of wizzards.

The ſuperior aſked them in what manner the governor had warned ſo many of them in ſo ſhort a time, at ſuch a diſtance from his own reſidence? They told him that it was by the trumpet; and that every perſon heard at their own door the diſtinct terms of the order. The father had heard nothing; but they told him that none heard the trumpet but the inhabitants of the villages to which it was directed. This is a piece of very curious information; but, after allowing a good deal to the exaggeration of the reverend Jeſuits, it cannot, we think, be doubted but that the Peruvians actually poſſeſſed this ſtentorophonic art. For we may obſerve that the effect deſcribed in this narration reſembles what *we now know* to be the effect of ſpeaking trumpets, while it is unlike what the inventor of ſuch a tale would naturally and ignorantly ſay. Till ſpeaking trumpets were really known, we ſhould expect the ſound to be equally diffuſed on all ſides, which is not the caſe; for it is much ſtronger in the line of the trumpet than in any direction very oblique to it.

About the middle of the 17th century, Athanaſius Kircher turned his attention to the philoſophy of ſound, and in different works threw out many uſeful and ſcientific hints on the conſtruction of ſpeaking trumpets (ſee Acoustics and Kircher); but his mathematical illuſtrations were ſo vague, and his own character of inattention and credulity ſo notorious, that for ſome time theſe works did not attract the notice to which they were well entitled.

About the year 1670, Sir Samuel Morland, a gentleman of great ingenuity, ſcience, and order, took up the ſubject, and propoſed as a queſtion to the Royal Society of London, What is the beſt form for a ſpeaking trumpet? which he called a ſtentorophonic horn. He accompanied his demand with an account of his own notions on the ſubject (which he acknowledged to be very vague and conjectural), and an exhibition of ſome inſtruments conſtructed according to his views. They were in general very large conical tubes, ſuddenly ſpreading at the very mouth to a greater width. Their effect was really wonderful. They were tried in St James's park; and his Majeſty K. Charles II. ſpeaking in his ordinary colloquial pitch of voice through a trumpet only $5\frac{1}{2}$ feet long, was clearly and moſt diſtinctly heard at the diſtance of a thouſand yards. Another perſon, ſelected we ſuppoſe for the loudneſs and diſtinctneſs of his voice, was perfectly underſtood at the diſtance of four miles and a half. The fame of this ſoon ſpread; Sir Samuel Morland's principles were refined, conſidering the novelty of the thing, and differ conſiderably from Father Kircher's. The aërial undulations, (for he ſpeaks very accurately concerning the nature of ſound) endeavour to diffuſe themſelves in ſpheres, but are ſtopped by the tube, and therefore reundulate towards the axis like waves from a bank, and, meeting in the axis, they form a ſtrong undulation a little farther advanced along the tube, which again ſpreads, is again reflected, and ſo on, till it arrives at the mouth of the tube greatly magnified, and then it is diffuſed through the open air in the ſame manner, as if all proceeded from a very ſonorous point in the centre of the wide end of the trumpet. The author diſtinguiſhes with great judgement between the prodigious reinforcement of ſound in a ſpeaking trumpet and that in the muſical trumpet, bugle-horn, conch-ſhell, &c.; and ſhows that the difference conſiſts only in the violence of the firſt ſonorous agitation, which can be produced by us only on a very ſmall extent of ſurface. The mouth-piece diameter, therefore, of the muſical trumpet muſt be very ſmall, and the force of blaſt very conſiderable. Thus one ſtrong but ſimple undulation will be excited, which muſt be ſubjected to the modifications of harmony, and will be augmented by uſing a conical tube (A). But a ſpeaking trumpet muſt make no change on the nature of the firſt undulations; and each point of the mouth-piece muſt be equally conſidered as the centre of ſonorous undulations, all of which muſt be reinforced in the ſame degree, otherwiſe all diſtinctneſs of articulation will be loſt. The mouth-piece muſt therefore take in the whole of the mouth of the ſpeaker.

Trum.

When Sir Samuel Morland's trumpet came to be generally known on the continent, it was ſoon diſcovered that the ſpeaker could be heard at a great diſtance only in the line of the trumpet; and this circumſtance was by a Mr Caſſegrain (*Journ. des Sçavans*, 1672, p. 131.) attributed to a defect in the principle of its conſtruction, which he ſaid was not according to the laws of ſonorous undulations. He propoſed a conoid formed by the revolution of a hyperbola round its aſſymptote as the beſt form. A Mr Haſe of Wirtemberg, on the other hand, propoſed a parabolic conoid, having the mouth of the ſpeaker

(A) Accordingly the ſound of the bugle horn, of the muſical trumpet, or the French horn, is prodigiouſly loud, when we conſider the ſmall paſſage through which the moderate blaſt is ſent by the trumpeter.

Trumpet. ſpeaker placed in the focus. In this conſtruction he plainly went on the principle of a reflection ſimilar to that of the rays of light; but this is by no means the caſe. The effect of the parabola will be to give one reflection, and in this all the circular undulations will be converted into plane waves, which are at right angles to the axis of the trumpet. But nothing hinders their ſubſequent diffuſion; for it does not appear that the ſound will be enforced, becauſe the agitation of the particles on each wave is not augmented.

The ſubject is exceedingly difficult. We do not fully comprehend on what circumſtance the affection or agitation of our organ, or ſimply of the membrana tympani, depends. A more violent agitation of the ſame air, that is, a wider oſcillation of its particles, cannot fail to increaſe the impulſe on this membrane. The point therefore is to find what concourſe of feeble undulations will produce or be equivalent to a great one. The reaſonings of all theſe reſtorers of the ſpeaking trumpet are almoſt equally ſpecious, and each point out ſome phenomenon which ſhould characteriſe the principle of conſtruction, and thus enable us to ſay which is moſt agreeable to the procedure of nature. Yet there is hardly any difference in the performance of trumpets of equal dimenſions made after theſe different methods.

The propagation of light and of elaſtic undulations ſeem to require very different methods of management. Yet the ordinary phenomena of echoes are perfectly explicable by the acknowledged laws either of optics or acouſtics; ſtill however there are ſome phenomena of ſound which are very unlike the genuine reſults of elaſtic undulations. If ſounds are propagated ſpherically, then what comes into a room by a ſmall hole ſhould diffuſe itſelf from that hole as round a centre, and it ſhould be heard equally well at twelve feet diſtance from the hole in every direction. Yet it is very ſenſibly louder when the hearer is in the ſtraight line drawn from the ſonorous body through the hole. A perſon can judge of the direction of the ſounding body with tolerable exactneſs. Cannon diſcharged from the different ſides of a ſhip are very eaſily diſtinguiſhed, which ſhould not be the caſe by the Newtonian theory; for in this the two pulſes on the ear ſhould have no ſenſible difference.

The moſt important fact for our purpoſe is this: An echo from a ſmall plane ſurface in the midſt of an open field is not heard, unleſs we ſtand in ſuch a ſituation that the angle of reflected ſound may be equal to that of incidence. But by the uſual theory of undulations, this ſmall ſurface ſhould become the centre of a new undulation, which ſhould ſpread in all directions. If we make an analogous experiment on watery undulations, by placing a ſmall flat ſurface ſo as to project a little above the water, and then drop in a ſmall pebble at a diſtance, ſo as to raiſe one circular wave, we ſhall obſerve, that when this wave arrives at the projecting plane, it is diſturbed by it, and this diſturbance ſpreads from it on all ſides. It is indeed ſenſibly ſtronger in that line which is drawn from it at equal angles with the line drawn to the place where the pebble was dropped. But in the caſe of ſound, it is a fact, that if we go to a very ſmall diſtance on either ſide of the line of reflection, we ſhall hear nothing.

Here then is a fact, that whatever may be the nature of the elaſtic undulations, ſounds are reflected from a ſmall plane in the ſame manner as light. We may avail ourſelves of this fact as a mean for enforcing ſound, Trumpet. though we cannot explain it in a ſatisfactory manner. We ſhould expect from it an effect ſimilar to the hearing of the original ſound along with another original ſound coming from the place from which this reflected ſound diverges. If therefore the reflected ſound or echo arrives at the ear in the ſame inſtant with the original ſound, the effect will be doubled; or at leaſt it will be the ſame with two ſimultaneous original ſounds. Now we know that this is in ſome ſenſe equivalent to a ſtronger ſound. For it is a fact, that a number of voices uttering the ſame or equal ſounds are heard at a much greater diſtance than a ſingle voice. We cannot perhaps explain how this happens by mechanical laws, nor aſſign the exact proportion in which 10 voices exceed the effect of one voice; nor the proportion of the diſtances at which they ſeem equally loud. We may therefore, for the preſent, ſuppoſe that two equal voices at the ſame diſtance are twice as loud, three voices three times as loud, &c. Therefore if, by means of a ſpeaking trumpet, we can make 10 equal echoes arrive at the ear at the ſame moment, we may ſuppoſe its effect to be to increaſe the audibility 10 times; and we may expreſs this ſhortly, by calling the ſound 10 times louder or more intenſe.

But we cannot do this preciſely. We cannot by any contrivance make the ſound of a momentary ſnap, and thoſe of its echoes, arrive at the ear in the ſame moment, becauſe they come from different diſtances. But if the original noiſe be a continued ſound, a man's voice, for example, uttering a continued uniform tone, the firſt echo may reach the ear at the ſame moment with the ſecond vibration of the larynx; the ſecond echo along with the third vibration, and ſo on. It is evident, that this will produce the ſame effect. The only difference will be, that the articulations of the voice will be made indiſtinct, if the echoes come from very different diſtances. Thus if a man pronounce the ſyllable *taw*, and the 10 ſucceſſive echoes are made from places which are 10 feet farther off, the 10th part of a ſecond (nearly) will intervene between hearing the firſt and the laſt. This will give it the ſound of the ſyllable *thaw*, or perhaps *raw*, becauſe *r* is the repetition of *t*. Something like this occurs when, ſtanding at one end of a long line of ſoldiers, we hear the muſkets of the whole line diſcharged in one inſtant. It ſeems to us the ſound of a running fire.

The aim therefore in the conſtruction of a ſpeaking trumpet may be, to cauſe as many echoes as poſſible to reach a diſtant ear without any perceptible interval of time. This will give diſtinctneſs, and ſomething equivalent to loudneſs. *Pure* loudneſs ariſes from the violence of the ſingle aerial undulation. To increaſe this may be the aim in the conſtruction of a trumpet; but we are not ſufficiently acquainted with the mechaniſm of theſe undulations to bring this about with certainty and preciſion; whereas we can procure this accumulation of echoes without much trouble, ſince we know that echoes are, *in fact*, reflected like light. We can form a trumpet ſo that many of theſe lines of reflected ſound ſhall paſs through the place of the hearer. We are indebted to Mr Lambert of Berlin for this ſimple and popular view of the ſubject; and ſhall here give an abſtract of his moſt ingenious Diſſertation on Acouſtic Inſtruments, publiſhed in the Berlin Memoirs for 1763.

Sound

Trumpet. Sound naturally ſpreads in all directions; but we know that echoes or reflected ſounds proceed almoſt ſtrictly in certain limited directions. If therefore we contrive a trumpet in ſuch a way that the lines of echo ſhall be confined within a certain ſpace, it is reaſonable to ſuppoſe that the ſound will become more audible in proportion as this diffuſion is prevented. Therefore, if we can oblige a ſound which, in the open air, would have diffuſed itſelf over a hemiſphere, to keep within a cone of 120 degrees, we ſhould expect it to be twice as audible within this cone. This will be accompliſhed, by making the reflections ſuch that the lines of reflected ſound ſhall be confined within this cone. *N. B.* We here ſuppoſe that nothing is loſt in the reflection. Let us examine the effect of a cylindrical trumpet.

Plate DXXXIX. fig. 1. Let the trumpet be a cylinder ABED, (fig. 1.), and let C be a ſounding point in the axis. It is evident that all the ſound in the cone BCE will go forward without any reflection. Let CM be any other line of ſound, which we may, for brevity's ſake, call a *ſonorous* or *phonic line*. Being reflected in the points M, N, O, P, it is evident that it will at laſt eſcape from the trumpet in a direction PQ, equally diverging from the axis with the line CM. The ſame muſt be true of every other ſonorous line. Therefore the echoes will all diverge from the mouth of the trumpet in the ſame manner as they would have proceeded from C without any trumpet. Even ſuppoſing, therefore, that the echoes are as ſtrong as the original ſound, no advantage is gained by ſuch a trumpet, but that of bringing the ſound forward from C to *c*. This is quite trifling when the hearer is at a diſtance. Yet we ſee that ſounds may be heard at a very great diſtance, at the end of long, narrow, cylindrical, or priſmatical galleries. It is known that a voice may be diſtinctly heard at the diſtance of ſeveral hundred feet in the Roman aqueducts, whoſe ſides are perfectly ſtraight and ſmooth, being plaſtered with ſtucco. The ſmooth ſurface of the ſtill water greatly contributes to this effect. Cylindrical or priſmatical trumpets muſt therefore be rejected.

Fig. 2. Let the trumpet be a cone BCA (fig. 2.), of which CN is the axis, DK a line perpendicular to the axis, and DFHI the path of a reflected ſound in the plane of the axis. The laſt angle of reflection IHA is equal to the laſt angle of incidence FHC. The angle BFH, or its equal CFD, is equal to the angles FHD and FCH; that is, the angle of incidence CFD exceeds the next angle of incidence FHC by the angle FCD; that is, by the angle of the cone. In like manner, FDH exceeds CFD by the ſame angle FCD. Thus every ſucceeding angle, either of incidence or reflection, exceeds the next by the angle of the cone. Call the angle of the cone a, and let b be the firſt angle of incidence PDC. The ſecond, or DFC, is $b-a$. The third, or FHC, is $b-2a$, &c.: and the nth angle of incidence or reflection is $b-na$, after n reflections. Since the angle diminiſhes by equal quantities at each ſubſequent reflection, it is plain, that whatever be the firſt angle of incidence, it may be exhauſted by this diminution; namely, when n times a exceeds or is equal to b. Therefore to know how many reflections of a ſound, whoſe firſt incidence has the inclination b, can be made in an infinitely extended cone, whoſe angle is a, divide b by a; the quotient will give the number n of reflections, and the remainder, if any, will be the laſt angle of incidence or reflection leſs than a. It is very plain, that when an angle of reflection IHA is equal to or leſs than the angle BCA of the cone, the reflected line HI will no more meet with the other ſide CB of the cone. Trumpet.

We may here obſerve, that the greateſt angle of incidence is a right angle, or 90°. This ſound would be reflected back in the ſame line, and would be incident on the oppoſite ſide in an angle $=90°-a$, &c.

Thus we ſee that a conical trumpet is well ſuited for confining the ſound: for by prolonging it ſufficiently, we can keep the lines of reflected ſound wholly within the cone. And when it is not carried to ſuch a length as to do this, when it allows the ſounding line GH, for example, to eſcape without farther reflection, the divergency from the axis is leſs than the laſt angle of reflection BGH by half the angle BCA of the cone. Let us ſee what is the connection between the length and the angle of ultimate reflection.

We have $\text{ſin. } \overline{b-a} : \text{ſin. } b = CD : CF$, and $CF = CD \times \frac{\text{ſin. } b}{\text{ſin. } \overline{b-a}}$, and $\text{ſin. } \overline{b-2a} : \text{ſin. } \overline{b-a} = CF : CH$, and $CH = CF \times \frac{\text{ſin. } b-a}{\text{ſin. } \overline{b-2a}} = CD \times \frac{\text{ſin. } b}{\text{ſin. } \overline{b-a}} \times \frac{\text{ſin. } \overline{b-a}}{\text{ſin. } \overline{b-2a}}$, $= CD \times \frac{\text{ſin. } b}{\text{ſin. } \overline{b-2a}}$, &c.

Therefore if we ſuppoſe X to be the length which will give us n reflections, we ſhall have $X = CD \times \frac{\text{ſin. } b}{\text{ſin. } \overline{b-na}}$. Hence we ſee that the length increaſes as the angle $\overline{b-na}$ diminiſhes; but is not infinite, unleſs na is equal to b. In this caſe, the immediately preceding angle of reflection muſt be a, becauſe theſe angles have the common difference a. Therefore the laſt reflected ſound was moving parallel to the oppoſite ſide of the cone, and cannot again meet it. But though we cannot aſſign the length which will give the nth reflection, we can give the length which will give the one immediately preceding, whoſe angle with the ſide of the cone is a. Let Y be this length. We have $Y = CD \times \frac{\text{ſin. } b}{\text{ſin. } a}$. This length will allow every line of ſound to be reflected as often, ſaving once, as if the tube were infinitely long. For ſuppoſe a ſonorous line to be traced backwards, as if a ſound entered the tube in the direction ih, and were reflected in the points h, f, d, δ, D, the angles will be continually augmented by the conſtant angle a. But this augmentation can never go farther than $90° + \frac{1}{2}a$. For if it reaches that value at D, for inſtance, the reflected line DK will be perpendicular to the axis CN; and the angle ADK will be equal to the angle DKB, and the ſound will come out again. This remark is of importance on another account.

Now ſuppoſe the cone to be cut off at D by a plane perpendicular to the axis, KD will be the diameter of its mouth-piece; and if we ſuppoſe a mouth completely occupying this circle, and every point of the circle to be ſonorous, the reflected ſounds will proceed from it in the ſame manner as light would from a flame which completely

Trumpet. completely occupies its area, and is reflected by the inside of the cone. The angle FDA will have the greateſt poſſible ſine when it is a right angle, and it never can be greater than ADK, which is $=90+\frac{1}{2}a$. And ſince between $90°+\frac{1}{2}a$, and $90-\frac{1}{2}a$, there muſt fall ſome multiple of a; call this multiple b. Then, in order that every ſound may be reflected as often as poſſible, ſaving once, we muſt make the length of it $X=CD\times\frac{S,b}{S,a}$.

Now ſince the angle of the cone is never made very great, never exceeding 10 or 12 degrees, b can never differ from 90 above a degree or two, and its ſine cannot differ much from unity. Therefore X will be very nearly equal to $\frac{CD,}{S,a}$, which is alſo very nearly equal to $\frac{CD}{2S,\frac{1}{2}a}$; becauſe a is ſmall, and the ſines of ſmall arches are nearly equal and proportional to the arches themſelves. There is even a ſmall compenſation of errors in this formula. For as the ſine of 90° is ſomewhat too large, which would give X too great, $2S,\frac{1}{2}a$ is alſo larger than the ſine of a. Thus let a be 12°: then the neareſt multiple of a is 84 or 96°, both of which are as far removed as poſſible from 90°, and the error is as great as poſſible, and is nearly $\frac{1}{100}$th of the whole.

This approximation gives us a very ſimple conſtruction. Let CM be the required length of the trumpet, and draw ML perpendicular to the axis in O. It is evident that S, MCO : rad. $=$MO : CM, and CM; or $X=\frac{MO}{S,\frac{1}{2}a}=\frac{LM}{2S,\frac{1}{2}a}$, but $X=\frac{CD}{2S,\frac{1}{2}a}$, and therefore LM is equal to CD.

If therefore the cone be of ſuch a length, that its diameter at the mouth is equal to the length of the part cut off, every line of ſound will have at leaſt as many reflections, ſave one, as if the cone were infinitely long; and the laſt reflected line will either be parallel to the oppoſite ſide of the cone, or lie nearer the axis than this parallel; conſequently ſuch a cone will confine all the reflected ſounds within a cone whoſe angle is $2a$, and will augment the ſound in the proportion of the ſpherical baſe of this cone to a complete hemiſpherical ſurface. Deſcribe the circle DKT round C, and making DT an arch of 90, draw the chord DT. Then ſince the circles deſcribed with the radii DK, DT, are equal to the ſpherical ſurfaces generated by the revolution of the arches DK and DKT round the axis CD, the ſound will be condenſed in the proportion of DK^2 to DT^2.

This appears to be the beſt general rule for conſtructing the inſtrument; for, to procure another reflection, the tube muſt be prodigiouſly lengthened, and we cannot ſuppoſe that one reflection more will add greatly to its power.

It appears, too, that the length depends chiefly on the angle of the cone; for the mouth-piece may be conſidered as nearly a fixed quantity. It muſt be of a ſize to admit the mouth when ſpeaking with force and without conſtraint. About an inch and a half may be fixed on for its diameter. When therefore we propoſe to confine the ſound to a cone of twice the angle of the trumpet, the whole is determined by that angle. For ſince in this caſe LM is equal to CD, we have DK : CD $=$ LM (or CD) : CM and $CM=\frac{CD^2}{DK}$. Trumpet.

But $2S,\frac{1}{2}a : 1 = DK : CD$,
and $2S,\frac{1}{2}a : 1 = CD : CM$;
therefore $4S,^2\frac{1}{2}a : 1 = DK : CM$,

And $CM=\frac{DK}{4S,^2\frac{1}{2}a},=\frac{DK}{S,^2a}$ very nearly. And ſince DK is an inch and a half, we get the length in inches, counted from the apex of the cone $=\frac{1\frac{1}{2}}{S,^2a}$, or $\frac{3}{2S,^2a}$. From this we muſt cut off the part CD, which is $=\frac{DK}{S,\frac{1}{2}a}$, or very nearly $\frac{DK}{S,a}$, or $\frac{3}{2S,a}$, meaſured in inches, and we muſt make the mouth of the ſame width $\frac{3}{2S,a}$.

On the other hand, if the length of the trumpet is fixed on, we can determine the angle of the cone. For let the length (reckoned from C) be L; we have $2S,^2a=\frac{3}{L}$, or $S,^2a=\frac{3}{2L}$, and $S,a=\sqrt{\frac{3}{2L}}$.

Thus let 6 feet or 72 inches be choſen for the length of the cone, we have $S,a=\sqrt{\frac{3}{144}}=\sqrt{\frac{1}{48}}$, $=0{,}14434$, $=$ſin. 8° 17′ for the angle of the cone; and the width at the mouth is $\frac{3}{2,S,a}=10{,}4$ inches. This being taken from 72, leaves 61,6 inches for the length of the trumpet.

And ſince this trumpet confines the reflected ſounds to a cone of 16° 34′, we have its magnifying power $=\frac{DT^2}{DK^2}$. $=\frac{\frac{1}{2}DT^2}{\frac{1}{2}DK^2}=\frac{S,^2\,45°}{S,^2\,4°\,8'\frac{1}{2}}=96$ nearly. It therefore condenſes the ſound about 96 times; and if the diſtribution were uniform, it would be heard $\sqrt{96}$, or nearly 10 times farther off. For the loudneſs of ſounds is ſuppoſed to be inverſely as the ſquare of the diſtance from the centre of undulation.

But before we can pronounce with preciſion on the performance of a ſpeaking trumpet, we muſt examine into the manner in which the reflected ſounds are diſtributed over the ſpace in which they are all confined.

Let BKDA (fig. 3.) be the ſection of a conical trumpet by a plane through the axis; let C be the vertex of the cone, and CW its axis; let TKV be the ſection of a ſphere, having its centre in the vertex of the cone; and let P be a ſonorous point on the ſurface of the ſphere, and P *a f e l* the path of a line of ſound lying in the plane of the ſection. Fig. 3.

In the great circle of the ſphere take KQ$=$KP, DR $=$DQ, and KS$=$KR. Draw QB *h*; alſo draw Q *d n* parallel to DA; and draw PB, P *d*, PA.

1. Then it is evident that all the lines drawn from P, within the cone APB, proceed without reflection, and are diffuſed as if no trumpet had been uſed.

2. All

Trumpet. 2. All the ſonorous lines which fall from P on KB are reflected from it as if they had come from Q.

3. All the ſonorous lines between BP and *d* P have ſuffered but one reflection; for *d n* will no more meet DAA′ ſo as to be reflected again.

4. All the lines which have been reflected from KB, and afterwards from DA, proceed as if they had come from R. For the lines reflected from KB proceed as if they had come from Q; and lines coming from Q and reflected by DA, proceed as if they had come from R. Therefore draw R A *o*, and alſo draw R *g m* parallel to KB, and draw Q *c* A *q*, Q *b g*, P *c*, and P *b*. Then,

5. All the lines between *b* P and *c* P have been twice reflected.

Again, draw SB *p*, B *r* R, *r u* Q, S *x* A, R *y x*, Q *z y*.

6. All the lines between *u* P and *z* P have ſuffered three reflections.

Draw the tangents TA *t*, VB *v*, croſſing the axis in W.

7. The whole ſounds will be propagated within the cone *v* W *t*. For to every ſonorous point in the line KD there correſponds a point ſimilar to Q, regulating the firſt reflection from KB; and a point ſimilar to R, regulating the ſecond reflection from DA; and a point S regulating the third reflection from KB, &c. And ſimilar points will be found regulating the firſt reflection from DA, the ſecond from KB, and the third from DA, &c.; and lines drawn from all theſe through A and B muſt lie within the tangents TA and VB.

8. Thus the centres of reflection of all the ſonorous lines which lie in planes paſſing through the axis, will be found in the ſurface of this ſphere; and it may be conſidered as a ſonorous ſphere, whoſe ſounds firſt concentrate in W, and are then diffuſed in the cone *v* W *t*.

It may be demonſtrated nearly in the ſame manner, that the ſonorous lines which proceed from P, but not in the plane paſſing through the axis, alſo proceed, after various reflections, as if they had come from points in the ſurface of the ſame ſphere. The only difference in the demonſtration is, that the centres Q, R, S of the ſucceſſive reflections are not in one plane, but in a ſpiral line winding round the ſurface of the ſphere according to fixed laws. The foregoing concluſions are therefore general for all the ſounds which come in all directions from every point in the area of the mouth-piece.

Thus it appears, that a conical trumpet is well fitted for increaſing the force of ſounds by diminiſhing their final divergence. For had the ſpeaker's mouth been in the open air, the ſounds which are now confined within the cone *v* W *t* would have been diffuſed over a hemiſphere: and we ſee that prolonging the trumpet muſt confine the ſounds ſtill more, becauſe this will make the angle BWA ſtill ſmaller; a longer tube muſt alſo occaſion more reflections, and conſequently ſend more ſonorous undulations to the ear at a diſtance placed within the cone *v* W *t*.

We have now obtained a very connected view of the whole effect of a conical trumpet. It is the ſame as if the whole ſegment TKDV were ſounding, every part of it with an intenſity proportional to the denſity of the points Q, R, S, &c. correſponding to the different points P of the mouth-piece. It is eaſy to ſee that this cannot be uniform, but muſt be much rarer towards the margin of the ſegment. It would require a good deal of diſcuſſion to ſhow the denſity of theſe fictitious ſounding points; and we ſhall content ourſelves with giving a very palpable view of the diſtribution of the ſonorous rays, or the denſity (ſo to ſpeak) of the echoes, in the different ſituations in which a hearer may be placed. Trumpet.

We may obſerve, in the mean time, that this ſubſtitution of a ſounding ſphere for the ſounding mouth-piece has an exact parallel in Optics, by which it will be greatly illuſtrated. Suppoſe the cone BKDA (fig. 3.) to be a tube poliſhed in the inſide, fixed in a wall B *α*, perforated in BA, and that the mouth-piece DK is occupied completely by a flat flame. The effect of this on a ſpectator will be the ſame, if he is properly placed in the axis, as if he were looking at a flame as big as the whole ſphere. This is very evident. Fig. 3.

It is eaſy to ſee that the line *l e* S is equal to the line *l e f a* P; therefore the reflected ſounds alſo come to the ear in the ſame moments as if they had come from their reſpective points on the ſurface of the ſubſtituted ſphere. Unleſs, therefore, this ſphere be enormouſly large, the diſtinctneſs of articulation will not be ſenſibly affected, becauſe the interval between the arrival of the different echoes of the ſame ſnap will be inſenſible.

Our limits oblige us to content ourſelves with exhibiting this evident ſimilarity of the progreſs of echo from the ſurface of this phonic ſphere, to the progreſs of light from the ſame luminous ſphere ſhining through a hole of which the diameter is AB. The direct inveſtigation of the intenſity of the ſound in different directions and diſtances would take up much room, and give no clearer conception of the thing. The intenſity of the ſound in any point is preciſely ſimilar to the intenſity of the illumination of the ſame point; and this is proportional to the portion of the luminous ſurface ſeen from this point through the hole directly, and to the ſquare of the diſtance inverſely. The intelligent reader will acquire a diſtinct conception of this matter from fig. 4. which repreſents the diſtribution of the ſonorous lines, and by conſequence the degree of loudneſs which may be expected in the different ſituations of the hearer.

As we have already obſerved, the effect of the cone of the trumpet is perfectly analogous to the reflection of light from a poliſhed concave, conical mirror. Such an inſtrument would be equally fitted for illuminating a diſtant object. We imagine that theſe would be much more powerful than the ſpherical or even parabolic mirrors commonly uſed for this purpoſe. Theſe laſt, having the candle in the focus, alſo ſend forward a cylinder of light of equal width with the mirror. But it is well known, that oblique reflections are prodigiouſly more vivid than thoſe made at greater angles. Where the inclination of the reflected light to the plane of the mirror does not exceed eight or ten degrees, it reflects about three-fourths of the light which falls on it. But when the inclination is 80, it does not reflect one-fourth part.

We may alſo obſerve, that the denſity of the reflected ſounds by the conical trumpet ABC (fig. 4.) is preciſely ſimilar to that of the illumination produced by a luminous ſphere TDV, ſhining through a hole AB. There will be a ſpace circumſcribed by the cone formed by the lines TB *t* and VA *v*, which is uniformly illuminated by the whole ſphere (or rather by the ſegment TDV), and on each ſide there is a ſpace illuminated by Fig. 4.

ARTICULATE TRUMPET.

PLATE DXXXIX.

Fig. 1.

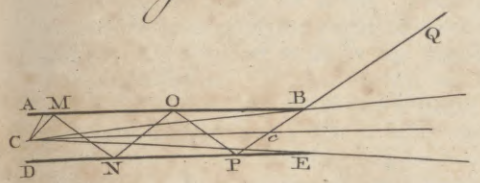


Fig. 2.

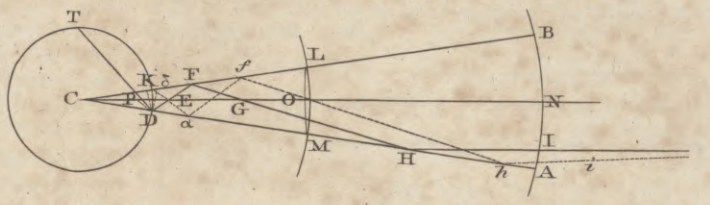


Fig. 3.

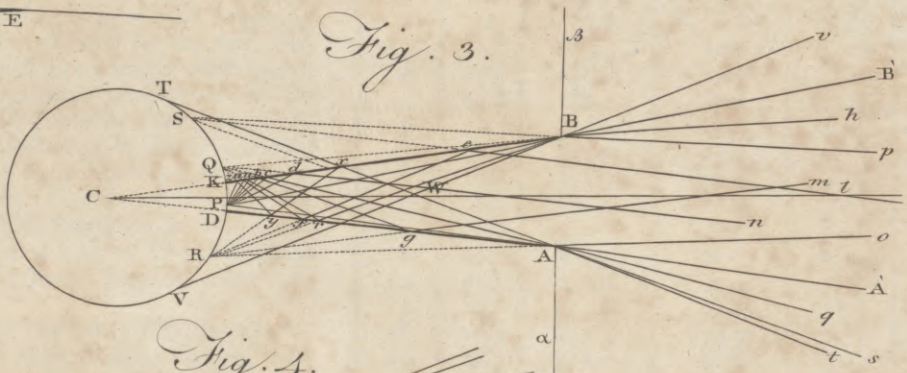


Fig. 4.

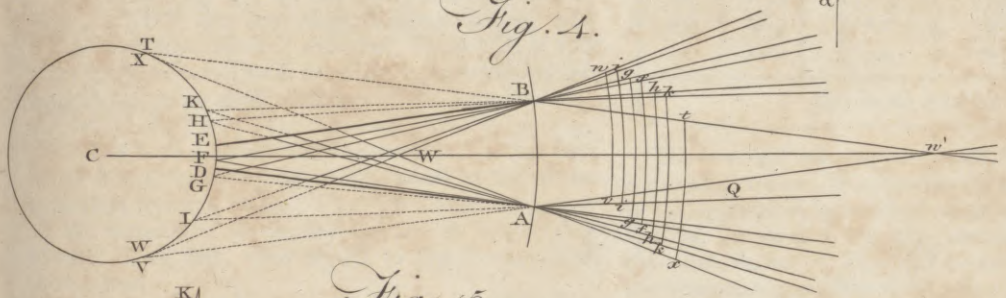


Fig. 5.

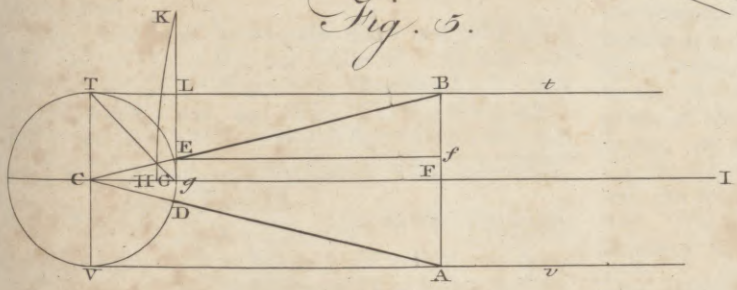


Fig. 7.

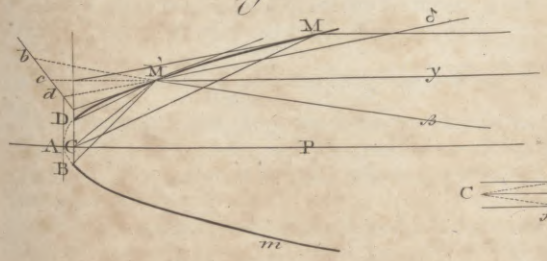


Fig. 6.

W. Train Sculpt

Trumpet. a part of it only, and the illumination gradually decreases towards the borders. A spectator placed much out of the axis, and looking through the hole AB, may not see the whole sphere. In like manner, he will not hear the whole sounding sphere: He may be so far from the axis as neither to see nor hear any part of it.

Assisting our imagination by this comparison, we perceive that beyond the point w' there is no place where *all* the reflected sounds are heard. Therefore, in order to preserve the magnifying power of the trumpet at any distance, it is necessary to make the mouth as wide as the sonorous sphere. Nay, even this would be an imperfect instrument, because its power would be confined to a very narrow space; and if it be not accurately pointed to the person listening, its power will be greatly diminished. And we may observe, by the way, that we derive from this circumstance a strong confirmation of the justness of Mr Lambert's principles; for the effects of speaking trumpets are really observed to be limited in the way here described.—Parabolic trumpets have been made, and they fortify the sound not only in the cylindrical space in the direction of the axis, but also on each side of it, which should not have been the case had their effect depended only on the undulations formed by the parabola in planes perpendicular to the axis. But to proceed.

Fig. 5. Let BCA (fig. 5.) be the cone, ED the mouth-piece, TEDV the equivalent sonorous sphere, and TBAV the circumscribed cylinder. Then CA or CB is the length of cone that is necessary for maintaining the magnifying power at all distances. We have two conditions to be fulfilled. The diameter ED of the mouth-piece must be of a certain fixed magnitude, and the diameter AB of the outer end must be equal to that of the equivalent sonorous sphere. These conditions determine all the dimensions of the trumpet and its magnifying power. And, first, with respect to the dimensions of the trumpet.

The similarity of the triangles ECG and BCF gives $CG : ED = CF : AB$; but $CG = BF$, $= \frac{1}{2}AB$, and $CF = CG + GF$, $= GF + \frac{1}{2}AB$; therefore $\frac{1}{2}AB : ED = GF + \frac{1}{2}AB : AB$, and $AB : ED = 2GF + AB : AB$; therefore $2GF \times ED + AB \times ED = AB^2$, and $2GF \times ED = AB^2, -AB \times ED, = AB \times \overline{AB - ED}$, and $GF = \frac{AB \times \overline{AB - ED}}{2ED}$. And, on the other hand, because $AB^2 - EB \times AD = 2GF \times ED$, we have $AB^2 - AB \times ED + \frac{1}{4}ED^2 = 2GF \times ED + \frac{1}{4}ED^2$, or $\overline{AB - \frac{1}{2}ED}^2 = 2GF \times ED + \frac{1}{4}ED^2$, and $AB = \sqrt{2GF \times ED + \frac{1}{4}ED^2} + \frac{1}{2}ED$.

Let x represent the length of the trumpet, y the diameter at the great end, and m the diameter of the mouth-piece. Then $x = \frac{y \times \overline{y - m}}{2m}$, and $y = \sqrt{2xm + \frac{1}{4}m^2} + \frac{1}{2}m$. Thus the length and the great diameter may be had reciprocally. The useful case in practice is to find the diameter for a proposed length, which is gotten by the last equation.

Now if we take all the dimensions in inches, and fix m at an inch and a half, we have $2xm = 3x$, and $\frac{1}{4}m^2 = 0{,}5625$, and $\frac{1}{2}m = 0{,}75$; so that our equation becomes $y = \sqrt{3x + 0{,}5625} + 0{,}75$. The following table gives the dimensions of a sufficient variety of trumpets. The first column is the length of the trumpet in feet; the second column is the diameter of the mouth in inches; the third column is the number of times that it magnifies the sound; and the fourth column is the number of times that it increases the distance at which a man may be distinctly heard by its means; the fifth contains the angle of the cone. Trumpet.

GF feet.	AB inches.	Magnifying.	Extending.	ACB.
				° ′
1	6.8	42.6	6.5	24.53
2	9.3	77.8	8.8	18.23
3	11.2	112.4	10.6	15.18
4	12.8	146.6	12.1	13.24
5	14.2	180.4	13.4	12.04
6	15.5	214.2	14.6	11.05
7	16.6	247.7	15.7	10.18
8	17.7	281.3	16.8	9.40
9	18.8	314.6	17.7	9.08
10	19.8	347.7	18.6	8.42
11	20.7	380.9	19.5	8.18
12	21.5	414.6	20.4	7.58
15	24.	513.6	22.7	7.09
18	26.2	612.3	24.7	6.33
21	28.3	711.2	26.6	6.05
24	30.2	810.1	28.5	5.42
ED in all is = 1.5				

The two last columns are constructed on the following considerations: We conceive the hearer placed within the cylindrical space whose diameter is BA. In this situation he receives an echo coming apparently from the whole surface TGV; and we account the effect of the trumpet as equivalent to the united voices of as many mouths as would cover this surface. Therefore the quotient obtained by dividing the surface of the hemisphere by that of the mouth-piece will express the magnifying power of the trumpet. If the chords gE, gT, be drawn, we know that the spherical surfaces $Tg\,V$, $Eg\,D$, are respectively equal to the circles described with the radii Tg, Eg, and are therefore as Tg^2 and Eg^2. Therefore the audibility of the trumpet, when compared with a single voice, may be expressed by $\frac{Tg^2}{Eg^2}$. Now the ratio of Tg^2 to Eg^2 is easily obtained. For if Ef be drawn parallel to the axis, it is plain that $Bf = \frac{BA - ED}{2}$, and that Ef is to fB as radius to the tangent of BCF; which angle we may call a. Therefore tan. $a = \frac{y - m}{2x}$, and thus we obtain the angle a. But if the radius CE be accounted 1, Tg is $= \sqrt{2}$, and Eg is $= 2$ sin. $\frac{a}{2}$. Therefore $\frac{Tg}{Eg} = \frac{\sqrt{2}}{2 \text{ sin. } \frac{a}{2}}$, and the magnifying power of the trumpet is $= \frac{2}{4 \text{ sin.}^2 \frac{a}{2}}$, $=$

Trumpet. $= \frac{1}{2 \sin.^2 \frac{a}{2}}$. The numbers, therefore, in the third column of the table are each $= \frac{1}{2 \sin.^2 \frac{a}{2}}$.

But the more uſual way of conceiving the power of the trumpet is, by conſidering how much farther it will enable us to hear a voice equally well. Now we ſuppoſe that the audibility of ſounds varies in the inverſe duplicate ratio of the diſtance. Therefore if the diſtance d, at which a man may be diſtinctly heard, be increaſed to z, in the proportion of EG to Tg, the ſound will be leſs audible, in the proportion of Tg^2 to EG^2. Therefore the trumpet will be as well heard at the diſtance z as the ſimple voice is heard at the diſtance d. Therefore $\frac{z}{d}$ will expreſs the *extending power* of the trumpet, which is therefore $= \frac{\sqrt{2}}{2 \sin. \frac{a}{2}}$. In this manner were the numbers computed for the fourth column of the table.

When the angle BCA is ſmall, which is always the caſe in ſpeaking trumpets, we may, without any ſenſible error, conſider EG as $= \frac{ED}{2}$, $= \frac{m}{2}$. And TG$=$TC $\times \sqrt{2}$, $= \frac{AB}{2}\sqrt{2} = \frac{AB}{\sqrt{2}} = \frac{y}{\sqrt{2}}$. This gives a very eaſy computation of the extending and magnifying powers of the trumpet.

$$\text{The extending power is} = \sqrt{2}\,\frac{y}{m}.$$

$$\text{The magnifying power is} = 2\,\frac{y^2}{m^2}.$$

We may alſo eaſily deduce from the premiſes, that if the mouth-piece be an inch and a half in diameter, and the length x be meaſured in inches, the extending power is very nearly $= \sqrt{\frac{8}{3}x}$; and the magnifying power $= \frac{8}{3}x$.

An inconvenience ſtill attends the trumpet of this conſtruction. Its complete audibility is confined to the cylindrical ſpace in the direction of the axis, and it is more faintly heard on each ſide of it. This obliges us to direct the trumpet very exactly to the ſpot where we wiſh it to be heard. This is confirmed by all the accounts we have of the performance of great ſpeaking trumpets. It is evident, that by lengthening the trumpet, and therefore enlarging its mouth, we make the lines TB t and VA v expand (fig. 4.); and therefore it will not be ſo difficult to direct the trumpet.

Fig. 4.

But even this is confined within the limits of a few degrees. Even if the trumpet were continued without end, the ſounds cannot be reinforced in a wider ſpace than the cone of the trumpet. But it is always advantageous to increaſe its length; for this makes the extreme tangents embrace a greater portion of the ſonorous ſphere, and thus increaſes the ſound in the ſpace where it is all reflected. And the limiting tangents TB, VA, expand ſtill more, and thus the ſpace of full effect is increaſed. But either of theſe augmentations is very ſmall in compariſon of the augmentation of ſize. If the trumpet of fig. 5. were made an hundred times longer, its power would not be increaſed one half. Trumpe

We need not therefore aim at much more than to produce a cylindrical ſpace of full effect; and this will always be done by the preceding rules, or table of conſtructions. We may give the trumpet a third or a fourth part more length, in order to ſpread a little the ſpace of its full effect, and thereby make it more eaſily directed to the intended object. But in doing this we muſt be careful to increaſe the diameter of the mouth as much as we increaſe the length; otherwiſe we produce the very oppoſite effect, and make the trumpet greatly inferior to a ſhorter one, at all diſtances beyond a certain point. For by increaſing the length while the part CG remains the ſame, we cauſe the tangents TB and VA to meet on ſome diſtant point, beyond which the ſound diffuſes prodigiouſly. The conſtruction of a ſpeaking trumpet is therefore a problem of ſome nicety; and as the trials are always made at ſome conſiderable diſtance, it may frequently happen that a trumpet which is not heard at a mile's diſtance, may be made very audible two miles off by cutting off a piece at its wide end.

After this minute conſideration of the conical trumpet, we might proceed to conſider thoſe of other forms. In particular, the hyperbolic, propoſed by Caſſegrain, and the parabolic, propoſed by Haaſe, ſeem to merit conſideration. But if we examine them merely as reflectors of echoes, we ſhall find them inferior to the conical.

With reſpect to the hyperbolic trumpet, its inaptitude is evident at firſt ſight. For it muſt diſſipate the echoes more than a conical trumpet. Indeed Mr Caſſegrain proceeds on quite different principles, depending on the mechaniſm of the aerial undulations: his aim was to increaſe the agitation in each pulſe, ſo that it may make a more forcible impulſe on the ear. But we are too imperfectly acquainted with this ſubject to decide *à priori*; and experience ſhows that the hyperbola is not a good form.

With reſpect to the parabolic trumpet, it is certain that if the mouth-piece were but a point, it would produce the moſt favourable reflection of all the ſounds; for they would all proceed parallel to the axis. But every point of an open mouth muſt be conſidered as a centre of ſound, and none of it muſt be kept out of the trumpet. If this be all admitted, it will be found that a conical trumpet, made by the preceding rules, will diſſipate the reflected ſounds much leſs than the parabolic.

Thus far have we proceeded on the fair conſequences of the well known fact, that echoes are reflected in the ſame manner as light, without engaging in the intricate inveſtigation of aerial undulations. Whoever conſiders the Newtonian theory of the propagation of ſound with intelligence and attention, will ſee that it is demonſtrated ſolely in the caſe of a ſingle row of particles; and that all the general corollaries reſpecting the lateral diffuſion of the elaſtic undulations are little more than ſagacious gueſſes, every way worthy of the illuſtrious author, and beautifully confirmed by what we can moſt diſtinctly and accurately obſerve in the circular waves on the ſurface of ſtill water. But they are by no means fit for becoming the foundation of any doctrine which lays the ſmalleſt claim to the title of accurate ſcience. We really know

rumpet. know exceedingly little of the theory of aerial undulations; and the conformity of the phenomena of ſound to theſe gueſſes of Sir Iſaac Newton has always been a matter of wonder to every eminent and candid mathematician: and no other ſhould pretend to judge of the matter. This wonder has always been acknowledged by Daniel Bernoulli; and he is the only perſon who has made any addition to the ſcience of ſounds that is worth mentioning. For ſuch we muſt always eſteem his doctrine of the ſecondary undulations of muſical cords, and the ſecondary pulſes of air in pipes. Nothing therefore is more unwarrantable, or more plainly ſhows the precipitant preſumption of modern ſcioliſts, than the familiar uſe of the general theory of aerial undulations in their attempts to explain the abſtruſe phenomena of nature (ſuch as the communication of ſenſation from the organ to the ſenſorium by the vibrations of a nervous fluid, the reciprocal communication of the volitions from the ſenſorium to the muſcle, nay, the whole phenomena of mind), by vibrations and vibratiunculæ.

Such attempts equally betray ignorance, preſumption, and meanneſs of ſoul. Ignorance of the extent to which the Newtonian theory may be logically carried, is the neceſſary conſequence of ignorance of the theory itſelf. It is preſumption to apply it to the phenomena of the intellectual world; and ſurely he has an abject ſoul who hugs and cheriſhes the humble thought, that his mind is an undulating fluid, and that its all-graſping comprehenſion, and all its delightful emotions, are nothing more than an etherial tune.—"Pol me occidiſtis amentes." This whim is older than Hartley: It may be found in Robinet's *Syſteme de la Nature*. This by the bye made its firſt appearance as a diſcourſe delivered by Brother Orateur in the lodge of the grand Orient at Lyons; from which ſource have proceeded all the coſmopolitical ſocieties in Europe, and that illumination by which reaſon is to triumph over revelation, and liberty and equality over civil government. We crave pardon of our readers for this ebullition of ſpleen; and we hope for it from all thoſe who can read Newton, and who eſteem his modeſty.

Thoſe who have endeavoured to improve the ſpeaking trumpet on mechanical principles, have generally aimed at increaſing the violence of the elaſtic undulations, that they may make a more forcible impulſe on the ear. This is the object in view in the parabolic trumpet. All the undulations are converted into others which are in planes perpendicular to the axis of the inſtrument; ſo that the ſame little maſs of air is agitated again and again in the ſame direction. From this it is obvious to conclude, that the total agitation will be more violent. But, in the firſt place, theſe violent agitations muſt diffuſe themſelves laterally as ſoon as they get out of the trumpet, and thus be weakened, in a proportion that is perhaps impoſſible for the moſt expert analyſt to determine. But, moreover, we are not ſufficiently acquainted with the mechaniſm of the very firſt agitations, to be able to perceive what conformation of the trumpet will cauſe the reflected undulations to increaſe the firſt undulations, or to check them. For it muſt happen, during the production of a continued ſound in a trumpet, that a parcel of air, which is in a ſtate of progreſſive agitation, as it makes a pulſe of one ſound, may be in a ſtate of retrograde agitation, as it is part of a pulſe of air producing another ſound. We cannot (at leaſt no mathematician has yet done it) diſcriminate, and then combine theſe agitations, with the intelligence and preciſion that are neceſſary for enabling us to ſay what is the ultimate accumulated effect. Mr Lambert therefore did wiſely in abſtaining from this intricate inveſtigation; and we are highly obliged to him for deducing ſuch a body of demonſtrable doctrine from the acknowledged, but ill underſtood, fact of the reflection of echoes. Trumpet.

We know that two ſounds actually croſs each other without any mutual diſturbance; for we can hear either of them diſtinctly, provided the other is not ſo loud as to ſtun our ears, in the ſame manner as the glare of the ſun dazzles our eyes. We may therefore depend on all the conſequences which are legitimately deduced from this fact, in the ſame manner as we depend on the ſcience of catoptrics, which is all deduced from a fact perfectly ſimilar and as little underſtood.

But the preceding propoſitions by no means explain or comprehend all the reinforcement of ſound which is really obtained by means of a ſpeaking trumpet. In the firſt place, although we cannot tell in what degree the aerial undulations are increaſed, we cannot doubt that the reflections which are made in directions which do not greatly deviate from the axis, do really increaſe the agitation of the particles of air. We ſee a thing perfectly ſimilar to this in the waves on water. Take a long ſlip of lead, about two inches broad, and having bent it into the form of a parabola, ſet it into a large flat trough, in which the water is about an inch deep. Let a quick ſucceſſion of ſmall drops of water fall preciſely on the focus of the parabola. We ſhall ſee the circular waves proceeding from the focus all converted into waves perpendicular to the axis, and we ſhall frequently ſee theſe ſtraight waves conſiderably augmented in their height and force. We ſay generally, for we have ſometimes obſerved that theſe reflected waves were not ſenſibly ſtronger than the circular or original waves. We do not exactly know to what this difference muſt be aſcribed: we are diſpoſed to attribute it to the frequency of the drops. This may be ſuch, that the interval of time between each drop is preciſely equal, or at leaſt commenſurable, to the time in which the waves run over their own breadth. This is a pretty experiment; and the ingenious mechanician may make others of the ſame kind which will greatly illuſtrate ſeveral difficult points in the ſcience of ſounds. We may conclude in general that the reflection of ſounds, in a trumpet of the uſual ſhapes, is accompanied by a real increaſe of the aerial agitations; and in ſome particular caſes we find the ſounds prodigiouſly increaſed. Thus, when we blow through a muſical trumpet, and allow the air to take that uniform undulation which can be beſt maintained in it, namely, that which produces its muſical tone, where the whole tube contains but one or two undulations, the agitation of a particle muſt then be very great, and it muſt deſcribe a very conſiderable line in its oſcillations. When we ſuit our blaſt in ſuch a manner as to continue this note, that is, this undulation, we are certain that the ſubſequent agitations conſpire with the preceding agitation, and augment it. And accordingly we find that the ſound is increaſed to a prodigious degree. A cor de chaſſe, or a bugle horn, when properly winded, will almoſt deafen the ear; and yet the exertion is a mere nothing in compariſon with what we make when bellowing with all

Trumpet. our force, but with not the tenth part of the noiſe. We alſo know, that if we ſpeak through a ſpeaking trumpet in the key which correſponds with its dimenſions, it is much more audible than when we ſpeak in a different pitch. Theſe obſervations ſhow, that the loudneſs of a ſpeaking trumpet ariſes from ſomething more than the ſole reflection of echoes conſidered by Mr Lambert—the very echoes are rendered louder.

In the next place, the ſounds are increaſed by the vibrations of the trumpet itſelf. The elaſtic matter of the trumpet is thrown into tremors by the undulations which proceed from the mouth-piece. Theſe tremors produce pulſes in the contiguous air, both in the inſide of the trumpet and on that which ſurrounds it. Theſe undulations within the trumpet produce original ſounds, which are added to the reflected ſounds: for the tremor continues for ſome little time, perhaps the time of three or four or more pulſes. This muſt increaſe the loudneſs of the ſubſequent pulſes. We cannot ſay to what degree, becauſe we do not know the force of the tremor which the part of the trumpet acquires: but we know that theſe ſounds will not be magnified by the trumpet to the ſame degree as if they had come from the mouth-piece; for they are reflected as if they had come from the ſurface of a ſphere which paſſes through the agitated point of the trumpet. In ſhort, they are magnified only by that part of the trumpet which lies without them. The whole ſounds of this kind, therefore, proceed as if they came from a number of concentric ſpherical ſurfaces, or from a ſolid ſphere, whoſe diameter is twice the length of the trumpet cone.

All theſe agitations ariſing from the tremors of the trumpet tend greatly to hurt the diſtinctneſs of articulation; becauſe, coming from different points of a large ſphere, they arrive at the ear in a ſenſible ſucceſſion; and thus change a momentary articulation to a lengthened ſound, and give the appearance of a number of voices uttering the ſame words in ſucceſſion. It is in this way, that, when we clap our hands together near a long rail, we get an echo from each poſt, which produces a chirping ſound of ſome continuance. For theſe reaſons it is found advantageous to check all tremors of the trumpet by wrapping it up in woollen liſts. This is alſo neceſſary in the muſical trumpet.

With reſpect to the undulations produced by the tremors of the trumpet in the air contiguous to its outſide, they alſo hurt the articulation. At any rate, this is ſo much of the ſonorous momentum uſeleſsly employed; becauſe they are diffuſed like common ſounds, and receive no augmentation from the trumpet.

Hearing trumpet. It is evident, that this inſtrument may be uſed (and accordingly was ſo) for aiding the hearing; for the ſonorous lines are reflected in either direction. We know that all tapering cavities greatly increaſe external noiſes; and we obſerve the brutes prick up their ears when they want to hear uncertain or faint ſounds. They turn them in ſuch directions as are beſt ſuited for the reflection of the ſound from the quarter whence the animal imagines that it comes.

Let us apply Mr Lambert's principle to this very intereſting caſe, and examine whether it be poſſible to aſſiſt dull hearing in like manner as the optician has aſſiſted imperfect ſight.

The ſubject is greatly ſimplified by the circumſtances of the caſe; for the ſounds to which we liſten generally come in nearly one direction, and all that we have to do is to produce a conſtipation of them. And we may conclude, that the audibility will be proportional to this conſtipation. Trump

Therefore let ACB, fig. 6. be the cone, and CD its axis. The ſound may be conceived as coming in the direction RA, parallel to the axis, and to be reflected in the points A, *b*, *c*, *d*, *e*, till the angle of incidence increaſes to 90°; after which the ſubſequent reflections ſend the ſound out again. We muſt therefore cut off a part of the cone; and, becauſe the lines increaſe their angle of incidence at each reflection, it will be proper to make the angle of the cone an aliquot part of 90°, that the leaſt incidence may amount preciſely to that quantity. What part of the cone ſhould be cut off may be determined by the former principles. Call the angle ACD, a. We have $C\,e = \frac{CA \cdot \text{fin. } a}{\text{fin. } (2n+1)\,a}$, when the ſound gets the laſt uſeful reflection. Then we have the diameter of the mouth $AB = 2\,CA \cdot \text{fin. } a$, and that of the other end $ef = C\,e \cdot 2 \text{ fin. } a$. Therefore the ſounds will be conſtipated in the ratio of CA^3 to $C\,e^3$, and the trumpet will bring the ſpeaker nearer in the ratio of CA to $C\,e$. Fig. 6.

When the lines of reflected ſound are thus brought together, they may be received into a ſmall pipe perfectly cylindrical, which may be inſerted into the external ear. This will not change their angles of inclination to the axis nor their denſity. It may be convenient to make the internal diameter of this pipe $\frac{1}{3}$ of an inch. Therefore $C\,e \cdot \text{fin. } a$ is $= \frac{1}{6}$ of an inch. This circumſtance, in conjunction with the magnifying power propoſed, determines the other dimenſions of the hearing trumpet. For $C\,e = \frac{1}{6 \text{ fin. } a} = \frac{CA \cdot \text{fin. } a}{\text{fin. } (2n+1)\,a}$, and $CA = \frac{\text{fin. } (2n+1\,a)}{6 \text{ fin.}^2 a}$.

Thus the relation of the angle of the cone and the length of the inſtrument is aſcertained, and the ſound is brought nearer in the ratio of CA to $C\,e$, or of fin. $(2n+1)\,a$ to fin. a. And ſeeing that we found it proper to make $(2n+1)\,a = 90°$, we obtain this very ſimple analogy, 1 : fin. a = CA : $C\,e$. And the fine of $\frac{1}{2}$ the angle of the cone is to radius as 1 to the approximating power of the inſtrument.

Thus let it be required that the ſound may be as audible as if the voice were 12 times nearer. This gives $\frac{CA}{C\,e} = 12$. This gives fin. $a = \frac{1}{12}$, and $a = 4°\ 47'$, and the angle of the cone $= 9.34$. Then $CA = \frac{1}{6 \text{ fin.}^2 a} = \frac{1}{6\frac{1}{144}} = \frac{144}{6}$, $= 24$. Therefore the length of the cone is 24 inches. From this take $C\,e = \frac{CA}{12} = 2$, and the length of the trumpet is 22 inches. The diameter at the mouth is $2\,C\,e$, $= 4$ inches. With this inſtrument one voice ſhould be as loud as 144.

If it were required to approximate the ſound only four times, making it 16 times ſtronger than the natural

voice

Trumpet. voice at the same distance, the angle ACB must be 29°; A*e* must be 2 inches, AB must be 1⅓d inches, and *e f* must be ⅓d of an inch.

It is easy to see, that when the size of the ear-end is the same in all, the diameters at the outer end are proportional to the approximating powers, and the lengths of the cones are proportional to the magnifying powers.

We shall find the parabolic conoid the preferable shape for an acoustic trumpet; because as the sounds come into the instrument in a direction parallel to the axis, they are reflected so as to pass through the focus. The parabolic conoid must therefore be cut off through the focus, that the sounds may not go out again by the subsequent reflections; and they must be received into a cylindrical pipe of one-third of an inch in diameter. Therefore the parameter of this parabola is one-sixth of an inch, and the focus is one-twelfth of an inch from the vertex. This determines the whole instrument; for they are all portions of one parabolic conoid. Suppose that the instrument is required to approximate the sound 12 times, as in the example of the conical instrument. The ordinate at the mouth must be 12 times the 6th of an inch, or 2 inches; and the mouth diameter is four inches, as in the conical instrument. Then, for the length, observe, that DC in fig. 7. is ⅛th of an inch, and MP is 2 inches, and AC is $\frac{1}{12}$th of an inch, and $DC^2 : MP^2 = AC : AP$. This will give AP = 12 inches, and CP = 11½ths; whereas in the conical tube it was 22. In like manner an instrument which approximates the sounds four times, is only 1⅓d inches long, and 1⅓d inches diameter at the big end. Such small instruments may be very exactly made in the parabolic form, and are certainly preferable to the conical. But since even these are of a very moderate size when intended to approximate the sound only a few times, and as they can be accurately made by any tinman, they may be of more general use. One of 12 inches long, and 3 inches wide at the big end, should approximate the sound at least 9 times.

Fig. 7.

A general rule for making them.—Let *m* express the approximating power intended for the instrument. The length of the instrument in inches is $\frac{m \times \overline{m-1}}{6}$, and the diameter at the mouth is $\frac{m}{3}$. The diameter at the small end is always one-third of an inch.

In trumpets for assisting the hearing, all reverbation of the trumpet must be avoided. It must be made thick, of the least elastic materials, and covered with cloth externally. For all reverbation lasts for a short time, and produces new sounds which mix with those that are coming in.

We must also observe, that no acoustic trumpet can separate those sounds to which we listen from others that are made in the same direction. All are received by it, and magnified in the same proportion. This is frequently a very great inconvenience.

There is also another imperfection, which we imagine cannot be removed, namely, an odd confusion, which cannot be called indistinctness, but a feeling as if we were in the midst of an echoing room. The cause seems to be this: Hearing gives us some perception of the direction of the sounding object, not indeed very precise, but sufficiently so for most purposes. In all instruments which we have described for constipating sounds, the last reflections are made in directions very much inclined to the axis, and inclined in many different degrees. Therefore they have the appearance of coming from different quarters; and instead of the perception of a single speaker, we have that of a sounding surface of great extent. We do not know any method of preventing this, and at the same time increasing the sound. Trumpet.

There is an observation which it is of importance to make on this theory of acoustic instruments. Their performance does not seem to correspond to the computations founded on the theory. When they are tried, we cannot think that they magnify so much: Indeed it is not easy to find a measure by which we can estimate the degrees of audibility. When a man speaks to us at the distance of a yard, and then at the distance of two yards, we can hardly think that there is any difference in the loudness; though theory says, that it is four times less in the last of the two experiments; and we cannot but adhere to the theory in this very simple case, and must attribute the difference to the impossibility of measuring the loudness of sounds with precision. And because we are familiarly acquainted with the sound, we can no more think it four times less at twice the distance, than we can think the visible appearance of a man four times less when he is at quadruple distance. Yet we can completely convince ourselves of this, by observing that he covers the appearance of four men at that distance. We cannot easily make the same experiment with voices.

But, besides this, we have compared two hearing trumpets, one of which should have made a sound as audible at the distance of 40 feet as the other did at 10 feet distance; but we thought them equal at the distance of 40 and 18. The result was the same in many trials made by different persons, and in different circumstances. This leads us to suspect some mistake in Mr Lambert's principle of calculation; and we think him mistaken in the manner of estimating the intensity of the reflected sounds. He conceives the proportion of intensity of the simple voice and of the trumpet to be the same with that of the surface of the mouth-piece to the surface of the sonorous hemisphere, which he has so ingeniously substituted for the trumpet. But this seems to suppose, that the whole surface, generated by the revolution of the quadrantal arch TEG round the axis CG (fig. 4.), is equally sonorous. We are assured that it is not: For even if we should suppose that each of the points Q, R, and S (fig. 3.), are equally sonorous with the point P, these points of reflection do not stand so dense on the surface of the sphere as on the surface of the mouth-piece. Suppose them arranged at equal distances all over the mouth-piece, they will be at equal distances also on the sphere, only in the direction of the arches of great circles which pass through the centre of the mouth-piece. But in the direction perpendicular to this, in the circumference of small circles, having the centre of the mouth-piece for their pole, they must be rarer in the proportion of the sine of their distance from this pole. This is certainly the case with respect to all such sounds as have been reflected in the planes which pass through the axis of the trumpet; and we do not see (for we have not examined this point) that any compensation is made by the reflection which is not in planes

Trumpet ‖ Tryphiodorus.

planes paſſing through the axis. We therefore imagine, that the trumpet does not increaſe the ſound in the proportion of $g\,E^2$ to $g\,T^2$ (fig. 5.), but in that of $\frac{g\,E^2}{GE}$ to $\frac{g\,T^2}{CT}$.

Mr Lambert ſeems aware of ſome error in his calculation, and propoſes another, which leads nearly to this concluſion, but founded on a principle which we do not think in the leaſt applicable to the caſe of ſounds.

TRUMPET, Marine, is a muſical inſtrument conſiſting of three tables, which form its triangular body. It has a very long neck with one ſingle ſtring, very thick, mounted on a bridge, which is firm on one ſide, but tremulous on the other. It is ſtruck by a bow with one hand, and with the other the ſtring is preſſed or ſtopped on the neck by the thumb.

It is the trembling of the bridge, when ſtruck, that makes it imitate the ſound of a trumpet, which it does to that perfection, that it is ſcarcely poſſible to diſtinguiſh the one from the other. And this is what has given it the denomination of trumpet-marine, though, in propriety, it be a kind of monochord. Of the ſix diviſions marked on the neck of the inſtrument, the firſt makes a fifth with the open chord, the ſecond an octave, and ſo on for the reſt, correſponding with the intervals of the military trumpet.

TRUMPET-Flower. See BIGNONIA, BOTANY *Index*.

TRUMPETER. See PSOPHIA, ORNITHOLOGY *Index*.

TRUNCATED, in general, is an appellation given to ſuch things as have, or ſeem to have, their points cut off: thus, we ſay, a truncated cone, pyramid, leaf, &c.

TRUNCHEON, a ſhort ſtaff or baton uſed by kings, generals, and great officers, as a mark of their command.

TRUNDLE, a ſort of carriage with low wheels, whereon heavy and cumberſome burdens are drawn.

TRUNK, among botaniſts, that part of the herb which ariſes immediately from the root, and is terminated by fructification; the leaves, buds, and auxiliary parts of the herb not entering in its deſcription.

TRUNNIONS, or TRUNIONS, of a piece of ordnance, are thoſe knobs or bunches of metal which bear her up on the cheeks of the carriage.

TRUSS, a bundle, or certain quantity of hay, ſtraw, &c. A truſs of hay contains 56 pounds, or half an hundred weight: 36 truſſes make a load.

TRUSS is alſo uſed for a ſort of bandage or ligature made of ſteel, or the like matter, wherewith to keep up the parts in thoſe who have hernias or ruptures.

TRUSS, in a ſhip, a machine employed to pull a yard home to its reſpective maſt, and retain it firmly in that poſition.

TRUSTEE, one who has an eſtate, or money, put or truſted in his hands for the uſe of another.

TRUTH, a term uſed in oppoſition to falſehood, and applied to propoſitions which anſwer or accord to the nature and reality of the thing whereof ſomething is affirmed or denied.

TRYPHIODORUS, an ancient Greek poet, who lived ſome time between the reigns of Severus and Anaſtaſius. His writings were very numerous; yet none of them have come down to us, except an epic poem, on which Mr Addiſon has made ſome entertaining remarks in the Spectator, N° 63. Tryphiodorus

The firſt edition of this extraordinary work was publiſhed by Aldus at Venice, with Quintus Calaber's Paralipomena, and Coluthus's poem on the rape of Helen. It has been ſince reprinted at ſeveral places, particularly at Francfort in 1580 by Friſchlinus; who not only corrected many corrupt paſſages, but added two Latin verſions, one in verſe and the other in proſe. That in verſe was reprinted in 1742, with the Greek, at Oxford, in 8vo, with an Engliſh tranſlation in verſe, and Notes, by Mr Merrick. Tum

TUAM, a town of Ireland, in the province of Connaught, and county of Galway, with an archbiſhop's ſee. It was once a famous city, though now it is reduced to a village; but it ſtill retains the title of a city, as being an archiepiſcopal ſee. W. Long. 8. 46. N. Lat 53. 33.

TUB, in commerce, denotes an indetermined quantity or meaſure: thus, a tub of tea contains about 60 pounds; and a tub of camphor from 56 to 86 pounds.

TUBE, in general, a pipe, conduit, or canal; a cylinder, hollow within-ſide, either of lead, iron, glaſs, wood, or other matter, for the air or ſome other matter to have a free conveyance through it.

Auricular TUBE, or inſtrument to facilitate hearing. See *Articulate TRUMPET*.

TUBERCLES, among phyſicians, denote little tumors which ſuppurate and diſcharge pus; and are often found in the lungs, eſpecially of conſumptive perſons.

TUCUMAN, a province of Paraguay, in South America, bounded on the north by the provinces of Los-Chicas and Choco; on the eaſt by Choco and Rio-de-la-Plata, on the ſouth by the country of Chicuitos and Pampes, and on the weſt by the biſhopric of St Jago. The air is hot, and the ſoil ſandy: however, ſome places are fruitful enough. The Spaniards poſſeſs a great part of this country.

TUFA, a ſtone conſiſting of volcanic aſhes concreted together with various other ſpecies of ſtone. It is of various colours, blackiſh gray, bluiſh gray, and yellow; every colour having a different mixture and ſolidity: but all of them have the bad quality of mouldering down on long expoſure to the weather; notwithſtanding which, they have been uſed in buildings both ancient and modern. The yellow kind reſiſts the air leſs than any other.

TULIPA, TULIP; a genus of plants belonging to the claſs of hexandria; and in the natural ſyſtem ranging under the 10th order, *Coronariæ*. See BOTANY *Index*; and for the culture of the tulip, ſee GARDENING.

TULIP-Tree. See LIRIODENDRON, BOTANY *Index*.

TULL, JETHRO, an Oxfordſhire gentleman who farmed his own land, and introduced a new method of culture, to raiſe repeated crops of wheat from the ſame land without the neceſſity of manure: the principles of which he publiſhed about 30 years ſince, in a Treatiſe on Horſe-hoeing Huſbandry.

TUMBRELL, TUMBRELLUM, or *Turbichetum*, is an engine of puniſhment, formerly employed for the correction of ſcolds and unquiet women.

TUMEFACTION, the act of ſwelling or riſing into a tumor.

TUMOR,

TUMOR, in *Medicine* and *Surgery*, a preternatural riſing or eminence in any part of the body.

TUMORS, in *Farriery*. See FARRIERY *Index*.

TUN, a large veſſel or caſk, of an oblong form, biggeſt in the middle, and diminiſhing towards its two ends, girt about with hoops, and uſed for ſtowing ſeveral kinds of merchandiſe for convenience of carriage; as brandy, oil, ſugar, ſkins, hats, &c.

TUN is alſo the name of a meaſure. A tun of wine is four hogſheads; of timber, a ſquare of 40 ſolid feet; and of coals, 20 cwt.

TUN is alſo a certain weight whereby the burden of ſhips, &c. is eſtimated.

TUNBRIDGE, a town of Kent in England, ſituated on a branch of the river Medway, over which there is a bridge. It is a large well built place, noted for the mineral waters four or five miles ſouth of the town. E. Long. 0. 20. N. Lat. 51. 14.

TUNE. See MUSIC and TONE.

TUNGSTEN, one of the metals. See CHEMISTRY and MINERALOGY *Index*.

TUNICA, a kind of waiſtcoat or under garment, in uſe among the Romans. They wore it within doors by itſelf, and abroad under the gown. The common people could not afford the toga, and ſo went in their tunics; whence Horace calls them *populus tunicatus*.

TUNICA, in *Anatomy*, is applied to the membranes which inveſt the veſſels, and divers others of the leſs ſolid parts of the body; thus the inteſtines are formed of five tunics or coats.

TUNIS, a large and celebrated town of Barbary, in Africa, and capital of a kingdom of the ſame name. It is ſeated on the point of the gulf of Goletta, about eight miles from the place where the city of Carthage ſtood. It is in the form of a long ſquare, and is about four miles in circumference, with ten large ſtreets, five gates, and 35 moſques. The houſes are all built with ſtone, though but one ſtory high; but the walls are very lofty, and flanked with ſeveral ſtrong towers. It has neither ditches nor baſtions, but a good citadel, built on an eminence on the weſt ſide of the city. It is ſaid to contain 300,000 inhabitants, of whom 30,000 are Jews. The divan, or council of ſtate, aſſembles in an old palace; and the dey is the chief of the republic, who reſides there. The harbour of Tunis has a very narrow entrance, through a ſmall canal. In the city they have no water but what is kept in ciſterns, except one well kept for the baſhaw's uſe. It is a place of great trade, and is 10 miles from the ſea. E. Long. 10. 16. N. Lat. 36. 42.

Obſerv. the City Tunis by Stanin the n. Mag. iv. 8.

TUNIS, a country of Africa, bounded on the north and eaſt by the Mediterranean ſea and the kingdom of Tripoli, on the ſouth by ſeveral tribes of the Arabs, and on the weſt by the kingdom of Algiers and the country of Eſab; being 300 miles in length from eaſt to weſt, and 250 in breadth from north to ſouth. This country was formerly a monarchy; but a difference ariſing between a king and his ſon, one of whom was for the protection of the Chriſtians, and the other for that of the Turks, in 1574 the inhabitants ſhook off the yoke of both. From this time it became a republic under the protection of the Turks, and pays a certain tribute to the baſhaw who reſides at Tunis. The air in general is healthy; but the ſoil in the eaſtern parts is indifferent for want of water. Towards the middle the mountains and valleys abound in fruits; but the weſtern part is the moſt fertile, becauſe it is watered with rivers. The environs of Tunis are very dry, upon which account corn is generally dear. The inroads of the Arabs oblige the inhabitants to ſow their barley and rye in the ſuburbs, and to incloſe their gardens with walls. However, there are plenty of citrons, lemons, oranges, dates, grapes, and other fruits. There are alſo olive trees, roſes, and odoriferous plants. In the woods and mountains there are lions, wild beeves, oſtriches, monkeys, cameleons, roebucks, hares, pheaſants, partridges, and other ſorts of birds and beaſts. The moſt remarkable rivers are the Guadilcarbar, Magrida, Magerada, and Caps. The form of government is ariſtocratic; that is, by a council, whoſe preſident is the dey, not unlike the doge of Venice. The members of the divan or council are choſen by the dey, and he in his turn is elected by the divan; which is compoſed of ſoldiers, who have more than once taken off the dey's head. The baſhaw is a Turk, reſiding at Tunis; whoſe buſineſs is to receive the tribute, and protect the republic: the common revenues are only 400,000 crowns a-year, becauſe the people are very poor; nor can they ſend above 40,000 men into the field; nor more than 12 men of war of the line to ſea, even upon the moſt extraordinary occaſions. There are generally about 12,000 Chriſtian ſlaves in this country; and the inhabitants carry on a great trade in linen and woollen cloth. In the city of Tunis alone there are above 3000 clothiers and weavers. They alſo have a trade in horſes, olives, oil, ſoap, oſtriches eggs and feathers. The Mahometans of this city have nine colleges for ſtudents, and 86 petty ſchools. The principal religion is Mahometaniſm; but the inhabitants conſiſt of Moors, Turks, Arabs, Jews, and Chriſtian ſlaves. However the Turks, though feweſt in number, domineer over the Moors, and treat them little better than ſlaves.

TUNKERS, a religious ſect of Baptiſts in Pennſylvania, ſo called from the word *tunker*, to put a morſel in ſauce. They are alſo called *tumblers*, becauſe in performing baptiſm they plunge the perſon into the water with the head firſt. As the Germans found the letters *t* and *b* like *d* and *p*, the words *tunkers* and *tumblers*, have been ſometimes written *dunkers* and *dumplers*. Their church government and diſcipline are the ſame with thoſe of the Engliſh Baptiſts, except that every brother is allowed to ſpeak in the congregation, and the beſt ſpeaker is uſually ordained to be their miniſter. They are a harmleſs, well-meaning people.

TUNNAGE. See TONNAGE.

TUNNY. See SCOMBER, ICHTHYOLOGY *Index*.

TUNNY-FISHING. See FISHERY.

TURBAN, the head-dreſs of moſt of the eaſtern nations. It conſiſts of two parts, a cap and ſaſh of fine linen or taffety, artfully wound in divers plaits about the cap. The cap has no brim, is pretty flat, though roundiſh at top, and quilted with cotton; but does not cover the ears. There is a good deal of art in giving the turban a fine air; and the making of them is a particular trade. The ſaſh of the Turk's turban is white linen; that of the Perſians red woollen. Theſe are the diſtinguiſhing marks of their different religions. Sophi king of Perſia, being of the ſect of Ali, was the firſt who aſſumed the

Turban || Turgot.

the red colour, to diſtinguiſh himſelf from the Turks, who are of the ſect of Omar, and whom the Perſians eſteem heretics.

TURBINATED, is a term applied by naturaliſts to ſhells which are ſpiral, or wreathed conically from a larger baſis to a kind of apex.

TURBITH or TURPETH MINERAL. See MERCURY, N° 1720 and 1728 CHEMISTRY.

TURBO, the WREATH, a genus of ſhell-fiſh. See CONCHOLOGY *Index*.

TURBOT. See PLEURONECTES, ICHTHYOLOGY *Index*.

TURCÆ or TURCI, (Mela); ſuppoſed to be the *Tuſci* of Ptolemy; whom he places between Caucaſus and the Montes Ceraunii. The name is ſaid to denote, "to deſolate, or lay waſte." Herodotus places them among the wild or barbarous nations of the north. There is a very rapid river called *Turk*, running into the Caſpian ſea, from which ſome ſuppoſe the Turks to take their name. They made no figure in the world till towards the 7th century; about the beginning of which they ſallied forth from the Portæ Caſpiæ, laid waſte Perſia, and joined the Romans againſt Choſroes king of Perſia. In 1042 they ſubdued the Perſians, in whoſe pay they ſerved, and from whom they derived the Mahometan religion; and afterwards pouring forth, overran Syria, Cappadocia, and the other countries of the Hither Aſia, under diſtinct heads or princes, whom Ottoman ſubduing, united the whole power in himſelf, which to this day continues in his family, and who fixed his ſeat of empire at Pruſa in Bithynia. His ſucceſſors ſubdued all Greece, and at length took Conſtantinople in 1453; which put a period to the Roman empire in the Eaſt, under Conſtantine the laſt emperor. It is a ſtanding tradition or prophecy among the Turks, that their empire will at length be overturned by the Franks or Chriſtians; which ſeems now to be drawing on apace towards accompliſhment.

TURCOISE. See TURQUOISE.

TURCOMANIA, a province of Aſiatic Turkey, anſwering to the ancient kingdom of Armenia.

TURDUS, the THRUSH; a genus of birds belonging to the order of *Paſſeres*. See ORNITHOLOGY *Index*.

TURENNE, VISCOUNT. See TOUR.

TURF, *peat*, a blackiſh earth uſed in ſeveral parts of the world as fuel. Turf, as diſtinguiſhed from peat, conſiſts of mould interwoven with the roots of vegetables.

TURGESCENCE, among phyſicians, denotes a ſwelling or growing bloated.

TURGOT, ANNE ROBERT JAMES, a celebrated French financier, was born at Paris in 1727, of a very ancient Norman family. His father was a long time provoſt of the corporation of merchants; during which he was the object of general admiration, on account of his prudent adminiſtration. M. Turgot was the youngeſt of three brothers, and was deſtined for the church. He had ſcarcely attained the age at which reflection commences, when he reſolved to ſacrifice all temporal advantages to liberty and conſcience, and to purſue his eccleſiaſtical ſtudies without declaring his repugnance to their propoſed object. At the age of 23 years he took his degree, and was elected prior of the Sorbonne.

Turgot. Turin.

The time when it was neceſſary for him to declare that he would not be an eccleſiaſtic was now arrived. He announced this reſolution to his father by letter, ſhowing the motives which induced him to decline the clerical order. His father conſented, and he was appointed maſter of requeſts. M. Turgot prepared himſelf for this office by particular application to thoſe parts of ſcience which are moſt connected with its functions and duties, viz. natural philoſophy, agriculture, manufactures, commerce, &c. About this period he wrote ſome articles for the *Encyclopédie*, of which the principal are Etymology, Exiſtence, Expanſibility, Fair, and Foundation. He had prepared ſeveral others, but the perſecution againſt the *Encyclopédie* induced him to decline farther contributions.

In 1761 M. Turgot was appointed intendant of Limoges, when he gave activity to the ſociety of agriculture; opened a mode of public inſtruction for female profeſſors of midwifery; procured for the people the attendance of able phyſicians during the raging of epidemic diſeaſes; eſtabliſhed houſes of induſtry, ſupported by charity (the only ſpecies of alms-giving which does not encourage idleneſs); introduced the cultivation of potatoes into his province, &c. &c. While M. Turgot proceeded with unremitting activity and zeal, in promoting the good of the people over whom he was placed, he meditated projects of a more extenſive nature, ſuch as an equal diſtribution of the taxes, the conſtruction of the roads, the regulation of the militia, the prevention of a ſcarcity of proviſion, and the protection of commerce.

At the death of Louis XV. the public voice called M. Turgot to the firſt offices of government, as a man who united the experience reſulting from habits of buſineſs to all the improvement which ſtudy can procure. After being at the head of the marine department only a ſhort time, he was, Auguſt 24. 1774, appointed comptroller general of the finances. During his diſcharge of this important office, the operations he carried on are aſtoniſhing. He ſuppreſſed 23 kinds of duties on neceſſary occupations, uſeful contracts, or merited compenſations. He aboliſhed the corvée, or the labour required from the public for the highways, ſaving the nation thirty millions of livres annually.—He ſet aſide another kind of corvée, which reſpected the carriage of military ſtores and baggage.—He abated the rigour in the adminiſtration of indirect impoſitions, to the great profit of the contributors, the king, and the financiers; beſide many other eſſential improvements in political economy.

At length, however, by the artifices of the courtiers, he was deprived of his offices; and in retirement he devoted himſelf to the ſciences and the belles lettres, which he had cultivated in his youth. Natural philoſophy and chemiſtry were his favourite purſuits; ſometimes he indulged in poetry. He compoſed, it is ſaid, only one Latin verſe, intended for a picture of Dr Franklin.

Eripuit cœlo fulmen, mox ſceptra tyrannis."

He died in 1781.

TURIN, an ancient and populous city of Italy, and capital of Piedmont, where the ſovereign reſides, with an archbiſhop's ſee, a ſtrong citadel, and an univerſity. It is ſeated on a vaſt plain, at the confluence of the rivers Doria and Po. But the air is unhealthy in the autumn

tumn and winter on account of the thick fogs. One half of this place is lately built; and the ſtreets are ſtraight and clean, being waſhed by an aqueduct. It contains many elegant buildings. When the plague reigned at Marſeilles in 1720, a great number of artificers withdrew to Turin; inſomuch that there are now above 87,000 inhabitants, and 48 churches and convents. Turin is very well fortified, and extremely ſtrong; as the French found by experience in 1706, who then beſieged it a long while to no purpoſe. The citadel, which is flanked with five baſtions, is without doubt a maſterpiece of architecture. There are fine walks on the ramparts, and fine gardens on the ſide of the river Po; and the houſe commonly called *La Charité* is remarkable, as there is room for 3000 poor people. The college of the academy is very large and well built, and has a great number of ancient inſcriptions. In the royal library are 19,000 manuſcripts, beſides 30,000 printed books. In December 1798, it was taken poſſeſſion of by the French, who in June following were driven out of it by the Auſtrians. But with the reſt of Italy it is now under the dominion of the French. It is charmingly ſeated at the foot of a mountain, 62 miles north-eaſt of Genoa, 72 ſouth-weſt of Milan, and 280 north-weſt of Rome. E. Long. 7. 45. N. Lat. 44. 50.

TURKEY, an extenſive empire, ſituated partly in Europe, and partly in Aſia. It is bounded on the north by the empire of Ruſſia, Hungary, and the Black ſea; on the weſt by the gulf of Venice and the Mediterranean; on the ſouth by the Mediterranean and Arabia; and on the eaſt by Perſia. In its preſent ſtate, we may compute it as extending from the river Unna, in eaſt longitude about 17°, to the mountains which ſeparate it from Perſia, in about 50° of eaſt longitude from Greenwich, or about 33° from weſt to eaſt; while from the moſt ſoutherly point, a little above Baſſora, in north latitude 31°, to the confines of European Ruſſia, in north latitude 47°, it occupies a range of 16° of latitude. In Britiſh miles its extent is eſtimated at 1750 in length, by a medial breadth of about 1000, and its area at 652,960 ſquare miles.

Turkey is naturally divided into European and Aſiatic, ſeparated from each other by the Black ſea, the Archipelago, and the ſtraits by which theſe are connected. European Turkey is ſubdivided into 11 provinces, viz. MOLDAVIA, BESSARABIA, WALACHIA, BOSNIA, SERVIA (partially), BULGARIA, ROMELIA (including *Macedonia* and *Thrace*), DALMATIA, ALBANIA (including *Epirus*), CROATIA (partially), and the MOREA, or ancient Greece; while Aſiatic Turkey is ſubdivided into ſeven provinces, viz. NATOLIA (*Aſia Minor*), DIARBEC (*Meſopotamia*), SYRIA (including *Judæa*), GEORGIA (*Iberia*), TURCOMANIA (*Armenia*), IRAC-ARABIA, and KURDISTAN (*Aſſyria*). See each of theſe articles in the general alphabet.

The iſlands belonging to Turkey are extremely numerous; compriſing thoſe of the Archipelago, or the Grecian iſlands, and ſeveral in the Levant. The moſt important are LEMNOS, LESBOS or *Mytelene*, SCIO, SAMOS, COS, RHODES, CYPRUS, CANDIA, PAROS, DELOS, NAXIA, SANCTORINI, PATMOS, NEGROPONT, ANDRO *, COLTERI or *Salumis* *, EGINA, ZANTE *, CEPHALONIA, LEUCADIA, CORFU, and CERIGO or *Cytherea*, which ſee under their proper heads.

Both European and Aſiatic Turkey abound in mountainous tracts, interſperſed with numerous plains and valleys, and here and there a deſert of conſiderable extent. The plains are watered by numerous large rivers, and, in the Aſiatic part, conſiſt chiefly of paſture grounds. Turkey.

5 Mountains. Among the mountains of European Turkey may be noticed the Carpathian chain, which divides it from the Auſtrian territories; the celebrated mountains of Hæmus; the Acroceraunian mountains; and the claſſical hills of Pindus, Oſſa, Pelion, and Athos. The moſt important mountains of Aſiatic Turkey are, Mount Caucaſus, dividing it from Ruſſia; Mount Taurus, now called Thuron; Olympus; Ida; the mountains of Elivend, and perhaps Mount Ararat, the reſting-place of the Ark, dividing it from Perſia; and Mount Lebanon, celebrated in ſcripture for its cedars.

6 Rivers. The principal river of European Turkey is the Danube, with its tributary ſtreams, the Save, the Morava, the Boſna, and the Pruth; but we may alſo notice the Mariſſa or Hebrus, and the Vardan or Axius. In Aſiatic Turkey are ſeen the Kiſil-Irmak or Halys, the Saccaria, the Sarabat or Hermus, the Minder or Meander, the Araxes, the Orontes, the Jordan, and the Euphrates.

7 Lakes. The lakes of European Turkey are of little importance, and in the Aſiatic part there are only three that merit notice. Theſe are the Dead ſea and the ſea of Galilee in Paleſtine, and the Van in Armenia.

8 Climate and ſeaſons. The climate in the greater part of the Turkiſh empire is delightful, and the ſeaſons mild and genial. The heats of the ſummer, except in the deſerts of Syria, and on the ſhores of the Black ſea, are tempered by the keen winds that blow from the higher regions, and the winter is in general extremely mild. The unhealthineſs of the large towns on the coaſt of Aſiatic Turkey, is owing much more to the indolent and dirty habits of the people, than to any inſalubrity of the climate.

9 Natural hiſtory. Turkey affords a moſt ample field to the naturaliſt, whether his taſte lead him to explore the animal, the vegetable, or the mineral kingdom. In the firſt of theſe he will find the lion, a variety of the tiger, the hyena, the jackal, the ibex, the goat and cat of Angora, and many other quadrupeds common in Europe. Among the birds, one of the moſt numerous and moſt uſeful is the ſtork; partridges of a large ſize, quails, woodcocks, cranes, and ſeveral birds of prey, are alſo very common. The Black ſea and the Archipelago abound with excellent fiſh, and contain great variety of curious molluſca, and other marine animals. Among the inſects, that deſtructive animal the locuſt is a frequent viſitant; and Sonnini particulariſes the tarantula, and a monſtrous ſpecies of ſpider, which he calls *galeode araneoide*, or the ſcorpion ſpider. Of the domeſtic animals, the Turks abound in excellent horſes, aſſes of a large ſize, and that moſt uſeful beaſt of burden, the camel.

To enumerate the vegetable productions of Turkey, would far exceed our ſcanty limits. The foreſts of European Turkey, though far leſs extenſive than in ancient times, furniſh abundance of the fineſt timber, eſpecially oak, cedar, larch, walnut, cheſnut, and beech, while the olive, the date, the almond, the peach, the mulberry, the cherry, the lemon, and the orange, are the natural productions of Aſiatic Turkey. Many of the moſt valuable drugs employed in medicine, are alſo the produce of this empire, eſpecially opium, rhubarb, myrrh, aſafœtida and other fetid gums, ſcammony, ſenna, galls, and coloquintida.

Turkey.

Both gold and silver mines are found in Turkey, but from the indolence of the natives they are scarcely ever worked. Many of the islands abound in mineral treasures, especially Cyprus, where are found mines of gold, copper, vitriol, and iron; and where rock crystal, jasper, and several precious stones, are occasionally procured. The chief mineral production of Turkey, however, is its marble, of which it furnishes several of the most rare and beautiful varieties. That from the Grecian island Paros, is proverbially excellent.

10 Outline of the Turkish history.

The people whom we now call Turks, and who form the great mass of population of the Turkish empire, are generally believed to be the descendants of the ancient Scythians. These are supposed to have migrated from the Altai mountains in Tartary, about the middle of the sixth century, and to have gradually diffused themselves towards the west, till they reached the lake Mæotis, the modern sea of Azof, near which they settled in Armenia Minor or Turcomania. At this time the Roman empire in the east was sufficiently strong to prevent the invaders from extending beyond the river Oxus, on the banks of which they established themselves, and soon became a formidable foe to the emperors of Constantinople.

11 Foundation of the Ottoman empire. A. D. 1300.

There is little certain or interesting in the history of these barbarians till the reign of the caliph Othman, or Osman, who in the end of the 13th century established what from him has been called the Ottoman empire. He first took the title of sultan, and fixed the seat of his government at Prusa, the capital of Bithynia. His successor Orkan was a restless, ambitious, and cruel prince, who greatly extended the limits of the empire, took possession of Gallipoli, and penetrated into Thrace. Amurath the grandson of Osman, in 1362, established the famous military bands called *janizaries*, which still form the chief engines and chief moderators of Turkish despotism. These were first composed of young Christian slaves that had been taken in war, and educated in the Mohammedan religion. They were inured to obedience by severe discipline, and trained to warlike exercise; and as every sentiment which enthusiasm can inspire, and every mark of honour which the favour of the prince could confer, were employed to animate them with martial ardour, and excite in them a sense of their own importance, these janizaries, (or new soldiers) soon became the chief strength and pride of the Ottoman arms. On the assassination of Amurath in 1389, he was succeeded by his son Bajazet, surnamed Ilderim, or the Thunderbolt, whose reign forms one of the most splendid epochs in the Turkish history.

12 Establishment of the Janizaries, 1362.

13 Reign of Bajazet. An. 1389.

Early in this reign, viz. in 1396, the Hungarians were defeated at Nicopoli in Bulgaria, and in 1402, was fought the famous battle between Bajazet and Timur or Tamerlane, the chief of the Moguls, between Cesarea and Aneyra, which ended in the captivity of Bajazet, and the temporary humiliation of the Turks. See MOGULS, N° 19. and 20.

On the death of Bajazet, his son Mousa became sultan, and in 1412 defeated the emperor Sigismund with great slaughter. Mousa was succeeded by his brother Mohammed I. by whom he had been assassinated. The reign of Amurath II. successor of Mohammed, contributed greatly to increase the splendour of the Turkish empire. In this reign Constantinople was attacked, but for the present escaped pillage. Amurath was successfully opposed in his hostilities against the Christian princes, by the Albanian chief George Castriota, whom the Turks call Scanderbeg *.

Turks

* See Scanderbeg.

Amurath was succeeded by Mohammed II. and soon after his accession, viz. in 1453, the city of Constantinople was taken by the Turks, and has ever since remained the capital of their empire. The events of which we have thus drawn the faint outline, are related at some length in the article CONSTANTINOPOLITAN HISTORY, N° 111—168.

14 Taking of Constantinople, An. 14.

Three years after the taking of Constantinople, Mohammed laid siege to Belgrade, from which, after an obstinate resistance, he was at length repulsed with considerable loss. Abandoning his attempt on Hungary, the sultan made preparations for an expedition into Greece, where the princes Thomas and Demetrius, brothers of the emperor, still continued to maintain their authority. Alarmed at the progress of the Turkish arms, these princes resolved on retiring into Italy, on which the peninsula was seized by the Albanians. This tribe sent a deputation to Mohammed, offering to give up to him the Grecian cities and fortresses, provided they should be allowed to keep the open country; but this offer was rejected by the sultan, who under the appearance of assisting the Greeks, entered the country with a formidable army, defeated the Albanians, took several cities, and carried off great numbers of the inhabitants.

15 Other successes of Mohammed II.

Mohammed was succeeded by his second son Bajazet II. in 1481, preferred by the janizaries to his elder brother Zizan, who fled for protection to Pope Alexander VI. by whom he is said to have been poisoned, at the instigation of Bajazet, and for the reward of 300,000 ducats. Selim, his youngest son and successor, was a successful prince. He conquered Egypt, Aleppo, Antioch, Tripoli, Damascus, and Gaza, and defeated the Persians. Solyman, surnamed the Magnificent, one of the most accomplished, enterprising, and warlike, of the Turkish princes, ascended the Ottoman throne in consequence of the death of Selim.

16 Bajazet II. An. 148

17 Solyman An. 15

Having quelled some insurrections in Asia, he commenced hostilities against the European princes, and entering Hungary, made himself master of Belgrade, then reckoned the chief barrier of that kingdom against the Turkish power. He next turned his victorious arms against the island of Rhodes, then the seat of the knights of St John of Jerusalem. After incredible efforts of courage and military conduct, the knights obtained an honourable capitulation, and retired to the small island of Malta, where they fixed their residence. See MALTA. He afterwards annexed Hungary to the Ottoman empire. His dominions extended from Algiers to the river Euphrates, and from the farther end of the Black sea to the extremity of Greece and Epirus. During the siege of Sigeth, a city of Hungary, before which the Turks lost above 30,000 men, Solyman expired in the 74th year of his age, and 41st of his reign.

18 Selim II. An. 15

His son and successor, Selim II. besieged and took Cyprus; but in the famous sea fight at Lepanto, in 1571, the Turkish fleet was utterly destroyed by Don John of Austria. He afterwards invested and took Tunis by storm, putting the garrison to the sword.

19 Amurath III. An. 15

On his death, Amurath III. ascended the Ottoman throne, and extended his dominions on both sides by the addition of Raab in Hungary, and Tigris in Persia. His son, Mohammed III. has no claim to notice except

except on account of his barbarity. He began his reign by ſtrangling 19 of his brothers, and ordering 12 of his father's wives, whom he ſuſpected to be pregnant, to be drowned. This monſter of cruelty had, however, a ſucceſsful reign of nine years duration. During the government of his ſon, Achmet I. the affairs of Turkey underwent a material change for the worſe *. On his death, the janizaries and the divan elected his brother Muſtapha, whom in two months they declared incapable of reigning, and threw him into priſon; after this they proclaimed his young nephew, Oſman, the ſon of Achmet, emperor. This prince formed a deſign of curbing the power of the janizaries, for which he was depoſed and murdered; and Muſtapha was again called from his priſon to the imperial throne, but was ſoon after ſtrangled.

Under Amurath, or Morad IV. ſurnamed Gaſi, the Intrepid, every thing again aſſumed a new appearance. He was ſucceſsful in his wars, and took Bagdat from the Perſians. A debauch of wine put an end to his life, and diſhonoured his memory. His ſon Ibrahim, who ſucceeded him, had every vice; he was a weak prince, and wholly deſtitute of courage. He was ſtrangled by four mutes.

After a long interval of inactivity, the Turks again became formidable to Europe, under Mohammed IV. who ſucceeded him. His grand viſier Kupuli, who at once directed the councils and conducted the armies of the Porte, took Candia from the Venetians. After carrying on many wars againſt the Germans, the Poles, the Ruſſians, and other European powers, he was compelled to reſign the turban to Solyman II. in 1687, a prince happy in his domeſtic government, but unſucceſsful in his wars. His brother, Achmet II. was likewiſe unfortunate in his wars. In his reign the Turks were driven out of Hungary and Tranſylvania †. The acceſſion of his nephew, Muſtapha II. to the Ottoman throne, gave a new turn to the affairs of the Porte. Poſſeſſed of more vigour than his predeceſſor, he reſolved to command his troops in perſon. He accordingly took the field, paſſed the Danube, ſtormed Lippa, ſeized Itul, and falling ſuddenly on a body of Imperialiſts, under Veterani, he killed that officer, diſperſed his forces, and cloſed with ſucceſs the campaign. He was afterwards defeated by Prince Eugene in an uncommonly bloody battle at Zenta, a ſmall village on the weſtern bank of the Thuyſe, in the kingdom of Hungary. About 20,000 Turks were left dead on the field, and 10,000 were drowned in the river, endeavouring to avoid the fury of the ſword. The magnificent pavilion of the ſultan, and all the ſtores, fell into the hands of Prince Eugene, and ſoon after this misfortune the haughty Muſtapha was dethroned.

His brother and ſucceſſor, Achmet III. gave an aſylum to Charles XII. king of Sweden, at Bender, a Turkiſh town in Moldavia, after his defeat at the battle of Pultava. (See RUSSIA, N° 118. and SWEDEN, N° 140.). Being unſucceſsful in his war againſt Kouli Khan and the Perſians (ſee PERSIA), he was depoſed, and ſuceeeded by Mohammed V.

From the depoſition of Achmet III. till the acceſſion of Muſtapha III. in 1754, nothing of importance occurs in the hiſtory of the Turkiſh empire. During the reign of this latter ſultan was begun and terminated that deſtructive war with Ruſſia, of which the principal events have been enumerated in the article RUSSIA, N° 143 and 144. Turkey.

In this reign an extraordinary alarm was excited in Turkey by the ſudden appearance of a new prophet in Upper Aſia. This man, whoſe name was *Shiek Manſour*, pretended that he was predoomed by the eternal immutable decrees of heaven to fill up the meaſure of divine revelation to mankind; and that, as he was to be the laſt, ſo he was the greateſt of the prophets. The ſcene of his miniſtry was in the wide and deſolate regions on the borders of the Caſpian ſea; and though the firſt rumour of his proceedings repreſented him as at the head of a multitude of armed enthuſiaſts, ready to overturn the eſtabliſhed government, and the religion of Mohammed, it was ſoon diſcovered that all the military fury of his zeal was directed againſt the Chriſtians. 27 Appearance of a new prophet in Aſia.

About the ſame time a formidable rebellion broke out in Egypt, which, though it has never properly formed a part of the Turkiſh empire, may be conſidered as tributary to the Turks, and as conſtituting the granary of that empire. This rebellion which has been ſufficiently noticed under the article EGYPT, N° 125, was ſuppreſſed chiefly by the wiſe conduct and intrepid bravery of Hoſſan Bey, the captain pacha, who at the age of 70, fought with all the ardour of youth, and all the ſkill of the moſt conſummate general. That veteran, however, was recalled before he was able to carry all his patriotic deſigns into execution, that he might aid the divan with his counſel, in the critical ſituation into which the empire was brought by the arrogant claims of the court of Ruſſia. The reſult of the deliberations was a precipitate declaration of war againſt that court, contrary to the better judgment of the old pacha. The war commenced in autumn 1787, and the hordes of Tartars which were firſt brought into the field, headed by the new prophet, were everywhere defeated by the ſuperior diſcipline of the Ruſſian troops commanded by Prince Potemkin. Some enterpriſes which were undertaken by the Turks againſt the iſland of Taman and the Krimea were attended with as little ſucceſs as the attempts of the Tartars; while the emperor Joſeph declared to the Porte, that he would aſſiſt his ally the empreſs of Ruſſia with an army of 80,000 men. Four Auſtrian armies were accordingly aſſembled; one at Carlſtadt in Croatia, under the command of General de Vins; another at Peterwaradin in Hungary, commanded by General Langlois; a third on the borders of Lithuania, under General Febris; and the fourth in the Buccowine, under the orders of the prince of Saxe-Cobourg. Two other generals, 10 lieutenant-generals, and 30 major-generals, were all ordered to prepare for active ſervice in the frontier armies. 28 A rebellion in Egypt.

The war between the Turks and Auſtrians was carried on with various ſucceſs. At firſt the advantage was evidently on the ſide of the Ottomans, and the imperial Joſeph acquired no warlike renown. His declared purpoſe was to get poſſeſſion of Belgrade; from which, however, he was repulſed with diſgrace. The prince of Saxe-Cobourg in his department of the war diſplayed indeed prodigies of valour; but being oppoſed to a ſuperior force, he was long obliged to act only on the defenſive. At length being joined by a body of Ruſſian forces under General Soltikoff, preparations were made for commencing in form the ſiege of Choczim, which was ſurrendered to the allied armies on Michael-

Turkey.

mas day 1788, after a defence which would have done honour to the ableſt general in Europe. Still, however, ſucceſs ſeemed to lean to the Turks. The grand vizier made a ſudden incurſion into the Bannat, and ſpread conſternation and diſmay to the very gates of Vienna. The Auſtrian affairs ſeemed approaching to a very alarming criſis; not only the ſplendid views of conqueſt which were beheld in the imagined partition of a tottering empire had totally diſappeared, but had left in their place the ſad and gloomy reverſe of a diſcontented and impoveriſhed people, an exhauſted treaſury, and an army thinned by peſtilence and deſertion. The firſt campaign of an invaſive war had already produced an impreſſion on the territory of the invader.

In this ſituation of affairs Marſhal Laudohn was with ſome difficulty drawn from his retirement to take the command of the army in Croatia; and under his auſpices fortune began to ſmile on the Auſtrian arms. He quickly reduced Dubicza and Nevi, though they were both defended by the moſt obſtinate bravery. He then ſat down before Turkiſh Gradiſca; but the autumnal rains coming on with ſuch violence, that the Save overflowed its banks, he was compelled to raiſe the ſiege. During this period the war in the Bannat raged with the utmoſt violence; torrents of blood were ſhed on both ſides; much deſperate valour diſplayed on the one ſide, and many brave actions performed on the other; while a very great part of that fine but unfortunate country ſuffered all the deſolation and ruin that fire and ſword, under the dominion of vengeance and animoſity, could inflict. The inhabitants were objects of commiſeration; but the injuſtice with which the emperor had commenced the war, made his perſonal loſſes be conſidered as nothing more than the due reward of his conduct.

29 Acceſſion of Selim III. An. 1789.

In the midſt of theſe military operations Achmet IV. was depoſed, and ſucceeded by Selim III. the late ſultan. The new emperor did not want either courage or prudence, and he continued the war with Ruſſia and Auſtria, with great ſpirit and reſolution. Thoſe events of this war in which the Ruſſians were more immediately concerned, have been already noticed under the article RUSSIA, N° 156, 158, 160 and 161; ſo that we have merely to relate the remaining operations of the Auſtrians.

30 Marſhal Laudohn takes Gradiſca and Belgrade.

Marſhal Laudohn renewed his attempts upon Gradiſca as ſoon as the ſeaſon would permit, and after a brave defence it fell into his hands. This, with ſome other ſucceſſes, rouſed the emperor from his inactivity, and made him ſeriouſly determine on the attack which he had long meditated on Belgrade. The enterpriſe was intruſted to Laudohn, who, with that good fortune which ſeemed conſtantly to attend him, made himſelf maſter of the place in leſs than a month. The reſt of the campaign was little elſe than a ſeries of the moſt important ſucceſſes. While one detachment of General Laudohn's forces took poſſeſſion of Czernitz in Walachia, another made itſelf maſter of Cladova in Servia. Bucharеſt, the capital of the former of theſe provinces, fell without oppoſition into the hands of Prince Cobourg; while Akerman on the Black ſea was reduced by the Ruſſians; and Bender ſurrendered to Prince Potemkin, not without ſuſpicion of ſiniſter practices, on the 15th of November.

31 Peace with Auſtria, An. 1790.

Soon after this, the emperor Joſeph died, and his ſucceſſor Leopold ſhewed a deſire for peace. After the reduction of Orſova, therefore, which happened on the 16th of April 1790, the war was carried on with languor on the part of Auſtria; and in the month of June a conference was agreed on at Reichenbach, at which the miniſters of Pruſſia, Auſtria, Britain, and the United Provinces, aſſiſted, and at which alſo an envoy from Poland was occaſionally preſent. After a negociation, which continued till the 17th of Auguſt, it was agreed that a peace ſhould be concluded between the king of Hungary and the Ottoman Porte; that the baſis of this treaty ſhould be a general ſurrender of all the conqueſts made by the former, retaining only Choczim as a ſecurity till the Porte ſhould accede to the terms of the agreement, when it alſo was to be reſtored. Turkey.

32 and with Ruſſia.

In the following year the Porte was compelled to conclude a peace with the empreſs of Ruſſia, and from that period till the depoſition of Selim in 1807, no event of conſequence has occurred. The Porte has alternately been at war with Britain and with France, but in neither conteſt has ſhe acquired either honour or territory. As the very confined limits to which we are now reduced forbid us to dwell on theſe minor tranſactions, we ſhall haſten to conclude this hiſtorical outline with an account of the revolution which placed Muſtapha IV. on the Ottoman empire.

In the ſpring 1807, the ſpirit of inſurrection had ſhown itſelf among the janizaries belonging to the garriſons of the Dardanelles, and in the camp of the grand vizier. In the afternoon of the 25th of May, the garriſons of the caſtles of the Dardanelles were in a ſtate of tumult, on account of the European uniform, the new tactics, &c. Hali Aga, the commandant of Madſchia-burna, on the Aſiatic ſhore, was murdered. Indſche Bey, commandant of the entrance of the Black ſea, only eſcaped the ſame fate by flight. The reis effendi happening to come to inſpect that poſt juſt at the ſame time, the military immediately roſe upon him as one of the introducers of the nizam geded. He endeavoured to ſave himſelf in a bark, by paſſing over to Buyukdere, but 100 piſtol ſhots laid him and his attendants dead. It ſeems that the rage of the janizaries had been embittered againſt him by the recollection of a promiſe he made to raiſe their pay, on condition they would adopt the new diſcipline, and which promiſe he never performed. 33 Depoſition of Selim and acceſſion of Muſtapha IV.

Another circumſtance increaſed the ſpirit of oppoſition; the ſultan had given notice that the janizaries were no longer to attend him as uſual to the moſque, but that this duty was to devolve upon the troops diſciplined after the European manner. Thouſands of janizaries were now marching to Conſtantinople, and arrived in the ſuburb of Pera on the evening of the 28th. They ſwore to each other to conduct the revolution with the beſt order. Any perſon who ſhould in the leaſt injure any Frank was to ſuffer death. One individual janizary only met with his fate, for taking bread from a Greek (a baker), without paying for it. Behind the janizaries barracks, in the well-known place called Eimeldan, the janizaries planted their colours, and took with them their camp kettles; an infallible ſignal of inſurrection. For a time, the ſultan thought of defending himſelf; and troops, powder, and cannon, were brought to the ſeraglio. Soon after the mufti, the ſeimen baſche, the kaimakan, and the two kazcakars of Romelia and Natolia, joined the janizaries.

Turkey. zaries. A council was held in form, and it was propoſed as a preliminary, to requeſt the grand ſeignior to aboliſh the new diſcipline by a fettiva from the mufti. The grand ſeignior, however, thought he ſhould be able to put a ſtop to the inſurrection before the ſtep could be taken, in conſequence of his ſending the heads of Mahmud, Terſana Emin, Hagai Ibrahim, and the kiaga Mehmeſch Effendi, to the Eimeldan. This meaſure completely failed; the janizaries were more enraged than ever; they did not require the heads of the univerſally eſteemed Mahmud Effendi, but that of the Reis Effendi, then in the camp of the grand vizier.

The janizaries continued to ſearch every place for thoſe miniſters, who had promoted the adoption of the European diſcipline, and publicly avowed themſelves as its patrons, namely, Franſiſto, Ibrahim, Juſſuf Aga, Hadſchi Ibrahim, and Achmet Bey, captains of the grand ſeignior's guard, Haſſan Aga, Achmet Effendi, and others, 12 in number, who were all taken, dragged to the Eimeldan, and there cut to pieces. At this juncture the grand ſeignior ſent a hatti ſcheriff, a letter written in his own hand, in which he for ever aboliſhed the nizam geded, and pronounced an execration on it. But the hatti ſcheriff was not now accepted; the depoſition of the grand ſeignior was reſolved on. The whole force of the janizaries now proceeded to the ſeraglio. The mufti and the ullemas alone entered the haram, while the reſt of the miniſters, the agas, the janizaries, and the people, ſurrounded the palace.

Muſtapha IV. born on the 7th of September 1799, the eldeſt ſon of the ſultan Achmet IV. ſet aſide in 1789, was raiſed to the Turkiſh throne. And according to ancient cuſtom, Selim, the former ſultan, threw himſelf at the feet of Muſtapha, kiſſed the border of his garment, and immediately repaired to that department of the ſeraglio occupied by the princes of the Ottoman blood who no longer reign. The ſolemn invitation to Muſtapha, to aſcend the throne, was made on the 29th of May, and on the 3d of June the ceremony of inveſting him with the ſabre of the prophet, took place.

34 ulation Turkey. The population of the whole Turkiſh empire is uſually eſtimated at 18,000,000. Of theſe, 10,000,000 have been allotted to Aſiatic Turkey, and the remaining 8,000,000 to Turkey in Europe. A conſiderable part of this population conſiſts of Jews and mercantile Chriſtians, from different parts of Europe, who are diſtinguiſhed by the name of Franks.

35 vern- nt. The government of Turkey is deſpotic, but the power of the ſultan is by no means ſo abſolute as we are generally led to ſuppoſe. Beſides, being ſtrictly ſubject to the laws of the Koran, and thus to the national religion, ſuch obſtructions to his abſolute will are raiſed by the power of the muſti, or chief prieſt and judge, by the frequent inſurrections of the janizaries, and the ambition of the pachas, or governors of provinces, that many Chriſtian ſovereigns are much more deſpotic. The principal title of the ſultans is, as we have ſeen, grand ſeignior, and the court of Conſtantinople is uſually ſtyled the Porte, or Ottoman Porte, either from the large gate at the entrance of the ſeraglio, or, what is more probable, from the palace of the vizier, where all the affairs of ſtate are tranſacted. The principal miniſters of the Porte are the grand vizier or prime miniſter, the mufti, the reis effendi or chief ſecretary of ſtate, the kiſlar-aga or chief of the black eunuchs, and the aga of the janizaries. Turkey.

36 Revenues. The revenues of the whole Turkiſh empire are computed at about 7,000,000l. ſterling, while the uſual expence does not exceed 5,000,000l. This revenue is partly derived from the capitation tax on unbelievers and from the cuſtoms, but principally from the tax on land, amounting to about 6s. per acre. The ſultan is alſo ſuppoſed to poſſeſs a conſiderable private treaſure, but of this nothing certain is known.

37 Military ſtrength. The military ſtrength of Turkey is but inconſiderable for ſo large an empire. The whole of the land forces are ſuppoſed never to exceed 150,000 men, and theſe are ill diſciplined, and now diſpirited by ſucceſſive diſaſtrous wars. The navy is eſtimated at 30 ſail of the line; but the ſhips are ill built, badly manned, and wretchedly navigated. In ſhort, the military ſtrength of the Ottoman empire is not improperly ſaid to be more deſtructive to its own provinces than to any ſtate with which they are at war, and more terrible to its friends than its enemies.

38 Religion and laws. The eſtabliſhed religion of Turkey is Mahometaniſm, the tenets of which have been already explained under the articles MAHOMETANISM and ALCORAN. The laws of the empire are entirely founded on the Koran; but in particular caſes the judges are guided by certain commentaries on that work, which have acquired the force of laws. The chief of theſe are the commentaries of Abou-Hanife.

The mufti, or Mohammedan pontiff, reſides at Conſtantinople, but his power has ſeldom interfered with the civil government. Next to him in rank are the moulahs, who, though eſteemed dignitaries of the church, are in fact rather doctors of the law, while the Koran is alſo a code of civil obſervance. From the moulahs are ſelected the inferior muftis or judges throughout the empire, and the cadeleſquiers, or chief juſtices. The next claſs of divines includes the imaums, or pariſh prieſts, who perform the ſervice of the moſques, while the cadis are judges annually appointed to adminiſter juſtice in the towns and villages, and being regarded as churchmen, like the moulahs, have directed their chief attention to the judicial part of the Koran. From this brief view it will be obſerved, that the eccleſiaſtical orders of muftis and imaums ſomewhat reſemble the Chriſtian biſhops and parochial clergy; while the other diſtinctions ariſe from the ſingularity of both religion and laws being united in the Koran, ſo that a lawyer or judge muſt be at the ſame time a ſkilful divine. The Turks have alſo their monks, ſtyled derviſhes, of four various orders and inſtitutions, dedicated by ſolemn vows to religious offices, public prayer, and preaching. The Greeks, along with their faith, retain their prieſts, biſhops, archbiſhops, and patriarchs; but their church is in the laſt ſtate of degradation, and its dignities openly ſold by the Turks; this abomination, however, it muſt be confeſſed, partly ariſes from the miſerable ambition and avarice of the Greek eccleſiaſtics, who think they can atone by idle ceremonies for the neglect of all the invaluable morality of the goſpel.

39 Language and literature. The Turkiſh language is of far inferior reputation to the Perſian or Arabic, being a mixture of ſeveral dialects, and poſſeſſing neither the force, elegance, nor purity

Turkey. rity of these two celebrated oriental tongues. Literature, however, is not wholly neglected, and it has been repeatedly attempted to establish a printing-press at Constantinople; but the design failed from the interest of the copyists, who inferred that this art would deprive them of their bread. A late traveller informs us that there are in this capital several *kuttub-chans*, or public libraries, among which are those of St Sophia, and the Solimanie Jamasy; but none are so elegant as that founded by the grand vizier Raghid, which is wholly built of marble in the midst of a square court, and is filled with books chiefly theological. A librarian constantly attends, and there are convenient seats with carpets and cushions. In the neighbourhood is a school founded by the same vizier, in which about 100 boys are taught to read and write. The market for books is extensive, containing many shops well supplied with oriental manuscripts. The Turks have their ancient poets, historians, and divines; but of little reputation when compared with those of Persia and Arabia. The state of education among the Turks may be conceived to be very low, and ignorance is indeed a chief part of the national character. The only profession which requires a shadow of learning is that of the law, which is intimately connected with their theology. The celebrated doctors have disciples, who are trained up to that department; but there seems nothing that can deserve the name of college or university.

40 Of commerce.

The Turks cannot be regarded as a commercial people, though they admit of an extensive commercial intercourse with the states of Europe, through the medium of Frank and Greek merchants. The chief ports are Smyrna and Constantinople, the former of which is the great centre of the Levant trade, while the latter is concerned chiefly in the trade with Russia, by the Black sea. At both these ports, and indeed throughout the Turkish empire, the trade is nominally carried on by factors from the different European states; but it is managed more immediately by Jew or Armenian brokers, who take numerous advantages of the ignorance of the factors, and seldom fail to enrich themselves at the expence of their employers. The commodities exported from Turkey, chiefly to Britain, Germany, Italy, Holland, and France, consist for the most part of bees wax, boxwood, silk, cotton yarn, walnut planks, sponges, opium, and other drugs enumerated in N° 9. madder root, and other dye stuffs, and various dried fruits, such as figs, raisins, and currants. The imports are chiefly tin and tin plates, sugar, shalloons, cotton yarn and cotton goods, muslins, clocks and watches, cutlery and glass ware, indigo, gunpowder, pistols and military stores, logwood, rum, coffee, and various spices, especially pepper, ginger, and cinnamon. The exports are principally from Smyrna, where the trade is carried on almost entirely by way of exchange, while at Constantinople the imports are generally paid for by cash or bills. The exchange is commonly against the Turks.

The Turkish money usually employed in commerce is the piastre, which, according to the exchange or agio, is rated at from 13 to 17 in the English pound sterling, so that the average value of the piastre is about 1s. 6d. Each piastre is divided into 40 paras, and each para into three aspers. The principal weight employed is the kintal, equal to about one cwt. English, divided into 44 oke, and each oke into 400 drahen.

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From their jealousy with respect to strangers, it is extremely difficult to form a true estimate of the national character of the Turks. An intelligent writer, who seems well qualified to direct our judgment in this respect, has thus delineated the Turkish character. "The Turks are in general a sagacious, thinking people; in the pursuit of their own interest, or fortune, their attention is fixed on one object, and they persevere with great steadiness until they attain their purpose. They are in common life seemingly obliging and humane, not without appearances of gratitude: perhaps all or either of these, when extended towards Christians, are practised with a view of some advantage. Interest is their supreme good; where that becomes an object of competition, all attachment of friendship, all ties of consanguinity, are dissolved; they become desperate, no barrier can stop their pursuit, or abate their rancour towards their competitors. In their demeanour they are rather hypochondriac, grave, sedate, and passive; but when agitated by passion, furious, raging, ungovernable; big with dissimulation; jealous, suspicious, and vindictive beyond conception; perpetuating revenge from generation to generation. In matters of religion, tenacious, supercilious, and morose *".

Turkey. 41 Character of the Turks.

The manners and customs of the Turks are distinguished by the peculiarity of their religion from those of other European nations. On the birth of a child the father himself gives the name, putting at the same time a grain of salt into its mouth. The circumcision is not performed till the age of 12 or 14. Marriage is only a civil contract, which either party may break, and is managed by female mediation, the youth seldom seeing his bride till after the ceremony. The dead are perfumed with incense, and buried in a cloth, open at top and bottom, that the deceased may be able to sit up and answer the questions of the angels of death. The burial-grounds are near the highways, and stones are often placed at the heads of the graves, with carved turbans denoting the sex. As they never intrench upon a former grave, the cemeteries are very extensive. In diet the Turks are extremely moderate, and their meals are dispatched with great haste. Rice is the favourite food, and is dressed in three ways. In boiling, the meat is cut into small pieces, and in roasting still smaller, a bit of meat and an onion being placed alternately on a very long spit. The fish of the Archipelago are excellent, and the beef tolerable, except that of the buffalo, which is very hard. The hares, partridges, and other game, are of superior flavour. The meal is usually spread on a low wooden table, and the master of the house pronounces a short prayer. The frugal repast is followed by fruits and cold water, which are succeeded by hot coffee and pipes with tobacco. The houses of the Turks are seldom expensive; the chief furniture is the carpet which covers the floor, and a low sofa on one side of the room. In regard to dress, Tournefort observes that the use of the turban is unhealthy. The shirt is of callico, and the loose robe is fastened by a girdle, in which is stuck a dagger, while the tobacco box, pocket-book, &c. are worn in the bosom. The robe is generally of European broad cloth, trimmed with various furs. The shoes or slippers are slight, and unfit for much exercise. The dress of the women differs little from that of the men, the chief distinction being the head-dress; that of the fair sex consisting of a bonnet like

* *Potter's Observations on the Religion, Manners, &c. of the Turks*, vol. i. p. 4.

42 Manners and customs.

like an inverted basket, formed of pasteboard covered with cloth of gold, with a veil extending to the eyebrows, while a fine handkerchief conceals the under part of the face. The personal cleanliness of both sexes is highly laudable; but the European eye is not pleased with the female custom of staining the nails with a red tincture. The amusements of the Turks partake of their indolent apathy, if we except hunting, and those of a military description. To recline on an elegant carpet, or in a hot season by the side of a stream, and smoke the delicate tobacco of Syria, may be regarded as their chief amusement. Chess and draughts are favourite games; but those of chance are considered as incompatible with strict morals. The coffee-houses and baths furnish other sources of amusement; and the bairam, or festival which follows their long lent, is a season of universal dissipation *.

It appears to be a mistaken notion, that the practice of eating opium, to procure intoxication, is general among the Turks. We are assured by a late traveller, that this practice is confined to a few individuals, who are regarded by the majority of their countrymen with as much contempt as drunkards are in the more polished societies of Europe.

TURKEY. See MELEAGRIS, ORNITHOLOGY *Index*.

TURMERIC. See CURCUMA, BOTANY *Index*.

TURNEP, a species of BRASSICA. See BOTANY *Index*; and for the culture, see AGRICULTURE *Index*.

TURNEP-Bread. See BREAD.

TURNEP-Fly. See CHRYSOMELA, ENTOMOLOGY *Index*.

TURNING, the art of forming hard bodies, as wood, ivory, iron, into a round or oval shape, by means of a machine called a *lathe*.

This art was well known to the ancients, and seems to have been carried by them to a very great degree of perfection; at least, if we believe the testimony of Pliny and several other authors, who tell us, that those precious vases enriched with figures in *half-relief*, which still adorn our cabinets, were turned on the lathe.

The art of turning is of considerable importance, as it contributes essentially to the perfection of many other arts. The architect uses it for many ornaments, both within and without highly finished houses. The mathematician, the astronomer, and the natural philosopher, have recourse to it, not only to embellish their instruments, but also to give them the necessary dimension and precision. In short, it is an art absolutely necessary to the goldsmith, the watchmaker, the joiner, the smith.

Turning is performed by the lathe, of which there are various kinds, and several instruments, as gouges, chisels, drills, formers, screw tales, used for cutting what is to be turned into its proper form as the lathe turns round. The following is a simple kind of lathe (fig. 1.). in which *a* is the footstool, *b* the cord, *c* the frame of the lathe, *d d* the puppets, *e e* the points, *f* the spanging-tree.

The lathe should be fixed in a place very well lighted; it should be immoveable, and neither too high nor too low. The puppets should neither be so low as to oblige the workman to stoop in order to see his work properly, nor so high that the little chips, which he is continually driving off, should come into his eyes.

The piece to be turned should be rounded (if it be wood) before it be put on the lathe, either with a small hatchet made for the purpose, or with a plane, or with a file, fixing it in a vice, and shaving it down till it is everywhere almost of an equal thickness, and leaving it a little bigger than it is intended to be when finished off. Before putting it on the lathe, it is also necessary to find the centres of its two end surfaces, and that they should be exactly opposite to each other, that when the *points* of the puppets are applied to them, and the piece is turned round, no side may belly out more than another. To find these two centres, lay the piece of wood to be turned upon a plank; open a pair of compasses to almost half the thickness of the piece; fix one of the legs in the plank, and let the point of the other touch one of the ends of the piece, brought into the same plane with the plank on which the compasses is fixed and very near the fixed leg. Describe four arches on that end at equal distances from each other at the circumference of the end, but intersecting one another within; the point of intersection is the centre of the end. In the same manner must the centre in the other end be found. After finding the two centres, make a small hole at each of them, into which insert the points of the puppets, and fix the piece so firmly as not to be shaken out, and yet loose enough to turn round without difficulty.

The piece being thus fixed, it is necessary in the next place to adjust the cord, by making it pass twice round the piece, and in such a manner that the two ends of the cord, both that which is fixed to the *spang* and to the *foot-board*, come off on the side on which the turner stands, that the piece may move against the edge of the cutting-tool and be turned. If the lathe be moved by a wheel, the manner of adjusting the cord needs no directions.

If the workman does not choose to be at the trouble to find the two centres of the piece in the manner described above, let him lay, as nearly as he can, the centre of one end upon the *point* of the left hand *puppet*, and then let him push forward the right hand puppet, striking it with a mallet till its point is as near as he can in the centre of the other end of the piece; and then fixing the right hand puppet by a gentle blow of the mallet on the key, let him turn round the piece to see by the eye if the centres have been properly found. If any part of it bellies out, let him strike that part gently with the mallet till it goes properly; then let him strike one of the puppets pretty smartly to drive the points into the piece, and afterwards fix the puppet by striking the key. If the workman cannot judge by the eye whether the piece be turning properly round its centres or not, he should apply gently the point of an instrument called a *triangular graver*, leaning it on the *rest*, and it will mark by a line the place where the piece is out of its centre; and by striking upon this line with a mallet, the piece can easily be placed properly. The *rest*, of which we have just spoken, ought to be placed upon the two arms of the lathe, and fixed with screws as near the piece as the workman pleases.

The piece being fixed between the two points of the puppets (or, as they are called in Scotland, the *heads*), the cord adjusted, and the *rest* fixed as near the work as possible without touching it; the workman is now to take a *gouge* (fig. 2. in which *a* is the mouth and *b* the handle) of a proper size in his left hand, and hold it by the handle a little inclined, keeping the back of the hand

Turning. hand lowermoſt. With his right hand, the back of which is to be turned upwards, he is to graſp it as near the end as poſſible on this ſide of the *reſt*; then leaning the gouge on the *reſt*, he is to preſent the edge of it a little higher than the horizontal diameter of the piece, ſo as to form a kind of tangent to its circumference; then putting the right foot on the foot-board, and turning round the wheel, and holding the gouge firmly on the *reſt*, the piece will be cut neatly. In the ſame manner are the chiſels, formers, and other inſtruments to be uſed, taking care that the wood be cut equally, and that the inſtrument be not puſhed improperly, ſometimes ſtronger than at others; and taking care alſo that the inſtrument uſed do not follow the work, but that it be kept firmly in the hand without yielding.

The young turner ought to endeavour to acquire the management of the gouge and the chiſel, which are the inſtruments by far the moſt frequently uſed, and the moſt neceſſary in this art: by them, almoſt entirely, are the ſoft woods *turned*; but as for hard woods and other things, as box, ebony, horn, ivory, and the metals, they are hardly ever turned except by *ſhaving off*. In that caſe gravers are to be uſed with ſquare, round, or triangular mouths (fig. 3, 4, 5.). They ſhould be held horizontally while applied to the wood, and not obliquely as directed for the gouge and the chiſel.

Fig. 3, 4, and 5.

After the work is completely turned, it is next to be poliſhed; and this cannot be done with the inſtruments hitherto mentioned. Soft woods, as pear-tree, hazel, maple, ought to be poliſhed with ſhark-ſkin or Dutch ruſhes. There are different ſpecies of ſharks; ſome of which have a grayiſh, others a reddiſh ſkin. Shark-ſkin is always the better to be a good deal uſed; at firſt it is too rough for poliſhing. The *Dutch-ruſh* (*equiſetum hyemale*), which grows in moiſt places among mountains, and is a native of Scotland. The oldeſt plants are the beſt. Before uſing them they ſhould be moiſtened a little, otherwiſe they break in pieces almoſt immediately, and render it exceedingly difficult to poliſh with them. They are particularly proper for ſmoothing the hard woods, as box, lignum vitæ, ebony, &c. After having cleaned up the piece well, it ſhould be rubbed gently either with wax or olive-oil, then wiped clean and rubbed with its own raſpings or with a cloth a little worn. Ivory, horn, ſilver, and braſs, are poliſhed with pumice-ſtone finely pounded and put upon leather or a linen cloth a little moiſtened: with this the piece is rubbed as it turns round in the lathe; and to prevent any dirt from adhering to any part of it, every now and then it is rubbed gently with a ſmall bruſh dipt in water. To poliſh very finely, the workmen make uſe of tripoli, a particular kind of earth, and afterwards of putty or calx of tin. Iron and ſteel are poliſhed with very fine powder of emery; this is mixed with oil, and put between two pieces of very tender wood, and then the iron is rubbed with it. Tin and ſilver are poliſhed with a burniſher and that kind of red ſtone called in France *ſanguine dune*. They may be poliſhed alſo with putty, putting it dry into ſhamoy-ſkin, or with the palm of the hand.

To ſucceed in turning iron, it is neceſſary to have a *lathe* exceedingly ſtrong in all its parts, and exceedingly well fixed. The puppets ſhould be ſhort, and the *reſt* well fixed very near the work: the back of the *reſt* ſhould be two or three lines lower than the iron to be turned. Turni

The lathe and other inſtruments being prepared, it is neceſſary to determine the length and thickneſs of the iron to be turned according to the deſign which is to be executed, and to make a model of it in wood a little thicker than it ought to be: Then one exactly like this is to be forged of the beſt iron that can be procured; that is to ſay, it muſt not be new, but well prepared and well beaten with hammers; it muſt have no flaws, nor cracks, nor pimples. New iron, which has not been well beaten, often contains round drops of caſt iron, called by the workmen *grains*, which blunt the edges of the gouges, chiſels, and other inſtruments uſed for cutting, break them, or make them ſlide. The iron being forged according to the model, it ſhould be annealed, that is, heated red hot and allowed to cool ſlowly on the coals till the fire go out of itſelf. Some people, to ſoften the iron, cover it over with clay and allow it to cool. The iron cylinder being thus made, it is next to be put upon the lathe, finding the centres as formerly directed, and boring a ſmall hole in them that the iron may not eſcape from the points.

The points ſhould be oiled from time to time to prevent their being exceſſively heated and ſpoiled while the iron is turning. A *crotchet* is then to be applied to the iron to be turned, a little above its centre, pretty gently, and by this means the inequalities of the cylinder will be taken off. Other inſtruments are then to be applied to mould the iron according to the model; and whenever any of them grow hot, they are to be plunged into a baſon of water lying beſide the workman. If the iron, after being properly turned, is to be bored like a gun-barrel, one of the puppets is to be removed and another ſubſtituted in its place, having a ſquare hole through it, into which the collar of the iron is to be fixed firmly, ſo as not to ſhake; then borers are to be applied, like thoſe which lockſmiths uſe to bore keys; and beginning with a ſmall one, and afterwards taking larger ones, the hole is to be made as wide and deep as neceſſary; great care muſt be taken to hold the borers firm on the *reſt*, otherwiſe there is danger of not boring the hole ſtraight. The borer muſt be withdrawn from time to time to oil it and to clean the hole. Since it is difficult to make a hole quite round with borers alone, it is neceſſary to have alſo an inſtrument a good deal ſmaller than the hole, one of the ſides of which is ſharp, very well tempered, and a little hollow in the middle. This inſtrument being fixed in a pretty long handle, is to be applied with ſteadineſs to the inner ſurface of the hole, and it will entirely remove every inequality that may have been there before its application.

To cut a ſcrew upon the cylinder, ſome perſons uſe an inſtrument conſiſting principally of a female ſcrew; but this is rather an improper inſtrument; for if one preſſes too violently, or inclines it ever ſo little to the right or left, he runs the greateſt riſk of ſpoiling the ſcrew. To avoid this danger, ſome uſe it only to trace out the lines of the ſcrew, and afterwards finiſh it with a file. But the following is a much better way. Take a tap for making a female ſcrew, the threads of which have been cut very accurately, and exactly of the ſize of the ſcrew which you want; and having put it in the opening which you have traced in the collar of the

axis

Fig. 1.

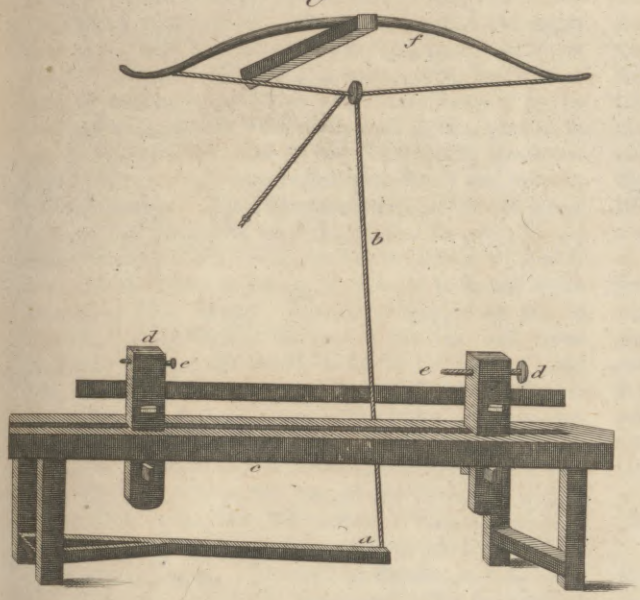


Fig. 2. Fig. 3. Fig. 4. Fig. 5.

VARIATION of the Compass.

Fig. 1.

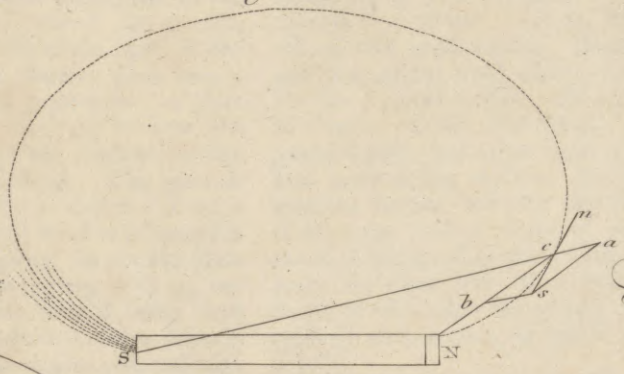


Fig. 3.

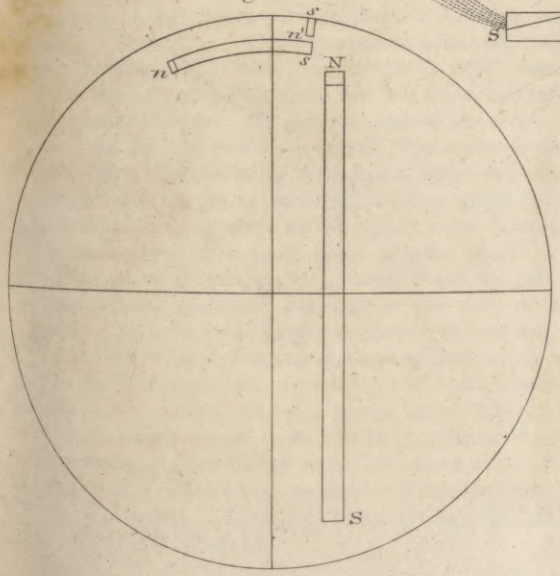
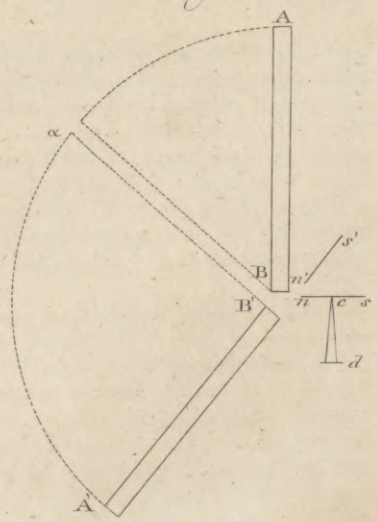


Fig. 2.



W. Frain Sculpt.

Turning. axis on which the ſcrew is to be cut, ſolder it with tin, ſal-ammoniac, and roſin, as exactly correſponding to the axis as poſſible. Take then a puppet with a hole cut into a correſponding female ſcrew, into which the male ſcrew is to be put. The axis on which the ſcrew is to be cut muſt be placed exactly horizontally between the two puppets. The *reſt* is then to be brought as near as poſſible to the place where the ſcrew is to be cut, and a ſmall hollow ſhould be cut in that part of it which is exactly oppoſite to the place where the ſcrew is to be cut, to hold your inſtrument firmly and prevent it from ſhaking. The inſtrument with which the ſcrew is to be cut ſhould be very ſharp, and its point ſhould make an angle of 60° with the ſcrew to be cut; and if you wiſh the ſcrew to be cut very deep, it ſhould make an angle a little larger. The lathe being now put in motion, the tap fixed at the end of the axis will move gradually through the female ſcrew in the puppet; and your inſtrument in the mean time will trace a ſimilar male ſcrew on the axis fixed in the lathe. Many perſons, after having in this manner drawn the outlines of the ſcrew, finiſh it with a ſcrew-tale of three teeth correſponding exactly to the ſize of the ſcrew, or with a triangular file; but this laſt method is rather improper.

For turning ovals, a lathe of ſomewhat a different conſtruction is uſed. The axis or ſpindle, having on it the pulley over which the band-cord paſſes for turning the lathe, is fixed between the two puppets ſo as to turn round eaſily: one end of it paſſes through one of the puppets, and to it is firmly fixed a circular plate of braſs, ſo that it turns round along with the ſpindle. Upon this plate two brazen ſegments of circles are faſtened, the circumferences of which correſpond to the circumference of the plate: their chords are parallel, and equally diſtant from the centre of the plate, ſo that they leave a diſtance between them. They have a groove in each of them: in theſe grooves another plate is placed which exactly fills up the ſpace between the two grooves, but is ſhorter than the diameter of the large circular plate on which it is laid. This plate is made to ſlide in the grooves. To its centre is fixed a ſhort ſpindle, on which the piece of wood to be turned is fixed. When the lathe is ſet a going, the circular plate moves round, and carries the piece along with it; the plate of braſs on which the piece is fixed being fixed looſely in the grooves already deſcribed, ſlides down a little every time that the grooves become perpendicular to the floor (and there are particular contrivances to prevent it from ſliding down too far); and by theſe two motions combined, the circular one of the large plate, and the ſtraight one of the ſmall, the circumference of the piece of wood to be turned neceſſarily deſcribes an oval; and gouges or other tools being applied in the uſual manner ſupported on the *reſt*, it is cut into an oval accordingly. The ſmall plate may be made to ſlide either more or leſs in the grooves; and by this contrivance the tranſverſe diameter of the oval, or rather ellipſe, may be made longer or ſhorter at pleaſure.

1. *The method of moulding boxes of ſhell and horn.*—In the firſt place, form a proper mould, which muſt conſiſt of two pieces, viz. of a circle about half an inch thick, which ſhould ſlope a little in order to draw out the moulded ſhell the more eaſily; and a ring fitted to the outſide of the circle, ſo that both together make the ſhape of a box. Theſe two pieces being adjuſted, it is neceſſary to round the ſhell to be moulded of ſuch a ſize Turning. that when moulded, it will be a little higher than the ring of the mould, that there may be no deficiency. The mould is then to be put into a preſs on a plate of iron, exactly under the ſcrew of the preſs; put then the ſhell upon the circle of the mould, ſo that its centre alſo is exactly oppoſite to the ſcrew of the preſs: then take a piece of wood formed into a truncated cone, and not ſo thick as the diameter of the circle of the mould, nor ſo deep as the ring: then put a plate of iron above the cone, and ſcrew down the preſs gently and cautiouſly till the whole is well fixed: then plunge the whole into a cauldron of boiling water placed above a fire. In 8 or 10 minutes the ſhell or horn will begin to ſoften; ſcrew the preſs a little firmer that the wooden cone may ſink into the ſoftened ſhell: repeat this from time to time till the cone is quite ſunk in the mould; then take out the preſs and plunge it into cold water. When it is cold, take the box now formed out of the mould, and put into the inſide of it a new mould of tin exactly of the form you wiſh the inſide of the box to be; do the ſame with the outſide, put it again into the preſs and plunge it into boiling water; ſcrew the preſs gradually till the box receive the deſired form.

2. *Method of preparing green wood ſo that it will not ſplit in the turning.*—Cut the wood into pieces of a proper ſize, put them into a veſſel full of potaſh ley. Boil them about an hour; take the cauldron from the fire, allow the ley to cool; and take out the wood and dry it in the ſhade.

3. *Method of giving an ebony-black to hard and fine woods.*—After forming the wood into the deſtined figure, rub it with aquafortis a little diluted. Small threads of wood will riſe in the drying, which you will rub off with pumice-ſtone. Repeat this proceſs again, and then rub the wood with the following compoſition: Put into a glazed earthen veſſel a pint of ſtrong vinegar, two ounces of fine iron-filings, and half a pound of pounded galls, and allow them to infuſe for three or four hours on hot cinders. At the end of this time augment the fire, and pour into the veſſel four ounces of copperas, and a chopin of water having half an ounce of borax and as much indigo diſſolved in it; and make the whole boil till a froth riſes. Rub ſeveral layers of this upon the wood; and when it is dry, poliſh it with leather, on which you have put a little tripoli.

3. *Method of giving to plum-tree the colour of brazil wood.*—Slake lime with urine, and bedaub the wood over with it while it is hot: allow it to dry; then take off the coat of lime, and rub it with ſhamoy ſkin well oiled. Or, ſteep the wood in water, having a quantity of alum diſſolved in it: then, having allowed brazil wood to diſſolve in water five or ſix hours, ſteep the wood in it, kept lukewarm during a night; and when it is dry, rub it, as before directed, with ſhamoy ſkin well oiled.

5. *Method of giving a fine black colour to wood.*—Steep the wood for two or three days in lukewarm water in which a little alum has been diſſolved; then put a handful of logwood, cut ſmall, into a pint of water, and boil it down to leſs than half a pint. If you then add a little indigo, the colour will be more beautiful. Spread a layer of this liquor quite hot on the wood with a pencil, which will give it a violet colour.

Turning, Turnſtone.

When it is dry, ſpread on another layer; dry it again and give it a third: then boil verdegriſe at diſcretion in its own vinegar, and ſpread a layer of it on the wood: when it is dry, rub it with a bruſh, and then with oiled ſhamoy ſkin. This gives a fine black, and imitates perfectly the colour of ebony.

6. *Method of cleaning and whitening bones before uſing them.*—Having taken off with a ſaw the uſeleſs ends of the bones, make a ſtrong ley of aſhes and quicklime, and into a pailful of this ley put four ounces of alum, and boil the bones in it for an hour; then take the veſſel containing the ley off the fire, and let it cool; then take out the bones and dry them in the ſhade.

7. *Method of ſoldering ſhells.*—Clean the two ſides of the ſhells which you wiſh to join together; then, having joined them, wrap them up in linen folded double and well moiſtened; then heat two plates of iron pretty hot that they may keep their heat for ſome time; and putting the ſhells rolled up between them under a preſs, which you muſt ſcrew very tight, leave them there till the whole is cold, and they will be ſoldered. If you do not ſucceed the firſt time, repeat the proceſs.

8. *Method of moulding ſhells.*—Put ſix pints of water into a kettle; add to it an ounce of olive or other oil; make the water boil; then put in your ſhell, and it will grow ſoft. Take it out and put it into a mould under a preſs, and it will take the figure you want. This muſt be done quickly; for if the ſhell cool ever ſo little, the proceſs will fail. It will not require much preſſure.

9. *Method of tinging bones and ivory red.*—Boil ſhavings of ſcarlet in water. When it begins to boil, throw in a quarter of a pound of aſhes made from the dregs of wine, which will extract the colour: then throw in a little rock alum to clear it, and paſs the water through a linen cloth. Steep the ivory or bone in aquafortis, and put it into the water. If you wiſh to leave white ſpots, cover the places deſtined for them with wax.

10. *To tinge ivory black.*—Steep the ivory during five or ſix days in water of galls with aſhes made with dried dregs of wine and arſenic; then give it two or three layers of the ſame black with which plum-tree is blackened, in order to imitate ebony. Or, diſſolve ſilver in aquafortis, and put into it a little roſe-water. Rub the ivory with this, and allow it to dry in the ſun.

11. *Method of hardening wood to make pulleys.*—After finiſhing the pulley, boil it ſeven or eight minutes in olive oil, and it will become as hard as copper.

12. *To make Chineſe varniſh.*—Take of gum lac in grains four ounces; put it into a ſtrong bottle with a pound of good ſpirit of wine, and add about the bulk of a hazel nut of camphor. Allow them to mix in ſummer in the ſun, or in winter on hot embers for 24 hours, ſhaking the bottle from time to time. Paſs the whole through a fine cloth, and throw away what remains upon it. Then let it ſettle for 24 hours, and you will find a clear part in the upper part of the bottle, which you muſt ſeparate gently, and put into another vial, and the remains will ſerve for the firſt layers.

TURNSTONE. See TRINGA, ORNITHOLOGY *Index.*

TURPENTINE, a tranſparent viſcous ſubſtance, flowing either naturally or by inciſion from ſeveral reſinous trees; as the terebinthus, pine, larch, fir, &c. See PINUS, BOTANY *Index.* See alſo CHEMISTRY and MATERIA MEDICA *Index.* Turpentine || Tuſcan

Oil of TURPENTINE. See CHEMISTRY and MATERIA MEDICA *Index.*

TURPETH, the cortical part of the root of a ſpecies of convolvulus. See MATERIA MEDICA *Index.*

TURQUOISE, is the tooth of an animal penetrated with copper ore.

TURRITIS, TOWER-MUSTARD; a genus of plants belonging to the claſs tetradynamia; and in the natural ſyſtem ranging under the 39th order, *Siliquoſæ.* See BOTANY *Index.*

TURTLE. See TESTUDO, ERPETOLOGY *Index.*

TURTLE-Dove. See COLUMBA, ORNITHOLOGY *Index.*

TUSCAN ORDER, in *Architecture.* See ARCHITECTURE, N° 42.

TUSCAN Earth, a yellowiſh kind of bole found in many parts of Italy, and particularly about Florence, where there is a ſtratum eight or ten feet thick, at the depth of five or ſix feet from the ſurface. It is ſuppoſed to have an aſtringent property.

TUSCANY, a duchy of Italy, which makes part of the ancient Hetruria, and, excepting ſome detached parts, is encompaſſed by a part of the Mediterranean, called here the *Tuſcan ſea;* the eccleſiaſtical ſtate; the duchy of Modena; and the republic of Lucca; its extent from north to ſouth being about 116 Engliſh miles, and from eaſt to weſt about 80.

Though ſome parts of it are mountainous, yet both the hills and dales are covered with vines, olives, citron, lemon, and orange trees, &c. The mountains yield alſo copper, iron, alum, &c. and ſome of the fineſt marble. Here is alſo plenty of corn, rice, ſaffron, honey, wax, wool, flax, hemp, with mineral waters, rich paſture, ſalt-pits, ſulphur, alabaſter, calcedony, lapis lazuli, borax, amethyſts, carnelians, jaſpers, cryſtals and black ſlate. In ſome places the elms and aſhes yield manna.

The principal river in Tuſcany is the Arno, which has its ſource in the Apennine mountains, and falls into the ſea below Piſa. There are ſome other ſmaller rivers.

This duchy fell under the dominion of the Romans about 455 years before Chriſt. The Oſtrogoths poſſeſſed themſelves of it in the fifth century, and after them the Lombards, who were expelled by Charlemagne anno 800; in conſequence of which it became ſubject to the German emperors, who appointed governors over it. At laſt the cities of Florence, Piſa, Sienna, and ſome others, during the contentions between the pope and the emperor, and their reſpective adherents, the Guelphs and Gibbelines, withdrew themſelves from the dominion of both, and erected themſelves into ſeparate commonwealths. In that of Florence, John de Medicis, a popular nobleman, ſo inſinuated himſelf into the favour of his countrymen, that they inveſted him with ſovereign power. Pope Pius V. conferred the title of *grand duke* on Coſmo de Medicis anno 1570, in whoſe family the duchy continued until the death of Gaſton de Medicis, who died anno 1737. The duchy was then transferred to the duke of Lorrain, afterwards the emperor

Tuscany || Tympan.

peror Francis I. in lieu of the duchy of Lorrain, which, by the peace of 1736, was given to King Staniſlaus during his life, and then was to be annexed to France. Leopold, the ſecond ſon of Francis I. and afterwards emperor of Germany, ſucceeded to this duchy. It is now enjoyed by Leopold's ſecond ſon, brother to the preſent emperor of Germany, Francis II. The grand duke's annual revenues are computed at about 500,000l. ſterling, ariſing chiefly from the tenths of all eſtates that are ſold or alienated, and the ground rents of the houſes in Leghorn, and the duties on almoſt all manner of proviſions. Tuſcany now forms part of the kingdom of Italy ſubject to France.

TUSK, or TORSK. See GADUS, ICHTHYOLOGY *Index*.

TUSSILAGO, COLT'S-FOOT; a genus of plants, belonging to the claſs of ſyngeneſia; and in the natural ſyſtem ranging under the 49th order, *Compoſitæ*. See BOTANY *Index*.

TUTENAG, an alloy of zinc. See CHEMISTRY *Index*.

TUTOR, in the civil law, is one choſen to look to the perſons and eſtates of children left by their fathers and mothers in their minority. The different kinds of *tutory* eſtabliſhed among the Romans, and the powers and duties of tutors, are deſcribed in *Inſt. leg.* 1. tom. xiii. ſect. 1. and 2. to which the reader is referred. See alſo the article GUARDIAN.—For the nature and effects of tutory in the Scotch law, which is founded on that of the Romans. See *Scots LAW*, Part III. Sect. 7.

TUTOR is alſo uſed in the Engliſh univerſities for a member of ſome college or hall, who takes on him the inſtruction of young ſtudents in the arts and faculties.

TUTTY, an impure ore of zinc, employed as an unguent and abſorbent. See MATERIA MEDICA *Index*.

TWEED, a river of Scotland, which riſes on the confines of Clydeſdale, and running eaſtward through Tweedale, and dividing the ſhire of Merſe from Teviotdale and Northumberland, falls into the German ſea at Berwick. It abounds with ſalmon. See BERWICK.

TWEEDALE, or PEEBLES, a county in the ſouth of Scotland. See PEEBLES-SHIRE,

TWELFTH-DAY, the feſtival of the Epiphany, or the manifeſtation of Chriſt to the Gentiles; ſo called, as being the twelfth day, excluſive, from the nativity or Chriſtmas-day.

TWILIGHT, that light, whether in the morning before ſunriſe, or in the evening after ſunſet, ſuppoſed to begin and end when the leaſt ſtars that can be ſeen by the naked eye ceaſe or begin to appear.

TWINKLING *of the STARS*. See OPTICS, N° 21.

TWINS, two young ones delivered at a birth, by an animal which ordinarily brings forth but one.

TWITE. See FRINGILLA, ORNITHOLOGY *Index*.

TYGER, or TIGER. See FELIS, MAMMALIA *Index*.

TYLE, or TILE, in building, a thin laminated brick uſed on the roofs of houſes.

TYMPAN, among printers, a double frame belonging to the preſs, covered with parchment, on which the blank ſheets are laid in order to be printed off. See *PRINTING-Preſs*.

TYMPANUM, in *Mechanics*, a kind of wheel placed round an axis or cylindrical beam, on the top of which are two levers or fixed ſtaves for the more eaſily turning the axis in order to raiſe a weight required. Tympanum || Type.

TYMPANUM, in *Anatomy*. See ANATOMY, N° 141.

TYMPANY, or TYMPANITES, in *Medicine*. See MEDICINE, N° 337, and SURGERY *Index*.

TYNDALE, WILLIAM, a zealous Engliſh reformer, and memorable for having made the firſt Engliſh verſion of the Bible, was born on the borders of Wales ſome time before 1500. He was of Magdalene-hall in Oxford, where he diſtinguiſhed himſelf by imbibing early the doctrines of Luther, and by as zealouſly propagating them. Afterwards he removed to Cambridge, and from thence went to live with a gentleman in Glouceſterſhire in the capacity of tutor to his children.—While he continued there, he ſhowed himſelf ſo furious for Luther, and ſo inveterate to the pope, that he was forced, merely for the ſecurity of his perſon, to leave the place. He next endeavoured to get into the ſervice of Tonſtall biſhop of Durham, but did not ſucceed. His zeal for Lutheraniſm made him deſirous to tranſlate the New Teſtament into Engliſh; and as this could not ſafely be done in England, he went into Germany, where, ſetting about the work, he finiſhed it in 1527. He then began with the Old Teſtament, and finiſhed the five books of Moſes, prefixing diſcourſes to each book, as he had done to thoſe of the New Teſtament. At his firſt going over into Germany, he went into Saxony, and had much conference with Luther; and then returning to the Netherlands, made his abode chiefly at Antwerp. During his peregrinations from one country to another, he ſuffered ſhipwreck upon the coaſt of Holland, and loſt all his books and papers. His tranſlations of the Scriptures being in the mean time ſent to England, made a great noiſe there; and, in the opinion of the clergy, did ſo much miſchief, that a royal proclamation was iſſued, prohibiting the buying or reading them. But the clergy were not ſatisfied with this, they knew Tyndale capable of doing infinite harm, and therefore thought of nothing leſs than removing him out of the way. For this purpoſe one Philips was ſent over to Antwerp, who inſinuated himſelf into his company, and under the pretext of friendſhip betrayed him into cuſtody. He was ſent to the caſtle of Filford, about 18 miles from Antwerp; and though the Engliſh merchants at Antwerp did what they could to procure his releaſe, and letters were alſo ſent from Lord Cromwell and others out of England, yet Philips beſtirred himſelf ſo heartily, that he was tried and condemned to die. He was firſt ſtrangled by the hands of the common hangman, and then burned near Filford caſtle, in 1536. While he was tying to the ſtake, he cried with a fervent and loud voice, "Lord, open the king of England's eyes."

TYPE (*τυπος*), an impreſſion, image, or repreſentation of ſome model, which is termed the *antitype*. In this ſenſe the word occurs often in the writings of divines, who employ it to denote that prefiguration of the great events of man's redemption which they have found or fancied in the principal tranſactions recorded in the Old Teſtament.

TYPE, among letter-founders and printers, the ſame with letter.

Type ‖ Tyre.

TYPE is also used to denote the order observed in the intension and remission of fevers, pulses, &c.

TYPHA, CAT'S-TAIL; a genus of plants belonging to the class of moncœcia, and in the natural system ranging under the 3d order, *Calamariæ*. See BOTANY *Index*.

TYPHON. See WHIRLWIND.

TYPHON, the devil of the ancient Egyptians. See POLYTHEISM, N° 29.

TYPOGRAPHY, the art of printing. See PRINTING.

TYRANT, among the ancients, denoted simply a king or monarch; but the ill use which several persons invested with that sacred character made of it, has altered the import of the word; and tyrant now conveys the idea of an unjust or cruel prince, who rules in a more despotic manner than the laws allow.

TYRE, formerly a celebrated city of Asia, on the coast of Syria, situated under the 54th degree of east longitude, and 32d of north latitude. It was built, according to some writers, 2760 years before the Christian era. There were two cities of that name; the one called *Palætyrus*, situated on the continent; and the other the city of *Tyre*, built on an island about half a mile from the shore. It was about 19 miles in circumference, including Palætyrus; the town on the island was about four miles round. The buildings of Tyre were very magnificent; the walls were 150 feet high, and broad in proportion. This city was at one period the most famous commercial city in the world. Of its commercial transactions, the most particular account that is to be found in any ancient writer has been given by the prophet Ezekiel, which at the same time conveys a magnificent idea of the extensive power of that state. It resisted Nebuchadnezzar king of Babylon for 13 years; at the end of which, wearied with fruitless efforts, the inhabitants resolved to place the sea between them and their enemy, and passed accordingly into the island. The new city stood out against Alexander the Great for seven months; and before he could take it, he was obliged to fill up the strait which separated the island from the continent. It was repaired afterwards by Adrian, and became the metropolis of the province. It afterwards fell into the hands of the Arabs; and after being taken by Baldwin II. king of Jerusalem, it was destroyed by the sultan of Egypt in 1289, and abandoned. An excellent account of its modern state may be found in Volney's Travels, vol. ii. It now consists of a small village, composed of fishermen's huts, and containing about 50 or 60 poor families.

Tyre ‖ Tyrone.

TYRIAN DYE. See MUREX, CONCHOLOGY *Index*.

TYRONE, a county of Ireland, in the province of Ulster, 46 miles in length and 37 in breadth; bounded on the north by Londonderry, on the east by Armagh and Lough-Neagh, on the south by Fermanagh, and on the west by Donnegal. It is a rough and rugged country, but tolerably fruitful; contains 12,683 houses, 30 parishes, 4 baronies, 4 boroughs, and formerly sent 10 members to the Irish parliament. The principal town is Dungannon.

U, V.

U.

U, or u, the 20th letter and 5th vowel of our alphabet, is formed in the voice by a round configuration of the lips, and a greater extrusion of the under one than in forming the letter o, and the tongue is also more cannulated. The sound is short in *curst*, *must*, *tun*, *tub*; but is lengthened by a final *e*, as in *tune*, *tube*, &c. In some words it is rather acute than long; as in *brute*, *flute*, *lute*, &c. It is mostly long in polysyllables; as in *union*, *curious*, &c.; but in some words it is obscure, as in *nature*, *venture*, &c. This letter in the form of V or v, is properly a consonant, and as such is placed before all the vowels; as in *vacant*, *venal*, *vibrate*, &c. Though the letters v and u had always two sounds, they had only the form v till the beginning of the fourth century, when the other form was introduced, the inconvenience of expressing two different sounds by the same letter having been observed long before. In numerals V stands for five; and with a dash added at top, thus $\bar{V}$, it signifies 5000.

In abbreviations, amongst the Romans, V. A. stood for *veterani assignati*; V. B. *viro bono*; V. B. A. *viri boni arbitratu*; V. B. F. *vir bonæ fidei*; V. C. *vir consularis*; V. C. C. F. *vale, conjux charissime, feliciter*; V. D. D. *voto dedicatur*; V. G. *verbi gratia*; Vir. Ve. *virgo vestalis*; V. L. *videlicet*; V. N. *quinto nonarum*.

VACCINIUM, the WHORTLE-BERRY, or *Bilberry*, a genus of plants belonging to the class octandria, and arranged in the natural system under the 18th order, *Bicornes*. See BOTANY *Index*.

Vaccinium ‖ Vadium.

VACUUM, in *Philosophy*, denotes a space devoid of all matter or body.

It has been greatly disputed whether there be in nature a perfect vacuum, or space void of all matter; but if bodies consist of material solid atoms, it is evident that there must be vacuities, or motion would be impossible (See METAPHYSICS, N° 193.). We can even produce something very near a vacuum in the receiver of an air-pump and in the Torricellian tube (see PNEUMATICS, *passim*).

VADIUM, a pledge in law, is either *vivum* or *mortuum*.

VADIUM Vivum, or *Living Pledge*, is when a man borrows a sum (suppose 200l.) of another; and grants him an estate, as of 20l. per annum, to hold till the rents and profits shall repay the sum so borrowed. This is an estate conditioned to be void as soon as such sum is raised. And in this case the land or pledge is said to be living: it subsists, and survives the debts; and, immediately on the discharge of that, reverts to the borrower.

dium || alais.

VADIUM Mortuum, or *Dead Pledge*. See MORTGAGE.

VAGABOND, or VAGRANT, one who wanders illegally, without a ſettled habitation. Such perſons are cognizable by the laws. See IDLENESS.

VAGINA, properly ſignifies a ſheath or ſcabbard; and the term *vagina* is uſed in architecture for the part of a terminus, becauſe reſembling a ſheath out of which the ſtatue ſeems to iſſue.

VAGINA. See ANATOMY *Index*.

VAILLANT, JOHN FOY, a phyſician and great medalift, to whom, according to Voltaire, France was indebted for the ſcience of medals, and Louis XIV. for one half of his cabinet, was born at Beauvais in 1632. Through the means of the miniſter Colbert he travelled into Italy, Greece, Egypt, and Perſia, to collect medals for the royal cabinet; and returned with ſo many as made the king's cabinet ſuperior to any in Europe. In one of his voyages the ſhip was taken by an Algerine corſair. After a captivity of near five months he was permitted to return to France, and received at the ſame time 20 gold medals which had been taken from him. He embarked in a veſſel bound for Marſeilles, and was carried on with a favourable wind for two days, when another corſair appeared, which, in ſpite of all the ſail they could make, bore down upon them within the reach of cannon ſhot. Mr Vaillant, dreading the miſeries of a freſh ſlavery, reſolved, however, to ſecure the medals which he had received at Algiers, and therefore ſwallowed them. But a ſudden turn of the wind freed them from this adverſary, and caſt them upon the coaſt of Catalonia, where, after expecting to run aground every moment, they at length fell among the ſands at the mouth of the Rhone. Mr Vaillant got to ſhore in a ſkiff, but felt himſelf extremely incommoded with the medals he had ſwallowed, which might weigh altogether five or ſix ounces, and therefore did not paſs like Scarborough waters. He had recourſe to a couple of phyſicians; who were a little puzzled with the ſingularity of his caſe; however, nature relieved him from time to time, and he found himſelf in poſſeſſion of the greateſt part of his treaſure when he got to Lyons. Among his collection was an Otho, valuable for its rarity.—He was much careſſed on his return; and when Louis XIV. gave a new form to the academy of inſcriptions in 1701, Mr Vaillant was firſt made aſſociate, and then penſionary. He wrote ſeveral works relating to ancient coins, and died in 1706.

VAIR, or VAIRE, a kind of fur, formerly uſed for lining the garments of great men and knights of renown. It is repreſented in engraving by the figures of little bells reverſed, ranged in a line. See HERALDRY, Chap. II. Sect. 2.

VAIRY, in *Heraldry*, expreſſes a coat, or the bearings of a coat, when charged or chequered with vairs.

VALAIS, a valley in Swiſſerland, which extends from the ſource of the river Rhone to the lake of Geneva. It is near 100 miles in length, but of unequal breadth. It is bounded on the north by the Alps, which ſeparate it from the cantons of Berne and Uri, on the eaſt by the mountains of Forche, on the ſouth by the duchy of Milan and the Val d'Aoſte, and on the weſt by Savoy and the republic of Geneva. The inhabitants profeſs the Roman Catholic religion, and are ſubject to the ſwelling of the throat called *bronchocele*; and idiots are ſaid to abound among them more than in any other place of the globe. They are naturally hardy, enterpriſing, and good-natured. Valais is ſurrounded on all ſides by very high mountains, moſt of which are covered with perpetual ſnow. The ſoil is fertile in corn, wine, and fruits. The muſcat-wine, which is produced here is excellent, and well known all over Europe. This country comprehends 55 large pariſhes, with one biſhop. The religion is the Roman Catholic.

Valais || Valentinian.

VALANTIA, a genus of plants belonging to the claſs polygamia, and in the natural ſyſtem arranged under the 41ſt order, *Aſperifoliæ*. See BOTANY *Index*.

VALENCIA, a province of Spain, which has the title of a kingdom; and is bounded on the eaſt and ſouth by the Mediterranean ſea, on the north by Catalonia and Arragon, and on the weſt by New Caſtile and the kingdom of Murcia. It is about 165 miles in length, and 63 in breadth. It is one of the moſt populous and agreeable parts of Spain, enjoying almoſt a perpetual ſpring. The great number of rivers wherewith it is watered renders it extremely fertile, particularly in fruits and wine. There are very rugged mountains in it, which contain mines of alum and other minerals.

VALENCIA, a city of Spain, and capital of the kingdom of the ſame name. It contains about 12,000 houſes, beſides thoſe of the ſuburbs and the ſummer-houſes round it. It has an univerſity, and an archbiſhop's ſee; and was taken from the Moors by the Chriſtians in the 13th century. The town is handſome, and adorned with very fine ſtructures. It is not very ſtrong, though there are ſome baſtions along the ſides of the walls. They have manufactures in wool and ſilk, which bring in great ſums to the inhabitants. It is ſeated on the river Guadalaviar, over which there are five handſome bridges; and it is about three miles from the ſea, where there is a harbour, 110 miles north of Murcia, and 165 eaſt by ſouth of Madrid. This city ſurrendered to the earl of Peterborough in the year 1705; but it was loſt again in 1707. W. Long. 0. 10. N. Lat. 39. 27.

VALENCIENNES, an ancient, ſtrong, and conſiderable city of France, in the department of the North and late province of Hainault, containing about 20,000 ſouls. The Scheldt divides it into two parts. It is a very important place: the citadel and fortifications, the work of Vauban, were conſtructed by order of Louis XIV. who took this town from the Spaniards. It was confirmed to him by the treaty of Nimeguen, in 1678. In 1793, it ſurrendered to the allies after a ſevere ſiege, but was afterwards abandoned; and is now in poſſeſſion of the French. Beſides lace, this city is noted for manufactories of woollen ſtuffs and very fine linens. It is 20 miles weſt-ſouth-weſt of Mons, 17 north-eaſt of Cambray, and 120 north-eaſt by north of Paris. E. Long. 3. 37. N. Lat. 50. 21.

VALENS, FLAVIUS, emperor of the Eaſt, a great patron of the Arians. Killed by the Goths in the year 379. See CONSTANTINOPLE, N° 76.

VALENTINIAN I. emperor of the Weſt, a renowned warrior, but a tyrant over his ſubjects. See ROME, N° 523.

VALENTINIAN II. emperor of the Weſt, a prince celebrated for his virtues, and above all for his moderation; yet a conſpiracy was formed againſt him by Arbogaſtes,

Valentinian || Valet.

bogaſtes, the commander in chief of his armies; and he was ſtrangled in the year 392. See ROME, N° 536.

VALENTINIANS, in church hiſtory, a ſect of Chriſtian heretics, who ſprung up in the ſecond century, and were ſo called from their leader Valentinus.

The Valentinians were only a branch of the Gnoſtics, who realiſed or perſonified the Platonic ideas concerning the Deity, whom they called *Pleroma* or *Plenitude*. Their ſyſtem was this: the firſt principle is Bythos, i. e. Depth, which remained many ages unknown, having with it Ennoe or Thought, and Sige or Silence; from theſe ſprung the Nous or Intelligence, which is the only ſon, equal to and alone capable of comprehending the Bythos; the ſiſter of Nous they called *Aletheia* or *Truth;* and theſe conſtituted the firſt quaternity of æons, which were the ſource and original of all the reſt: for Nous and Aletheia produced the World and Life; and from theſe two proceeded Man and the Church. But beſides theſe 8 principal æons, there were 22 more; the laſt of which, called *Sophia*, being deſirous to arrive at the knowledge of Bythos, gave herſelf a great deal of uneaſineſs, which created in her Anger and Fear, of which was born Matter. But the Horos or Bounder ſtopped her, preſerved her in the Pleroma, and reſtored her to Perfection. Sophia then produced the Chriſt and the Holy Spirit, which brought the æons to their laſt perfection, and made every one of them contribute their utmoſt to form the Saviour. Her Enthymeſe, or Thought, dwelling near the Pleroma, perfected by the Chriſt, produced every thing that is in the world by its divers paſſions. The Chriſt ſent into it the Saviour, accompanied with angels, who delivered it from its paſſions, without annihilating it: from thence was formed corporeal matter. And in this manner did they romance concerning God, nature, and the myſteries of the Chriſtian religion.

VALERIAN, or VALERIANUS, *Publius Licinius*, emperor of Rome, remarkable for his captivity and cruel treatment by Sapor I. king of Perſia. See ROME, N° 491.

VALERIANA, a genus of plants belonging to the claſs triandria, and in the natural ſyſtem arranged under the 48th order, *Aggregatæ*. See BOTANY and MATERIA MEDICA *Index*.

VALERIUS MAXIMUS, a Latin hiſtorian, ſprung from the families of the Valerii and Fabii, which made him take the name of *Valerius Maximus*. He ſtudied polite literature, and afterwards followed Sextus Pompey to the wars. At his return he compoſed an account of the actions and remarkable ſayings of the Romans and other great men; and dedicated that work to the emperor Tiberius. Many of the learned think that this is the ſame that is now extant, and bears the name of Valerius Maximus; but others maintain, that what we have now is only an abridgment of the work written by this celebrated hiſtorian, and that this abridgment was made by one Nepotian of Africa. However, this work is well written, and contains a great number of memorable actions performed by the Greeks and Romans that are worthy of being read.

VALET, a French term, uſed as a common name for all domeſtic men ſervants employed in the more ſervile offices, as grooms, footmen, coachmen, &c. But with us it is only uſed in the phraſe *valet de chambre*, which is a ſervant whoſe office is to dreſs and undreſs his maſter, &c.

Valet || Vanbrugh

VALETTA, a city of Malta, and capital of the iſland (ſee MALTA, N° 26.). It is ſituated in E. Long. 14. 34. N. Lat. 35. 54.

VALETUDINARY, among medical writers, denotes a perſon of a weak and ſickly conſtitution, and frequently out of order.

VALID, in *Law*, an appellation given to acts, deeds, tranſactions, &c. which are clothed with all the formalities requiſite to their being put into execution, and to their being admitted in a court of juſtice.

VALLADOLID, an ancient, large, and handſome city of Spain, in Old Caſtile, and capital of a principality of the ſame name, with a biſhop's ſee and an univerſity. It is ſurrounded with ſtrong walls, embelliſhed with handſome buildings, large public ſquares, piazzas, and fountains; containing 11,000 houſes, with fine long and broad ſtreets, and high houſes, adorned with balconies. There is a ſquare in the middle of the city, ſurrounded with handſome brick houſes, having under them piazzas, where people may walk dry in all weathers. Within theſe piazzas merchants and tradeſmen keep their ſhops. All the houſes are of the ſame height, being four ſtories; and there are balconies at every window, of gilt iron. In the whole there are 70 monaſteries and nunneries; the fineſt of which is that of the Dominicans, remarkable for its church, which is one of the moſt magnificent in the city. The kings reſided a long while at this place; and the royal palace, which ſtill remains, is of very large extent, though but two ſtories high; within are fine paintings of various kinds, and at one of the corners a curious clock, made in the ſame manner as that of Straſburg. The environs of the city are a fine plain, covered with gardens, orchards, vineyards, and meadows. It is ſeated on the rivers Eſcarva and Peſuerga, in W. Long. 4. 47. N. Lat. 41. 42.

VALUE, in *Commerce*, denotes the price or worth of any thing.

VALVE, in *Hydraulics*, *Pneumatics*, &c. is a kind of lid or cover of a tube or veſſel, ſo contrived as to open one way, but which, the more forcibly it is preſſed the other way, the cloſer it ſhuts the aperture; ſo that it either admits the entrance of a fluid into the tube or veſſel, and prevents its return; or admits its eſcape, and prevents its re-entrance.

VALVE, in *Anatomy*, a thin membrane applied on ſeveral cavities and veſſels of the body, to afford a paſſage to certain humours going one way, and prevent their reflux towards the place from whence they came.

VAMPYRE, a ſpecies of bat. See VESPERTILIO, MAMMALIA *Index*.

VAN, a term derived from the French *avant* or *avaunt*, ſignifying before or foremoſt of any thing: thus we ſay, the van-guard of the army, &c.

VANBRUGH, SIR JOHN, a celebrated Engliſh dramatic writer and architect, was deſcended of a family in Cheſhire which came from France, though by his name he appears to have been originally of Dutch extraction. He was born about the middle of the reign of Charles II. and received a liberal education. His firſt comedy, called the Relapſe or Virtue in Danger, was acted in the year 1697 with great applauſe; which gave him ſuch encouragement,

Vanbrugh ‖ Vandyck.

encouragement, that he wrote eleven more comedies. He was the friend of Mr Congreve, whoſe genius was naturally turned for dramatic performances; and theſe two gave new life to the Engliſh ſtage, and reſtored its ſinking reputation. Sir John was alſo eſteemed an able architect. Under his direction was raiſed Blenheim-houſe in Oxfordſhire. He died in 1726.

VANDELLIA, a genus of plants belonging to the claſs didynamia. See BOTANY *Index*.

VAN-DIEMEN'S LAND. See DIEMEN.

VANDYCK, SIR ANTHONY, a celebrated painter, was born at Antwerp in the year 1599. After giving early proofs of his genius, he became the diſciple of the illuſtrious Rubens. In the church of the Auguſtines at Antwerp, at the high altar, is a celebrated picture of Rubens, repreſenting, in one part, the Virgin Mary ſitting with the child Jeſus in her lap, and in another part ſeveral ſaints, male and female, ſtanding. The breaſt of one of theſe, St Sebaſtian, is ſaid to have been painted by Vandyck when he was only a diſciple of Rubens. This great maſter being engaged one day abroad, his diſciples went into his painting-room, where, after having been ſome time employed in admiring his works, they began to play or romp in ſuch a manner, that the breaſt of St Sebeſtian, which was not yet dry, was bruſhed away by a hat thrown at random. This accident put an end to their play: they were very anxious to reſtore it, fearing that if Rubens diſcovered it they ſhould all be diſcarded. At length it was agreed that Anthony ſhould undertake to mend the ſaint's breaſt. In ſhort, taking his maſter's pallet and bruſhes, he ſucceeded ſo well that his companions imagined Rubens would overlook it. They were miſtaken; for Rubens at his return knew immediately that ſome one had touched upon his performance: calling his diſciples, he aſked them why any one had dared to meddle with his painting? They were ſome time doubtful whether they ſhould confeſs or deny the fact. Threats at length prevailed: they owned that Vandyck had thrown his hat upon it. Upon this, cloſeting Vandyck, inſtead of chiding him, he told him, that "it was proper and even neceſſary for him to travel into Italy, the only ſchool that produced excellent painters." By this advice, and with the aſſiſtance of his maſter, he ſet out for Italy, about the year 1621, being then about 21 or 22 years of age. Having ſtaid a ſhort time at Rome, he removed to Venice, where he attained the beautiful colouring of Titian, Paul Veroneſe, and the Venetian ſchool.

After a few years he returned to Flanders, with ſo noble, ſo eaſy, and natural a manner of painting, that Titian himſelf was hardly his ſuperior: and no other maſter could equal him in portraits. Soon after his return, he accidentally met with D. Teniers, who accoſted him with great politeneſs, and aſked him whether he had much buſineſs ſince he came from Rome? "What buſineſs, think you, can I have had time to do (replied Vandyck)? I am only juſt arrived here. Would you believe, that I offered to draw that fat brewer's picture who juſt paſſed by us for two piſtoles, and that the looby laughed in my face, ſaying it was too dear? I aſſure you, that if the cards do not turn up better, I ſhall make no long ſtay at Bruſſels." Soon after this, he painted thoſe two famous pictures, the Nativity and a dying Chriſt; the firſt in the pariſh-church, the ſecond in that of the Capuchins, at Termond.

Vandyck ‖ Variation.

Vandyck, finding he could not make a fortune in his own country, took a reſolution of going over into England. Accordingly he borrowed ſome guineas of Teniers, and ſet out, furniſhed with letters of recommendation. His ſuperior genius ſoon brought him into great reputation; and above all, he excelled in portraits, which he drew with an inconceivable facility, and for which he charged a very high price, according to the inſtructions which had been given him on that head. It is affirmed, that for ſome of them he received 400 guineas apiece. He ſoon found himſelf loaded with honours and riches; and as he had a noble and generous heart, he lived equal to his fortune. He married a daughter of the lord Ruthven, earl of Gowry; and though ſhe had but little fortune, maintained her in a ſtyle ſuitable to her birth. He generally kept a magnificent equipage, and a numerous retinue. He died in 1641, at the age of 42, leaving property, it is ſaid, to the amount of 40,000l. ſterling.

VANE, a thin ſlip of bunting hung to the maſt-head, or ſome other conſpicuous place in the ſhip, to ſhow the direction of the wind. It is commonly ſewed upon a wooden frame called the *ſtock*, which contains two holes whereby to ſlip over the ſpindle, upon which it turns about as the wind changes.

VANILLA, or VANILLO. See EPIDENDRUM, BOTANY *Index*.

VAPOUR, in *Philoſophy*, the particles of bodies rarefied by heat, and thus rendered ſpecifically lighter than the atmoſphere, in which they riſe. See EVAPORATION and HEAT, CHEMISTRY *Index*.

VAPOURS, in *Medicine*, otherwiſe called *hypochondriaſis* or *ſpleen*. See MEDICINE, N° 276 and 321.

VAPOUR-Bath, in *Chemiſtry*, a term applied to a chemiſt's bath or heat, in which a body is placed ſo as to receive the fumes of boiling water.

We alſo uſe the term *vapour-bath*, when a ſick perſon is made to receive the vapours ariſing from ſome liquid matter placed over a fire. Many contrivances have been propoſed for this purpoſe; and their expediency and utility are beſt known to thoſe who are converſant in this buſineſs. A late writer has ſuggeſted a new conſtruction of vapour baths; and the whole apparatus is reduced to a tin-boiler, tin pipes wrapped in flannel, and a deal box with a cotton cover, for the reception of the body and circulation of the vapour.

VARI, in *Medicine*, little, hard, and ruddy tumors, which frequently infeſt the faces of young perſons of a hot temperament of body.

VARIATION *of the Compaſs*, is the deviation of the magnetic or mariner's needle from the meridian or true north and ſouth line. On the continent it is called the *declination* of the magnetic needle; and this is a better term, for reaſons which will appear by and by.

We have given the general facts relating to magnetic variation under the article MAGNETISM, N° 19.; and under the articles COMPASS, and *Azimuth* COMPASS, we have noticed the methods of aſcertaining the variation at any particular time or place. We ſhall here only give a ſhort hiſtorical account of the progreſſive diſcoveries reſpecting magnetic variation, and notice the

Variation. the explanations that have been offered to account for this phenomenon.

About the time that the polarity of the magnet was firſt obſerved in Europe, the magnetic direction, both in Europe and in China, was nearly in the plane of the meridian. It was therefore an ineſtimable preſent to the mariner, giving him a ſure direction in his courſe through the pathleſs ocean. But by the time that the European navigators had engaged in their adventurous voyages to far diſtant ſhores, the deviation of the needle from the meridian was very ſenſible even in Europe. The ſon of Columbus poſitively ſays, that it was obſerved by his father in his firſt voyage to America, and made his companions ſo anxious leſt they ſhould not find the way back again to their own country, that they mutinied and refuſed to proceed. It is certain that Gonzales Oviedo and Sebaſtian Cabot obſerved it in their voyages. Indeed it could not poſſibly eſcape them; for in ſome parts of their ſeveral tracks the needle deviated above 25° from the meridian; and the rudeſt dead reckoning, made on the ſuppoſition of the needle pointing due north and ſouth, muſt have thrown the navigators into the utmoſt confuſion. We know that ſpherical trigonometry was at that time abundantly familiar to the mathematicians of Europe, and that no perſon pretended to take the command of a ſhip bound to a diſtant port that was not much more informed in this ſcience than moſt maſters of ſhips are at preſent. The deviation of the compaſs, however, was not generally allowed by mathematicians, who had not yet become ſenſible of the neceſſity of quitting the Ariſtotelian trammels, and inveſtigating nature by experiments. They choſe rather to charge the navigators with inaccuracy in their obſervations than the ſchoolmen with errors in principles. Pedro de Medina at Valladolid, in his *Arte de Naviggar*, publiſhed in 1545, denies the variation of the compaſs. But the concurring reports of the commanders of ſhips on diſtant voyages, in a few years, obliged the landſmen in their cloſets to give up the point; and Martin Cortez, in a treatiſe of navigation, printed at Seville before 1556, treats it as a thing completely eſtabliſhed, and gives rules and inſtruments for diſcovering its quantity. About the year 1580 Norman publiſhed his diſcovery of the *dip* of the needle, and ſpeaks largely of the horizontal deviation from the plane of the meridian, and attributes it to the attraction of a point, not in the heavens, but in the earth, and deſcribes methods by which he hoped to find its place. To the third, and all the ſubſequent editions of Norman's book (called the *New Attractive*), was ſubjoined a diſſertation by Mr Borroughs, comptroller of the navy, on the variation of the compaſs, in which is recorded the quantity of this deviation in many places; and he laments the obſtacle which it cauſes to navigation by its total uncertainty previous to obſervation. The author indeed offers a rule for computing it *à priori*, founded on ſome conjecture as to its cauſe; but, with the modeſty and candour of a gentleman, acknowledges that this is but a gueſs, and intreats all navigators to be aſſiduous in their obſervations, and ready in communicating them to the public. Accordingly obſervations were liberally contributed from time to time, and were publiſhed in the ſubſequent treatiſes on navigation.

But in 1635 the mariners were thrown into a new and great perplexity, by the publication of a *Diſcourſe Mathematical on the Variation of the Magnetical Needle*, by Mr Henry Gillebrand, Greſham profeſſor of aſtronomy. Variation. He had compared the variations obſerved at London by Burroughs, Gunter, and himſelf, and found that the north end of the mariner's needle was gradually drawing more to the weſtward. For Norman and Burroughs had obſerved it to point about 11½ degrees to the eaſt of north in 1580; Gunter found its deviation only 6¼ in 1622, and he himſelf had obſerved only 4° in 1634; and it has been found to deviate more and more to the weſtward ever ſince, as may be ſeen from the tables given under MAGNETISM.

Mr Bond, teacher of mathematics in London, and employed to edit and improve the impreſſions of the popular treatiſes of navigation, about 1650, declared, in a work called the "Seaman's Kalendar," that he had diſcovered the true progreſs of the deviation of the compaſs; and publiſhed in another work, called "the Longitude Found," a table of the variation for 50 years. This was, however, a gratuitous prognoſtication, not founded on any well-grounded principles; and though it agreed very well with the obſervations made in London, which ſhowed a gradual motion to the weſtward at the rate of —.12′ annually, by no means agreed with the obſervations made in other places. See Phil. Tranſ. 1668.

But this news ſoon loſt its credit: for the inconſiſtency with obſervation appeared more and more every day, and all were anxious to diſcover ſome general rule, by which a near gueſs at leaſt might be made as to the direction of the needle in the moſt frequented ſeas. Halley recommended the matter in the moſt earneſt manner to the attention of government; and, after much unwearied ſolicitation, obtained a ſhip to be ſent on a voyage of diſcovery for this purpoſe. He got the command of this ſhip, in which he repeatedly traverſed the Atlantic ocean, and went as far as the 50th degree of ſouthern latitude. See his very curious ſpeculations on this ſubject in the Phil. Tranſ. 1683 and 1692.

After he had collected a prodigious number of obſervations made by others, and compared them with his own, he publiſhed in 1700 a ſynoptical account of them in a very ingenious form of a ſea chart, where the ocean was croſſed by a number of lines paſſing through thoſe planes where the compaſs had the ſame deviation. Thus, in every point of one line there was no variation in 1700; in every point of another line the compaſs had 20° of eaſt variation; and in every point of a third line it had 20° of weſt variation. Theſe lines have ſince been called *Halleyan lines*, or curves. This chart was received with univerſal applauſe, and was undoubtedly one of the moſt valuable preſents that ſcience has made to the arts.

The polarity of the magnetic needle, and a general though intricate connection between its poſitions in all parts of the world, naturally makes the philoſopher ſpeculate about its cauſe. We ſee that Cortez aſcribed it to the attraction of an eccentric point, and that Bond thought that this point was placed not in the heavens, but in the earth. This notion made the baſis of the famous Theory of Magnetiſm of Dr Gilbert of Colcheſter. See MAGNETISM, N° 71.

Gilbert's theory may be underſtood from the following general propoſition. Plate DXL. fig. 1.

Let NS (fig. 1.) be a magnet, of which N is the north

Variation. north and S the ſouth pole: Let $n s$ be any oblong piece of iron, poiſed on a point c like a compaſs needle. It will arrange itſelf in a poſition $n c s$ preciſely the ſame with that which would be aſſumed by a compaſs needle of the ſame ſize and ſhape, having n for its north and s its ſouth pole. And while the piece of iron remains in this poſition, it will be in all reſpects a magnet ſimilar to the real compaſs needle. The pole n will attract the ſouth pole of a ſmall magnetiſed needle, and repel its north pole. If a paper be held over $n s$, and fine iron-filings be ſtrewed on it, they will arrange themſelves into curves iſſuing from one of its ends and terminating at the other, in the ſame manner as they will do when ſtrewed on a paper held over a real compaſs needle. But this magnetiſm is quite temporary; for if the piece of iron $n s$ be turned the other way, placing n where s now is, it will remain there, and will exhibit the ſame phenomena. We may here add, that if $n s$ be almoſt infinitely ſmall in compariſon of NS, the line $n s$ will be in ſuch a poſition that if $s a$, $s b$, be drawn parallel to N c, S c, we ſhall have $s a$ to $s b$, as the force of the pole N to the force of the pole S. And this is the true cauſe of that curious diſpoſition of iron-filings when ſtrewed round a magnet. Each fragment becomes a momentary magnet, and arranges itſelf in the true magnetic direction, and when ſo arranged, attracts the two adjoining fragments, and co-operates with the forces, which alſo arrange them. We throw this out to the ingenious mechanician as the foundation of a *complete* theory of the magnetical phenomena. When the filings are infinitely fine, the curves N c S have this property, that, drawing the tangent $n c s$, we always have $s a : s b =$ force of N : force of S; and thus we may approximate at pleaſure to the law of magnetic attraction and repulſion. The theory, of which an outline is given under MAGNETISM, is founded on this principle, and applies with ſucceſs to every phenomenon yet obſerved.

Now, to apply this theory to the point in hand.—Let $n s$ (fig. 2.) be a ſmall compaſs needle, of which n is the north and s the ſouth pole: let this needle be poiſed horizontally on the pin $c d$; and let $n' s'$ be the poſition of the *dipping needle*. Take any long bar of common iron, and hold it upright, or nearly ſo, as repreſented by AB. The lower end B will repel the pole n and will attract the pole s, thus exhibiting the properties of a north pole of the bar AB. Keeping B in its place, turn the bar round B′ as a centre, till it come into the poſition A′B′ nearly parallel to $n' s'$. You will obſerve the compaſs needle $n s$ attract the end B′ with either pole n or s, when B′A′ is in the poſition B′ α perpendicular to the direction $n' s'$ of the dipping needle: and when the bar has come into the poſition B′ A′, the upper end B′ will ſhow itſelf to be a ſouth pole by attracting n and repelling s. This beautiful experiment was exhibited to the Royal Society in 1673 by Mrs Hindſhaw.

From this it appears, that the great magnet in the earth induces a momentary magnetiſm on ſoft iron preciſely as a common magnet would do. Therefore (ſays Dr Gilbert) it induces permanent magnetiſm on magnetiſable ores of iron, ſuch as loadſtones, in the ſame manner as a great loadſtone would do; and it affects the magnetiſm already imparted to a piece of tempered ſteel preciſely as any other great magnet would.

Therefore the needle of the mariner's compaſs in every part of the world arranges itſelf in the magnetic direction, ſo that if poiſed as a dipping needle ſhould be, it will be a tangent to one of the curves N c S of fig. 1. The horizontal needle being ſo poiſed as to be capable of playing only in a horizontal plane, will only arrange itſelf *in the plane* of the triangle N c S. That end of it which has the ſame magnetiſm with the ſouth pole S of the great magnet included in the earth will be turned towards its north pole N. Therefore what we call the north pole of a needle or magnet really has the magnetiſm of the ſouth pole of the great primitive magnet. If the line NS be called the axis, and N and S the poles of this great magnet, the plane of any one of theſe curves N c S will cut the earth's ſurface in the circumference of a circle, great or ſmall according as the plane does or does not paſs through the centre of the earth. Variation.

Dr Halley's firſt thought was, that the north pole of the great magnet or loadſtone which was included in the bowels of the earth was not far from Baffin's bay, and its ſouth pole in the Indian ocean ſouth-weſt from New Zealand. But he could not find any poſitions of theſe two poles which would give the needle that particular poſition which it was obſerved to aſſume in different parts of the world; and he concluded that the great terreſtrial loadſtone had four irregular poles (a thing not unfrequent in natural loadſtones, and eaſily producible at pleaſure), two of which are ſtronger and two weaker. When the compaſs is at a great diſtance from the two north poles, it is affected ſo as to be directed nearly in a plane paſſing through the ſtrongeſt. But if we make it approach much more to the weakeſt, the greater vicinity will compenſate for the ſmaller abſolute force of the weak pole, and occaſion conſiderable irregularities. The appearances are favourable to this opinion. If this be the real conſtitution of the great magnet, it is almoſt a deſperate taſk to aſcertain by computation what will be the poſition of the needle. Halley ſeems to have deſpaired: for he was both an elegant and a moſt expert mathematician, and it would have coſt *him* little trouble to aſcertain the places of two poles only, and the direction which theſe would have given to the needle. But to ſay what would be its poſition when acted on by four poles, it was neceſſary to know the law by which the magnetic action varied by a variation of diſtance; and even then, the computation would have been exceedingly difficult.

In order to account for the change of variation, Dr Halley ſuppoſes this internal magnet not to adhere to the external ſhell which we inhabit, but to form a nucleus or kernel detached from it on all ſides, and to be ſo poiſed as to revolve freely round an axis, the poſition of which he hopes to diſcover by obſervation of the compaſs. Dr Halley imagined that the nucleus revolved from eaſt to weſt round the ſame axis with the earth. Thus the poles of the magnet would change their poſitions relatively to the earth's ſurface, and this would change the direction of the compaſs needle.

The great Euler, whoſe delight it was always to engage in the moſt difficult mathematical reſearches and computations, undertook to aſcertain the poſition of the needle in every part of the earth. His diſſertation on this ſubject is to be ſeen in the 13th volume of the Memoirs of the Royal Academy of Berlin, and is exceedingly

Variation. ingly beautiful, abounding in thoſe analytical *tours d'adreſſe* in which he ſurpaſſed all the world. He has reduced the computation to a wonderful ſimplicity.

He found, however, that four poles would engage him in an analyſis which would be exceſſively intricate, and has contented himſelf with computing for two only; obſerving that this ſuppoſition agrees ſo well with obſervation, that it is highly probable that this is the real conſtitution of the terreſtrial magnet, and that the coincidence would have been perfect if he had hit on the due poſitions of the two poles. He places one of them in lat. 76° north, and long. 96° weſt from Teneriffe. The ſouth pole is placed in lat. 58° ſouth, and long. 158° weſt from Teneriffe. Theſe are their ſituations for 1757.—Mr Euler has annexed to his diſſertation a chart of Halleyan curves ſuited to theſe aſſumptions, and fitted to the year 1757.

It muſt be acknowledged, that the *general* courſe of the variations according to this theory greatly reſembles the real ſtate of things; and we cannot but own ourſelves highly indebted to this great mathematician for having made ſo fine a firſt attempt. He has improved it very conſiderably in another diſſertation in the 22d volume of theſe memoirs. But there are ſtill ſuch great differences, that the theory is of no uſe to the navigator, and it only ſerves as an excellent model for a farther proſecution of the ſubject. Since that time another large variation chart has been publiſhed, fitted to a late period; but the public has not ſufficient information of the authorities or obſervations on which it is founded.

The great object in all theſe charts is to facilitate the diſcovery of a ſhip's longitude at ſea. For the lines of variation being drawn on the chart, and the variation and the latitude being obſerved at ſea, we have only to look on the chart for the interſection of the parallel of obſerved latitude and the Halleyan curve of obſerved variation. This interſection muſt be the place of the ſhip. This being the purpoſe, the Halleyan lines are of great ſervice; but they do not give us a ready conception of the direction of the needle. We have always to *imagine* a line drawn through the point, cutting the meridian in the angle correſponding to the Halleyan line. We ſhould learn the general magnetic affections of the globe much better if a number of magnetic meridians were drawn. Theſe are the interſections of the earth's ſurface with planes paſſing through the magnetical axis, cutting one another in angles of 5° or 10°. This would both ſhow us the places of the magnetic poles much more clearly, and would, in every place, ſhow us at once the direction of the needle. In all thoſe places where theſe magnetic curves touch the meridians, there is no variation; and the variation in every other place is the angle contained between theſe magnetic meridians and the true ones.

The program of a work of this kind has been publiſhed by a Mr Churchman, who appears to have engaged in the inveſtigation with great zeal and conſiderable opportunities. It is pretty certain that the north magnetic pole (or point, as Mr Churchman calls it) is not far removed from the ſtations given it by Halley and Euler; and there ſeems no doubt but that in the countries between Hudſon's bay and the weſtern coaſts of North America the needle will have every poſition with reſpect to the terreſtrial meridian, ſo that the north end of a compaſs needle will even point due ſouth in ſeveral places. Almoſt every thing that can be deſired in this inquiry would be obtained by a few *well-choſen* obſervations made in thoſe regions. It would be of immenſe advantage to have the *dips* aſcertained with great preciſion. Theſe would enable us to judge at what depth under the ſurface the pole is ſituated; for the well-informed mechanician, who will ſtudy ſeriouſly what we have ſaid about the magnetical curves, will ſee that a compaſs needle, when compared with the great terreſtrial magnet, is but as a particle of iron-filings compared to a very large artificial magnet. Therefore, from the poſition of the dipping needle, we may infer the place of the pole, if the law of magnetic action be given; and this law may be found by means of other experiments, which we could point out. See MAGNETISM, N° 80, *et ſeq.* Variatio

Mr Churchman has adopted the opinion of only two poles. According to him, the north pole was (in 1800) in Lat. 58° N. and Long. 134° W. from Greenwich, very near Cape Fairweather; and the ſouth pole lies in Lat. 58° S. and Long. 165° E. from Greenwich. He alſo imagines that the north pole has moved to the eaſtward, on a parallel of latitude, about 65 ſince the beginning of the 19th century (from 1600), and concludes that it makes a revolution in 1096 years. The ſouthern pole has moved leſs, and completes its revolution in 2289 years. This motion he aſcribes to ſome influences which he calls *magnetic tides*, and which he ſeems to conſider as celeſtial. This he infers from the changes of variation. He announces a phyſical theory on this ſubject, which, he ſays, enables him to compute the variation with preciſion for any time paſt or to come; and he even gives the proceſs of trigonometrical computation illuſtrated by examples. But as this publication (entitled *The Magnetic Atlas*), publiſhed for the author, by Darton and Harvey, 1794, is only a program, he expreſſes himſelf obſcurely, and ſomewhat enigmatically, reſpecting his theory. He ſpeaks of the influence of one pole being greater than that of the other; and ſays, that in this caſe the magnetic equator, where the needle will be parallel to the axis, will not be in the middle between the poles. This is true of a common magnet. He muſt therefore abide by this ſuppoſition in its other conſequences. The magnetic meridians muſt be planes paſſing through this axis, and therefore muſt be circles on the ſurface of the earth. This is incompatible with the obſervations; nay, his charts are ſo in many places, particularly in the Pacific ocean, where the variations by his chart are three times greater than what has been obſerved.—His parallels of dip are ſtill more different from obſervation, and are incompatible with any phenomena that could be produced by a magnet having but two poles. His rules of computation are exceedingly exceptionable. He has in fact but one example, and that ſo particular, that the mode of computation will not apply to any other. This circumſtance is not taken notice of in the enunciation of his firſt problem; and the reader is made to imagine that he has got a rule for computing the variation, whereas all the rules of calculation are only running in a circle. The variation computed for the port of St Peter and Paul in Kamtſchatka, by the rule, is ten times greater than the truth.

For our own part, we have little hopes of this problem ever being ſubjected to accurate calculation. We believe,

Variation. believe, indeed, that there is a cosmical change going on in the earth which will produce a progressive change in the variation of the needle; and we see none more likely than Dr Halley's motion. There is nothing repugnant to our knowledge of the universe in the supposition of a magnetic nucleus revolving within this earth; and it is very easy to conceive a very simple motion of revolution, which shall produce the very motion of the sensible poles for which Mr Churchman contends. We need only suppose that the magnetical axis of this nucleus is not its axis of revolution. It may not even bisect that axis; and this circumstance will cause the two poles to have different degrees of motion in relation to the shell which surrounds it.

But this regular progress of the magnet within the earth may produce very irregular motions of the compass needle, by the intervention of a third body susceptible of magnetism. The theory of which we have just given a hint comes here to our assistance. Suppose NS (fig. 3.) to represent the primitive magnet in the earth, and *n s* to be a stratum of iron ore susceptible of magnetism. Also let *n' s'* be another small mass of a similar ore; and let their situations and magnitudes be such as is exhibited in the figure. The fact will be that *n* will be the north pole and *s* the south pole of the great stratum, and *n'* and *s'* will be the north and south poles of the small mass or loadstone. Any person may remove all doubts as to this, by making the experiment with a magnet NS, a piece of iron or soft tempered steel *n s*, and another piece *n' s'*. The well-informed and attentive reader will easily see, that by such interventions every conceivable anomaly may be produced. While the great magnet makes a revolution in any direction, the needle will change its position gradually, and with a certain regularity; but it will depend entirely on the size, shape, and situation, of these intervening masses of magnetisable iron ore, whether the change of variation of the compass shall be such as the primitive magnet alone would have produced, or whether it shall be of a kind wholly different.

Now, that such intervening disturbances *may* exist, is past contradiction. We know that even on the film of earth which we inhabit, and with which only we are acquainted, there are extensive strata or otherwise disposed masses of iron ores in a state susceptible of magnetism; and experiments made on bars of hard tempered steel, and on bits of such ores, assure us that the magnetism is not induced on such bodies in a moment, but propagated gradually along the mass.—That such disturbances do actually exist, we have many relations. There are many instances on record of very extensive magnetic rocks, which affect the needle to very considerable distances. The island of Elba in the Mediterranean is a very remarkable instance of this. The island of Cannay also, on the west of Scotland, has rocks which affect the needle at a great distance.

A similar effect is observed near the Feroe islands in the North sea; the compass has no determined direction when brought on shore. *Journ. des Sçavans*, 1679, p. 174.

In Hudson's straits, in latitude 63°, the needle has hardly any polarity. *Ellis's Voyage to Hudson's Bay.*

Bouguer observed the same thing in Peru. Nay, we believe that almost all rocks, especially of whin or trappe stone, contain iron in a proper state.

All this refers only to the thin crust through which the human eye has occasionally penetrated. Of what may be below we are ignorant; but when we see appearances which tally so remarkably with what would be the effects of great masses of magnetical bodies, modifying the general and regularly progressive action of a primitive magnet, whose existence and motion is inconsistent with nothing that we know of this globe, this manner of accounting for the observed change of variation has all the probability that we can desire. Nay, we apprehend that very considerable changes may be produced in the direction of the compass needle, even without the supposition of any internal motion. If the great magnet resembles many loadstones we are acquainted with, having more than two poles, we know that these poles will act on each other, and gradually change each other's force, and consequently the direction of the compass. This process, to be sure, tends to a state of things which will change no more.—But the period of human history, or of the history of the race of Adam, may make but a small part of the history of this globe; and therefore this objection is of little force. Variation.

There can be no doubt of the operation of the general terrestrial magnetism on every thing susceptible of magnetic properties; and we cannot hesitate to explain in this way many changes of magnetic direction which have been observed. Thus, in Italy, Father de la Torré observed, that during a great eruption of Vesuvius the variation was 16° in the morning, at noon it was 14°, and in the evening it was 10°, and that it continued in that state till the lava grew so dark as no longer to be visible in the night; after which it slowly increased to 13½, where it remained. Daniel Bernoulli found the needle changed its position 45′ by an earthquake. Professor Muller at Manheim observed that the declination of the needle in that place was greatly affected by the earthquake in Calabria. Such streams of lava as flowed from Hecla in the last dreadful eruption must have made a transference of magnetic matter that would considerably affect the needle. But no observations seem to have been made on the occasion; for we know that common ironstone, which has no effect on the needle, will, by mere cementation with any inflammable substance, become magnetic. In this way Dr Knight sometimes made artificial loadstones.—But these are partial things, and not connected with the general change of variation now under consideration.

We have said so much on this subject, chiefly with the view of cautioning our readers against too sanguine expectations from any pretensions to the solution of this great problem. We may certainly gather from these observations, that even although the theory of the variation should be completed, we must expect (by what we already know of magnetism in general) that the disturbances of the needle, by local causes intervening between it and the great influence by which it is chiefly directed, may be so considerable as to affect the position of the compass needle in a very sensible manner: for we know that the metallic substances in the bowels of the earth are in a state of continual change, and this to an extent altogether unknown.

There is another irregularity of the mariner's needle that we have noticed under MAGNETISM, page 365, namely, the daily variation. This was first observed

Variation. by Mr George Graham in 1722 (Philoſophical Tranſactions, N° 383.), and reported to the Royal Society of London. It uſually moves (at leaſt in Europe) to the weſtward from 8 morning till 2 P. M. and then gradually returns to its former ſituation. The diurnal variations are ſeldom leſs than 0° 5′, and often much greater. Mr Graham mentions (Philoſophical Tranſactions, N° 428.) ſome obſervations by a Captain Hume, in a voyage to America, where he found the variation greateſt in the afternoon. This being a general phenomenon, has alſo attracted the attention of philoſophers. The moſt detailed accounts of it to be met with are thoſe of Mr Canton (ſee MAGNETISM), in Philoſophical Tranſactions, vol. li. part 1. p. 399, and thoſe of Van Swinden, in his Treatiſe on Electricity and Magnetiſm.

Mr Canton attempts to account for theſe changes of poſition, by obſerving that the force of a magnet is weakened by heat. A ſmall magnet being placed near a compaſs needle, ENE from it, ſo as to make it deflect 45° from the natural poſition, the magnet was covered with a braſs veſſel, into which hot water was poured. The needle gradually receded from the magnet 45′, and returned gradually to its place as the water cooled. This is confirmed by uniform experience.

The parts of the earth to the eaſtward are firſt heated in the morning, and therefore the force of the earth is weakened, and the needle is made to move to the weſtward. But as the ſun warms the weſtern ſide of the earth in the afternoon, the motion of the needle muſt take the contrary direction.

But this way of explaining by a change in the force of the earth ſuppoſes that the changing cauſe is acting in oppoſition to ſome other force. We do not know of any ſuch. The force, whatever it may be, ſeems ſimply to produce its own effect, in deranging the needle from the direction of terreſtrial magnetiſm. If Æpinus's theory of magnetic action be admitted, we may ſuppoſe that the ſun acts on the earth as a magnet acts on a piece of ſoft iron, and in the morning propels the fluid in the north-weſt parts. The needle directs itſelf to this conſtipated fluid, and therefore it points to the eaſtward of the magnetic north in the afternoon. And (to abide by the ſame theory) this induced magnetiſm will be ſomewhat greater when the earth is warmer; and therefore the diurnal variation will be greateſt in ſummer. This change of poſition of the conſtipated fluid muſt be ſuppoſed to bear a very ſmall ratio to the whole fluid, which is naturally ſuppoſed to be conſtipated in one pole of the great magnet in order to give it magnetiſm. Thus we ſhall have the diurnal variation a very ſmall quantity. This is departing, however, from the principle of Mr Canton's explanation; and indeed we cannot ſee how the weakening the general force of the terreſtrial magnet ſhould make any change in the needle in reſpect to its direction; nor does it appear probable that the change of temperature produced by the ſun will penetrate deep enough to produce any ſenſible effect on the magnetiſm. And if this be the cauſe, we think that the derangements of the needle ſhould vary as the thermometer varies, which is not true. The other method of explaining is much better, if Æpinus's theory of magnetic attraction and repulſion be juſt; and we may ſuppoſe that it is only the ſecondary magnetiſm (i. e. that of the magnetiſable minerals) that is ſenſibly affected by the heat; this will account very well for the greater mobility of the fluid in ſummer than in winter. Variation.

A great objection to either of theſe explanations is the prodigious diverſity of the diurnal variations in different places. This is ſo very great, that we can ſcarcely aſcribe the diurnal variation to any change in the magnetiſm of the primitive terreſtrial magnet, and muſt rather look for its cauſe in local circumſtances. This concluſion becomes more probable, when we learn that the deviation from the meridian and the deviation from the horizontal line are not affected at the ſame time. Van Swinden aſcribes them ſolely to changes produced on the needles themſelves. If their magnetiſm be greatly deranged by the ſun's poſition, it may throw the magnetic centre away from the centre of the needle's motion, and thus produce a very ſmall change of poſition. But if this be the cauſe, we ſhould expect differences in different needles. Van Swinden ſays, that there are ſuch, and that they are very great; but as he has not ſpecified them, we cannot draw any concluſion.

But, beſides this regular diurnal variation, there is another, which is ſubjected to no rule. The aurora borealis is obſerved (in Europe) to diſturb the needle exceedingly, ſometimes drawing it ſeveral degrees from its poſition. It is always obſerved to increaſe its deviation from the meridian, that is, an aurora borealis makes the needle point more weſterly. This diſturbance ſometimes amounts to ſix or ſeven degrees, and is generally obſerved to be greateſt when the aurora borealis is moſt remarkable.

The obſervation of the connection of the polarity of the needle with the aurora borealis occurred to the late Profeſſor Robiſon in 1759, when a midſhipman on board the Royal William in the river St Lawrence. The point of the heavens to which all the rays of light converged was preciſely that which was oppoſite to the ſouth end of the dipping needle.

This is a very curious phenomenon, and we have not been able to find any connection between this meteor and the poſition of a magnetic needle. It is to be obſerved, that a needle of copper or wood, or any ſubſtance except iron, is not affected. We long thought it an electric phenomenon, and that the needle was affected as any other body balanced in the ſame manner would be; but a copper needle would then be affected.

We ſee the needle frequently diſturbed both from its general annual poſition, and from the change made on it by the diurnal variation. This is probably the effect of auroræ boreales which are inviſible, either on account of thick weather or daylight. Van Swinden ſays, he ſeldom or never failed to obſerve auroræ boreales immediately after any anomalous motion of the needle; and concluded that there had been one at the time, though he could not ſee it. Since no needle but a magnetic one is affected by the aurora borealis, we may conclude that there is ſome natural connection between this meteor and magnetiſm. This ſhould farther incite us to obſerve the circumſtance above mentioned, viz. that the ſouth end of the dipping needle points to that part of the heavens where the rays of the aurora appear

ariation to converge. We wish that this were diligently obser-
ll ved in places which have very different variation and
arnish. dip of the mariner's needle.

For the diurnal and this irregular variation, consult the Dissertations of Celsius and of Hiorter, in the Memoirs of Stockholm; Wargentin, Philosophical Transactions, vol. xlviii.; Braun (*Comment. Petropol. Novi*, tom. v. vii. ix.); Graham and Canton as above.

VARIETY, a change, succession, or difference, in the appearance or nature of things; in opposition to *uniformity*.

VARIETY, in *Botany*, is a change in some less essential part or quality; as colour, size, pubescence or age. —Externally; by the plaiting or interweaving of the branches—by bundling or uniting of several stalks into one broad flat one; by the greater breadth, or narrowness, or curling of leaves—by becoming awnless, or smooth, or hirsute. Internally; by becoming mutilated in the corolla; or having one larger than ordinary —by luxuriancy, multiplication, or fulness—by becoming proliferous, or crested—by bearing bulbs instead of seeds—or being viviparous.

The usual causes of variation are, climate, soil, exposure, heat, cold, winds, culture.

VARIOLA, the SMALLPOX. See MEDICINE, N° 222—224.

VARIX, in *Medicine*, the dilatation of a vein, arising from the too great abundance or thickness of the blood.

VARNISH, a clear limpid fluid, capable of hardening without losing its transparency, used by painters, gilders, &c. to give a lustre to their works, to preserve them and defend them from the air.

A coat of varnish ought to possess the following properties: 1. It must exclude the action of the air; because wood and metals are varnished to defend them from decay and rust. 2. It must resist water; for otherwise the effect of the varnish could not be permanent. 3. It ought not to alter such colours as are intended to be preserved by this means. It is necessary therefore that a varnish should be easily extended or spread over the surface, without leaving pores or cavities; that it should not crack or scale; and that it should resist water. Now resins are the only bodies that possess these properties. Resins consequently must be used as the bases of varnish. The question which of course presents itself must then be, how to dispose them for this use? and for this purpose they must be dissolved, as minutely divided as possible, and combined in such a manner that the imperfections of those which might be disposed to scale may be corrected by others.

Resins may be dissolved by three agents. 1. By fixed oil. 2. By volatile oil. 3. By alcohol. And accordingly we have three kinds of varnish: the fat or oily varnish, essential varnish, and spirit varnish. Before a resin is dissolved in a fixed oil, it is necessary to render the oil drying. For this purpose the oil is boiled with metallic oxides; in which operation the mucilage of the oil combines with the metal, while the oil itself unites with the oxygen of the oxide. To accelerate the drying of this varnish, it is necessary to add oil of turpentine. The essential varnishes consist of a solution of resin in oil of turpentine. The varnish being applied, the essential oil flies off, and leaves the resin. This is used only for paintings. When resins are dissolved in alcohol, the varnish dries very speedily, and is subject to crack; but this fault is corrected by adding a small quantity of turpentine to the mixture, which renders it brighter, and less brittle when dry. Varnish.

We shall now give the method of preparing a number of varnishes for different purposes.

A Varnish for Toilet-boxes, Cases, Fans, &c.—Dissolve two ounces of gum mastich and eight ounces of gum sandarach in a quart of alcohol; then add four ounces of Venice turpentine.

A Varnish for Wainscots, Cane-chairs, Iron-chairs, Grates.—Dissolve in a quart of alcohol eight ounces of gum sandarach, two ounces of seed lac, four ounces of rosin; then add six ounces of Venice turpentine. If the varnish is wished to produce a red colour, more of the lac and less of sandarach should be used, and a little *dragon's blood* should be added. This varnish is so thick that two layers of it are equal to four or five of another.

A Varnish for Fiddles, and other Musical Instruments. —Put four ounces of gum sandarach, two ounces of lac, two ounces of gum mastich, an ounce of gum elemi, into a quart of alcohol, and hang them over a slow fire till they are dissolved; then add two ounces of turpentine.

Varnish in order to employ Vermilion for painting Equipages.—Dissolve in a quart of alcohol six ounces of sandarach, three ounces of gum lac, and four ounces of rosin; afterwards add six ounces of the cheapest kind of turpentine; mix with it a proper quantity of vermilion when it is to be used.

Gold-coloured Varnish.—Pound separately four ounces of stick lac, four ounces of gamboge, four ounces of dragon's blood, four ounces of anotta, and one ounce of saffron: put each of them separately into a quart of alcohol, and expose them for five days in a narrow-mouthed bottle to the sun, or keep them during that time in a very warm room, shaking them every now and then to hasten the solution. When they are all melted, mix them together. More or less of each of these ingredients will give the different tints of gold according as they are combined. In order to make silver imitate gold exactly when covered with this varnish, the quantity of ingredients must be somewhat greater. The method of gilding silver-leaf, &c. with this varnish is as follows: The silver-leaf being fixed on the subject, in the same manner as gold-leaf, by the interposition of proper glutinous matters, the varnish is spread upon the piece with a brush or pencil. The first coat being dry, the piece is again and again washed over with the varnish till the colour appears sufficiently deep. What is called *gilt leather*, and many picture frames, have no other than this counterfeit gilding. Washing them with a little rectified spirit of wine affords a proof of this; the spirit dissolving the varnish, and leaving the silver-leaf of its own whiteness. For plain frames, thick tinfoil may be used instead of silver. The tin-leaf, fixed on the piece with glue, is to be burnished, then polished with emery and a fine linen cloth, and afterwards with putty applied in the same manner: being then lacquered over with the varnish five or six times, it looks very nearly like burnished gold. The same varnish, made with a less proportion of the colouring materials, is applied also on works of brass; both for heightening the colour of the metal to a resemblance with that of gold, and

Varniſh. and for preſerving it from being tarniſhed or corroded by the air.

Oil Varniſhes.—Gum copal and amber are the ſubſtances principally employed in oil varniſhes; they poſſeſs the properties neceſſary for varniſhes, ſolidity and tranſparency.—The copal being whiteſt, is uſed for varniſhing light, the amber for dark colours. It is beſt to diſſolve them before mixing them with the oil, becauſe by this means they are in leſs danger of being ſcorched, and at the ſame time the varniſh is more beautiful. They ſhould be melted in a pot on the fire; they are in a proper ſtate for receiving the oil when they give no reſiſtance to the iron ſpatula, and when they run off from it drop by drop. The oil employed ſhould be a drying oil, and perfectly free from greaſe. It ſhould be poured into the copal or amber by little and little, conſtantly ſtirring the ingredients at the ſame time with the ſpatula. When the oil is well mixed with the copal or amber, take it off the fire; and when it is pretty cool, pour in a greater quantity of the eſſence of turpentine than the oil that was uſed. After the varniſh is made, it ſhould be paſſed through a linen cloth. Oil varniſhes become thick by keeping; but when they are to be uſed, it is only neceſſary to pour in a little eſſence of turpentine, and to put them for a little on the fire. The turpentine is neceſſary in oil varniſhes to make them dry properly; generally twice as much of it is uſed as of oil. Leſs is neceſſary in ſummer than in winter. Too much oil hinders the varniſh from drying; but when too little is uſed, it cracks and does not ſpread properly. We ſhall ſubjoin the moſt uſeful oil varniſhes:

White Copal Varniſh.—On 16 ounces of melted copal pour four, ſix, or eight ounces of linſeed oil, boiled and quite free from greaſe. When they are well mixed, take them off the fire (not forgetting to ſtir them properly); and when pretty cool, pour in 16 ounces of the eſſence of Venice turpentine. Paſs the varniſh through a cloth.—Amber varniſh is made in the ſame way.

Black Varniſh for Coaches and Iron Work.—This varniſh is compoſed of bitumen of Paleſtine, roſin, and amber, melted ſeparately, and afterwards mixed: the oil is then added, and afterwards the turpentine, as directed above. The uſual proportions are, 12 ounces of amber, two ounces of roſin, two ounces of bitumen, ſix of oil, and 12 of the eſſence of turpentine.—Golden-coloured varniſh may be made alſo by ſubſtituting linſeed oil for alcohol.

Eſſential Oil Varniſhes.—The only eſſential oil varniſhes uſed are for pictures. Picture varniſhes ſhould be white, light, and quite tranſparent, which will preſerve the colours without giving them any diſagreeable tint; and it ſhould be poſſible to take them off the picture without injuring it. They are uſually made of gum maſtich and turpentine diſſolved together in ſome eſſential oil. The varniſh is paſſed through a cloth, and allowed to clarify. It is applied cold to the picture.

Varniſh for Glaſs, in order to preſerve it from the Rays of the Sun.—Pulveriſe a quantity of gum adragant, and let it diſſolve for 24 hours in the white of eggs well beat up; then rub it gently on the glaſs with a bruſh.

Varniſhes before they are uſed ſhould be carefully kept from duſt, which would ſpoil them; and they ſhould be kept in a veſſel quite clean and dry. When uſed, they ſhould be lifted lightly with a bruſh, and ſpread upon a ground altogether free from dirt and moiſture. The ſubſtance, after being varniſhed, ſhould be expoſed to the heat of the ſun, or placed in a warm room covered with a glaſs caſe, to keep out all filth. Oil varniſhes require more heat than alcohol varniſhes. The varniſh ſhould be put on very quickly, making great ſtrokes with the pencil or bruſh, taking care that theſe ſtrokes never croſs one another; it ſhould be ſpread equally, and never thicker than a leaf of paper; a ſecond coat ſhould never be put on till the firſt is quite dry. If the varniſh, after being put on, becomes dull and uneven, it muſt be taken off entirely, and new varniſh put on. Varniſh.

When wainſcot is to be varniſhed, it is firſt painted of a wooden colour. This colour is made by infuſing in water either red or yellow ochre (according to the colour wiſhed for), terra ombria (a kind of ochre) and white lead; into this as much as neceſſary is put of *parchment paſte*. Two thin coats of this are to be put on, and, after they are quite dry, the varniſh.

Varniſhes are poliſhed with pumice-ſtone and tripoli earth. The pumice-ſtone muſt be reduced to an impalpable powder, and put upon a piece of ſerge moiſtened with water; with this the varniſhed ſubſtance is to be rubbed lightly and equally. The tripoli muſt alſo be reduced to a very fine powder, and put upon a clean woollen cloth moiſtened with olive oil, with which the poliſhing is to be performed. The varniſh is then to be wiped with ſoft linen, and, when quite dry, cleaned with ſtarch or Spaniſh white, and rubbed with the palm of the hand or with a linen cloth.

To recover colours or varniſh, and to take off the dirt and filth which may adhere to them, a ley is uſed made of potaſh and the aſhes of lees of wine. Take 48 ounces of potaſh, and 16 of the above-mentioned aſhes, and put them into ſix quarts of water, and the ley is made: inſtead of the aſhes an equal quantity of potaſh would probably do as well. To clean dirty colours, dilute ſome of this ley with four times its quantity of water, and rub the picture with it; then waſh it with river water; and when dry, give it a coat or two of varniſh. In order to take off a varniſh, waſh it with the above-mentioned ley, then with water, and then lift it off the ſubſtance on which it was with any iron inſtrument.—We ſhall finiſh this article with a deſcription of the famous Chineſe varniſh.

The Chineſe varniſh is not a compoſition, but a reſin which exudes from a tree called in China *tſi-chu*, "varniſh tree." This tree grows in ſeveral provinces of the ſouthern parts of China. The Chineſe take the following method of propagating this tree: In ſpring they chooſe a vigorous ſhoot about a foot in length, which proceeds immediately from the trunk; and coat over the lower part, by which it adheres to the tree, with a kind of yellow earth, at leaſt three inches in thickneſs. This coat is carefully covered with a mat, to defend it from rain and the injuries of the air. Towards the autumnal equinox they detach a little of the earth, to obſerve in what condition the ſmall roots are, which begin to ſpring forth from the ſhoot. If they find that the filaments which compoſe them are of a reddiſh colour, they judge it is time to make an amputation; but they defer it if the roots are white, becauſe this colour ſhows that

Varniſh. that they are yet too tender: they then cloſe up the coat again, and wait till the ſpring following. When the ſhoot is ſeparated from the trunk of the tree, it is put into the earth; but in whatever ſeaſon it is planted, whether in ſpring or autumn, great care muſt be taken to put plenty of cinders into the hole prepared for it; without this precaution the ants would deſtroy the yet tender roots, or at leaſt deprive them of all their moiſture, and cauſe them to decay.

The Chineſe do not procure varniſh from the tſi-chu until its trunk is nearly five inches in diameter, which ſize it ſeldom attains to before ſeven or eight years. Varniſh extracted from a tree ſmaller or of leſs age would not have the ſame body and ſplendour. This liquor diſtils only in the night time, and during the ſummer ſeaſon. To cauſe the gum to flow, they make ſeveral rows of inciſions round the trunk, the number of which is proportioned to the vigour of the tree. The firſt row is ſeven inches from the earth, and the reſt are at the ſame diſtance one from the other, and continue to the top of the trunk, and even ſometimes on the boughs which are of ſufficient ſtrength and ſize. The Chineſe uſe a crooked iron for making theſe inciſions, which muſt run a little obliquely, and be equal in depth to the thickneſs of the bark; they make them with one hand, and with the other hold a ſhell, the edges of which they inſert into the opening, where it remains without any ſupport. Theſe inciſions are made towards evening, and next morning they collect the varniſh which has fallen into the ſhells; the following evening they are again inſerted, and this operation is continued until the end of ſummer. A thouſand trees yield almoſt in one night 20 pounds of varniſh.

While the varniſh diſtils, it exhales a malignant vapour, the bad effects of which can only be prevented by preſervatives and great precaution. The merchant who employs the workmen is obliged to keep by him a large vaſe filled with rape-oil, in which a certain quantity of thoſe fleſhy filaments have been boiled that are found in hog's lard, and which do not melt. When the workmen are going to fix the ſhells to the trees, they carry ſome of this oil along with them, and rub their face and hands with it, which they do with greater care when they collect in the morning the varniſh that has diſtilled during night. After eating, they waſh their whole bodies with warm water, in which the bark of the cheſnut tree, fir wood, cryſtallized ſaltpetre, and ſome other drugs, have been boiled. When they are at work near the trees, they put upon their heads a ſmall cloth bag in which there are two holes, and cover the fore part of their bodies with a kind of apron made of doe-ſkin, which is ſuſpended from their necks with ſtrings, and tied round them with a girdle. They alſo wear boots, and have coverings on their arms, made of the ſame kind of ſkin. The labourer who ſhould attempt to collect varniſh without uſing this precaution, would ſoon be puniſhed for his raſhneſs, and the moſt dreadful effects would enſue. The diſorder ſhows itſelf by tetters, which become of a bright red colour, and ſpread in a very ſhort time; the body afterwards ſwells, and the ſkin burſts and appears covered with an univerſal leproſy. The unhappy wretch could not long endure the excruciating pain which he feels, did he not find a ſpeedy remedy in thoſe preſervatives which are uſed againſt the malignant and noxious exhalations of the varniſh. Varniſh.

The ſeaſon of collecting varniſh being ended, the merchant puts it into ſmall caſks cloſely ſtopped. A pound of it newly made coſts him about one ſhilling and eight pence ſterling; but he gains cent. per cent. upon it, and ſometimes more, according to the diſtance of the place to which he tranſports it.

Beſides the luſtre and beauty which that varniſh gives to many of the Chineſe manufactures, it has alſo the property of preſerving the wood upon which it is laid, eſpecially if no other matter be mixed with it. It prevents it from being hurt either by dampneſs or worms.

Every workman has a particular art and method of uſing the varniſh. This work requires not only much ſkill and dexterity, but alſo great attention, to obſerve the proper degree of fluidity which the gum ought to have, as it muſt be neither too thick nor too liquid when it is laid on. Patience above all is neceſſary in thoſe who wiſh to ſucceed. To be properly varniſhed, a work muſt be done at leiſure; and the whole ſummer is ſcarcely ſufficient to bring it to perfection. It is therefore rare to ſee any of thoſe cabinets which are imported to us from Canton ſo beautiful and durable as thoſe manufactured in Japan, Tong-king, and Nang-king, the capital of the province of Kiang-nan: not that the artiſts do not employ the ſame varniſh; but as they work for Europeans, who are more eaſily pleaſed, they do not take the trouble of giving the pieces which come from their hands all the poliſh they are capable of receiving.

There are two methods of laying on the varniſh; the ſimpleſt is, when it is immediately laid on the wood. The work is firſt poliſhed, and then daubed over with a kind of oil which the Chineſe call *tong-yeou*. When this oil is dry, it receives two or three coats of varniſh; which remain ſo tranſparent, that all the ſhades and veins of the wood may be ſeen through them. If the artiſt is deſirous of entirely concealing the ſubſtance on which they are laid, nothing is neceſſary but to add a few more coats; theſe give the work a ſhining ſurface, the ſmoothneſs of which equals that of the moſt beautiful ice. When the work is dry, various figures are painted upon it in gold and ſilver, ſuch as flowers, birds, trees, temples, dragons, &c. A new coat of varniſh is then ſometimes laid over theſe figures, which preſerves them, and adds much to their ſplendour. The ſecond method requires more preparation. The Chineſe workmen fix to the wood by means of glue a kind of paſteboard, compoſed of paper, hemp, lime, and other ingredients, well beaten, that the varniſh may incorporate with them. Of this they make a ground perfectly ſmooth and ſolid, over which the varniſh is laid in thin coats, that are left to dry one after the other.

It often happens, that the luſtre of varniſhed tables and other pieces of furniture is inſenſibly deſtroyed by tea and warm liquors. "The ſecret of reſtoring to varniſh its ſhining black colour (ſays a Chineſe author) is to expoſe it for one night to a white hoar-froſt, or to cover it ſome time with ſnow." For a method of imitating *Chineſe varniſh*, ſee TURNING.

VARNISH alſo ſignifies a ſort of ſhining coat, wherewith potters-ware, delft-ware, china-ware, &c. are covered,

Varnish, Varro.

vered, which gives them a smoothness and lustre. Melted lead is generally used for the first, and smalt for the second. See GLAZING.

VARNISH, among medalists, signifies the colours antique medals have acquired in the earth.

The beauty which nature alone is able to give to medals, and art has never yet attained to counterfeit, enhances the value of them: that is, the colour which certain soils in which they have a long time lain tinges the metals withal: some of which are blue, almost as beautiful as the turquoise; others with an inimitable vermilion colour; others with a certain shining polished brown, vastly finer than Brasil figures.

The most usual varnish is a beautiful green, which hangs to the finest strokes without effacing them, more accurately than the finest enamel does on metals.

No metal but brass is susceptible of this; for the green rust that gathers on silver always spoils it, and it must be got off with vinegar or lemon juice.

Falsifiers of medals have a false or modern varnish, which they use on their counterfeits, to give them the appearance or air of being antique. But this may be discovered by its softness; it being softer than the natural varnish, which is as hard as the metal itself.

Some deposite their spurious metals in the earth for a considerable time, by which means they contract a sort of varnish, which may impose upon the less knowing; others use sal ammoniac, and others burnt paper.

VARRO, MARCUS TERENTIUS, the most learned of all the Romans, was born 28 years B. C. He was a senator of the first distinction, both for birth and merit; and bore many great offices. He was an intimate friend of Cicero; and this friendship was confirmed and immortalized by a mutual dedication of their learned words to each other. Thus Cicero dedicated his Academic Questions to Varro; and Varro dedicated his treatise on the Latin tongue to Cicero. In the civil wars he was zealously attached to Pompey; but after his defeat soon submitted to Cæsar, who was reconciled to him. Afterwards he applied his whole time to letters, and had the charge of the Greek and Latin libraries at Rome. He was above 70 when Antony proscribed him; however, he found means to escape and save his life, though he could not save some of his works and his library from being plundered by the soldiers. After this storm was over, he pursued his studies as usual; and Pliny relates, that he continued to study and to write when he was 88 years of age. He was 80 when he wrote his three books *De re Rustica*, which are still extant. Five of his books *De lingua Latina*, which he addressed to Cicero, are all extant. There remain, too, divers fragments of his works, particularly of his Menippean Satires, which are medleys of prose and verse; and Scaliger has collected some of his epigrams from among the *Catalecta Virgilii*. His books *De lingua Latina*, and *De re Rustica*, were printed with the notes of Joseph Scaliger, Turnebus, and Victorius, by Henry Stephens at Paris, 1573, in 8vo, and have been published separately since among the *Auctores de lingua Latina*, and the *Auctores de re Rustica*.

There was another Varro of antiquity, called *Atacinus*, who was born about 10 years after the first, at a small town near Narbonne. Though infinitely below the Roman in learning, he was at least as good, if not a better, poet; which perhaps has made Lillius Gyraldus and other critics confound them. He composed many works in verse; some fragments of which were collected, and published with those of other ancient poets, at Lyons in 1603. His chief works were, A poem on the war with the Sequani, a people of Gaul; and the Astronomics, that went under the name of Planciades the grammarian. But the *Argonautics*, in four books, was what gained him the greatest reputation: and though indeed nothing but a translation of Apollonius Rhodius, yet was so well done as to be commended by Quintilian.

Varro ‖ Vaudois.

VARRONIA, a genus of plants belonging to the class pentandria, and arranged in the natural system under the 41st order, *Asperifoliæ*. See BOTANY *Index*.

VASCULAR, something consisting of divers vessels, as arteries, veins, &c.

VASE, a term frequently used for ancient vessels dug from under ground, or otherwise found, and preserved in the cabinets of the curious. In architecture, the appellation *vase* is also given to those ornaments placed on corniches, foshles, or pedestals, representing the vessels of the ancients, particularly those used in sacrifice, as incense-pots, flower-pots, &c. See *PORTLAND-Vase*.

VASSAL, in our ancient customs, signified a tenant or feudatory; or person who vowed fidelity and homage to a lord, on account of some land, &c. held of him in fee; also a slave or servant, and especially a domestic of a prince.—*Vassallus* is said to be *quasi inferior socius*; as the vassal is inferior to his master, and must serve him; and yet he is in a manner his companion, because each of them is obliged to the other. See *FEODAL System*.

VATICAN, a magnificent palace of the pope in Rome, which is said to consist of several thousand rooms: but the parts of it most admired are the grand staircase, the pope's apartment, and especially the library, which is one of the richest in the world, both in printed books and manuscripts.

VAUBAN, SEBASTIAN LE PRESTRE, SEIGNEUR DE, marshal of France, and the greatest engineer that country ever produced, was born in 1633. He displayed his knowledge of fortification in the course of many sieges, and his services were rewarded with the first military honours. He was made governor of Lisle in 1668, commissary general of the fortifications of France in 1678, governor of the maritime parts of Flanders in 1689, and a marshal of France in 1703. He died in 1707, after having brought the arts of attacking and defending fortified places to a degree of perfection unknown before. His writings on these subjects are in great esteem.

VAUDOIS, VALDENSES, or *Waldenses*, in ecclesiastical history, a name given to a sect of reformers, who made their first appearance about the year 1160.

The origin of this famous sect, according to Mosheim, was as follows: Peter, an opulent merchant of Lyons, surnamed *Valdensis*, or *Validisius* from Vaux or Waldum, a town in the marquisate of Lyons, being extremely zealous for the advancement of true piety and Christian knowledge, employed a certain priest called *Stephanus de Evisa*, about the year 1160, in translating from Latin into French the four Gospels, with other books of Holy Scripture, and the most remarkable sentences of the ancient doctors, which were so highly esteemed

Vaudois | Ubiquitarians. esteemed in this century. But no sooner had he perused these sacred books with a proper degree of attention, than he perceived that the religion which was now taught in the Roman church, differed totally from that which was originally inculcated by Christ and his apostles. Struck with this glaring contradiction between the doctrines of the pontiffs and the truths of the Gospel, and animated with zeal, he abandoned his mercantile vocation, distributed his riches among the poor (whence the Waldenses were called *poor men of Lyons*), and forming an association with other pious men, who had adopted his sentiments and turn of devotion, he began in the year 1180 to assume the quality of a public teacher, and to instruct the multitude in the doctrines and precepts of Christianity.

Soon after Peter had assumed the exercise of his ministry, the archbishop of Lyons, and the other rulers of the church in that province, vigorously opposed him. However, their opposition was unsuccessful; for the purity and simplicity of that religion which these good men taught, the spotless innocence that shone forth in their lives and actions, and the noble contempt of riches and honours, which was conspicuous in the whole of their conduct and conversation, appeared so engaging to all such as had any sense of true piety, that the number of their followers daily increased.—They accordingly formed religious assemblies, first in France, and afterwards in Lombardy, from whence they propagated their sect throughout the other provinces of Europe with incredible rapidity, and with such invincible fortitude, that neither fire, nor sword, nor the most cruel inventions of merciless persecution, could damp their zeal, or entirely ruin their cause.

VAULT, in *Architecture*, an arched roof, so contrived that the stones which form it sustain each other.

Vaults are on many occasions to be preferred to soffits or flat ceilings, as they give a greater height and elevation, and are besides more firm and durable.

VAYER. See MOTHE.

VAYVODE, or VAIVODE. See WAYWODE.

UBES, ST, a sea-port town of Portugal, in the province of Estremadura, seated on a bay of the Atlantic ocean, 21 miles south of Lisbon. It stands on an eminence, with a very strong castle built on a rock. The soil around is fertile in corn, wine, and fruits; and it is furnished with good fish from the sea, and a small lake in the neighbourhood. Here great quantities of fine salt are made, which is carried to the American plantations. E. Long. 8. 54. N. Lat. 38. 22.

UBIQUITARIANS, formed from *ubique*, "everywhere," in ecclesiastical history, a sect of Lutherans which rose and spread itself in Germany; and whose distinguishing doctrine was, that the body of Jesus Christ is everywhere, or in every place.

Brentius, one of the earliest reformers, is said to have first broached this error, in 1560. Luther himself, in his controversy with Zuinglius, had thrown out some unguarded expressions, that seemed to imply a belief of the omnipresence of the body of Christ; but he became sensible afterwards, that this opinion was attended with great difficulties, and particularly that it ought not to be made use of as a proof of Christ's corporal presence in the eucharist. However, after the death of Luther, this absurd hypothesis was renewed, and dressed up in a specious and plausible form by Brentius, Chemnitius, and Andræas, who maintained the communication of the properties of Christ's divinity to his human nature. It is indeed obvious, that every Lutheran who believes the doctrine of consubstantiation (see *SUPPER of the Lord*), whatever he may pretend, must be an Ubiquitarian. Ubiquitarians || Veer.

UBIQUITY, OMNIPRESENCE; an attribute of the Deity, whereby he is always intimately present to all things; gives the *esse* to all things; knows, preserves, and does all in all things.

UDDER, in comparative anatomy, that part in brutes wherein the milk is prepared, answering to the mammæ or breasts in women. See ANATOMY, COMPARATIVE.

VEDAS, the sacred books of the Hindoos, believed to be revealed by God, and called *immortal*. They are considered as the fountain of all knowledge human and divine, and are four in number; of which we have the following account in the first volume of the Asiatic Researches: the *Rigveda* consists of five sections; the *Yajurveda* of eighty-six: the *Samaveda* of a thousand; and the *Atharvaveda* of nine; with eleven hundred *sac'ha's*, or branches, in various divisions and subdivisions. The *Vedas* in truth are infinite; but have been long reduced to this number and order: the principal part of them is that which explains the duties of man in a methodical arrangement; and in the fourth is a system of divine ordinances.

From these are reduced the four *Upavedas*, the first of which was delivered to mankind by BRAHMA, INDRA, DHANWANTARI, and five other deities; and comprises the theory of disorders and medicines, with the practical methods of curing diseases.

The second consists of music, invented for the purpose of raising the mind by devotion to the felicity of the Divine nature; the third treats of the fabrication and use of arms; and the fourth of *sixty-four* mechanical arts. Of however little value we may esteem the mechanical arts of the Hindoos, and however despicable their theological system may really be, the *Upaveda*, which treats of diseases and the method of curing them, surely deserves to be studied by every European physician practising in India. There are indeed a great number of medical books in the Shanscrit language worthy of attention; for though the theories of their authors may be groundless and whimsical, they contain the names and descriptions of many Indian plants and minerals, with their uses, discovered by *experience*, in the cure of diseases.

VEDETTE, in *War*, a centinel on horseback, with his horse's head towards the place whence any danger is to be feared, and his carabine advanced, with the butt-end against his right thigh. When the enemy has encamped, there are vedettes posted at all the avenues, and on all the rising grounds, to watch for its security.

To VEER *and* HAUL, to pull a rope tight, by drawing it in and slackening it alternately, till the body to which it is applied acquires an additional motion, like the increased vibrations of a pendulum, so that the rope is straitened to a greater tension with more facility and dispatch. This method is particularly used in hauling the bowlines.

The wind is said to veer and haul when it alters its direction, and becomes more or less fair. Thus it is said to veer aft and to haul forward.

Veer
||
Vega.

VEER, *Ter-Veer*, anciently *Camp-Veer*, a town of Zealand in the United Provinces, ſtanding at the mouth of the Eaſt Schelde, about four miles from Middleburgh, and eight from Fluſhing. Veer, in Dutch, ſignifies a paſſage or ferry over an arm of the ſea or a river; and as there was once a ferry here over the Schelde to the village of Compen, on the iſland of North Beveland, the town thereby got the name of *Veer*, *Camp-Veer*, and *Ter-Veer*. It is well fortified, and formerly enjoyed a good trade, eſpecially to Scotland; the natives enjoying particular privileges here. The harbour is very good, and the arſenal the beſt furniſhed in the world. Hence the Veres, anciently earls of Oxford, are ſaid to have derived both their origin and name.

VEERING, or WEARING, the operation by which a ſhip, in changing her courſe from one board to the other, turns her ſtern to windward. Hence it is uſed in oppoſition to TACKING, wherein the head is turned to the wind and the ſtern to leeward. See SEAMANSHIP.

VEGA, LOPEZ DE, a celebrated Spaniſh poet. He was the ſon of Felix de Vega and Franciſca Fernandez, who were both deſcended from honourable families, and lived in the neighbourhood of Madrid. Our poet was born in that city on the 25th of November 1562. He was, according to his own expreſſion, a poet from his cradle; and beginning to make verſes before he had learned to write, he uſed to bribe his elder ſchool-fellows with part of his breakfaſt, to commit to paper the lines he had compoſed. Having loſt his father while he was yet ſtill a child, he engaged in a frolic very natural to a lively boy, and wandered with another lad to various parts of Spain, till, having ſpent their money, and being conducted before a magiſtrate at Segovia for offering to ſell a few trinkets, they were ſent home again to Madrid. Soon after this adventure, our young poet was taken under the protection of Geronimo Manrique, biſhop of Avila, and began to diſtinguiſh himſelf by his dramatic compoſitions, which were received with great applauſe by the public, though their author had not yet completed his education: for, after this period, he became a member of the univerſity of Alcala, where he devoted himſelf for four years to the ſtudy of philoſophy. He was then engaged as ſecretary to the duke of Alva, and wrote his Arcadia in compliment to that patron: who is frequently mentioned in his occaſional poems. He quitted that employment on his marriage with Iſabel de Urbina, a lady (ſays his friend and biographer Perez de Montalvan) beautiful without artifice, and virtuous without affectation. His domeſtic happineſs was ſoon interrupted by a painful incident: Having written ſome lively verſes in ridicule of a perſon who had taken ſome injurious freedom with his character, he received a challenge in conſequence of his wit; and happening, in the duel which enſued, to give his adverſary a dangerous wound, he was obliged to fly from his family, and ſhelter himſelf in Valencia. He reſided there a conſiderable time; but connubial affection recalled him to Madrid. His wife died in the year of his return. His affliction at this event led him to relinquiſh his favourite ſtudies, and embark on board the Armada which was then preparing for the invaſion of England. He had a brother who ſerved in that fleet as a lieutenant; and being ſhot in an engagement with ſome Dutch veſſels, his virtues were celebrated by our afflicted poet, whoſe heart was peculiarly alive to every generous affection. After the ill ſucceſs of the Armada, the diſconſolate Lopez de Vega returned to Madrid, and became ſecretary to the marquis of Malpica, to whom he has addreſſed a grateful ſonnet. From the ſervice of this patron he paſſed into the houſehold of the count of Lemos, whom he celebrates as an inimitable poet. He was once more induced to quit his attendance on the great, for the more inviting comforts of a married life. His ſecond choice was Juana de Guardio, of noble birth and ſingular beauty. By this lady he had two children, a ſon who died in his infancy, and a daughter named *Feliciana*, who ſurvived her father. The death of his little boy is ſaid to have haſtened that of his wife, whom he had the misfortune to loſe in about ſeven years after his marriage. Having now experienced the precarioufneſs of all human enjoyments, he devoted himſelf to a religious life, and fulfilled all the duties of it with the moſt exemplary piety: ſtill continuing to produce an aſtoniſhing variety of poetical compoſitions. His talents and virtues procured him many unſolicited honours. Pope Urban VIII. ſent him the croſs of Malta, with the title of Doctor in Divinity, and appointed him to a place of profit in the Apoſtolic Chamber: favours for which he expreſſed his gratitude by dedicating his *Corona Tragica* (a long poem on the fate of Mary queen of Scots) to that liberal pontiff. In his 73d year he felt the approaches of death, and prepared himſelf for it with the utmoſt compoſure and devotion. His laſt hours were attended by many of his intimate friends, and particularly his chief patron the duke of Seſſa, whom he had made his executor; leaving him the care of his daughter Feliciana, and of his various manuſcripts. The manner in which he took leave of thoſe he loved was moſt tender and affecting. He ſaid to his diſciple and biographer Montalvan, That true fame conſiſted in being good: and that he would willingly exchange all the applauſes he had received to add a ſingle deed of virtue to the actions of his life. Having given his dying benediction to his daughter, and performed the laſt ceremonies of his religion, he expired on the 25th of Auguſt 1635.

Veg
Vegeta
Phyſiol.

VEGETABLE PHYSIOLOGY.—Under the article BOTANY, and alſo under PLANT, we have already delivered ſome of the commonly received doctrines on this ſubject. But as ſome late inveſtigations ſeem to lead to new views with regard to the ſtructure and nature of vegetables, we have thought it neceſſary to reſume the ſubject, and to give as full a detail of the experiments and obſervations to which we allude as our limits will permit: we ſhall firſt treat of the ſtructure, and ſecondly of the phyſiology of plants.

I. STRUCTURE OF PLANTS.—In conſidering the ſtructure or anatomy of plants, we ſhall treat, 1ſt, of the root; 2d, of the ſtem and branches; 3d, of the leaves; and 4th, of the flowers; in the order in which they are now enumerated.

1. *The ROOT.*—The root is that organ belonging to vegetables by which they are ſupplied with nouriſhment, and by which they are fixed to a commodious ſituation.

It was formerly ſuppoſed to be compoſed of outer and inner bark, of wood, and of pith; but Mrs Ibbetſon, who * *Nich. Jour.* xx 161. and 334. has lately communicated * to the public the reſults of an elaborate

Vegetable Physiology.

elaborate ſeries of experiments on this ſubject, thinks that it is wholly compoſed of the rind much thickened, with perhaps a very little of the outer bark, but no inner bark; of a quantity of wood, hardly any pith, and no ſpiral veſſels. Mrs Ibbetſon ſearched in vain for the larger veſſels of the inner bark, till it occurred to her that the want of this bark accounted for there being no leaves on the root. Mrs Ibbetſon had often been aſſured that roots were found bearing leaves, but on diſſection of theſe ſuppoſed roots, ſhe found that they were branches which croſſed the root.

The root conſiſts of the caudex, ſtock or main body, and of the radiculæ or fibres which ariſe from the caudex, and are the organs by which the moiſture is immediately imbibed.

In botanical terminology, we generally conſider all that part of a plant which is under ground as the root; but Linné comprehends under his definition, what we term the body or trunk of the plant; and he went ſo far as to call the ſtems of trees "*roots above ground*;" but as Dr Smith juſtly remarks, this ſeems paradoxical and ſcarcely correct. Dr Smith adds, that perhaps it would be more accurate to call the caudex a *ſubterraneous ſtem*; although he is rather inclined to think that it has functions diſtinct from the ſtem, analogous to digeſtion; for there is evidently a great difference in many caſes, between the fluids of the root, at leaſt the ſecreted ones, and thoſe of the reſt of the plant.

In botanical phyſiology, by the term *root*, is often underſtood the parts only which ſerve to keep the plants firm in the ground: thus the bulbous and fleſhy roots as they are called, are, ſtrictly ſpeaking, not roots; the radiculæ or fibres being the real roots. The duration of roots is various; they are either annual, biennial, or perennial.

2. *The* STEMS *and* BRANCHES.—Linné long ago divided the ſtems of trees into four parts; the rind, the bark, the wood, and the pith: and nearly a ſimilar diviſion has been adopted by moſt vegetable phyſiologiſts till the preſent time.

Mrs Ibbetſon (aided by a powerful ſolar microſcope), however, thinks that nature points out a more regular diviſion, a diviſion marked not only by the form, but by the difference of the *juices*, with which the parts are ſwelled.

Mrs Ibbetſon divides the ſtem of trees into ſix parts: 1. The rind; 2. The bark and inner bark; 3. The wood; 4. The ſpiral nerves; 5. The nerves or circle of life (corona of Hill); and, 6. The pith.

Of the rind.—Mrs Ibbetſon conceives the rind to be merely an outward covering to the tree, which prevents its juices from being evaporated by the influence of the ſun's heat. The rind is continued under ground: but it may be as uſeful there to prevent the entrance of the duſt and earth, the preſſure of ſtones, or the injury of inſects.

The rind is compoſed of two rows of cylinders, with a ſingle line to divide them. The cylinders are filled with a pellucid liquor. There are ſeldom more than four or five layers of veſſels in the rind; but it is in general ſo covered with paraſitic plants, as powdery lichens, &c. that its thickneſs is often more than doubled.

The rind does not appear to be neceſſary to plants in general, as there are many in which the bark ſerves as a covering in its ſtead; but it ſeems to form an eſſential part of trees.

2. *Of the bark and inner bark.*—Theſe parts, though certainly different as to *form*, contain the ſame kind of juice; and being ſo nearly allied, may be treated of as one. From the bark and inner bark the leaves take their origin, as will be ſhown when we come to treat of the formation of the leaf-bud. Mrs Ibbetſon conceives that the juice of the bark is the blood of the tree.

In the bark alone are produced the gums, the reſins, the oil, the milk, &c.; in ſhort all that belongs to the tree; gives taſte to it; all that makes one plant differ from another, and all its virtues, if the expreſſion may be uſed. The bark is generally green; the inner bark white, yellow, or green. The former conſiſts of veſſels croſſing each other; the latter of bundles of veſſels of two ſizes. The large veſſels conſiſt of broad cylinders, having a bottom with a hole in it, through which the liquid paſſes, though not with perfect eaſe.

Mrs Ibbetſon ſays that on expoſing ſeveral pieces of the inner bark to the ſolar microſcope, the moment ſhe turned the light on the ſpecimen, the juice, which had before proceeded up the pipes rather ſlowly, was ſuddenly propelled forward with a force truly aſtoniſhing.

When the heat and light were increaſed by cauſing the focus of the rays to fall on the veſſels, the ſide diviſions of the veſſels were broken through, thus inundating the ſpecimen; but when a proper degree of light and heat was kept up, it was curious to obſerve the liquid paſſing from pipe to pipe, in one regular and eaſy flow, making only a ſhort ſtop as it iſſued through the ſtraitened apertures at the bottom of the veſſels. Mrs Ibbetſon has often ſtood for more than an hour watching the current, (which paſſes, however, much ſlower than the ſap does), nor could ſhe perceive while the heat and light were on it, that it required any additional expedient to haſten its momentum; but during the cold and darkneſs of night, ſhe ſuppoſes that the preſſure of the baſtard grain mentioned by Mr Knight, may very likely aſſiſt its flow, as it is at night that the baſtard grain is preſſed againſt the cylinders.

The baſtard grain is found however only in the wood; but the contraction at the bottom of the large veſſels of the inner bark, may probably ſerve the ſame purpoſe, the impetus of the current being increaſed by the leſſening of the apertures of the veſſels.

The veſſels of the inner bark are very thick in proportion to their ſize, and there is placed in them a peculiar circular body, which reſembles a cullender full of holes ſo ſmall that no liquid could paſs them. In viewing the thick juice which runs through theſe pipes, Mrs Ibbetſon obſerved many bubbles of air, the ſize of which was increaſed or diminiſhed according to the temperature; and as their ſize varied, ſo was the flow of the liquid accelerated or retarded. To ſee theſe veſſels well, the ſpecimens may be placed in a baſket which is to be faſtened in a running ſtream for ſome time, or boiled thoroughly, and then thrown into green wax perfectly melted.

Mirbel ſays that "ſome plants have the ſame juices in every part of them:" but Mrs Ibbetſon does not coincide with his idea, for ſhe did not find it to be ſo; though the potent ſmell of the liquid belonging to the bark often extends to other parts of the plant, yet it generally vaniſhes if kept ſeparate for a day, or becomes ſo

Vegetable Phyſiology.

faint in compariſon with the real liquid of the bark as to prove that it does not form an ingredient of theſe parts. Mirbel ſays that the cylinders of the inner bark are merely vacancies of the ordinary veſſels; but Mrs Ibbetſon ſtates that they are exactly the ſame as theſe veſſels, and occupy the ſame place.

They have a peculiar ſhape, being unlike any other veſſels of the tree, and they perform a particular office.

The veſſels of the bark are ſmaller, and more ſimple than thoſe of the inner bark, and are divided by a line or two, running longitudinally between them.

3. *Of the* WOOD.—This is a very obvious part. Place the ſtem of any plant in a coloured liquid, and every veſſel which conveys the ſap from the earth to the top of the tree will be tinged.

The ſap is a thin watery liquor, probably medicated from the earth, in order to become ſuitable for the life of vegetables.

Mrs Ibbetſon ſuppoſes that the ſap may vary with the ſoil, though on trial ſhe has never found that change which might have been ſuſpected.

If we make a tranſverſe ſection of the ſtem of a tree, two different kinds of layers preſent themſelves in the wood; ſome running in a circular manner, which timber merchants call the *ſilver grain;* and others from the circumference to the centre, which they denominate the *baſtard grain.* Linné long ago believed that one of the circular layers was added to the tree each year. This opinion has often been controverted, and among others by Duhamel and Mirbel; but Mrs Ibbetſon has had an opportunity of verifying the accuracy of Linné's opinion. She alſo obſerved that the layer was large or ſmall according to the expoſure of the tree, and the favourableneſs of the ſeaſon: thus in expoſed ſituations, the circles taken as a whole, were much narrower than in trees not expoſed. In ſome trees ſhe noticed only half a circular layer.

Mrs Ibbetſon thinks the baſtard ſtripe conſiſts of two lines or ſtrings with a little ſcale between them; and they appear from their extreme ſuſceptibility to be formed of the ſame leather-like ſubſtance as the ſpiral veſſels, which we are immediately to notice.

Mr Knight merely calls them *ſcales;* but as he mentions their preſſing cloſe (which they certainly do) to the cylinders at night, and during cold weather, it is obvious (whichever of the opinions we adopt) that the baſtard grains are capable of ſupplying the place of the ſun's rays, by their preſſure.

The wood-veſſels are far more ſimple in ſtructure that thoſe of the bark; they are very narrow cylinders, and the two rows next to the corona are covered by the ſpiral veſſels.

It is indeed difficult to determine the exact extent of the ſpiral veſſels even with the aſſiſtance of the ſolar microſcope, for it is by *unwinding* them alone that they can be known; and their extreme fineneſs confuſes, in conſequence of which they have been taken for ſap veſſels. Neither Mr Knight nor Mirbel was led into this miſtake, and Mrs Ibbetſon thinks that there can be no doubt that theſe veſſels (formerly ſo called) are ſolid ſtrings which hold no liquid.

The veſſels of the wood may be beſt ſeen in ſlices of the ſtems of young trees; and if not very viſible when recently cut, they will ſoon become ſo if the ſlices are kept in a dry place. Vegetable Phyſiology.

If the wood-veſſels are cut longitudinally and obſerved with a high magnifier, as ſoon as the light is permitted to come on the glaſs, the flow of ſap will be accelerated, and with perfect eaſe will run up veſſels ſo diminutive that to meaſure them is almoſt impoſſible.

A few of the wood-veſſels are ſeparated and run with the ſpiral veſſels to each leaf, in order to nouriſh it, as will be more particularly noticed, when we come to treat of the leaf-bud.

But little of the ſap, however, paſſes off in this way from the principal current, which flows on; its chief purpoſe being to form the ſtamen and the pollen appertaining to it, and afterwards to lend its principal aid to the formation of the fruit and ſeed.

4. *The ſpiral veſſels* are a quantity of ſolid ſtrings coiled up into a ſpiral form. Mrs Ibbetſon ſuppoſes them to be formed of a leather-like ſubſtance, and, as already mentioned, to be rolled round the wood. In this ſpiral manner they run up the ſtems of trees and plants of every kind (with a few exceptions), and from thence into every leaf and flower. Theſe ſpiral cords are ſingly too ſmall to be obſerved by the naked eye. They run into every fibre of the leaf, and are faſtened to its edges, thus croſſing among the veſſels in every direction like a ſpider's web; by which diſpoſition they can draw the leaves in any way that is neceſſary for them.

The larger of the interior wood-veſſels are each ſupplied with ſets of ten or twelve ſpiral cords, but the ſmaller of theſe have only three or four to each.

In the cabbage leaf and in the burdock, the ſpiral cords may be found in bundles almoſt as thick as a packthread, but in ſmaller leaves they are properly proportioned. Theſe ſpiral cords, Mrs Ibbetſon thinks, are the cauſe of the motions of plants. See PLANT, p. 601, where theſe cords are called *air*-veſſels.

5. *Of the corona or circle of life.*—The next part to be noticed is the ſmall circle of veſſels ſituated between the wood and the pith, the importance of which, in the formation of the ſeed, will be noticed under *Impregnation of the Seed;* where are alſo related ſtrong proofs to ſhow that a plant cannot exiſt a day without the corona, and that if a young plant be deprived of this part, it will not grow again, though it will certainly do ſo if the plant be ſomewhat old. It is very curious that almoſt every botanical anatomiſt ſhould have figured this part, without giving it a name, or noticing it particularly; and that theſe anatomiſts ſhould have attributed all its powers to the pith, which, from the ſhort term of its exiſtence, and its being perpetually impeded in its progreſs to make way for the flower-bud, can evidently have but little influence. The circle of life, however, has not eſcaped the notice of Hill, who termed it the corona.

The circle of life conſiſts of rows of little cylinders which have their own peculiar juice, generally of an auſtere quality. From the corona all branches take their riſe, and from it all wood threads grow. The cylinders of which it is compoſed run up into all flower-buds, but never approach the leaf-bud as is repreſented by fig. 1. and 2.; when theſe cylinders enter the flower-bud, they make their way diſtinctly to each ſeparate flower, Plate DXLI. fig. 1. 2.

Vegetable Physiology.

flower, forming the piſtil, and after depoſiting in each ſide the *line*, which is the firſt origin of life, they are afterwards impregnated, or acquire the power of giving life by the juice of the ſtamen, which runs through the ſame ſtring into the ſeed.

That the principal *vitality* of the plant reſides in the corona, we think is proved by the experiments and obſervations of Mrs Ibbetſon under *Impregnation of Seed*, and ſeems to be farther confirmed by the following remarks.

When a branch is cut from a tree, or a tree is torn up, the corona or circle of life is the firſt part that dies; and if, after a ſudden froſt, we examine the flowers of a fruit tree, we ſhall find that neither the calyx, the corolla, the ſtamina, nor the ſeeds are hurt, but that the piſtilla are deſtroyed. And if we now obſerve the piſtils with care, we ſhall ſee that it is the *line of life* which is decayed, and that this is the firſt part in which mortification commences. The peculiar liquor of the piſtil acquires a blood-red colour, and the veſſels which run up to the ſtigma become black, inſtead of their natural yellow colour.

If in wood, this line is injured (either by the decay of the bark or other means) the circle will undulate into a thouſand forms, for the purpoſe of regaining a healthy ſituation in which it may purſue its courſe.

Mrs Ibbetſon, to prove the power of the circle of life, relates the following obſervations reſpecting the *poa reptans*.

She had often meaſured in winter, ſeven or eight yards of this graſs, which appeared perfectly dead; and yet in May or June, ſhe perceived life in it at the moſt diſtant end from the ſtalk. Next ſpring ſhe took up two of theſe creeping branches which were much alike; and on diſſecting one of them through its whole length, ſhe found in it a collection of little veſſels not thicker than a very fine thread.

This collection of veſſels had run about half way the length of the branch, which was about three yards.

Mrs Ibbetſon having merely opened the cover of the graſs, laid it down again, and the little veſſels continued increaſing till they reached the end of the branch, when they made a ſtop, and it was perceived that the graſs began to thicken; and at the end neareſt the roots, the dead part became inflated with juice, loſt by degrees its dead appearance, thickened about the joints within, and at laſt ſhot forth freſh leaves and freſh roots from every joint.

Mrs Ibbetſon has ſince watched with the greateſt care, and found that the fine thread which runs through the graſs protected by the dead ſcale, was the circle of life. When this thread is ſtopped by the covers decaying, it waits till the ſeaſon permits the reſt of the plant to grow. From what has been ſaid, it is evident that the dead matter may be inflated with a living juice, and live itſelf again, provided the life near the ſtem of the plant be not extinguiſhed. Mrs Ibbetſon has obſerved this to happen in many plants, as in hydrangea, in which the ſtalks apparently lie down and are inflated again, or at leaſt a part of them.

6. *Pith.*—Linné conſidered the pith of plants as of equal importance with the ſpinal marrow of animals; but Mrs Ibbetſon thinks this part of but little conſequence, and transfers this importance to the circle of life, which ſhe compares to the brain and ſpinal marrow. She conceives that the pith forms merely a ſource of moiſture for the plant when required. The pith ſtops with every flower-bud, and begins again to grow as ſoon as the bud is paſt; it decreaſes as the ſtrength and ſize of the tree increaſe; it is the only part of the tree which is devoid of veſſels; it is merely a net, not a bundle of cylinders, and is commonly of a remarkably ſplendid or ſilver white colour.

It has been ſaid that the pith aſſumes a variety of figures, but Mrs Ibbetſon thinks this is a miſtake, though ſhe admits a few different ſorts.

All young trees and ſhrubs are provided with pith; but in the progreſs of their growth they need it no longer, the wood being a good ſubſtitute. On the ſame account, in general, we find no pith in water plants, which have a hollow ſtem, and rarely ſuffer from drought.

Linné thought that the pith was the ſeat of life and the ſource of vegetation; or in a word, the primary part of the plant. Duhamel conſidered it as of but little importance at all. Wildenow and Knight concur with Mrs Ibbetſon in regarding it as a reſervoir of moiſture for the young plants; and Dr Smith holds a medium opinion between that of Linné and the other authors juſt named.

He ſays "there is in certain reſpects an analogy between the medulla of plants, and the nervous ſyſtem of animals; it is no leſs aſſiduouſly protected than the ſpinal marrow; it is branched off and diffuſed through the plant, as nerves through the animal. Hence it is not abſurd to preſume that it may in like manner give life and vigour to the whole, though by no means, any more than nerves, the organ or ſource of nouriſhment *."

* See Fig. 3. 4. and 5.

We were ſomewhat ſurpriſed to find that Mrs Ibbetſon had not particularly noticed the cellular tiſſue as a diſtinct part to be ſeen in the ſtems of trees, as it has been long known; we ſhall therefore ſubjoin a deſcription of it. It is a ſucculent cellular ſubſtance, generally of a green colour, at leaſt in the leaves and branches. Duhamel long ago called it *envellope cellulaire*, and Mirbel, more lately, *tiſſue herbacé*.

Duhamel ſuppoſed that the cellular tiſſue formed the cuticle, or epidermis; but this is not very probable, as his own experiments ſhow that when the cuticle is removed, the cellular integument exfoliates, at leaſt in trees, or is thrown off in conſequence of the injury, and a new cuticle, covering a new layer of the cellular tiſſue, is formed under the old one. This ſubſtance is very univerſal, even in moſſes and ferns. Leaves conſiſt almoſt entirely of a plate of this ſubſtance, covered on each ſide by the cuticle. The ſtems and branches both of annual and perennial plants are inveſted with it; but in woody plants it is dried up, and reproduced almoſt continually, ſuch parts only having that reproductive power. The old layers remain, are puſhed outward by the new ones, and form at length the rugged dry dead covering of the old trunks of trees. The cellular integument is a part of plants of the greateſt importance; for in it the juices of plants are operated on by light, air, &c.

With regard to the branches of trees, it has been already noticed, that they derive their origin from the corona; and they are compoſed exactly of the ſame parts as the trunks from which they ariſe.

3. *The LEAVES.*—Mrs Ibbetſon has, with the aſſiſt-

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Vegetable Phyſiology

ance of the ſolar microſcope, and by great attention to this natural proceſs, been enabled to give ſome new and intereſting views on this ſubject. Her opinion reſpecting the formation of the leaf-bud is, "That leaves are formed or woven by the veſſels or cotton that is generally ſuppoſed by botaniſts (to be) placed there to defend the bud from the ſeverities of winter; that theſe veſſels (or cotton) are a continuation of thoſe of the bark and inner bark in the ſtem of the plant; that theſe veſſels compoſe the various interlacing branches of the leaf, which are ſoon filled up by the concentrated and thickened juices of the inner bark, which form the pabulum of the leaf."

Mrs Ibbetſon ſays the truth of her aſſertion may be eaſily ſeen by diſſecting early buds, in which, except two or three, nothing but the cotton-like veſſels will be found. She aſks then what could be the uſe of theſe veſſels? and anſwers, that to put them within the bud to keep the outſide warm is againſt nature, for it is contrary to nature. The leaf-bud in its firſt ſtate conſiſts of two or three ſcales, incloſing a parcel of veſſels, which appear like very moiſt coarſe cotton, but when drawn out and placed in the ſolar microſcope, they ſhew themſelves to be merely the veſſels of the bark and inner bark elongated and curled up in various forms.

Theſe veſſels are of three kinds like the bark, &c. Firſt, Three or four ſhort thick ones which appear to grow from the larger veſſels of the inner bark, and through which the thickened juice flows, but with this difference, that the holes are not there.

Then there are two ſmaller ſized veſſels, which exactly reſemble the ſmaller veſſels of the bark.

Mrs Ibbetſon has always found the ſhort thick kind of veſſels to form the mid-rib of the leaves, and the ſmaller-ſized veſſels to compoſe the interlacing fibres (or veſſels) of the other parts of the leaves; and from often comparing the full-grown leaf with the leaf of the bud, ſhe feels the moſt thorough conviction that the latter takes its origin as above noticed. The pabulum of the leaf which lies between the veſſels, is compoſed of that thick juice which runs in the bark or inner bark of the tree, and which does not exiſt in any other part of it. The pabulum differs eſſentially from the ſap, and may be called the blood of the tree, as it poſſeſſes peculiar properties in different trees; thus it is of a gummy nature in one, of a reſinous in a ſecond, and of an oily nature in a third, &c.

Mrs Ibbetſon is not certain whether the pabulum both flows forwards and in a retrograde direction; but ſhe is convinced that the greateſt part of it is taken up in forming the leaves. The pabulum of the leaf, after the veſſels are arranged and croſſed, grows over in bladders, making alternate layers with the ſmaller pipes (veſſels), and with the branches of the leaf.

Mrs Ibbetſon ſtates, that ſhe does not know any tree which gives a more convincing proof of the formation of the leaves in the bud, than may be ſeen in the horſe cheſnut (*æſculus hippocaſtanum*) about the month of November or December.

Several different mid-ribs may be taken out at once from the ſame leaf-bud, which have an innumerable number of extremely fine ſilken veſſels faſtened to or growing up from each ſide of them. When theſe veſſels have become ſufficiently interlaced with each other, the pabulum will begin to grow over them, in form of ſmall bladders full of a watery-juice; and then larger veſſels will croſs over them, which will ſoon be followed by another row of bladders, and a ſimilar proceſs will go on until the leaf has attained its proper thickneſs. The leaves thus formed are very ſmall, but when once their ſhape is completed every part of them continues to increaſe in ſize. Fig. 6. repreſents the leaf-bud of the horſe-cheſnut, as it was examined by Mrs Ibbetſon about the month of January. Fig. 6.

Vegetable Phyſiology.

Mrs Ibbetſon next notices the arrangement of the leaves in the buds of different trees; but we ſhall conſider them by and bye.

The rolling, folding, or plaiting, &c. of the leaf-bud, it is obſerved, does not merely take place at once; but to complete the proceſs of budding, it appears that this arrangement of the leaves is repeated ſeveral times. During this arrangement the bud-leaves are immerſed in the glutinous liquor which runs in the bark (and forms the pabulum); and the preſſure of the leaves is very great. By this preſſure and the rolling, &c. the leaves are completed; for if a leaf be taken from the bud before this proceſs commences, it may be compared to a piece of cloth before it is dreſſed; for its back will be obſcured by the ends of veſſels, which, had it remained *in ſitu*, would have been all rubbed off, except the hairs which remain on many plants.

We come now to the formation of the edge of the leaf, a curious and beautiful proceſs.

The bud if opened will appear full of the glutinous liquor which forms the pabulum, and the leaves arranged in the manner proper to the particular tree from which the bud is taken. If one of the leaves be taken out, the edges (in whatever manner folded) will exhibit a perfect double row of bubbles, following the ſcollop of the edge of the leaf; and it will appear as if it were ſet with brilliants.

Things being in this ſtate, all that is wanting for the completion of the leaf is the formation of the pores, now to be mentioned. Mrs Ibbetſon ſtates that in many hundred *forming leaves* which ſhe expoſed to the ſolar microſcope, ſhe had never once been able to ſee the pores; which ſhe has often obſerved after the leaves have completely quitted the bud; and ſhe is uncertain whether this is owing to the greater thickneſs of the young leaf, and its being covered with more hairs than it is afterwards, which obſcure or conceal the pores; or whether it be cauſed by the upper net-work of the leaf growing laſt. While the upper and under cuticles of the leaf are growing, the edge of it is completing; for the bubbles generally divide, and partly dry up, leaving horny points in their ſtead. When the edges of the leaves are completely formed, they burſt from the bud and aſſume a different aſpect.

The veſſels of the leaves (thoſe confined within the mid ribs and ſide ribs of the leaves) are of two ſorts, the ſpiral, and the nouriſhing. The ſpiral veſſels are thoſe corkſcrew-like wires which ſurround the two laſt rows of the ſap veſſels. The nouriſhing veſſels are the only parts formed of the wood. They convey the ſap neceſſary for the ſupport of the leaves, and run on each ſide of the ſpiral veſſels.

To prove that ſhe has given a fair and accurate account of the formation of the leaf, Mrs Ibbet-

ſon

Vegetable Physiology.

fon adds the following remarks. The colour of leaves, ſhe obſerves, is not to be found in their ſubſtance, but in the liquid with which it is filled. The darkeſt green leaf that can be procured, has both its upper and under cuticles of a perfect white colour. In the cuticle the pores are to be found.

A leaf has rather a thicker net below than it has above: but this does not ſufficiently account for the varieties of tints in different leaves.

The under net (or cuticle) does not lie ſo cloſe to the pabulum of the leaf as the upper one; which may account for the colour not piercing ſo much through. When the two nets (or cuticles) are taken off, then the pabulum of the leaf appears.

The pabulum is formed of little bladders, filled with a dark-green liquid, and interlaced with veſſels. When the pabulum is removed, a bed of large veſſels preſents itſelf; then a collection of bladders; which is followed by the larger lines (or veins) of the leaf. We next meet with another bed of bladders, which is covered by the under cuticle. Though the bladders differ in ſize and colour as well as in thickneſs in different leaves, yet the general arrangement is the ſame in moſt plants; but there are exceptions, as the firs, graſſes, or thoſe graſſy leaves of early ſpring, which we have in the iris, crocus, ſnow-drop, &c. for their leaves are of a different nature.

But we ſhall now refer to the figures, which will ſerve to illuſtrate the mode of formation, &c. of the leaf-bud.

Fig. 8. 9. Fig. 7. 8. 9. exhibit the commencement of the formation and growth of leaves; *a*, *a*, *a*, *a*, the mid rib; *b*, *b*, *b*, the young veſſels appearing like cotton; *c*, *c*, the ſpiral nerves; *d*, the ſmaller veſſels croſſing each other.

Fig. 10. Fig. 10. ſhews the formation of the pabulum; *e*, *e*, the fine veſſels growing up each ſide of the mid rib; *f*, the

Fig. 11. pabulum. Fig. 11. bud of the lime-tree (*tilia Europea*).

4. *Of the* FLOWERS, *including the calyx, corolla, ſtamina, and piſtillum.*—Linné long ago expreſſed his opinion that each of theſe parts was formed from a particular part of the ſtem; thus the calyx was formed by the bark, the corolla by the inner bark, the ſtamina by the wood, and the piſtilla by the pith. Linné alſo reckoned the pith of a plant (which he conſidered to be of equal importance with the ſpinal marrow of animals), as the ſole formative organ of the whole vegetable kingdom.

Linné's idea reſpecting the formation of the calyx, corolla, &c. has been often refuted; but Mrs Ibbetſon comes forward to defend the opinion of the illuſtrious author with a little modification. She does not, as already noticed, conſider the pith as of great importance; ſhe therefore ſays, that the corona or circle of life forms the piſtil, not the pith; and thinks that each part of the ſtem has, when it arrives near the flower ſtalk, its peculiar juice.

Mrs Ibbetſon, as a ſtrong proof that the circle of life forms the piſtil, ſays that it is to be found in all theſe leaves that bear the flower either on the middle or on their ſide; but in no other leaves.

She firſt obſerved this in the butcher's broom, where this circle leads directly up to the flower; then in ſcolopendrums, and afterwards in xylophyllos.

The leaves of ſuch plants are more woody than any others, as every one may know on breaking them. In ſueh plants alſo, the circle of life may be traced as leading from one flower to another. Vegetable Phyſiology.

Mrs Ibbetſon alſo thinks that all thoſe parts which concur in forming the flower alſo join in forming the fruit and ſeed.

Mrs Ibbetſon then adverts to the opinion of Wildenow, when he ſays, "we find in the ſpringing flower, elongations of air-veſſels, but we never ſee the elongations from each particular part, one forming the future calyx, another the corolla, and ſo forth." "For inſtance, in the common ſun-flower (*helianthus annuus*), where in an immenſe large receptacle, numerous ſmall flowers are placed, how ſhould theſe elongations be able to unfold themſelves into florets from the bark, inner bark, &c. through ſuch a receptacle? There would ariſe a confuſion amongſt theſe ſmall parts which is never met with."

"How ſhould, beſides, the ſtamina be formed in herbs, which are not ligneous, or the piſtil in plants which have no pith? Every one may thus eaſily conceive that all theſe opinions are mere hypotheſes, which may be refuted, even without the aid of anatomical diſſection.

Mrs Ibbetſon attaeks Wildenow's opinion, and ſays that he adduces the ſyngeneſian claſs to prove the accuracy of it, the claſs which contains the very plants that would have proved the miſtake of his argument, had he diſſected them.

Mrs Ibbetſon then propoſes the following queſtions to Wildenow. Why, if the nouriſhment of each part of the ſtem be not confined to each different part of the flower, does the whole arrangement of the parts *alter*, the moment it gets to the flower-ſtalk.

Why are there particular veſſels to confine and carry the juice to each peculiar part, if it were not of conſequence that this juice ſhould touch no other places? For what purpoſe is the curious and artificial management in the bottom and top of a ſeed-veſſel, which enables the diſſector to ſay, that "there are five diviſions of little veſſels proceeding from the wood; I know, therefore (though I do not ſee it), that this muſt be a pentandrian flower; here is but one middle veſſel proceeding from the circle of life (for the pith ſtops), it is therefore of the order monogynia; here are five diviſions of little veſſels proceeding from the inner bark, it muſt therefore have five petals?" Mrs Ibbetſon wiſhes others to be convinced of theſe facts as well as herſelf. If a cut be made above or below the ſeed-veſſel of a lily, a violet, or a tulip, ſhe thinks conviction of her accuracy will follow. Why in cutting above or below the ſeed-veſſel of a ſyngeneſian flower can you directly tell, whether it belong to the order ſuperflua, æqualis, or ſegregata? Look at the bottom of the ſeed-veſſel of the *ſonchus*; every *pin-hole* of the veſſel of the male is carried up by correſponding veſſels in the outward cuticle of the ſeed till it meets and joins the *ligature of the males*; and the female liquor is protruded through the inſide of the ſeed, and is perhaps one of the ſtrongeſt proofs of the impregnation of the female. In the ſyngeneſian claſs (ſee fig. 12.), the delicacy of the veſſels, which may be ſuppoſed too ſmall for a liquid to flow through them, muſt not impede the belief that it does ſo, when we conſider

Vegetable Physiology.

fider the circulation of blood in the diminutive animal that torments the body of the flea or louſe. Mrs Ibbetſon ſays ſhe has ſeen the liquor run up with the utmoſt celerity through the upper cuticle of a very ſmall ſeed of a plant belonging to the ſyngeneſian claſs, till it met the male and continued its courſe. It is to be underſtood that the juice from the corolla flows in the reſt of the cuticle, and that the largeſt veſſels are thoſe for the *male liquor*. See fig. 12. 13.

Fig. 12. 13.

II. Physiology of Plants.—In treating this part of the ſubject, we propoſe to conſider, firſt, the impregnation of ſeeds, and, ſecond, the irritability of vegetables.

1. *The impregnation of the ſeed.*—The inveſtigation of what is included under this title, forms one of the moſt beautiful and intereſting purſuits of the vegetable phyſiologiſt. Mrs Ibbetſon has communicated ſome curious obſervations on this ſubject. Provided with a powerful ſolar microſcope for opaque objects, ſhe proceeds to an examination of the ſeed, and the firſt ſhooting of the infant plant, or rather of the germ or veſſel which precedes it; and ſhe remarks that it is almoſt impoſſible to aſcertain the exact time when the ſeed is firſt formed in the pericarp; but that ſhe has always found it in the winter buds when they were large enough for diſſection.

It is curious to obſerve the veſſels, which, ſhe ſays, may properly be called the life, tracing their way to each flower-bud; for a ſeed may be ſaid to depend for perfection on two *ſeparate moments*: the one in which the life *firſt enters the ſeed*, when the whole outward form appears to be perfected; and the ſecond, when the impregnation of the ſeed takes place, by the ripening of the pollen.

But when the life enters, it leaves a little ſtring, and remains for a long time afterwards in a torpid ſtate. This ſtring croſſes the corculum, or heart of the ſeed, ſo called becauſe it is the cradle of the infant plant. She then ſtates that the ſeed is attached to the ſeed-veſſel by two diſtinct organs, termed by the firſt botaniſts the umbilical cord, but as ſhe thinks improperly, ſince they do not convey nouriſhment to the infant plant, which is wholly the office of the ſecond ſet of veſſels. We cannot agree with Mrs Ibbetſon in her opinion; for although the umbilical cord of an infant contains nouriſhing veſſels, it alſo contains nerves, and yet we would never think of reſtricting this term alone to the arteries. The firſt of the connecting organs Mrs Ibbetſon conceives to be the circle of life, firſt, becauſe without it the plant dies, and, ſecond, becauſe although every other part be eradicated by degrees and the circle of life be uninjured, the plant will grow again.

She has made theſe experiments many thouſand times and with the above reſults. The circle of life conſiſts of delicate ſimple veſſels, which carry a juice of a particular nature, and may be traced in every part lying between the wood and the pith. Theſe veſſels are not to be found in the leaf-bud; for they paſs by it to the female flower, where they eſtabliſh a new life in the ſeed: a life which will enable it to grow, but not to give life without impregnation. Theſe veſſels are the life, therefore, from which all flower branches grow and all root-threads proceed. In calling theſe veſſels the circle of life, Mrs Ibbetſon ſays ſhe only expreſſes what its office ſeems to denote.

Vegetable Physiology.

Mrs Ibbetſon goes on to deſcribe the next (or ſecond) organ by which the ſeed is attached to the ſeed-veſſel. It conſiſts of the nouriſhing veſſels, which ſhe is inclined to think proceed from the inner bark; at leaſt they may certainly be traced thence after the infant plant has left the ſeed. When introduced, they enter not the ſeed at the ſame place as the life does; they come not into the corculum, but paſs it, and ſpread themſelves over a ſmall ſpot below it, which is viſibly of a different nature from the reſt of the ſeed. In farinaceous plants this ſpot is yellow, and yields a milk-white juice; but in other ſeeds it is white, and gives a glutinous water of a ſweetiſh taſte. Mrs Ibbetſon thinks it probable that the nouriſhing veſſels come from the fruit *filled with this juice*, which medicated with that part of the ſeed (which very apparently diſſolves), they together form a nouriſhment ſuited to the infant plant. When the ſeed is ſo far perfected, it remains in an almoſt torpid ſtate, or growing very little; while the flower expands daily, and the ſtamens are haſtily advancing to their perfect ſtate.

It is now that by an almoſt imperceptible contraction of the lower part of the piſtil, the juice is raiſed to the ſtigma (A) on which it may be ſeen hanging in a large glutinous drop, which never falls off. As ſoon, however, as the mid-day heat abates, this juice, which is peculiar to the piſtil, retires again within the tube, the contraction ceaſing with the heat that cauſed it. The ſame proceſs goes on daily, till the ſtamina are ripe and ready to give out their interior powder to the piſtil, which is always ſo placed as to receive the greater part of it; and as the anther (B) requires only moiſture to burſt it, it ſoon yields that fine and imperceptible duſt, which quickly *melting and mixing with the beforementioned liquid*, forms a combination of ſo *powerful* and *ſtimulating* a quality, that it no ſooner runs down the interior of the ſtyle, and touches the nerve of life in the heart of the ſeed, than this veſſel ſhoots forth in the moſt ſurpriſing degree, forming directly a ſpecies of *circular hook* within the *void;* which in leſs than two days is often completely filled, though it had perhaps for many weeks before lain in an abſolute torpor. This circular nerve is ſoon covered by an excreſcence that hides it; but if the corculum be divided with a fine lancet, the circular hook is diſcoverable, until the young plant is near leaving its cradle or ſeed. At the turn of the hook the cotyledons grow, and the root ſhoots from the covered end. The plant may be now ſaid to lie in the ſeed in a contrary direction from that in which it will at a future time grow, ſince the root is above, and the ſtem below: but nature has provided for their change of place, ſince it is effected as they leave the ſeed. It has been already noticed that the nouriſhment of the infant plant

(A) In the journal it is ſaid "to the pointal;" but certainly ſtigma is meant, for piſtil and pointal are ſynonymous.

(B) In the journal it is called pollen, but anther muſt be meant.

Vegetable Physiology.

le plant is medicated between the juice brought in the nouriſhing veſſels, and the peculiar ſpot in the ſeed, forming a liquid which continues to abound; indeed the infant plant may be ſaid to *repoſe in it*, till the root has opened the whole or part of the ſeed. The root then changes its direction, and runs into the earth, ſoon forming a number of ſtringy hairs, which ſerve as ſo many ſuckers to draw the liquid nouriſhment from the earth, while the plant quickly ſhews, by the rapid progreſs it makes, the advantage it receives from its change of diet; for it ſoon raiſes itſelf from its proſtrate poſture, emerges from the ſeed, and is now ſeen in its proper direction. The above account, we think Mrs Ibbetſon juſtly remarks, affords a complete confirmation of the ſexual ſyſtem.

In the ſyngeneſian orders, the piſtil being moſtly ſingle, runs up from the ſeed; and the juice of the piſtil has no other way of reaching the pointal (ſtigma muſt be here meant), but by paſſing through the ſeed, which it does without producing any effect, or filling up the vacancy at the top of the corculum. But as ſoon as the juice of the piſtil becomes mixed with the pollen, which diſſolves in it, the void of the corculum is filled, the hook is ſoon afterwards formed, and the plant is rouſed to life. Mrs Ibbetſon relates ſome experiments which ſhe made to aſcertain whether the umbilical cord was, or was not, the life of the plant. She placed a bean in the earth, and when the infant plant was ready to leave the ſeed ſhe opened it with a fine lancet, and cut off the cotyledons, juſt where they join the heart and the circular hook which have been before deſcribed. She then tied a piece of very fine thread round the bean, and replaced it in the earth. The cotyledons grew again, though higher up, but they appeared very weak and ſickly for ſome time. She cut off the root of another bean which had been placed in the earth, and which was of the ſame age as the above, and found that the root grew again in a few days and appeared quite healthy.

In a third experiment ſhe ſeparated and cut off the nouriſhing veſſels from each ſide of the bean; but a great number of hairs grew from the wounded part, which, by attaining moiſture from the earth for nouriſhment, ſupplied the place of the veſſels cut off; ſo that it was not aſcertained whether or not the bean would live independent of theſe veſſels, which was the object of the experiment. We obſerve here, however, a grand proviſion of nature for the embryo plant: hairs being formed to ſupply it with moiſture when the nouriſhing veſſels are deſtroyed. Mrs Ibbetſon next took a bean which had been about four days in the earth, and opening it with great care took out with a fine lancet the part which ſhe eſteems the cord of life, that is the part which croſſes the corculum and ſhot forth on the firſt impregnation of the plant. *o o*, fig. 14. and 15. repreſent the nouriſhing veſſels of a bean; L to *n* two ſeminal leaves or cotyledons; *l l* the cord of life, which is more eaſily ſeen in the ſeed of the lily, fig. 15. *l l* croſſing the empty part of the corculum. Mrs Ibbetſon took a flower of the lilium genus, as having a large veſſel eaſily attained; and being careful not to ſeparate it from the nouriſhing veſſels, ſhe divided the line of life fig. 16. *l l*, cutting each thread between the ſeeds, and ſo cutting off their communication; but did not touch *o o*, which ſhe thinks is the nouriſhing veſſel.

The conſequence was, that the ſeeds of this flower were never impregnated. Mrs Ibbetſon next tried the effect of taking the nerve of life from the cheſnut, the walnut, acorn, &c.; firſt opening a ſeed without touching the nerve, that ſhe might be certain that the opening was not the cauſe of its death. Fig. 17. repreſents the heart taken out of a ſeed of the cheſnut; *l* is the circular hook already deſcribed; *o o* the nouriſhing veſſels, and *l l* the line of life, which was taken out from ſome ſeeds where it croſſes the heart at *m*. Fig. 18. is the ſeed of the gooſeberry; *o* the nouriſhing veſſels, *e* the line of life, and *m* the corculum or heart.

Fig. 17.

Fig. 18.

She found that all thoſe ſeeds from which ſhe took the nerve of life died; and that the others, which had been merely laid open, lived. She remarks that it is only at the beginning of life, that the plant can be killed by this proceſs; for when older, if the nerves of life decay, they ſhoot out above the declining part, and run into any part of the ſtem that is pure, to preſerve themſelves. Mrs Ibbetſon then ſtates that this nerve is the ſource of life in very decayed trees; and is alſo the cauſe of a double pith, or at leaſt the appearance of it, in many trees.

To obſerve this line of life, ſeeds muſt be examined in their firſt formation; for when it has done its office, it detaches itſelf. When the ſeed is boiled, the line of life and nouriſhing veſſels mark themſelves by becoming of a dark colour.

2. *Irritability of vegetables.*—In entering upon this ſubject, we ought to warn our readers, that very oppoſite opinions have been entertained reſpecting it; ſome phyſiologiſts of the greateſt eminence allowing that we have ſatisfactory proofs of the irritability of vegetables in a variety of plants, but more particularly in the motions of the mimoſæ, dionea, &c.; while others of no leſs reſpectability aſcribe theſe motions to the influence of light, heat, or ſome other mechanical agent.

As neither muſcles nor nerves have ever been demonſtrated in the vegetable ſtructure, of courſe the proofs of the irritability of vegetables are drawn from the intimate analogy which ſeems to exiſt between the motions of ſome plants and thoſe of animals. Some phyſiologiſts, from obſerving the ſimilarity of motions in the two kingdoms, were naturally led to aſcribe them to the ſame cauſe; others, from not being able to obſerve the ſame motive organs, namely, muſcles, in both kingdoms, denied that plants could poſſeſs irritability; a third ſet, waving the idea of irritability in the vegetable kingdom, have laboured to ſhew that the motions of plants depend on mechanical cauſes alone.

We ſhall firſt notice the obſervations of Mrs Ibbetſon, who aſcribes the motions of plants to the ſpiral wires which we have deſcribed. Her opinion is founded upon a number of new obſervations made with the ſolar microſcope, which we ſhall proceed to relate.

1ſt, The ſpiral veſſels are not to be found in any plants to which motion is unneceſſary.

She could not obſerve theſe veſſels in any of the firs, in any of the plants which ſpread their leaves upon the ſurface of the water, in any of the ſea weeds (c), of the lichens, or of the graſſes; and ſhe does not think

(c) She afterwards excepts the *conferva*, which have motion.

Vegetable Phyſiology.

that they exiſt in the ſcolopendrums or lemnas. We would here obſerve that if theſe obſervations were completely true, they would certainly afford a ſtrong proof in confirmation of her opinion; but we ſuſpect that they are not altogether juſt, eſpecially as we obſerve a diſcrepancy in the papers of Mrs Ibbetſon. Thus at one part ſhe has given us a very minute deſcription of the ſpiral veſſels in the runners of the *poa reptans*, and now ſhe ſays they are not to be found in the graſſes (D).

Mrs Ibbetſon's ſecond argument is, that if a plant whoſe leaves preſent their faces to the light, be turned ſo that the backs are to the ſun, the leaves in a few hours will regain their former poſition; but if this be often repeated, although the plant will not ſuffer, yet the leaves will be longer at every repetition in returning to their former ſituation, or will ceaſe to move at all. She accounts for this by ſaying, that the ſpiral-like elaſtic veſſels are relaxed by the operation, and loſe their power of coiling into their uſual form.

Others would account for the above fact by ſaying that the irritability of the plant was exhauſted by theſe repeated and unnatural actions; in the ſame manner as the mimoſa becomes gradually leſs ſenſible to impreſſions when too often renewed.

Mrs Ibbetſon's third argument is, that thoſe leaves which have moſt motion, are provided with moſt ſpiral veſſels, and have theſe veſſels moſt twiſted; as in the *populus tremula*.

Fourth proof. Mrs Ibbetſon divided the ſpiral veſſels of a vine leaf while growing, without touching the nouriſhing veſſels; and from that moment it never contracted, and when placed with its back to the light, it did not alter its poſition, though it was long before it decayed. Both electricity and galvaniſm cauſe theſe leaves to contract, by affecting the ſpiral wires (not the cuticle), for when the leaf is deprived of theſe veſſels it does not contract at all.

We would here remark that we ſuſpect much, in the above experiment, that more than the ſpiral veſſels was divided: at any rate there is very great diſcordance between Mrs Ibbetſon's experiments and that of M. Calandrini, who found that vine leaves turned to the light when they were ſeparated from the ſtem and ſuſpended by a thread.

Fifth argument. Mrs Ibbetſon obſerved, when ſhe placed ſome of the ſpiral veſſels taken from a cabbage leaf upon one end of a long netting needle, and cauſed a candle to approach, that they were much agitated, and at laſt flung themſelves off the needle. We think no concluſion can be drawn from what is here ſtated.

The freſh water *conferva* and the dodder tribe, are the only plants, without leaves, that Mrs Ibbetſon is acquainted with, which have ſpiral veſſels.

Mrs Ibbetſon ſays that the ſpiral veſſels are ſo very tough, and ſo very tightly coiled, in the leaf ſtem (*petiole*) of the *geranium cordifolium*, that ſhe has by means of them been enabled to draw up the leaf; but it is difficult to be done.

The ſixth proof is drawn from the effect produced by moiſture on Captain Kater's hygrometer, which will be noticed ſoon.

General Obſervations.—Mrs Ibbetſon ſays the ſpiral wires may be conſidered as a ſecondary cauſe of motion, as they are primarily acted upon by light and moiſture. By means of the ſpiral wire, all the movements of plants are made; by it, flowers open in the morning and ſhut in the evening; the leaves turn, and the creeping plants wind in their regular order. Mrs Ibbetſon ſays, the opening of the flower at a different time of the day, or its turning in a different manner, does not militate againſt the above ſtatement; as ſtrong light and dry weather produce a contraction of the wire, while darkneſs and moiſture effect a dilatation of it. It depends wholly upon the poſition in which the ſpiral wire is placed, whether by its dilatation the flowers ſhall be opened or ſhut, as in mechanics the ſame ſpring may be made to turn to the right or to the left, to open or to ſhut a box. Moſt of the flowers which Mrs Ibbetſon has obſerved to cloſe at noon, have an extremely limber corolla, formed only of a double cuticle without pabulum; and hence they are ſoon overcome by heat, and relaxation directly takes place; as in the *convolvulus nil*, the evening or tree primroſe, &c.

Vegetal Phyſiolo

We muſt add, however, that we regard this account of the ſpiral veſſels with ſome degree of doubt. We ſuſpect that the ſpiral veſſels, if they have the power of opening or ſhutting a flower, will always act in one uniform manner; i. e. if they are able to open it, they will always do ſo, and *vice verſa*.

The *nymphea alba* raiſes itſelf out of the water, and expands, about ſeven o'clock in the morning; and cloſes again, repoſing upon the ſurface, about four in the evening. Now its petals are much thicker than thoſe of the *leontodon taraxacum*, which ſhuts up its flowers between eight and nine in the evening.

We could multiply inſtances; but we conceive we have ſaid enough to ſhew, that the flowers with the moſt ſlender corolla are not uniformly thoſe which ſooneſt cloſe.

Mrs Ibbetſon ſays, contrary to the opinion of Mirbel, that the caſe in which the ſpiral veſſels are incloſed is capable of being ſtretched; indeed it is formed of ſo thin (or rather ſo looſe) a ſubſtance, as plainly to be intended to dilate and contract. The caſe is compoſed of a very few thin veſſels, interlaced with an extremely fine ſpiral wire; while the large ſpiral veſſels fill up the caſe in an irregular manner, the nouriſhing veſſels form a regular circle of tubes around it. See fig. 29. and 30.

Of the Indian graſs (*andropogon contortum* of Linné), of which Captain Kater's hygrometer is formed. —The chief part of it is made with the ſpiral awn of an Indian graſs, which readily untwiſts in a moiſt atmoſphere, and *vice verſa*. Now Mrs Ibbetſon aſks, if the moſt trifling change of moiſture can untwiſt one ſort of vegetable fibre, and by this means manage an inſtrument, why ſhould not a quantity of ſimilar formed fibres or ſpiral veſſels produce the ſame effect on leaves and flowers? She ſays, Captain Kater's hygrometer moves very ſenſibly if a finger be placed within half an inch of the fibre (awn.) Now, the moſt ſenſitive plant we have will not move but with the touch."

We are quite aware of the effects of moiſture on ſome vegetables.

(D) She found the ſpiral veſſels alſo in the *andropogon contortum*.

vegetables. We have ſtrong proofs of it in ſome of the moſſes, as in the *bryum hygrometricum*, which, if the fruitſtalk be moiſtened at the bottom, makes three or four revolutions; if the upper part be moiſtened, it turns the contrary way.

We can ſcarcely compare theſe motions with thoſe of the mimoſæ; for it is quite evident that they are produced by moiſture: but as we are to ſpeak of the motions of the mimoſæ in a little, we would only obſerve, that when Mrs Ibbetſon ſays "the ſenſitive plant will not move but with the touch," ſhe argues againſt herſelf; for this ſhews that it is acted upon by the ſame cauſes as animal muſcles, and that it is not governed by moiſture alone.

The only ſenſitive part of the Indian graſs is the awn, which is formed of a leather-like ſubſtance, infinitely thicker and ſtronger than the uſual ſpiral veſſels in plants. The awn is formed of two apparently flat pieces, with a cylindric hollow running through the middle, which is filled with a thick ſpiral wire. Fig. 21. 22. 23. and 24. Each ſide of the awn is briſtled; but the briſtles do not add to its ſenſibility.

Of the Nettle.—The awn or ſting of the nettle is a long pipe with a bag at the end divided into two parts; the ſmaller contains the poiſon, and the larger is ſituated below it. This bag ſeems alſo to be compoſed of a leather-like ſubſtance, and is likewiſe affected by light and moiſture.

The moment the upper part of the pipe is touched, the under part of the bag whirls up, breaks the poiſon bladder, and throws its contents violently up the pipe, burning the perſon who touches it.

Light thrown upon the bag by means of the ſolar microſcope, produces the ſame effect as touching it. The poiſonous liquor is protruded up the pipe with great force, till it iſſues out at the minute aperture at the point; but before it does ſo, the pipe is bent down with a jerk, by means of the ſpiral wire.

The ſpiral wire winds round the bag at the bottom of the pipe; and it is by the action of this wire that the bag is made to contract. The nettle lays down its ſtings every evening, juſt as the ſenſitive plant does its branches. See fig. 19, and 20.

Mimoſa Senſitiva.—The motions of this plant are regulated not only by the ſpiral wire, but alſo by a bag of a leather-like ſubſtance, which is capable of contraction and dilatation.

We ſhall next give Mrs Ibbetſon's plate reſpecting the ſtructure of this plant, with her deſcription.

Fig. 5. Fig. 25. is a repreſentation of the ſprings which govern each leaf; *d*, *d* is the ſtalk. Each leaf has a baſe *c*, *c*, which ſerves to concentrate the ſpiral wires. Theſe paſſing over in every direction, being drawn through the narroweſt parts of the ſtem *b b b b*, preſs the ſtem together; and, when touched, lay the leaves, one on the other, the whole way down the leaf-ſtalk. But, before the ſtimulus is applied, the ſtem is flattened in a contrary direction. The ball of the leaf is hollow and filled with oil. The parts *e e* and *p p* Fig. 26. (fig. 26.) are made of that leathery ſubſtance, which forms the cuticle, and is contracted by the light in the ſolar microſcope. The parts *e e* contain the oil which ſerves to lubricate the knots (we ſuppoſe), and enable them to ſlip over each other; beſide, probably, acting ſome important part in the formation of the various gaſſes and juices in the compoſition of the plant.

When touched, the whole ſtring relaxes at *o o*, and lets the branch fall. This it would alſo do at *m*, if it were not ſupported by the wood-veſſels turning into the leaf. Fig. 27. is the part *e e p p* uncut, and in its natural ſtate. Mrs Ibbetſon thinks that not only the motions of this plant, but of all others, depend upon the ſpiral wires which contract and dilate by the action of light and moiſture. She adds, that there are no ſpiral wires in the ſeminal leaves of the *mimoſa ſenſitiva*, and that the ſeminal leaves have no motion whatever.

In farther illuſtration of this ſubject, we ſhall next preſent our readers with ſome obſervations by Mr Lyall, lately publiſhed in Nicholſon's Journal *, reſpecting the irritability of the *mimoſa pudica*, and ſome other plants. * Vol. xxv. 92.

"It is well known (he obſerves), if we take a leaf of this plant, ſimilar to what is repreſented (fig. 31.), and then, by means of a pair of ſciſſars (completely dry), cut off half the pinnula A, this pinnula will contract at its joint, either immediately, or in a few ſeconds; its neighbour, or oppoſite pinnula, B, cloſing at the ſame time, or ſoon after.

"The pinnulæ A and B having come into contact, there is a pauſe, or a ſhort ceſſation, of motion; but in the courſe of a few more ſeconds, the next pair of pinnulæ, CC, will alſo ſhut up, and the ſame will happen with every pair of pinnulæ of that pinna ſucceſſively; only with this difference, that the intervals between the ſhutting up of each pair of pinnulæ will be ſhorter, the farther it is from the pinnula that was cut. After the whole of the pinnulæ of this pinna have completely cloſed, and a little interval, then the joint D will bend ſo as to allow the pinna to drop conſiderably.

"Nevertheleſs, the motion is often not ſo obvious in this joint, as in that to be mentioned.

"A longer pauſe will now intervene, in ſome caſes ſo long as to make us ſuppoſe that all motion is at an end; but at length the joint E ſuddenly bends, and aſtoniſhes the beholder.

"The petiole F now, inſtead of forming an acute angle with the ſtem above the joint, forms a very obtuſe angle with it.

"We ſhall now have another ceſſation of motion, and then the joint, H, will ſlightly bend; then another pauſe, then a ſhutting up of the pair of pinnulæ, II, and ſo on with the other pinnulæ, till the whole pinna is cloſed. The motions, however, will not be ſo regular in this pinna as they were in the other; for as the pinnulæ II approach, they preſs forward the next pair, and ſo on with all the reſt."

Theſe motions, the author ſuppoſes, are not occaſioned by impulſe; for a bit of the pinnula may be cut off almoſt without producing any motion.

But, allowing that a little motion were produced, it comes naturally as a queſtion, Why does the motion become ſo extenſive? how is the impulſe communicated to the origin of the petiole? The author does not think that theſe queſtions will ever be ſatisfactorily anſwered upon mechanical principles.

He admits indeed, that a ſtructure exiſts in the *mimoſa ſenſitiva*, correſponding to what Mrs Ibbetſon has deſcribed

Vegetable Phyſiology.

deſcribed; although he ſeems to have ſome doubts reſpecting it. He then proceeds to inquire, whether by ſuch a ſtructure, acted upon by heat, light, or moiſture, we could poſſibly explain the motions of the *mimoſa pudica*. "On the experiments above related, (he obſerves), I preſume no one would ſay, that moiſture was the cauſe of motion, as the ſciſſars were quite dry."

It is to be remembered alſo, that this plant will perform its motions under water.

As there was no change of light, conſequently this had no ſhare in the effect. Beſides, when moiſture is produced (Mr Lyall certainly means darkneſs) in conſequence of the abſtraction of light, all the pinnulæ ſhut up at the ſame time; not, however, in the regular order mentioned in the experiment. Neither does the motion take place from change of temperature, for the temperature was not altered.

A great many queſtions will here ſuggeſt themſelves, as, How does it happen that the motion is produced? how does it become ſo extenſive? how comes it that there are regular motions and pauſes, &c.?

The author concludes, by ſaying, that it is vain to attempt any mechanical ſolution of the phenomenon mentioned above, "which would ſeem to depend on an exquiſite irritability in the plant itſelf."

Dionæa Muſcipula.—Mr Lyall does not think that the motions of this plant are to be explained in the manner ſpoken of by Brouſſonet, who aſcribed them to the evacuation of a fluid from the leaf, which will be noticed when we ſpeak of the *droſeræ*. For the leaf may be touched without cauſing any efflux of fluid whatever, and yet it will contract completely.

Comparetti's explanation reſpecting the motion of this plant is not admitted; becauſe it ſeems improbable, is contrary to analogy, and inadequate to explain the phenomenon.

Of the Droſera Longifolia and Rotundifolia.—As many of the muſcles of the animal ſyſtem, as the heart, diaphragm, &c. act quite independent of the will, and as theſe parts are highly irritable, Mr Lyall wiſhes to ſhow, that a voluntary command of a muſcular force ſhould not be taken into the definition of the word irritability, as has been done by ſome. Mr Lyall ſays, "By irritability, I underſtand, that property inherent in ſome bodies (or rather parts of bodies), by which, when a ſtimulus is applied, they are enabled to contract.

The leaves of the droſera rotundifolia, when properly unfolded, lie round the ſtem in a ſtellated manner. The footſtalks of the leaves vary in length from half an inch to an inch and a half. The leaves are covered on their upper ſurface by a number of hairs, varying alſo in length from one line to three-eighths of an inch, and are each terminated by a little gland, which gland is covered by a tranſparent viſcid fluid, preſenting a fine appearance.

The chief difference between the droſera longifolia and rotundifolia is in the ſhape of the leaves; thoſe of the former being obovate, while thoſe of the latter are of an orbicular ſhape.

Mr Lyall mentions the obſervations of Mr Whately, who, it would appear, was the firſt in this kingdom who deſcribed the contractions of the droſeræ when irritated.

Mr Whately and Mr Gardom had obſerved ſome inſects impriſoned in the leaves of this plant, and hence were led to preſs with a pin the centre of other leaves in their natural and expanded form, when they very ſuddenly contracted, and, as it were, encircled the pin. Vegetal Phyſiolo

Roth had noticed, in 1779, that the leaves of the droſeræ moved, when irritated. He placed an ant upon the middle of a leaf of the droſera rotundifolia, but ſo as not to diſturb the plant. The ant endeavoured to eſcape, but was held faſt by the clammy juice of the points of the hairs, which was drawn out by its feet into fine threads; in ſome minutes the ſhort hairs on the diſk of the leaf began to bend, then the long hairs, and laid themſelves upon the inſect. After a while the leaf itſelf began to bend, and in ſome hours the end of the leaf was ſo bent inwards as to touch the baſe. The ſame happened when the experiments were made on the droſera longifolia, but more rapidly.

Roth alſo found that the hairs bent themſelves when he touched them with the point of a needle, with a hog's briſtle, or when he placed a very ſmall piece of wood the weight of an ant upon the leaves.

Mr Lyall next gives us an account of his own experiments. He ſays, "that for five months, he almoſt, every day, had the ſpecies of droſeræ under his eye, either at home or in the country;" and he confeſſes, that he never ſaw ſuch a rapid contraction of the leaves of the droſera rotundifolia, as had been noticed by Meſſrs Whately and Gardom: but in all his experiments the contraction was gradual, though it ſeldom failed to happen, if the plant was in good condition. In moſt of his experiments an hour was neceſſary for the complete bending of all the hairs; and it required ſome hours for the perfect ſhutting up of the leaves. Hence it is evident, that whoever has a wiſh to notice the motions of the droſeræ, muſt not ſet out with the expectation of ſeeing a rapid motion, ſimilar to what happens in the mimoſæ, follow the application of a ſtimulus; but, to obſerve the ultimate effects, muſt watch with an attentive eye, for at leaſt 20 minutes.

In accounting for the manner in which theſe motions are performed, various opinions have been held. Brouſſonet ſuſpects that the diſengagement of ſome fluids influences them. He ſays, that the inſect, by abſorbing the fluid which is on the points of the hairs, empties the veſſels of the leaf, which folds upon itſelf; and the quickneſs of the action is proportional to the number of hairs touched by the inſect.

Our author obſerves, that "this theory, at firſt ſight, does not appear even to be plauſible; for, how is it poſſible that an inſect can abſorb a thick tenacious fluid? No doubt, however, part of this fluid will be attached to the part of the inſect which touches it; but this ſeems quite unconnected with the contraction of the leaf. On the 30th of July, Mr Lyall brought from the country a number of plants of the droſera rotundifolia, and, on inſpecting them, he found many of the hairs of the leaves deprived of their viſcid fluid; but yet both they and the leaf remained quite expanded and in good condition. Next day, about four o'clock, he placed a ſmall bit of ſulphate of copper, in the diſk of one of theſe expanded leaves, and by ſix o'clock moſt of the hairs on one ſide of the leaf, even the outermoſt, had bent themſelves over the bit of copper; this ſeems

to

Vegetable Physiology.

to prove the inaccuracy of Brouſſonet's theory. In other experiments, he placed ſmall bits of bread or wood, on three or four of the central hairs, without touching the other hairs, or the viſcid fluid on their ends; and in a few hours he found that all the hairs had contracted around the foreign body. In ſome plants, the ſulphate of copper was placed upon ſome of the ſmall hairs in the diſk of the leaf, without touching the leaf itſelf; yet the bending of the hairs and leaf was complete.

"We have here proof (he adds), 1ſt, That the leaves do not contract when deprived of their viſcid fluid, which ought to have been the caſe if Brouſſonet's theory had been true. 2dly, That the contraction takes place even when the viſcid fluid does not cover the little glands. 3dly, That the contraction follows, although the foreign body is not brought into contact with all the hairs.

The opinion of Sennebier, who appears to have aſcribed the motions of the droſeræ to the effect of preſſure is next examined. "Sennebier ſeems (it is obſerved) ſenſible, that the contractions of the leaves take place even when light bodies are placed on them, which circumſtance of itſelf would lead us to ſuſpect, that preſſure is not alone the cauſe.

"I know (it is added), that, if we preſs on the centre of a leaf with a pin, &c. we may cauſe its margin to approximate the pin; and this certainly would be owing to a mechanical cauſe. But, ſuppoſe we ſee the contraction take place, as I have done, when a body ſpecifically lighter than the leaf itſelf is placed in the centre, as a bit of rotten wood; ſhould we be ſtill inclined to aſcribe it to a mechanical cauſe? Admit that it is the caſe. Suppoſe, then, we place the ſame bit of wood on the margin of the leaf, what effect ought to follow? If it were owing to a mechanical cauſe, or the weight of the foreign body, as in the laſt-mentioned caſe, then we ſhould expect, that the part of the margin of the leaf, on which the bit of wood reſted, would be depreſſed; which undoubtedly is not the caſe: but, on the contrary, the margin riſes, and then contracts towards the foreign body, or towards the footſtalk of the leaf.

"That this motion does not depend on preſſure, may be ſtill better illuſtrated, by placing a fly, or ſome other body, on the apex of a leaf of the droſera longifolia. The hairs near the foreign body will contract around it, and then the apex of the leaf will riſe upwards, and turn inwards, until it touches the baſe. Or, if the offending body is ſmall, the leaf will become convoluted around it."

From the reſult of his experiments, the author thinks, that the motions of the leaves of the droſeræ cannot be explained on mechanical principles. He conceives, that theſe motions are performed, if not by muſcles, at leaſt by *ſomething* which is equivalent to muſcles in the animal body.

It appears that the leaves of the droſera rotundifolia and longifolia remain completely expanded during the hotteſt ſunſhine and drieſt weather; during the coldeſt and wetteſt weather; during the greateſt darkneſs, and, finally, during the brighteſt light of day. This, however, is to be taken in a limited ſenſe, i. e. only during the expanſion of the leaves, not during the cold of winter. "Here, then, neither heat, cold, dryneſs, dampneſs, darkneſs, nor light in general, at all affect the leaves; but, if a foreign body be applied to the leaf ſo as to ſtimulate, then it will ſhut up" in the manner we have already deſcribed.

EXPLANATION OF PLATES DXLI. DXLII. AND DXLIII.

[*Note, that ſome errors in the references to figures in the text may be corrected by this explanation, which is accurate.*]

Fig. 1. Part of a branch, ſhewing the manner in which the line of life, *c c*, enters into the flower-bud, *a*, and paſſes by the leaf, *b b*.

Fig. 2. A flower-bud, ſhowing the line of life, *c c*, running up to each flower, *a*, *a*, *a*, *a*, *a*, *a*, *a*, and the pith terminating at *b*.

Fig. 3. Section of the ſtem of a tree; *a*, the rind; *b*, the bark; *c*, the inner bark; *d*, the wood; *e*, the ſpiral nerves; *f*, the corona or line of life; *g*, the pith; *h*, *h*, the ſilver grain; *o*, *o*, *o*, the baſtard grain.

Fig. 4. Cylinders of the inner bark.

Fig. 5. Cylinders of the wood.

Fig. 6, 7, 8, 9. Commencement of the growth of leaves, exhibited in different ſtages. *a*, *a*, *a*, *a*, The mid-rib; *b*, *b*, *b*, the young veſſels appearing like cotton; *c*, *c*, the ſpiral nerves; *d*, the ſmaller veſſels croſſing each other. Fig. 9. alſo ſhews *e*, *e*, the fine veſſels growing up each ſide of the mid-rib; and *f*, the pabulum.

Fig. 10. Leaf-bud of the lime-tree.

Fig. 11. Leaf-bud of the horſe-cheſnut about January.

Fig. 12. A ſeed-veſſel of the claſs ſyngeneſia; *a*, the calyx; *b*, female florets; *c*, male and female florets.

Fig. 13. Section juſt above the ſeed-veſſel of the dianthus. *a*, the calyx proceeding from the bark; *b*, the corolla, from the inner bark; *c*, *c*, *c*, *c*, ten ſtamina from the wood; *d*, the ſeed-veſſel; *e*, the piſtil from the corona or circle of life.

Fig. 14. Repreſentation of the bean. *o*, *o*, the nouriſhing veſſels; L to *n*, the ſeminal leaves, or cotyledons; *l*, to *l*, the embryo.

Fig. 15. *o*, The nouriſhing veſſels; *l l*, the embryo in the ſeed of the lily, croſſing the empty part of the corculum.

Fig. 16. Shews *l*, *l*, the line of life; *o*, *o*, the nouriſhing veſſels.

Fig. 17. Repreſents the heart taken out of the ſeed of a cheſnut. *l*, the circular hook; *o*, *o*, the nouriſhing veſſels; *l*, *l*, the line of life, which was taken out where it croſſes the heart at *m*.

Fig. 18. The ſeed of the gooſeberry. *o*, the nouriſhing veſſels; *l*, the line of life; *m*, the corculum or heart.

Fig. 19. The ſting of the nettle, as viewed with the ſolar microſcope; *z*, the bag of poiſon; *x*, the ſpiral wire.

Fig. 20. The ſting after the poiſon has been thrown to the point; *x*, the ſpiral wire contracted.

Fig. 21. Indian graſs greatly magnified, ſhowing the manner in which it is formed.

Fig. 22. Awn of the graſs.

Fig. 23. and 24. The graſs twiſted.

Fig. 25. Leaf of the mimoſa ſenſitiva.

Fig. 26. A longitudinal ſection of the leaf-ſtalk of the mimoſa ſenſitiva, the middle part containing five caſes of ſpiral wire, and each extremity only three.

Fig.

Vegetable Phyſiology ‖ Velez.

Fig. 27. The extremity of the uncut leaf-ſtalk, which is divided at *p p* in fig. 26.

Fig. 28. A horizontal ſection of the ſtem of the mimoſa.

Fig. 29. A caſe full of the ſpiral wire much magnified.

Fig. 30. Spiral wire ſtill more magnified.

Fig. 31. Leaf of the mimoſa pudica.

VEGETATIVE SOUL, among philoſophers, denotes that principle in plants, by virtue of which they vegetate, or receive nouriſhment and grow.

VEHICLE, in general, denotes any thing that carries or bears another along; but is more particularly uſed in pharmacy for any liquid ſerving to dilute ſome medicine, in order that it may be adminiſtered more commodiouſly to the patient.

VEII, in *Ancient Geography*, a city of Etruria, the long and powerful rival of Rome; diſtant about 100 ſtadia, or 12 miles, to the north-weſt; ſituated on a high and ſteep rock. Taken after a ſiege of 10 years by Camillus, ſix years before the taking of Rome by the Gauls: and thither the Romans, after the burning of their city, had thoughts of removing; but were diſſuaded from it by Camillus (Livy). It remained ſtanding after the Punic war; and a colony was there ſettled, and its territory aſſigned to the ſoldiers. But after that it declined ſo gradually, as not to leave a ſingle trace ſtanding. Famous for the ſlaughter of the 300 Fabii on the Cremera (Ovid). The ſpot on which it ſtood lies near Iſola, in St Peter's patrimony (Holſtenius).

VEIL, a piece of ſtuff, ſerving to cover or hide any thing.

In the Romiſh churches, in time of Lent, they have veils or curtains over the altar, crucifix, images of ſaints, &c.

A veil of crape is worn on the head by nuns, as a badge of their profeſſion: the novices wear white veils, but thoſe who have made the vows black ones. See the article NUN.

VEIN, in *Anatomy*, is a veſſel which carries the blood from the ſeveral parts of the body to the heart. See ANATOMY, N° 123.

VEIN, among miners, is a fiſſure in the horizontal ſtrata which contains ore, ſpar, cauk, clay, chert, croil, brownhen, pitcher-chert, cur, which the philoſophers call the *mother of metals*, and ſometimes *foil of all colours*. When it bears ore, it is called a *quick vein*; when no ore, a *dead vein*.

VELA, a remarkable cape on the coaſt of Terra Firma, in South America. W. Long. 71. 25. N. Lat. 12. 30.

VELARIUS, in antiquity, an officer in the court of the Roman emperors, being a kind of uſher, whoſe poſt was behind the curtain in the prince's apartment, as that of the chancellor's was at the entry of the balluſtrade; and that of the oſtiarii at the door. The velarii had a ſuperior of the ſame denomination, who commanded them.

VELEZ-DE-GOMARA, a town of Africa, in the kingdom of Fez, and in the province of Eriff. It is the ancient ACARTH. With a harbour and a handſome caſtle, where the governor reſides. It is ſeated between two high mountains, on the coaſt of the Mediterranean ſea. W. Long. 4. 0. N. Lat. 35. 10.

VELITES, in the Roman army, a kind of ancient ſoldiery, who were armed lightly with a javelin, a caſk, cuiraſs, and ſhield.

Velites ‖ Veneering.

VELLEIUS PATERCULUS. See PATERCULUS.

VELLUM, is a kind of parchment, that is finer, evener, and more white than the common parchment. The word is formed from the French *velin*, of the Latin *vitulinus*, "belonging to a calf."

VELOCITY, in *Mechanics*, ſwiftneſs; that affection of motion whereby a moveable is diſpoſed to run over a certain ſpace in a certain time. It is alſo called *celerity*, and is always proportional to the ſpace moved. See QUANTITY, N° 11 and 14, &c.

VELVET, a rich kind of ſtuff, all ſilk, covered on the outſide with a cloſe, ſhort, fine, ſoft ſhag, the other ſide being a very ſtrong cloſe tiſſue.

The nap or ſhag, called alſo the *velveting*, of this ſtuff, is formed of part of the threads of the warp, which the workman puts on a long narrow-channelled ruler or needle, which he afterwards cuts, by drawing a ſharp ſteel tool along the channel of the needle to the ends of the warp. The principal and beſt manufactories of velvet are in France and Italy, particularly in Venice, Milan, Florence, Genoa, and Lucca: there are others in Holland, ſet up by the French refugees; whereof that at Haerlem is the moſt conſiderable: but they all come ſhort of the beauty of thoſe in France, and accordingly are ſold for 10 or 15 per cent. leſs. There are even ſome brought from China; but they are the worſt of all.

VENAL, or VENOUS, in *Anatomy*, ſomething that bears a relation to the veins. This word is alſo uſed for ſomething bought with money, or procured by bribes.

VENEERING, VANEERING, or *Fineering*, a kind of marquetry, or inlaying, whereby ſeveral thin ſlices or leaves of fine wood, of different kinds, are applied and faſtened on a ground of ſome common wood.

There are two kinds of inlaying: the one, which is the more ordinary, goes no farther than the making of compartiments of different woods; the other requires much more art, and repreſents flowers, birds, and the like figures. The firſt kind is what we properly call *veneering*; the latter we have already deſcribed under MARQUETRY.

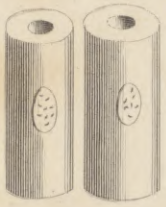
The wood intended for veneering is firſt ſawed out into ſlices or leaves, about a line thick: in order to ſaw them, the blocks or planks are placed upright in a kind of vice or ſawing preſs: the deſcription of which may be ſeen under the article juſt referred to. Theſe ſlices are afterwards cut into ſlips, and faſhioned divers ways, according to the deſign propoſed; then the joints being carefully adjuſted, and the pieces brought down to their proper thickneſs, with ſeveral planes for the purpoſe, they are glued down on a ground or block of dry wood, with good ſtrong Engliſh glue. The pieces thus joined and glued, the work, if ſmall, is put in a preſs; if large, it is laid on the bench, covered with a board, and preſſed down with poles, or pieces of wood, one end whereof reaches to the ceiling of the room, and the other bears on the boards. When the glue is quite dry they take it out of the preſs and finiſh it; firſt with little planes, then with divers ſcrapers, ſome whereof reſemble raſps, which take off dents, &c. left by the planes. When ſufficiently ſcraped, the work is poliſhed with the ſkin of

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.



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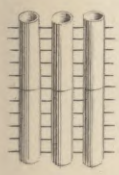

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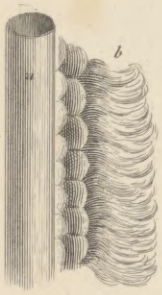

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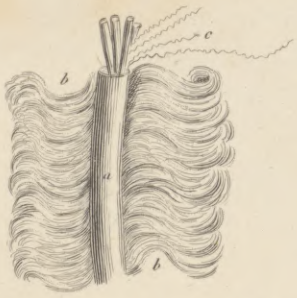

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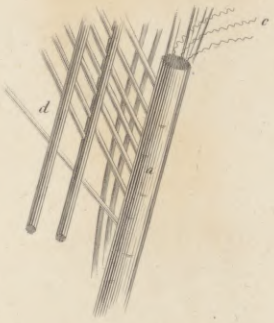

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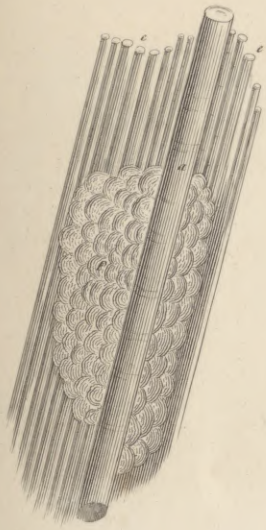

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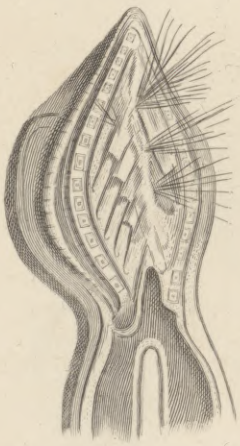

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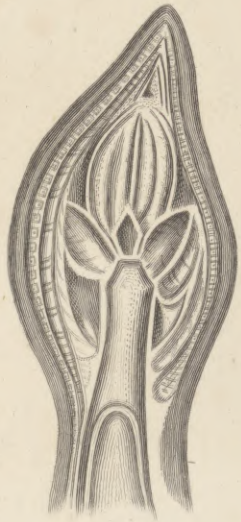

E. Mitchell, fculp!

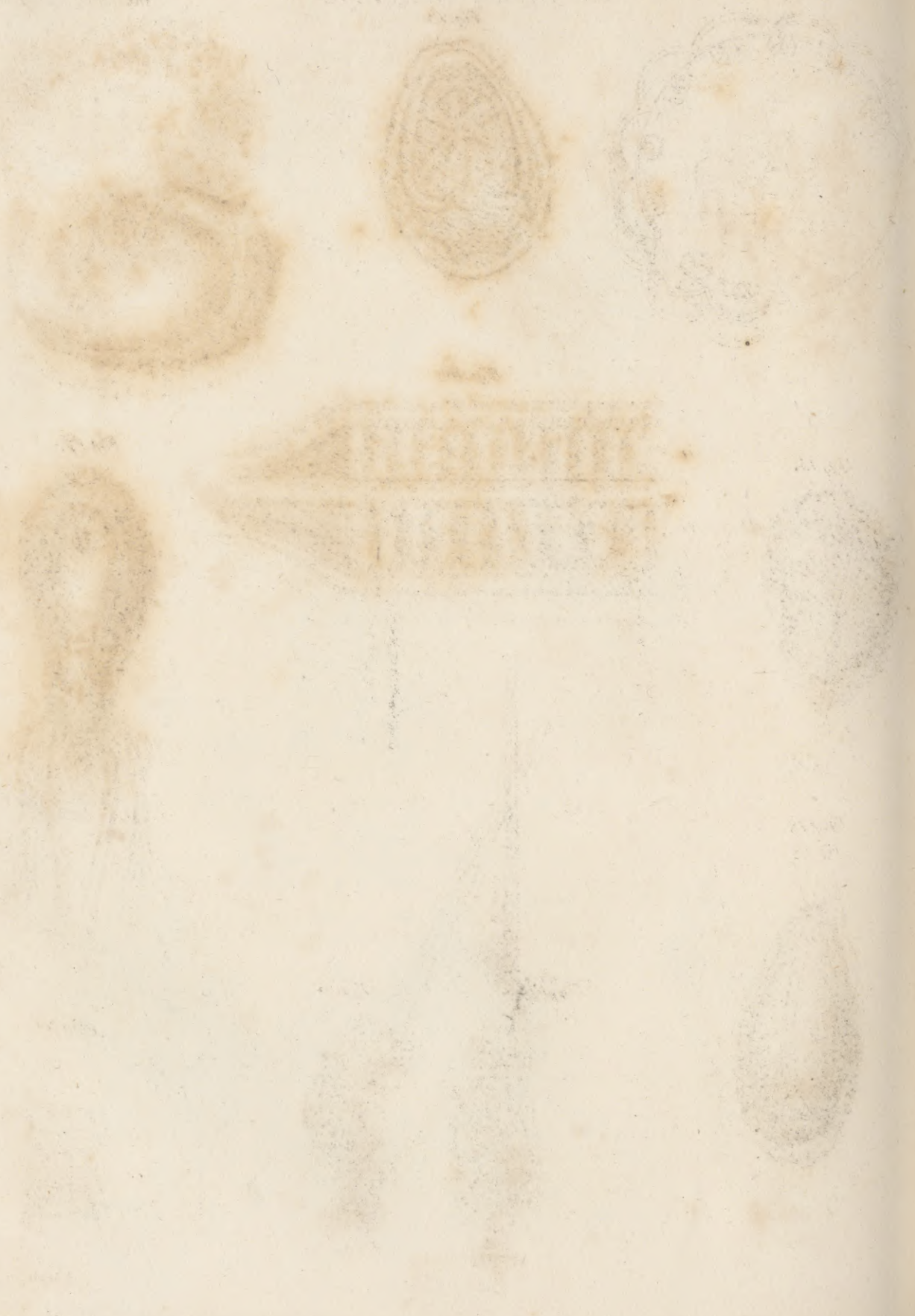

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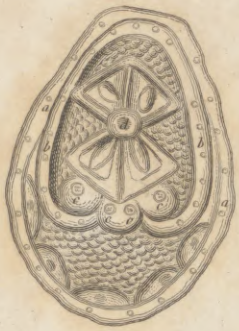
Fig. 13.



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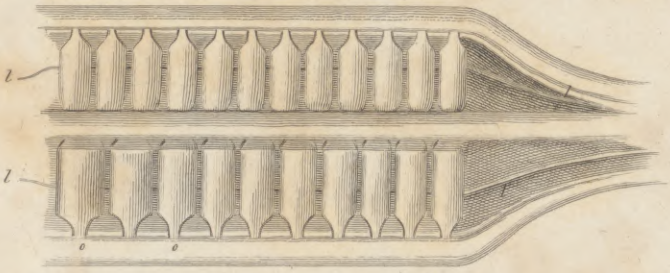

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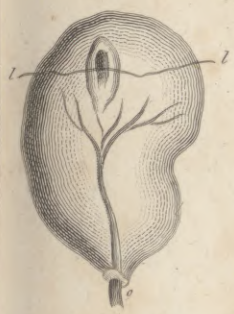

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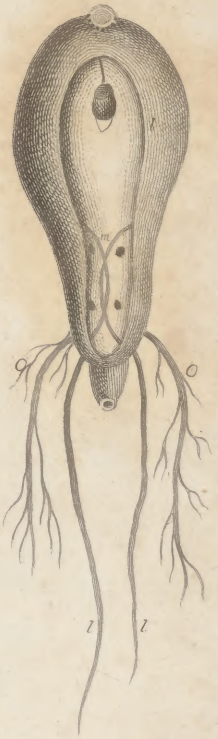

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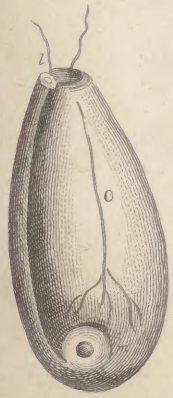

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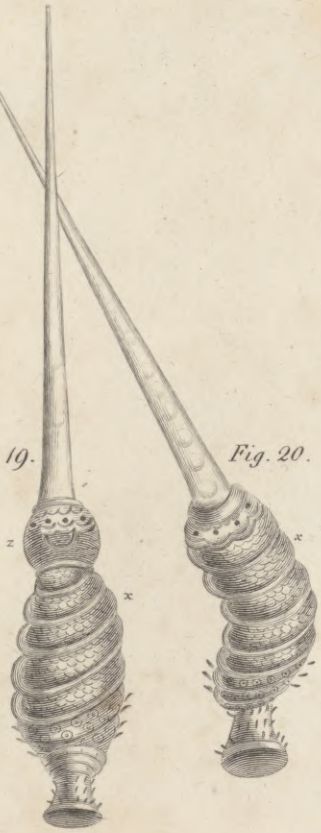
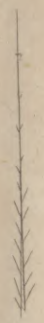


Fig. 20.

Fig. 21.

E. Mitchell sculpt.

Fig. 22.



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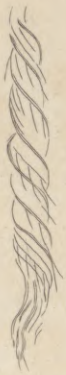

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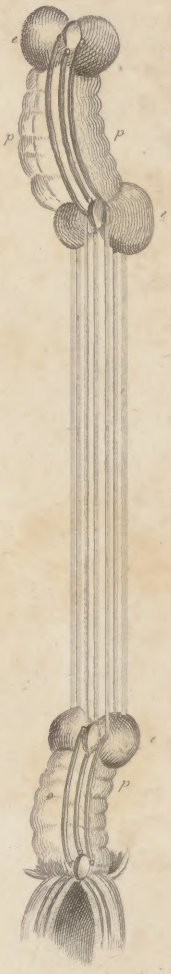

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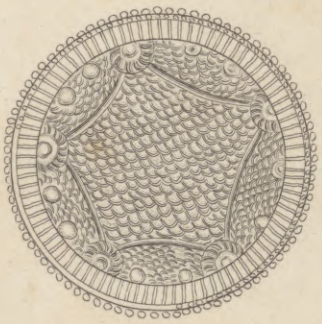

Fig. 29.

Fig. 30.

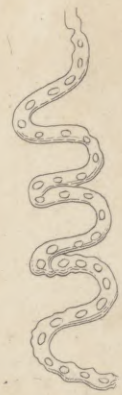

Fig. 31.

E. Mitchell sculp.

neering a sea dog, wax, and a brush and polisher of shave-grass: which is the last operation.

enice. VENEREAL, something belonging to venery; as the *lues venerea*, &c. See MEDICINE *Index*.

VENERY, is commonly used for the act of copulation, or coition, between the two sexes; it has also been employed by old writers as applicable to hunting or *the chace*, as *beasts of venery*.

VENESECTION, or PHLEBOTOMY, in *Surgery*. See SURGERY *Index*.

VENETIAN BOLE, a fine red earth used in painting, and called in the colour shops *Venetian red*.—It is dug up in Carinthia, and sent from Venice to all parts of the world; but the use of it is much superseded by a bright colcothar of vitriol.

VENICE, STATE OF, a celebrated republic, which for nearly ten centuries formed one of the most powerful of the maritime states of Europe. Its dominions lay chiefly along the coasts at the head of the Adriatic sea, comprehending not only a considerable tract round the city of Venice, but several districts both to the east and west of that sea, together with the islands of Corfu, Zante, Cephalonia, Cerigo, and some others of less note in the Archipelago. It was bounded to the north by the Alps, to the west by the duchy of Milan, and to the east by Croatia, a province of Turkey in Europe.

The republic of Venice is said to have taken its rise from a small Italian colony, who in the middle of the 5th century were driven by Attila king of the Huns from the cities of Aquileia, Verona, Mantua, &c. and took refuge in the group of small islands where now stands the city of Venice. Here they established themselves, and formed a small independent state, adopting the consular form of government which had so long prevailed at Rome. By the end of the 5th century they had become of consequence, and were able to raise and maintain a fleet and a small army. They engaged in a war with the Lombards, and distinguished themselves against the Istrian pirates, and the inhabitants of the neighbouring port of Trieste. They also assisted Justinian in his contest with the Goths, and received from him and his general Narses, many marks of favour and distinction.

About the year 697, the tribunitian power, which had prevailed in Venice from the end of the 5th century, was abolished, and the states elected a supreme magistrate, whom they called doge, or duke. He was to represent the honour and majesty of the state; to assemble and preside at the great council, where he had a casting vote in all disputed points; to nominate to all offices, places, and preferments, and to enjoy the same authority in the church as in the state. Excepting a short intermission of about five years, the power of the doges continued till the fall of the republic.

Under the doges, the power and wealth of the republic continued to increase. In 765, the Heraclians and Gezulans, subjects of the republic, revolted, and threw themselves on the protection of the emperor Charlemagne. That emperor settled them for the present at Malamoe, in the neighbourhood of the Venetian capital; but from this asylum they were quickly driven by the forces of the republic. Incensed at this affront committed against his authority, Charlemagne ordered his son Pepin to declare war against the Venetians; but as Astolphus king of the Lombards was then laying waste the territories of the church, the troops of Pepin were, by the intreaties of the pope, dispatched against that powerful monarch; and though, on the defeat of Astolphus they marched against the Venetians, it does not appear that the enterprise was productive of either honour or success. The war with Pepin was renewed in 804, on occasion of Obelerio, the doge of Venice, shewing an inclination to favour the Greek emperor Nicephorus against Pepin. Obelerio was related to the French monarch, having married his sister; and as on this account the Venetians were jealous of the attachment of their doge, he was superseded, and Valentin nominated commander in his place. Pepin had collected a numerous and well appointed army, and had fitted out a fleet to act against the Venetians by sea. With this formidable force he advanced directly to Venice, but here he was opposed with all the valour of independent citizens fighting for their liberties. Venice.

5 Intrepidity and success of the Venetians. An. 804.

The Venetians, however, notwithstanding the most obstinate defence, the most vigorous sallies, and their selling every inch of ground at an incredible expence of blood, were at length reduced to that part of the city south of the Rialto (*see the next article*); this stream and their own bravery, being now their only defence. While Pepin was preparing to throw a bridge over the canal, they resolved, as a last effort, to attack Pepin's fleet, and to vanquish or die in defence of their liberty. Embarking all the troops they could spare, they bore down with the advantage of the wind and tide, upon the enemy, and began the attack with such fury, as obliged the French admiral to give way. The lightness of their ships, and the knowledge of the soundings, gave the Venetians every advantage they could wish: the enemy's fleet was run aground, and the greater part of their troops perished in attempting to escape: the ships were all to a few either taken or destroyed. During this action at sea, Pepin resolved to assault the city by land, not doubting but the garrison was so weakened by the number of forces they had sent on board the fleet, as to be able to make but a slight resistance. Having for this purpose thrown a bridge over the Rialto, he was marching his troops across it, when he found himself attacked on every side by the Venetians from their boats, and others who had posted themselves on the bridge. The battle was long, bloody, and doubtful, until the Venetians employed all their power to break down the bridge; which at last yielding to their obstinate endeavours, a prodigious slaughter of the French ensued; they fought, however, like men in despair, seeing no hopes of safety but in victory; but all communication being cut off with the troops on shore, they were to a man either killed or drowned. The number of slain was so great, that the space between the Rialto and Malamoe was covered with dead bodies, and has ever since gone by a name expressive of the prodigious slaughter. Pepin was so struck with the intrepidity of the Venetians, that he raised the siege, abandoned the enterprise, and concluded a peace with the republic.

6 Venetian fleet defeated by the Saracens. An. 839.

In 839, the Venetians engaged in an offensive and defensive alliance against the Saracens, with the Greek emperor Michael, to whose assistance they sent a fleet of 60 galleys. In an engagement which took place between the allied fleets and that of the Saracens, the former

Venice.

mer were completely defeated, and almoſt all the Venetian galleys were either taken or deſtroyed. On the news of this defeat, the capital was thrown into the greateſt conſternation, juſtly dreading an attack from the victorious Saracens. This alarm, however, ſoon ſubſided, on finding that the barbarians had turned off on the ſide of Ancona. The city now became a prey to internal diſſenſion. Popular tumults were frequent, and in one of theſe the doge was murdered. By the prudent and vigorous adminiſtration of a ſucceeding doge, Orſo Participato, good order was re-eſtabliſhed, and at the commencement of the 10th century, the reputation of the republic for military proweſs was much advanced by a victory gained over the Huns, who had invaded Italy, and defeated Berengarius.

7 Increaſed power of the republic. An. 1084.

Towards the cloſe of the 11th century, Venice began to make a conſiderable figure among the ſtates of Europe, having acquired the ſovereignty of Dalmatia and Croatia, with which in 1084 they were formally inveſted by the Conſtantinopolitan emperor.

8 Take an active part in the cruſades. An. 1096.

About this time a cruſade, or holy war againſt the Saracens, was preached up by the emiſſaries of the pope, and the Venetian republic engaged in the undertaking with ſuch ardour, as to equip a fleet of 200 ſail, under the command of the doge Vitalis Michael. Before he ſailed for the coaſt of Aſia, however, the doge found it neceſſary to chaſtiſe the Piſans, whom he defeated in a terrible engagement. He then ſailed for Aſkalon, at that time beſieged by the Chriſtian forces, and it was chiefly by his valour that that city, as well as Caipha and Tiberias, fell into the hands of the Chriſtians. From theſe victories he was recalled to repel an invaſion of Dalmatia by the Normans, whom he alſo defeated, carrying off conſiderable booty. His ſucceſſor aſſiſted Baldwin in the conqueſt of Ptolemais, but was defeated and killed in attempting to quell a rebellion of the Croatians.

9 Diſpute with the Greek emperor,

Under the government of Domenico Micheli, who ſucceeded Ordelapho, the pope's nuncio arrived at Venice, and excited ſuch a ſpirit of enthuſiaſm among all ranks and degrees of men, that they ſtrove whoſe names ſhould be firſt enrolled for the holy war. The doge, having fitted out a fleet of 60 galleys, ſailed with it to Joppa, which place the Saracens were at that time beſieging. The garriſon was reduced to the laſt extremity when the Venetian fleet arrived, which ſurpriſed and defeated that of the enemy with great ſlaughter; ſoon after which the Saracens raiſed the ſiege with precipitation. Tyre was next beſieged, and ſoon was obliged to capitulate; on which occaſion, as well as on the taking of Aſcalon, the Venetians ſhared two-thirds of the ſpoils. While the doge was abſent on thoſe important affairs, the emperor of Conſtantinople, jealous of the growing power of the Venetians, reſolved to take advantage of their apparent incapacity to reſiſt an attack at home. The Venetians, however, had timely notice of his approach, and inſtantly recalled the doge, who on his return laid waſte and deſtroyed the country round Chios, ſeized on the iſlands of Samos, Leſbos, and Andros, then belonging to the emperor, and reduced ſeveral places in Dalmatia which had revolted.

10 and with Barbaroſſa. An. 1173.

In 1173, the republic ventured to oppoſe Frederick Barbaroſſa in his attack on the pope. Frederick, after a haughty reply to an embaſſy ſent him by the Venetians, diſpatched againſt them his ſon Otho, who ſoon arrived before the city with 75 galleys. The doge Sebaſtiano Ziani ſailed out with the few veſſels he had got equipped, to give the enemy battle. The fleets met off the coaſt of Iſtria, and a terrible engagement enſued, in which the imperial fleet was totally defeated, Otho himſelf taken priſoner, and 48 of his ſhips deſtroyed. On the doge's return, the pope went out to meet him, and preſented him with a ring, ſaying, "Take this, Ziani, and give it to the ſea, as a teſtimony of your dominion over it. Let your ſucceſſors annually perform the ſame ceremony, that poſterity may know that your valour has purchaſed this prerogative, and ſubjected this element to you, even as a huſband ſubjecteth his wife." Otho was treated with the reſpect due to his rank, and ſoon conceived a great friendſhip for Ziani. At laſt, being permitted to viſit the imperial court, on his parole, he not only prevailed on his father to make peace with the Venetians, but even to viſit their city, ſo famed for its commerce and naval power. He was received with all poſſible reſpect, and on his departure attended to Ancona by the doge, the ſenate, and the whole body of the nobility. During this journey he was reconciled to the pope; and both agreed to pay the higheſt honours to the doge and republic.

Venice.

11 They gain poſſeſſion of Conſtantinople, An. 1204

In the beginning of the 13th century, the Venetians in conjunction with the French, beſieged and took Conſtantinople, as has been related under the article CONSTANTINOPOLITAN HISTORY, N° 144—146, which they held till the year 1261.

12 War with the Genoeſe.

In the mean time the Genoeſe, by their ſucceſsful application to commerce, having raiſed themſelves in ſuch a manner as to be capable of rivalling the Venetians, a long ſeries of wars took place between the republics; in which the Venetians generally had the advantage, though ſometimes they met with terrible overthrows. Theſe expenſive and bloody quarrels undoubtedly contributed to weaken the republic notwithſtanding its ſucceſſes. In the year 1348, however, the Genoeſe were obliged to implore the protection of Viſconti duke of Milan, in order to ſupport them againſt their implacable enemies the Venetians. Soon after this, in the year 1352, the latter was utterly defeated with ſuch loſs, that it was thought the city itſelf muſt have fallen into the hands of the Genoeſe, had they known how to improve their victory. This was in a ſhort time followed by a peace; but from this time the power of the republic began to decline. Continual war with the ſtates of Italy, with the Hungarians, and their own rebellious ſubjects, kept the Venetians employed, ſo that they had no leiſure to oppoſe the Turks, whoſe rapid advances might have alarmed all Europe. After the deſtruction of the eaſtern empire, however, in 1453 the Turks began more immediately to interfere with the republic. Whatever valour might be ſhewn by the Venetians, or whatever ſucceſſes they might boaſt of, it is certain the Turks ultimately prevailed; ſo that for ſome time it ſeemed ſcarcely poſſible to reſiſt them. What alſo contributed greatly to the decline of the republic, was the diſcovery of a paſſage to the Eaſt Indies by the Cape of Good Hope in 1497. Till then the greateſt part of the Eaſt India goods imported into Europe paſſed through the hands of the Venetians; but as ſoon as the Cape was diſcovered, the conveyance by the way of Alexandria almoſt entirely ceaſed. Still, however, the Venetian

An. 1348.

power

power was ſtrong; and in the beginning of the 16th century they maintained a war againſt almoſt the whole force of France, Germany, and Italy, aſſociated againſt them in what has been called the *League of Cambray*. Soon after, however, we find them entering into an alliance with the king of France againſt the emperor.

After this, nothing of importance occurs in the hiſtory of the Venetian republic till the year 1645, when the republic was involved in a new and ſanguinary conflict with the Turks, in defence of the important iſland of Candia. The tranſactions to which this war gave riſe, and the ſpirit and bravery diſplayed by the Venetians, in defending their colonial poſſeſſions, are amply detailed under the article CANDIA.

At the end of the 17th century, the Venetians obtained an important acquiſition of territory by the conqueſt of the Morea, which at the peace of Carlowitz in 1699, was formally ceded by Turkey to the ſtate of Venice *.

During the war of the Succeſſion, the ſtates of Venice obſerved a ſtrict neutrality. They conſidered that diſpute as unconnected with their intereſts; taking care, however, to keep on foot an army on their frontiers in Italy, of ſufficient force to make them reſpected by the belligerent powers. But ſoon after the peace of Utrecht, the Venecians were again attacked by their old enemies the Turks, who beholding the great European powers exhauſted by their late efforts, and unable to aſſiſt the republic, thought this the favourable moment for recovering the Morea, which had been ſo lately raviſhed from them. The Turks obtained their object, and at the peace of Paſſarowitz in 1715, which terminated this unſucceſsful war, the Venetian ſtates yielded up the Morea; the grand ſeignior on his part reſtoring to them the ſmall iſlands of Cerigo and Cerigetto, with ſome places which his troops had taken during the courſe of the war in Dalmatia.

From the peace of Paſſarowitz to the concluſion of the 18th century, the affairs of Venice ceaſed to form an intereſting part of the hiſtory of Europe. Ever ſince the league of Cambray, the republic, weakened by its continual ſtruggles with Turkey, had declined in power and in conſequence, and was incapable of oppoſing a barrier to the encroachments of its more powerful neighbours. During the firſt war which the French republic maintained againſt the emperor in Italy, the ſtates of Venice afforded a tempting object to each of the contending parties; and in May 1797, the capital was occupied by a body of French troops, who under pretence of quelling a tumult that had ariſen in the city, took poſſeſſion of the forts, and ſubverted the exiſting authorities. By the treaty of Campo Formio, concluded between the emperor and the French republic in October of the ſame year, the French conſented that the emperor ſhould take poſſeſſion of the Venetian territory, with the iſlands in the Archipelago, which had been ſubject to the Venetian republic; and by the ſubſequent treaty of Luneville in 1801, this acceſſion of territory to the houſe of Auſtria was confirmed, ſo that the Venetian republic muſt now be conſidered as an Auſtrian province.

It is not neceſſary for us to be very minute in our account of the late conſtitution and government of Venice. The government was ſtrictly ariſtocratical, being veſted in the great council or ſenate, in which each of the nobility had a ſeat. The nobility were extremely numerous, being computed at not fewer than 2000, whereas the whole population of the ſtate did not exceed 2,500,000. Beſides the great council, or *il conſiglio grande*, there were four others; one compoſed of the doge and ſix counſellors, called *la ſignoria*; another called *il conſiglio du pregodi*, conſiſting of about 250 of the nobility; a third united to *la ſignoria*, conſiſting of 28 aſſeſſors, or great ſages, which gave audience to ambaſſadors; and a fourth, compoſed of 10 counſellors, who took cognizance of all criminal matters, and before whom even the doge himſelf muſt appear, if accuſed. The ſecret buſineſs of the ſtate was often carried on by ſpies and informers; and there were in the ducal palace ſeveral ſtatues of lions with open mouths, which formed ſo many receptacles for ſecret and anonymous information. Venice.

The office and privileges of the doge of Venice have been already mentioned under the article DOGE. Of late this office was little more than nominal; and the doge was a mere ſtate puppet, without authority and without power. His eſtabliſhment, however, was ſplendid, and his revenue not contemptible The mode of electing the doge deſerves notice, as it was well calculated to prevent bribery, or the exertion of party influence. He was elected by a plurality of voices, and held his dignity for life. In his election they made uſe of gold and ſilver balls, which were put into a veſſel, and ſerved for balloting. Thoſe who drew nine golden balls, firſt elected 40 counſellors, who drew 12 others, and elected 25 in addition. Of this number nine perſons, who had drawn golden balls, choſe 40 more; 11 of thoſe, appointed in the ſame way, choſe 41 counſellors, who finally proceeded to the election, till 25 votes or more fell upon the ſame perſon, who was then declared doge. After this election they placed the ducal cap upon his head, upon which he took poſſeſſion of the doge's palace. He never uncovered his head to any perſon, becauſe he did not wear the cap in his own name, but in that of the republic.

The military ſtrength of the Venetians conſiſted of nearly 30,000 land forces, under the command of a capitano, who was always a foreigner of diſtinction; beſides a conſiderable fleet, which they boaſted could, in time of war, be increaſed to 60 men of war, and above 100 galleys. The ordinary revenues of the ſtate have been computed at rather more than 1,000,000l. ſterling, a conſiderable part of which aroſe from the cuſtoms, and the duty on ſalt made at Corfu and Chioſa.

VENICE, the city which was the ſeat of government of the Venetian republic, is built on 72 ſmall iſlands at the head of the Adriatic or gulf of Venice, about five miles from the main land. That part of the gulf which lies between the city and the continent forms a kind of *laguna* or lake, which, at low water, is very ſhallow, and on the oppoſite ſide of the iſlands there are numerous ſhallows, the channels between which are marked by ſtakes, to direct ſhips in entering the port. The lagunes that lie between the iſlands form ſo many canals that interſect the city in all directions, and over theſe the ſtreets communicate by not fewer than 500 bridges. The principal or *great* canal is broad, and has a ſerpentine courſe through the middle of the city, but the others are narrow and crooked. The ſtreets are alſo narrow and winding, but clean and neat. The houſes are built on piles, and have each a door opening to the

Venice
||
Ventilator.

adjacent canal, and another to the ſtreet. As the narrowneſs of the ſtreets but ill adapts them for walking in, the only places of reſort on land are the *Rialto*, a noble bridge acroſs the great canal, bordered with booths and ſhops, and the great ſquare of St Mark, or *Piazza di St Marco*, an irregular quadrangle, formed of ſeveral buildings, ſome of which are magnificent. Of theſe, the *ducal palace*, where the buſineſs of the ſtate uſed to be tranſacted; the patriarchal church of St Mark; the ſteeple of St Mark, at a little diſtance from the church; the church of St Geminiano; and the *new* and *old Procuraries*, are moſt deſerving the notice of travellers. The canals form the great medium of communication, as well as the principal ſcene of relaxation and amuſement to the inhabitants. Here ply numerous gondolas, (ſee GONDOLA, and *Macgill's Travels*, vol. i.) which are rowed with admirable ſpeed and dexterity by the gondoliers; and here are occaſionally held races, or rather rowing matches. As the canals are, of neceſſity, the receptacles of all the filth of the city, they become, in hot weather, very offenſive; while, in winter, from their free communication with the gulf, they are frequently agitated by the Adriatic ſtorms. The whole city is about ſix miles in circumference, and the inhabitants are eſtimated at 160,000.

The inhabitants of Venice carried on a flouriſhing trade in ſilk manufactures, gold lace, mirrors and other articles of glaſs, beſides military ſtores and implements of war. At ſome diſtance from the city there is a large and commodious lazaretto, where ſhips coming from the Levant unload their goods, and perform quarantine from 20 to 40 days.

This celebrated city, once the ſeat of power, opulence and the fine arts, whoſe carnival revelries have been the ſubject of ſo many animated deſcriptions, has undergone a melancholy change. Her ſtreets and canals no longer reſound with the ſtrains of the muſician and the ſerenades of watchful lovers, and her gay gondolas, which were formerly occupied by faſhionable groups and parties of pleaſure, are now become the vehicles of trade, or ſerve for the accommodation of the ſoldier and the mechanic. The trade of the city, which had long declined, has, ſince the ceſſion of the Venetian territory to Auſtria, been almoſt entirely transferred to Trieſte. Venice is 72 miles E. by N. of Mantua; 115 N. E. of Florence; 140 E. of Milan; 212 N. of Rome, and 300 N. by W. of Naples. E. Long. 12° 33′. N. Lat. 45° 26′.

VENIRE FACIAS, in *Law*, is a judicial writ lying where two parties plead and come to iſſue, directed to the ſheriff, to cauſe 12 men of the ſame neighbourhood to meet and try the ſame, and to ſay the truth upon the iſſue taken.

VENTER, ſignifies the belly; but it is alſo uſed for the children by a woman of one marriage: there is in law a firſt and ſecond venter, &c. where a man hath children by ſeveral wives; and how they ſhall take in deſcents of lands.

VENTILATOR, a machine by which the noxious air of any cloſe place, as an hoſpital, gaol, ſhip, chamber, &c. may be diſcharged and changed for freſh.

The noxious qualities of bad air have been long known; and no one has taken greater pains to ſet the miſchiefs ariſing from foul air in a juſt light than Dr Hales; who has alſo propoſed an eaſy and effectual remedy by the uſe of his ventilators; his account of which was read to the Royal Society in May 1741. In the November following M. Triewald, military architect to the king of Sweden, informed Dr Mortimer ſecretary to the Royal Society, that he had in the preceding ſpring invented a machine for the uſe of his majeſty's men of war, in order to draw out the bad air from under their decks, the leaſt of which exhauſted 36,172 cubic feet in an hour, or at the rate of 21,732 tons in 24 hours. In 1742 he ſent one of them, formed for a 60 gun ſhip to France; which was approved of by the Royal Academy of Sciences at Paris; and the king of France ordered all the men of war to be furniſhed with the like ventilators. Ventilator

The ventilators invented by Dr Hales conſiſt of a ſquare box ABCD (fig. 1.) of any ſize; in the middle of one ſide of this box a broad partition or midriff is fixed by hinges X, and it moves up and down from A to C, by means of an iron rod ZR, fixed at a proper diſtance from the other end of the midriff, and paſſing through a ſmall hole in the cover of the box up to R. Two boxes of this kind may be employed at once, and the two iron rods may be fixed to a lever FG (fig. 2.) moving on a fixed centre O; ſo that by the alternate raiſing and preſſing down of the lever FG, the midriffs are alſo alternately raiſed and depreſſed, whereby theſe double bellows are at the ſame time both drawing in air, and pouring it out, through apertures with valves made on the ſame ſide with, and placed both above and below the hinges of the midriffs. In order to render the midriffs light, they are made of four bars lengthwiſe, and as many acroſs them breadthwiſe, the vacant ſpaces being filled up with thin pannels of fir board; and that they may move to and fro with the greater eaſe, and without touching the ſides of the boxes, there is an iron regulator fixed upright to the middle of the end of the box AC (fig. 1.) from N to L, with a notch cut into the middle of the end of the midriff at Z; ſo that the midriffs, in riſing and falling, ſuffer no other friction than what is made between the regulator and the notch. Moreover, as the midriff ZX moves with its edges only one-twentieth of an inch from the ſides of the box ABCDFE, very little air will eſcape by the edges; and, therefore, there will be no need of leathern ſides as in the common bellows. The end of the box at AC is made a little circular, that it may be better adapted between A and C to the riſing and falling midriff; and at the other end X of the midriff a ſlip of leather may be nailed over the joints if needful. The eight large valves through which the air is to paſs, are placed at the hinge-end of the boxes BK (fig. 2.) as at 1, 2, 3, &c. The valve 1 opens inward to admit the air to enter, when the midriff is depreſſed at the other end by means of the lever FG. And at the ſame time the valve 3 in the lower ventilator is ſhut by the compreſſed air which paſſes out at the valve 4. But when that midriff is raiſed, the valve 1 ſhuts, and the air paſſes out at the valve 2. And it is the ſame with the valves 5, 6, &c. of the other box; ſo that the midriffs are alternately riſing and falling, and two of the ventilators drawing in air, and two blowing it out; the air entering at the valves 1, 3, 6, 8, and paſſing out at the valves 2, 4, 5, 7. Before theſe laſt valves there is fixed to the ventilators a box QQNM (fig. 3.) as a common receptacle for all the air which comes out of theſe valves; which

Plate DXLIV fig. 1.

Fig. 2.

Fig. 3.

Ventilator which air passes off by the trunk P, through the wall of a building. See Description of Ventilators by Stephen Hales, D. D. Lond. 1743, 8vo.; and for the method of freeing mines, ships, prisons, &c. from noxious air by means of fire-pipes, see PNEUMATICS, N° 371.

VENTRI Inspiciendo, is a writ to search a woman that saith she is with child, and thereby withholdeth lands from the next heir: the trial whereof is by a jury of women.

VENTRICLE, properly denotes any little cavity; but is more particularly used by physicians and anatomists for the stomach and certain cavities of the heart and brain.

VENTRILOQUISM, an art by which certain persons can so modify their voice, as to make it appear to the audience to proceed from any distance, and in any direction. See PHYSIOLOGY *Index*.

VENUS, in Pagan worship, the goddess of love and beauty. Cicero mentions two other deities of this name. Venus, styled *Urania* and *Celestis*; and the *Venus Pandemos* or *Popularis*, the wife of Vulcan, and the goddess of wanton and effeminate love. To the first the Pagans ascribed no attributes but such as were agreeable to the strictest chastity and virtue; and of this deity they admitted no corporeal resemblance, she being only represented by the form of a globe, ending conically. Her sacrifices were termed *nephalia*, on account of their sobriety. To her honey and wine were offered, and no animal except the heifer; and on her altars the wood of figs, vines, or mulberries, was not suffered to be burnt. The Romans dedicated a temple to this goddess, to whom they gave the name of *Verticordia*; because she turned the hearts of lewd women, and inspired them with modesty and virtue.

But the most famous of these goddesses is the wife of Vulcan; who is represented as springing from the froth raised by the genitals of Saturn, when cut off by Jupiter and thrown into the sea. As soon as she was formed, she was laid in a beautiful shell embellished with pearl, and wafted by gentle zephyrs to the isle of Cytherea, whence she sailed to Cyprus. At her landing, flowers rose beneath her feet; she was received by the Hours, who braided her hair with golden fillets; and then wafted her to heaven, where her charms appeared so attractive, that most of the gods desired her in marriage; but Vulcan, by the advice of Jupiter, gained possession by putting poppies into her nectar. As Venus was the goddess of love and pleasure, the poets have been lavish in the description of her beauties; and the painters and statuaries have endeavoured to give her the most lovely form. Sometimes she is represented clothed in purple, glittering with gems, her head crowned with roses, and drawn in an ivory car by swans, doves, or sparrows; at others she stands attended by the Graces; but in all positions, her son Cupid is her inseparable companion. She was honoured as the mother of Hymeneus, Cupid, Æneas, and the Graces, and was passionately fond of Adonis and Anchises.

This goddess was principally worshipped at Paphos and Cyprus; and the sacrifices offered to her were white goats and swine, with libations of wine, milk, and honey. Her victims were crowned with flowers, or wreaths of myrtle.

VENUS, one of the planets. See ASTRONOMY *Index*. Venus Verditer.

VENUS's Fly-trap. See *DIONÆA Muscipula*, BOTANY *Index*.

VENUS, a genus of shell-fish. See CONCHOLOGY *Index*.

VEPRECULÆ, diminutive from *vepres*, "a briar or bramble;" the name of the 31st order in Linnæus's Fragments of a Natural Method. See BOTANY *Index*.

VERA-CRUZ, a sea-port town of North America, New Spain, with a very secure and commodious harbour, defended by a fort. Here the flotilla annually arrives from Spain to receive the produce of the gold and silver mines of Mexico; and at the same time a fair is held here for all manner of rich merchandise brought from China and the East Indies by way of the South sea, and for the merchandise of Europe by the way of the Atlantic ocean. This town is not two miles in circumference; and about it there is a wall of no great strength on the land-side. The air is unwholesome; and there are very few Spaniards here unless when the flotilla arrives, and then it is crowded with people from all parts of Spanish America. It is 200 miles south-east of Mexico. W. Long. 37. 25. N. Lat. 19. 12.

VERAGUA, a province of New Spain, bounded on the east by that of Costa Rica, on the west by Panama, on the north by Darien and the gulf of Mexico, and on the south by the South sea. It is about 125 miles in length from east to west, and 60 in breadth from north to south. It is a mountainous barren country; but has plenty of gold and silver. Conception is the capital town.

VERATRUM, a genus of plants belonging to the class polygamia, and in the natural system arranged under the 10th order, *Coronariæ*. See BOTANY and MATERIA MEDICA *Index*.

VERB, in *Grammar*. See GRAMMAR, chap. iv.

VERBASCUM, a genus of plants of the class pentandria, and in the natural system arranged under the 28th order, *Luridæ*. See BOTANY *Index*.

VERBENA, a genus of plants of the class of diandria, and in the natural system arranged under the 40th order, *Personatæ*. See BOTANY *Index*.

VERD, CAPE, a promontory on the west coast of Africa, 40 miles north-west of the mouth of the river Gambia. W. Long. 17. 38. N. Lat. 14. 45.

The islands of Cape de Verd are seated in the Atlantic ocean, about 400 miles west of the Cape. They are between the 13th and 19th degree of latitude; and the principal are 10 in number, lying in a semicircle. Their names are, *St Antony*, *St Vincent*, *St Lucia*, *St Nicholas*, the *isle of Sal*, *Bona Vista*, *Mayo*, *St Jago*, *Fuego*, and *Brava*.

VERDICT, (*Vere dictum*), is the answer of the jury given to the court concerning the matter of fact, in any case civil or criminal, committed by the court to their trial and examination. See LAW, N° clxxxvi. 51. and TRIAL.

VERDIGRISE, the acetate of copper, much used by painters as a green colour. See COPPER, CHEMISTRY *Index*.

VERDITER, or VERDATER, a preparation of copper, sometimes used by painters, &c. for a blue;

Verditer || Vermin.

but more usually mixed with a yellow for a green colour. See COPPER, CHEMISTRY *Index*, and *COLOUR-Making*, N° 28.

VERGE (*Virgata*), in *Law*, signifies the compass of the king's court, which bounds the jurisdiction of the lord steward of the household; and which is thought to have been 12 miles round.

The term *verge* is also used for a stick or rod, whereby one is admitted tenant to a copyhold estate, by holding it in his hand, and swearing fealty to the lord of the manor.

VERGERS, certain officers of the courts of king's bench and common pleas, whose business it is to carry white wands before the judges. There are also vergers of cathedrals, who carry a rod tipped with silver before the bishop, dean, &c.

VERGIL, POLYDORE. See VIRGIL.

VERJUICE, a liquor obtained from grapes or apples, unfit for wine or cyder; and chiefly used in sauces, ragouts, &c.

VERMES, the sixth class of animals in the Linnæan system, comprehending five orders. See NATURAL HISTORY, and CONCHOLOGY and HELMINTHOLOGY *Index*.

VERMICELLI, or VERMICHELLY, a composition of flour, cheese, yolks of eggs, sugar, and saffron, reduced to a paste, and formed into long slender pieces like worms, by forcing it with a piston through a number of little holes. It was first brought from Italy; and is chiefly used in soups and pottages.

VERMICULAR, an epithet given to any thing that bears a relation or resemblance to worms.

VERMIFORMIS, in *Anatomy*, a term applied to various parts in the human body, bearing some resemblance to worms.

VERMILION, a bright and beautiful red colour, composed of quicksilver and sulphur, in great esteem among the ancients under the name of *minium*. See CHEMISTRY, N° 1701, and 1713; but what goes by the name of minium amongst us, is a preparation of lead, known also by the name of *red-lead*. See CHEMISTRY, N° 1832.

VERMIN is a general term, denoting those animals which are either directly or indirectly injurious to mankind, the inferior animals, or the fruits of the earth; as fleas, caterpillars, flies, worms, &c.

VERMIN, *Destruction of*. As we propose in this article to point out the means of destroying some of those animals that are hurtful or troublesome to man, we shall employ the term vermin, in a more extended sense, including also under it, mice, rats, moles, &c. We shall endeavour to collect the most useful observations that have been made on the means of diminishing or extirpating such animals as are obviously injurious. We cannot avoid here remarking, that although the seemingly excessive increase of one species of animals is hurtful or inconvenient to another, or to man himself, and their existence is attended with great loss and damage, by their infesting and destroying grains and other fruits of the earth destined for the food of man or those animals that are subservient to him; we are not of opinion that this excess ought to be considered merely as a useless excrescence in the great scale of being; nor are we of opinion that their numbers ought not to be reduced, because we are too short-sighted to comprehend the wise purposes for which they are called into life. We have heard such a doctrine held up, although we are inclined to suspect that it is founded on a love of singularity or indolence, rather than proceeding from pure motives of benevolence. But we must abstain from such discussions, and occupy the limits allotted to the proper subject of consideration. Vermin.

Rats and Mice.—Various methods have been proposed for the destruction of these vermin. The following preparation has been recommended as very effectual. Take of the seeds of stavesacre (*delphinium staphisagria*), or of louse-wort (*pedicularis palustris*), powdered, more or less as the occasion requires, one part; of oat meal, three parts: mix them well, and make them up into a paste with honey. Lay pieces of this paste in the holes, and on the places where mice and rats frequent; and it will effectually kill or rid the places of those kind of vermin by their eating of it.

Some time ago the society for encouraging arts proposed a premium of 50l. for a preparation capable of alluring or fascinating rats so that they might be taken alive. In consequence of this, a great number of new traps, &c. were invented, and the following methods of alluring the rats to a certain place were published. One of the methods which is most easily and efficaciously practised, is the trailing of some pieces of their most favourite food, which should be of the kind which has the strongest scent, such as toasted cheese or boiled red herrings, from the holes or entrances of the closet to their recesses in every part of the house or contiguous building. At the extremities, and at different parts of the course of this trailed track, small quantities of meal, or any other kind of their food, should be laid to bring the greater number into the tracks, and to encourage them to pursue it to the place where they are intended to be taken; at that place, when time admits of it, a more plentiful repast is laid for them, and the trailing repeated for two or three nights.

Besides this trailing and way-baiting, some of the most expert of the rat-catchers have a shorter, and perhaps more effectual method of bringing them together; which is the calling them, by making such a whistling noise as resembles their own call; and by this means, with the assistance of the way-baits, they call them out of their holes, and lead them to the repast previously prepared for them at the places designed for taking them. But this is much more difficult to be practised than the art of trailing; for the learning of the exact notes or cries of any kind of beasts or birds, so as to deceive them, is a peculiar talent which is attained only by few.

In practising either of these methods of trailing or calling, great caution must be used by the operator to suppress and prevent the scent of his feet and body from being perceived; which is done by overpowering that scent, by other scents of a stronger nature. In order to do this, the feet are to be covered with cloths rubbed over with asafœtida, or other strong smelling substances; and even oil of rhodium is sometimes used for this purpose, but sparingly, on account of its high price, though it has a very alluring as well as disgusting effect. If this caution of avoiding the scent of the operators feet, near the track, and in the place where the rats are proposed to be collected, be not properly observed, it will very much obstruct the success of the at-

tempt

 tempt to take them; for they are very ſhy of coming where the ſcent of human feet lies very freſh, as it intimates to their ſagacious inſtinct the preſence of human creatures, whom they naturally dread. To the abovementioned means of alluring by trailing, way-baiting and calling, is added another of very material efficacy, which is the uſe of oil of rhodium, which like the *marum ſyriacum* and *valerian* in the caſe of cats, has a very extraordinary faſcinating power on theſe animals. This oil, as it is extremely dear, is therefore ſparingly uſed. It is exalted in a ſmall quantity in the place, and at the entrance of it, where the rats are intended to be taken, particularly at the time when they are to be laſt brought together, in order to their deſtruction; and it is uſed alſo by ſmearing it on the ſurface of ſome of the implements uſed in taking by the method below deſcribed; and the effect it has in taking off their caution and dread, by the delight they appear to have in it, is very extraordinary.

It is uſual, likewiſe, for the operator to diſguiſe his figure as well as ſcent, which is done by putting a ſort of gown or cloak, of one colour, that hides the natural form, and makes him appear like a poſt, or ſome ſuch inanimate thing, which habit muſt likewiſe be ſcented as above, to overpower the ſmell of his perſon; and beſides this, he is to avoid all motion till he has ſecured his point of having all the rats in his power.

When the rats are thus enticed and collected, where time is afforded, and the whole in any houſe and outbuildings are to be cleared away, they are ſuffered to regale on what they moſt like, which is ready prepared for them, and then to go away quietly for two or three nights; by which means thoſe that are not allured the firſt night, are brought afterwards, either by their fellows, or the effects of the trailing, &c. and will not fail to come duly again, if they are not diſturbed or moleſted. But many of the rat-catchers make ſhorter work, and content themſelves with what can be brought together in one night; but this is never effectual, unleſs where the building is ſmall and entire, and the rats but few in number.

The means of taking them when brought together are various. Some entice them into a very large bag, the mouth of which is ſufficiently capacious to cover nearly the whole floor of the place where they are collected; which is done by ſmearing ſome veſſel, placed in the middle of the bag, with oil of rhodium, and laying in the bag baits of food. This bag, which before lay flat on the ground with the mouth ſpread open, is to be ſuddenly cloſed when the rats are all in. Others drive or frighten them, by ſlight noiſes or motions into a bag of a long form, the mouth of which, after all the rats are come in, is drawn up to the opening of the place by which they entered, all other ways of retreat being ſecured. Others, again, intoxicate or poiſon them, by mixing with the repaſt prepared for them, the *coculus indicus*, or the *nux vomica*. They direct four ounces of *coculus indicus*, with 12 ounces of oat-meal, and two ounces of treacle or honey, made into a moiſt paſte with ſtrong beer; but if the *nux vomica* be uſed, a much leſs proportion will ſerve than is here given of the *coculus*. Any ſimilar compoſition of theſe drugs, with that kind of food the rats are moſt fond of, and which has a ſtrong flavour to hide that of the drugs, will equally anſwer the end. If indeed *coculus indicus* be well powdered, and infuſed in ſtrong beer for ſome time, at leaſt half the quantity here directed will ſerve as well as the quantity before mentioned. When the rats appear to be thoroughly intoxicated with the coculus, or ſick with the nux vomica, they may be taken with the hand and put into a bag or cage, the door of the place being firſt ſhut, leſt thoſe who have ſtrength and ſenſe remaining ſhould eſcape. Vermin.

In deſtroying rats, advantage may be taken of that remarkable degree of inſtinct which they poſſeſs of deſerting one place, where they find themſelves diſturbed or haraſſed, and retiring to new haunts. It is well known, that after one or two rats are poiſoned, or taken in traps, or wounded or otherwiſe injured, and afterwards permitted to eſcape, the whole colony immediately diſappears. The practice, however, of deſtroying rats that frequent dwelling-houſes, by poiſon, ſhould be as much as poſſible avoided; for they retire to places behind the wainſcot, &c. from which, after death, their putrid bodies emitting a moſt offenſive ſmell cannot be removed. But it is far leſs difficult than is generally imagined to ſecure the different apartments of a dwelling houſe, and even the cellars, from the inroads of rats and mice, and thus to prevent their unwelcome viſits, by ſhutting up the paſſages through which they enter. Stone and lime, when they can be applied, are effectual; but common plaſter, by introducing pieces of broken pottery ware or glaſs, along with it, will alſo anſwer the purpoſe; and even a piece of cork, with a pin or two ſtuck through it to prevent then from eating it away, is a complete barrier to mice entering through a hole in wood, and may even prevent the entrance of rats.

We have ſeen this method of ſhutting up the holes, as ſoon as they were opened by the induſtry of the enemy, ſteadily purſued for ſome time, attended with the fulleſt ſucceſs, even in an old houſe of conſiderable extent, and finiſhed from top to bottom with wood, ſome of which was much decayed.

Often for the ſake of food, rats and mice frequent gardens, fields, and woods, in the ſummer ſeaſon; but, on the approach of winter, they return to their former haunts in the habitations of man; and, accordingly, it is obſerved, that houſes which are free from thoſe vermin during the ſummer, ſwarm with them about the end of harveſt. Attention to this circumſtance in the habits of theſe animals, may be the means of ſecuring us from their viſits and depredations; for if, at the time alluded to, every hole and cranny through which rat or mouſe can enter, be ſhut up, and carefully kept cloſe and ſecure, the perſeverance of the foe is exhauſted and overcome by repeated and conſtant reſiſtance, and thus he is forced to abandon the unequal conteſt, and to retire to other haunts where his motions are leſs interrupted.

Various other methods have been propoſed for the deſtruction of rats; and although we have thrown out a hint againſt the uſe of arſenic for this purpoſe, in dwelling houſes; yet where it can be employed with perfect ſafety, and without riſk of the nuiſance alluded to, as in cellars and outhouſes, it is undoubtedly one of the moſt effectual to which we can have recourſe.

Suffocating theſe vermin by means of the fumes of ſulphur, as on board of ſhips, in granaries and other buildings which can be ſhut up, is ſometimes alſo ſucceſsfully

Vermin. ceſsfully practiſed. Rats and other vermin have alſo been effectually deſtroyed and eradicated by burning wood in cloſe apartments, thus producing fixed air or carbonic acid gas, by which they are alſo ſuffocated.

Moles.—Various methods have been propoſed for the deſtruction of theſe animals. But the following obſervations on this ſubject, which we ſhall give in the words of the author, ſeem to be more ſatisfactory than any thing we have met with.

"The great damage (ſays he) which moles occaſion in cultivated land, and particularly gardens, is well known; and the beſt means of remedying this evil is by deſtroying all thoſe that make their appearance, as far as poſſible. The ſecrets which quacks ſell for extirpating theſe deſtructive animals are of very little avail; and even poiſon produces no effect, as the mole does not drink, and lives only on roots and worms. In regard to gins and traps, the moles muſt be enticed to them by ſome kind of bait, which does not always produce the intended effect. Buffon adviſes a trench to be dug around the hills under which they conceal themſelves, and thus to cut them off from all communication with the neighbouring ground. This method requires three or four people to dig trenches; and though it may prove effectual, it is attended with too much trouble. The other methods propoſed by different naturaliſts are neither eaſier nor more certain.

"It is well known that this animal lives under the earth; and if at any time it comes forth from its holes, it is only when compelled to do ſo, in conſequence of large quantities of water accumulated after the heavy rains which fall in ſummer, or when the earth is ſo much parched and dried by the continued drought, that it can no longer continue its labour; but it again creeps back into the earth when it finds a ſpot convenient for its purpoſe.

"This animal, as already remarked, feeds upon roots and worms, and for this reaſon is generally found in rich fertile ſoil; but never in that which is marſhy or ſtony. In the winter time it retires to elevated places, becauſe it is there beſt ſecured from inundations. In ſummer, however, it deſcends to the low hillocks and flat land, and above all makes choice of meadows for the place of its reſidence; becauſe it finds the earth there freſher and ſofter for it to dig through. If the weather continues long dry, it repairs to the borders of ditches, the banks of rivers and ſtreams, and to places contiguous to hedges.

"The mole breeds generally at the beginning of winter, and the months when they are found big with young are January and February. In the month of April a great many of their young may be ſeen. Among 122 caught in the month of May by my method, there were only four big with young. This animal cannot live without digging; it is obliged to find its nouriſhment in the bowels of the earth; and on that account is under the neceſſity of making thoſe long ſubterranean paſſages which are found between one mole-hill and another. In general it begins to dig five or ſix inches under the ſurface; it ſcrapes the earth before it on one ſide till the quantity becomes too great for it to labour with eaſe; it then works towards the ſurface; and by puſhing with its head, and the aſſiſtance of its nervous paws, gradually raiſes up the earth which incommodes it, and which produces thoſe ſmall hills ſo common in fields. After getting rid of the earth in this manner, it proceeds forwards, and continues its labour as before. The farther it goes the more hills are produced. At each period of its labour it throws up four or five. Vermin.

"In places overgrown with graſs and ſhrubs, the mole is often contented with only forcing a paſſage through between the roots: and when the earth in gardens has been newly watered, it keeps itſelf at the depth of ſcarcely half an inch under the ſurface. This animal ſhews an equal averſion to great cold and violent heat; and in order to avoid both, it forces its way, when either prevail, to the greateſt depth in the earth.

"It continues its labour at all times, becauſe it is neceſſary for it to procure nouriſhment. It is abſolutely falſe that it ſleeps throughout the winter, as ſome naturaliſts have aſſerted; for it throws up the earth in the coldeſt ſeaſon, as well as during the ſummer. It is moſt buſily employed towards the end of winter, and at that period forms the greateſt number of hills. To this it is impelled by more than one reaſon. In the firſt place, it muſt provide nouriſhment for its young; ſecondly, it finds it eaſieſt at that time to dig its way through the earth; and laſtly, as the air begins to be milder, the animal then recovers that ſtrength which it had loſt during the intenſe cold. At this ſeaſon, therefore, it is moſt proper to purſue means for extirpating this animal, as it can be deſtroyed with greater eaſe while employed at its labour.

"The male is much ſtronger than the female, and the hills thrown up by the former are much larger as well as more numerous. The periods when the mole is moſt buſily employed in digging are in the morning, at ſunriſe, at noon, and at ſunſet. In dry weather moles are obſerved to throw up the earth for the moſt part only at ſunriſe, and in winter when the earth has been ſomewhat heated by the ſun's rays.

"A perſon may eaſily diſcover how many moles are contained in a certain ſpace of ground, by counting the freſh raiſed mole-hills which have no communication with each other. I muſt remark alſo, that this animal has very bad ſight, being almoſt totally blind; but its hearing, on the other hand, is ſo much the more acute.

"I ſhall now proceed to the method of deſtroying them. Immediately at day-break it will be neceſſary to make a tour round the garden or meadow, from which it is wiſhed to extirpate the moles; for at that time they will be all found at work, as may be ſeen by the hills newly thrown up. If the perſon is then cloſe to the hill, he muſt proceed as the gardeners do, and turn up with a ſtroke of the ſpade the hill together with the digger. The paſſage is then cut through before the animal is aware of the attack, and therefore it has not power to eſcape. If the mole-hill be freſh, even though the animal may not be throwing up earth, the perſon ought not to loſe his time in waiting, but ſhould immediately proceed to the operation above mentioned.

"If you find a freſh hill ſtanding by itſelf, which ſeems to ſhew by its ſituation that it has no communication with any other, which is always the caſe when the mole has worked from the ſurface downwards in endeavouring to procure a more convenient habitation, after the hill has been turned up with the ſpade, a bucket of water ſhould be poured over the mouth of the paſſage. By theſe means the animal, which is at no great diſtance, will be obliged to come forth, and may be eaſily caught with the hand.

"You

" You may diſcover alſo whether a hill has any communication with another, if you apply your ear to it, and then cough or make a loud noiſe. If it has no communication with the neighbouring hills, you will hear the terrified animal make a noiſe by its motion. It will then be impoſſible for it to eſcape; and you may either pour water into the hole, or turn up the hill with a ſpade until the mole is found; for in general it never goes deeper into the earth than from fifteen to eighteen inches.

" When any of the beds in a garden have been newly watered, the mole, attracted by the coolneſs and moiſture, readily repairs thither, and takes up its reſidence in them, making a paſſage at the depth of ſcarcely an inch below the ſurface. In that caſe it may be eaſily caught. When you ſee it at work, you need only tread behind the animal with your feet on the paſſage to prevent its retreat, and then turn up the hill with a ſpade; by which means you will be ſure to catch it.

" When you dig after it with a ſpade, the animal forces its way downwards into the earth in a perpendicular direction, in order that it may better eſcape the threatened danger. In that caſe it will not be neceſſary to dig long, but to pour water over the place, which will ſoon make the animal return upwards.

" People in general are not aware of the great miſchief occaſioned in fields and gardens by theſe animals. We are, however, informed by Buffon, that in the year 1740 he planted 15 or 16 acres of land with acorns, and that the greater part of them were in a little time carried away by the moles to their ſubterranean retreats. In many of theſe there were found half a buſhel, and in others a buſhel. Buffon, after this circumſtance, cauſed a great number of iron traps to be conſtructed, by which in leſs than three weeks he caught 1300. To this inſtance of the devaſtation occaſioned by theſe animals, we may add the following: In the year 1742 they were ſo numerous in ſome parts of Holland, that one farmer alone caught between five and ſix thouſand of them. The deſtruction occaſioned by theſe animals is, however, no new phenomenon. We are informed by hiſtory, that the inhabitants of the iſland of Tenedos, the Trojans, and the Æolians, were infeſted by them in the earlieſt ages. For this reaſon a temple was erected to Apollo Smynthius, the deſtroyer of moles.

Inſects.—Many inſects, in the different ſtates of exiſtence through which they paſs, are exceedingly troubleſome and deſtructive. Sometimes they ſpread their devaſtations in the ſtate of *larva* or *grub*, and ſometimes in that of perfect inſect.

Of the coleopterous inſects, the grub of the cockchaffer, which is a brownish or cheſnut-coloured beetle, commits the greateſt ravages. This beetle appears during great part of the ſummer, the moſt plentiful in May or June, and hence called the *May bug*. It flies only in the evening, and lodges during the day under the leaves of trees, which it devours, and is ſometimes in ſuch numbers, as to defoliate whole woods. The beetle depoſits its eggs in the earth, and from theſe are hatched white or bluiſh grubs, that feed on the roots of graſs, corn, and other vegetables, during the whole ſummer. In the winter they lie deep in the earth; but in the ſpring, as vegetation advances, they riſe to the ſurface, and renew their work of deſtruction. In this ſtate they continue for four, five, or ſix years, before they change to the chryſalis ſtate, in which they remain till the month of May, when the perfect inſect appears. As theſe inſects require ſo many years to aſſume the perfect form, they only appear occaſionally ſufficiently numerous to be extenſively deſtructive to the crops of grain, or vegetables in general. Their numbers, however, have often produced great alarm, and even excited the attention of governments to offer rewards for an effectual method of deſtroying them.

In the ſpring ſeaſon, if the weather prove warm, when the land is ploughed, up, theſe grubs are generally ſo near the ſurface as to be turned up with the plough; and being thus expoſed, they are picked up and devoured by various birds, which, it is ſuggeſted, ſhould not be diſturbed or driven away in this ſalutary labour. When theſe grubs infeſt meadow land, it has been propoſed to drown them in their holes by overflowing it. But it is ſuppoſed that this plan would not be ſucceſsful, even where it is practicable, unleſs there is a bed of clay immediately under the ſoil, to retain the water for a ſufficient length of time. A more efficacious way is recommended to prevent the increaſe of the grubs, by deſtroying the flies in May or June, before they have depoſited their eggs. This may be done by ſhaking and beating the trees and hedges in the middle of the day; and, as this is a work which may be performed by children, it is a leſs difficult taſk than would at firſt ſight be imagined. Domeſtic fowls are remarkably fond of theſe beetles, ſo that a double object is thus gained, the deſtruction of the beetles and the procuring of food for the poultry.

Some ſpecies of the dermeſtes, and alſo of the genus *ptinus*, are exceedingly deſtructive in the cabinets of naturaliſts, and alſo to furniture. Various methods have been recommended to ſtop their ravages. We believe the moſt effectual is ſpirit of turpentine, when it can be properly applied. A ſolution of corroſive ſublimate is ſometimes employed, but it ſhould be recollected that it ſeldom fails in time to produce ſome chemical change on animal and vegetable matters. Objects of natural hiſtory, as birds, animals, &c. are ſometimes expoſed to the moderate heat of an oven, or before a fire, for ſeveral hours; but this method will alſo be attended with injurious effects, unleſs practiſed with great care. Inſects which infeſt furniture have been deſtroyed by the application of oil, and allowing it to remain for a day or two, before the furniture is rubbed up. Japanned or varniſhed furniture may be ſecured from the effects of theſe inſects, by re-coating it, when they are in the larva ſtate, by which they are deprived of air. Railing, and other works out of doors, which are expoſed to the weather, are ſometimes eaten with inſects, and particularly by ſome of the larvæ of the genus *curculio*. The wood thus attacked may be prevented from farther ravages, by a freſh coat of paint.

The earwig is a deſtructive inſect in the flower, kitchen, and fruit garden. To prevent their depredations, it has been recommended to take them by the hand, when they come out during the night in ſearch of food. They may be taken alſo by rolling up a piece of paper, and hanging it up on the plants which they infeſt; for in theſe places they take ſhelter through the day. Another method of deſtroying them has been mentioned, and that is to watch them towards morning with the view of diſcovering the haunts to which they

Vermin. they reſort during the day; and this diſcovery being made, which may perhaps be a melon frame, dunghill, or heap of rubbiſh, the removing of which will deſtroy the greater number of theſe troubleſome inſects.

The ſmall inſect which commits ſuch depredations among turnips, by eating the ſeedling leaves as ſoon as they appear, as frequently to deſtroy whole crops, is ſuppoſed to be a ſmall black poliſhed beetle, belonging to the genus *chryſomela*. It does not ſeem to be well aſcertained whether this ſmall beetle, which is better known by the name of turnip fly, commits its ravages in the larva or in the beetle ſtate. It is ſaid that it prefers the leaves of the common radiſh to thoſe of the turnip, and it is therefore recommended to ſow radiſhes along with the turnips, to prevent the deſtruction of the latter.

Of the inſects belonging to the order hemiptera, there are ſome which are exceedingly deſtructive. The cock-roach, a native of the warmer parts of America and the Weſt Indies, is a very troubleſome, and a very voracious inſect. It has been introduced into this country, and particularly into the ſeaport towns, in conſequence of commercial intercourſe. It comes out to feed in the night-time, and eats almoſt of every thing that comes in its way. Cock-roaches are eaſily taken by the following method. Cover the outſide of a deep glaſs or baſon with paper; introduce ſome bits of bread or ſugar into the baſon or glaſs, and ſet it in a place frequented by the cock-roaches. They creep up by means of the paper on the outſide, and drop into the veſſel; but in conſequence of its ſmooth poliſhed ſurface, they cannot effect their eſcape. In the ſame way crickets and beetles may be taken and deſtroyed. It is quite unneceſſary to ſpeak of the means of deſtroying the myriads of locuſts which not unfrequently infeſt eaſtern countries, and particularly Egypt and Syria; for no means are likely to be deviſed, which promiſe to reſiſt the effects of ſuch an hoſt of foes, by whoſe ravages every green thing is conſumed; but the inſect itſelf becomes, among the poorer inhabitants of thoſe countries, a partial ſubſtitute for the fruits of the earth which it has deſtroyed. The inſects are taken, reduced to powder, and converted into a kind of meal.

The common or the bed-bug is a very troubleſome, and a very common inmate in the crowded houſes of many large towns in this country. Its uſual haunts are the crevices of wood, and particularly thoſe pieces of furniture which are uſually kept in the warmeſt corners of the apartment. Cleanlineſs will perhaps be found the beſt preſervative againſt the introduction and increaſe of theſe inſects; but ſometimes even the greateſt care and attention are ineffectual in keeping houſes entirely free from them. When it can be conveniently done, they are completely deſtroyed by immerſing the furniture in boiling water, or by baking it in an oven; and by filling up the crevices or holes which were their haunts, with glaziers putty, their return and increaſe will thus be prevented. But a very effectual method of deſtroying bugs, is to waſh the places which they frequent with ſpirit of turpentine, and then filling up the holes as already mentioned. It is a curious circumſtance in the hiſtory of theſe inſects, that ſome perſons entirely eſcape from their attacks, while to others they are exceedingly troubleſome and diſtreſſing. It is ſaid that lavender-water, ſprinkled over the bed-clothes, often prevents their approach. How far this is the caſe, we have had no opportunity of aſcertaining. Vermin.

The ſmall moth, which in the caterpillar ſtate commits ſuch ravages on woollen cloths, furs, and other animal ſubſtances, which remain for any length of time in dark undiſturbed places, may be deſtroyed with the greateſt certainty and facility, by expoſing the ſubſtances on which they are ſuſpected to make their depredations, to the vapour of ſpirit of turpentine, or bruſhing them with a bruſh dipped into the ſame fluid. This ſhould be done about the months of September or October; but their effects may be prevented by placing the cloths, furs, &c. which are likely to become their reſidence, in an airy ſituation, about the months of July and Auguſt.

The different kinds of lice are very numerous. Every animal has its peculiar ſpecies, and even mankind are not free from this peſt. It is often the conſequence of indolence and naſtineſs, and it is obſerved that the lice which infeſt any animal increaſe prodigiouſly when that animal becomes languid and ſickly. We believe that the application of ſpirits of turpentine, already ſo often recommended, would alſo be effectual in this caſe; but mercurial preparations afford a certain remedy againſt theſe inſects. For this purpoſe a very ſmall quantity of what is called mercurial ointment may be employed. At the ſame time it ought to be recollected, that cleanlineſs is the beſt preſervative. A ſingular notion prevails in this country, and even among perſons who are by no means in the loweſt rank of life, that it is a good ſign of health when children's heads are infeſted with theſe animals; and on this account they are not very anxious in having them entirely eradicated. A moment's reflection may ſhow the abſurdity of ſuch an opinion, ſo that it would be a waſte of time to adduce ſerious arguments againſt it.

It is perhaps more difficult for mankind to ſecure themſelves and their habitations from the viſits of the common flea. Cleanlineſs, however, may do much even in effecting this; and in particular it appears to us, that it would be extremely uſeful, frequently to rub up with a piece of cloth the more inacceſſible parts of furniture or apartments, or perhaps it would anſwer better to employ a ſmall hard bruſh. By the leſs acceſſible places we mean the corners and crevices of rooms and furniture where duſt is apt to collect, and eſpecially the canvas part of a bed. We are perſuaded that ſpirits of turpentine might alſo be found uſeful for the deſtruction of theſe very troubleſome inſects. The Scotch myrtle (*myrica gale*, Lin.) a plant very common in low and moiſt mooriſh places in this country, is ſaid to be an excellent remedy, in conſequence of its powerful aromatic odour, againſt the attacks of theſe animals. For this purpoſe, the plant is ſtrewed about the apartment or bed which is infeſted with fleas.

The following method of deſtroying or driving away all kinds of noxious vermin from fields and gardens, it is ſaid, has been proved by experience to be effectual. It is recommended by M. Socoloff, and the account of it is taken from the Peterſburgh Tranſactions *. As the deſtructive power of quicklime (ſays the author), heightened by a fixed alkali, which corrodes, diſſolves and deſtroys all the tender parts of animals, has been long known, I thought this mixture would be the beſt means for accompliſhing the object I had in view. I took three

* *Phil. Mag.* i. 169.

Vermin. three parts, therefore, of quicklime, newly made, and two parts of a ſaturated ſolution of fixed alkali in water, and thence obtained a ſomewhat milky liquor ſufficiently cauſtic, highly hoſtile and poiſonous to earthworms and other ſmall animals; for as ſoon as it touched any part of their bodies, it occaſioned in them violent ſymptoms of great uneaſineſs. If this liquor be poured into thoſe holes in which the earthworms reſide under ground, they immediately throw themſelves out as if driven by ſome force; and, after various contortions, either languiſh or die. If the leaves of plants or fruit-trees, frequented by the voracious caterpillars, which are ſo deſtructive to them, be ſprinkled over with this liquor, theſe inſects ſuddenly contract their bodies, and drop to the ground. For, though nature has defended them tolerably well by their hairy ſkins from any thing that might injure their delicate bodies, yet, as ſoon as they touch with their feet or mouths leaves which have been moiſtened by this liquor, they become as it were ſtupefied, inſtantly contract themſelves, and fall down.

"I had not an opportunity of trying a like experiment on locuſts; yet we may conclude, and not without probability, from their nature, and the general deſtructive qualities of the above liquor, that they, in like manner, may be driven from corn-fields, if it be poſſible to ſprinkle the corn with the liquor by means of a machine.

"With regard to plants or corn, theſe ſuſtain no injury from the liquor, becauſe it has no power over the productions of the vegetable kingdom, as I have fully learned from experience; or, if any hurt be ſuſpected, all the danger will be removed by the firſt ſhower that falls. This liquor may be procured in abundance in every place where lime is burnt. If the lime be freſh, one part of it infuſed in about ſeventy parts of common water will produce real lime-water. The want of the fixed alkali may be ſupplied by boiling wood-aſhes in water, and thickening the ley by evaporation.

"The liquor might be employed alſo to kill bugs and other domeſtic inſects which are noxious and troubleſome; but on account of its ſtrong lixivious ſmell, which diſpoſes the human body to putridity, I dare not recommend the uſe of it in houſes that are inhabited. Beſides, bugs may be eaſily got rid of, as I have repeatedly found from experience, by the oily pickle that remains in caſks in which ſalted herrings have been packed. To this liquor they have a ſtrong averſion; and, if they are moiſtened with it, they die in a very ſhort time *."

* *Phil. Mag.* 69. For deſtroying inſects and caterpillars, which infeſt fruit-trees, the following method is recommended as having been ſucceſsfully practiſed. The author obſerves that "The preſent year, for inſtance, (1805), offers a ſingularity which I have not before perceived. In ſome diſtricts the cherry tree has experienced, at the time of its bloſſoming, colds and winds which have prevented it from ſetting; but another plague, not leſs diſaſtrous, has attacked the cherry-trees and plum-trees over ſeveral diſtricts in France. Great ſwarms of little animals reſembling *vine-fretters*, but which are not ſo in reality, eſtabliſhed their habitations at the extremity of the branches of the cherry-trees. As ſoon as a branch was attacked, the leaves curled, and the juice was dried up. On opening the leaf, a conſiderable number of ants was diſcovered, which, jointly with the inſect which began the ravages, ſucked the branch, and made it wither. What I have remarked is, that uſually, when the vine-fretters attack any tree, the neighbouring tree very ſoon experiences the ſame fate; but the attack of this year is only partial. In an alley of cherry-trees which I poſſeſs, ſeven trees have been attacked, but not thoſe which are next each other. One tree was placed between two which were very much damaged by theſe inſects, and yet this one was not hurt.

Vermin.

"On theſe vermin the ſmoke of tobacco had no effect at all: this convinces me that they are different from the ordinary kind.

"Plum-trees, when attacked by the ſame inſect, do not loſe their fruit like the cherry-trees; but the little animals cover them with more rapidity, ſo as to extirpate even the appearance of fruit.

"Having effectually watered a plum-tree, I covered it with aſhes, in the manner we treat beans and cabbages, and the vermin were deſtroyed: but this is only practicable with a tree of low height.

"I made one remark, which I think is eſſential to communicate: it is, that plum-trees planted in ground which is not neceſſarily watered, are leſs attacked by theſe inſects than thoſe which have experienced a humidity communicated by the plants in their neighbourhood, to which watering is abſolutely neceſſary. I had one planted in a bed of artichokes: we know very well that this plant requires plenty of water; and the tree was entirely covered with inſects. Its leaves withered, and the fruit fell off; while two other plum-trees, in ground not watered at all, were much leſs attacked. This convinces me that theſe were not the ordinary vermin abundant in dry ſeaſons.

"I was only able to protect my cherries a little, by cutting off the extremities of the damaged branches.

"Several people had recourſe to ſulphur; but I did not follow that method. The ſmoke of ſulphur deſtroys the inſect, I admit, but it is at leaſt equally dangerous to the tree; I always prefer an aſperſion of the tree with ſoap-ſuds. This very year I experienced the good effects of it. I ſaw my plum-trees look green again, and the inſects abandon them. The aſperſion is very eaſily managed, by means of watering-pots or ſmall garden-engines. I have alſo employed a ley of wood aſhes with the ſame ſucceſs as ſoap and water.

"An obſervation equally important which I have made is, the great damage done this ſeaſon in all orchards by the caterpillar. As ſoon as they devoured the young leaves, they attacked the fruit. In ſpite of the great care taken in ſpring to get rid of them, the number of theſe inſects is incredible. I have ſeen them unite on the large branches, fix their neſts to them, and protect them by means of the downy matter which covers the buds of the enſuing ſeaſon. Whatever precaution is taken, it is almoſt impoſſible not to deſtroy theſe buds. It is only neceſſary to take off theſe neſts and burn them; and this is the only way of getting rid of the coveys. I employed the ſame aſperſion for my apple-trees, and by that means got rid of their enemies alſo *. * *Phil. Mag.* xxiv. 213.

"The following methods are practiſed in Germany for freeing granaries from mites or weevils:

"1. Cover completely the walls and rafters, above and below, of the granaries which are infeſted by wee-

Vermin.

vils, with quicklime ſlaked in water in which trefoil, wormwood, and hyſſop have been boiled. This compoſition ought to be applied as hot as poſſible.

" 2. A very ſagacious farmer has ſucceeded in deſtroying weevils by a very eaſy proceſs. In the month of June, when his granaries were all empty, he collected great quantities of the largeſt-ſized ants in ſacks, and then ſcattered them about the places infeſted with the weevils. The ants immediately fell upon and devoured every one of them; nor have any weevils ſince that time been ſeen on his premiſes.

" 3. Another method, not leſs efficacious, but which requires a great deal of care and attention in the application of it, is the following:—Place in your granaries a number of chafing-diſhes filled with lighted pieces of wood. Every aperture muſt then be carefully cloſed, in order to prevent any freſh air from entering. The carbonic acid gas, produced from the burning wood proves fatal to the inſects. Rats and mice, alſo, are ſo ſtrongly affected by it, that they are ſeen running out of their holes, and dying in all directions. The perſons employed to manage this proceſs muſt take great care of their own ſafety, by keeping a current of air around them until the burning wood is properly placed. Another danger may ariſe from the premiſes taking fire; but this alſo may be avoided by proper caution, particularly if they are paved with brick or ſtone*."

* *Phil. Mag.* xxvi. 91.

Grain, it is ſaid, has been preſerved from weevils and other deſtructive inſects, by covering the heaps with pieces of hemp cloth dipped in water and wrung out. At the end of two hours the weevils are found adhering to the cloths, which are to be removed carefully and plunged in water for ſome time to drown. A plant of henbane placed in the middle of a heap of grain is ſaid alſo to drive away the inſects. They muſt then be watched and deſtroyed as they attempt to eſcape.

Sulphur or flower of brimſtone is recommended as being an excellent remedy againſt the effects of inſects on plants. It may be applied by duſting the leaves affected, either by tying it up in muſlin cloth, or with a puff for hair powder, or with a dredging box. But the ſulphur not only deſtroys the worms and inſects which infeſt trees; it ſeems alſo to render the trees more healthy and vigorous. This was particularly the caſe with ſome peach trees on which it was ſprinkled.

The following method, diſcovered by M. Catin, is propoſed for deſtroying earth-fleas, bugs, ants, &c.

" Take black ſoap, of the beſt kind, one pound three quarters, the ſame quantity of flowers of ſulphur, muſhrooms two pounds, and ſixty meaſures of river or rain-water. Divide the water into two parts, one of which muſt be poured into a veſſel deſtined for that purpoſe: ſuffer the ſoap to diſſolve in it, and add the muſhrooms after they have been a little pounded. Boil the other half of the water in a kettle, and tie up the ſulphur in a bit of rag or piece of fine linen, and ſuſpend from it a ſufficient weight in order that it may ſink in the water. During the time the water is kept boiling, which muſt be at leaſt twenty minutes, ſtir it continually with a ſtick, and preſs the bag containing the ſulphur, that the latter may be forced out into the water, and communicate to it the neceſſary ſtrength and colour.

" When the liquor is taken from the fire, pour it directly into the caſk, and ſtir it round for a conſiderable time: the proceſs of ſtirring muſt be repeated daily till it acquire a fetid ſmell. Experience has ſhown that the more fetid the mixture is, its activity is the greater. Each time that the mixture is ſtirred, the caſk muſt be ſtopped immediately after. When you wiſh to uſe the liquid, nothing is neceſſary but to ſprinkle a little of it on the plants which you are deſirous of preſerving, or to dip their branches in it. It will be better, however, to make uſe of a ſyringe, having at the end a head, an inch or an inch and a half in diameter, pierced with ſmall holes. This inſtrument may be uſed for tender plants; when you apply the liquid to trees, a ſyringe with larger holes muſt be employed.

" Caterpillars, beetles, earth-fleas, bugs, and the tree-lice which infeſt orange trees, will be deſtroyed by the firſt application of the liquid. Inſects which reſide below the earth, ſuch as waſps, hornets, ants, &c. require that the liquid ſhould be ſquirted out gently, and without intermiſſion, that it may better penetrate to their neſts. Ants neſts, according to their ſize, require from two to three meaſures of liquid, and in many caſes it muſt be applied for twenty-four hours. When the ants aſſemble in another place, the proceſs muſt be repeated. Two ounces of *nux vomica* may be added to the mixture, and boiled along with the ſulphur. This ſubſtance, particularly when you wiſh to deſtroy ants, will be of great ſervice. When the whole of the liquid in the caſk has been uſed, the reſiduum muſt be buried in the earth to prevent domeſtic animals from eating it*."

* *Phil. Mag.* 189.

The uſe of elder as a preſervative to vegetables againſt the depredations of inſects is detailed in the following obſervations.

" Common elder has appeared to me uſeful, 1ſt, For preventing cabbage plants from being devoured or damaged by caterpillars; 2d, To prevent blights, and their effects on fruit and other trees; 3d, To preſerve corn from yellow flies and other inſects; 4th, To ſecure turnips from the ravage of flies, &c.

" 1ſt, The ſtrong and fetid odour of a bunch of elder leaves induced me to think that different kinds of butterflies might be incommoded by it in proportion to their delicacy. I therefore took ſome young twigs of elder, at the period when butterflies began to appear, and whipped well with them ſome cabbage plants, but in ſuch a manner as not to damage them. Since that time, during two ſummers, though the butterflies hovered round the plants, I never ſaw one of them ſettle on them; and I do not think that a ſingle butterfly was hatched on the cabbages treated in this manner, though a neighbouring board was dirtied by them in the uſual manner.

" 2d, After a ſhort reflection on the effects here mentioned, and on blights, which, in my opinion, are chiefly occaſioned by ſmall flies and ſmall inſects, whoſe organs are ſtill more delicate than thoſe of the former, I was induced to whip in the ſame manner with elder twigs, as high as I could reach, the branches of a plum-tree which grew in an eſpalier. The whipped leaves remained green and in a good condition, while from at leaſt ſix inches above to the top of the tree the reſt of the leaves were blighted, wrinkled, and full of worms. It is here to be obſerved that the tree was in full flower when I whipped it, therefore much too late for this operation, which ought to have been performed once or twice before flowering. But I am of opinion, that if trees were beſprinkled with a ſtrong infuſion of elder

every

every eight or 15 days, the ſucceſs would be certain, and that there would be no danger of injuring either the flowers or the fruit.

3d, What the farmers call the yellows in corn, and which they conſider as a kind of blight, is the effect, as every one knows, of a ſmall yellow fly with blue wings, nearly of the ſize of a gnat. It lays its eggs in the ear of wheat, and produces a worm almoſt inviſible to the naked eye, but which, when ſeen by a magnifying glaſs, is a large yellow larva, having the ſhining colour of amber. This fly is ſo productive, that I have counted upwards of forty worms in the chaff of one ear of wheat, which was a number ſufficient to deſtroy it entirely. I therefore propoſed to make my experiment as ſoon as poſſible; but the heat and drought of the ſeaſon having advanced the wheat more than uſual, it was in flower before I could attempt it. Next morning, however, at break of day, two ſervants having drawn bundles of elder over the ears of wheat on each ſide of the furrow, backwards and forwards, in places where the wheat was not ſo far advanced, I hoped that the fetid effluvia of the elder would prevent the flies from remaining on the ears that were covered with them: and, indeed, I was not entirely diſappointed; for, on examining my wheat ſome time after, I found that the part which had been beaten with elder was much leſs damaged than that which had not been treated in the ſame manner. I have no doubt, that, had I employed this precaution ſooner, the corn would have been completely preſerved. Should this be the caſe, the proceſs is ſimple; and I flatter myſelf that fine crops of corn may be ſaved by theſe means from this ſmall inſect, which is ſo deſtructive to them. One of theſe yellow flies laid on my thumb at leaſt eight or ten eggs, of an oblong form, in the ſmall interval of time which I employed in walking over two or three furrows, holding it by the wings, and which I could not obſerve without the aſſiſtance of a magnifying glaſs.

"4th, It often happens that whole crops of turnips are deſtroyed while young, in conſequence of being pricked by certain inſects. I have great reaſon to think that this evil may be prevented in an effectual manner, by cauſing a perſon to draw a bunch of elder, ſufficiently large to cover about the breadth of a foot, over the young turnips, going backwards and forwards. What confirms me in this idea is, that, having drawn a bunch of elder over a bed of young cauliflowers which had begun to be pricked, they afterwards remained untouched by theſe inſects.

"Another fact which tends to ſupport this idea is, that when my neighbourhood, about eight or nine years ago, was ſo infeſted with caterpillars that they devoured all the vegetables, leaving ſcarcely a green leaf untouched, they ſpared the elder trees amidſt this general devaſtation, and never moleſted them. In reflecting on theſe circumſtances, I am of opinion that the elder might be introduced with advantage into our gardens, as the means of preſerving fruit-trees and various plants from the rapacity of inſects.

"The dwarf elder appears to me to exhale a much more fetid ſmell than the common elder, and therefore ought to be preferred in making experiments on this ſubject *."

VERNACULAR, a word applied to ſomething that is peculiar to any one country.

VERNAL, ſomething belonging to the ſpring-ſeaſon. Vernal, Vernier.

VERNIER SCALE, a ſcale excellently adapted for the graduation of mathematical inſtruments, thus called from its inventor Peter Vernier, a perſon of diſtinction in the Franche Comté. See NONIUS.

Vernier's method is derived from the following principle. If two equal right lines, or circular arcs, A, B, are ſo divided, that the number of equal diviſions in B is one leſs than the number of equal diviſions of A, then will the exceſs of one diviſion of B above one diviſion of A be compounded of the ratios of one of A to A, and of one of B to B.

For let A contain 11 parts, then one of A to A is as 1 to 11, or $\frac{1}{11}$. Let B contain 10 parts, then one of B to B is as 1 to 10, or $\frac{1}{10}$. Now $\frac{1}{10}-\frac{1}{11}=\frac{11-10}{10\times 11}=\frac{1}{10\times 11}=\frac{1}{10}\times\frac{1}{11}$.

Or if B contains n parts, and A contains $n+1$ parts; then $\frac{1}{n}$ is one part of B, and $\frac{1}{n+1}$ is one part of A. And $\frac{1}{n}-\frac{1}{n+1}=\frac{\overline{n+1}-n}{n\times\overline{n+1}}=\frac{1}{n}\times\frac{1}{n+1}$.

The moſt commodious diviſions, and their aliquot parts, into which the degrees on the circular limb of an inſtrument may be ſuppoſed to be divided, depend on the radius of that inſtrument.

Let R be the radius of a circle in inches; and a degree to be divided into n parts, each being $\frac{1}{p}$th part of an inch.

Now the circumference of a circle, in parts of its diameter 2R inches, is $3{,}1415926\times 2R :: 1^\circ : \frac{3{,}1415926}{360}\times$ 2R inches.

Or, $0{,}01745329\times R$ is the length of one degree in inches.

Or, $0{,}01745329\times R\times p$ is the length of 1°, in pth parts of an inch.

But as every degree contains n times ſuch parts, therefore $n=0{,}01745329\times R\times p$.

The moſt commodious perceptible diviſion is $\frac{1}{8}$ or $\frac{1}{10}$ of an inch.

Example. Suppoſe an inſtrument of 30 inches radius, into how many convenient parts may each degree be divided? how many of theſe parts are to go to the breadth of the vernier, and to what parts of a degree may an obſervation be made by that inſtrument?

Now $0{,}01745\times R=0{,}5236$ inches, the length of each degree: and if p be ſuppoſed about $\frac{1}{8}$ of an inch for one diviſion; then $0{,}5236\times p=4{,}188$ ſhows the number of ſuch parts in a degree. But as this number muſt be an integer, let it be 4, each being 15″: and let the breadth of the vernier contain 31 of thoſe parts, or $7\frac{1}{4}^\circ$, and be divided into 30 parts.

Here $n=\frac{1}{4}$; $m=\frac{1}{30}$; then $\frac{1}{4}\times\frac{1}{30}=\frac{1}{120}$ of a degree,

Vernier || Verſailles.

gree, or 30′, which is the leaſt part of a degree that inſtrument can ſhow.

If $n=\frac{1}{5}$, and $m=\frac{1}{36}$; then $\frac{1}{5}\times\frac{1}{36}=\frac{60}{5\times36}$ of a minute, or 20″.

The following table, taken as examples in the inſtruments commonly made from 3 inches to 8 feet radius, ſhows the diviſions of the limb to neareſt tenths of inches, ſo as to be an aliquot of 60's, and what parts of a degree may be eſtimated by the vernier, it being divided into ſuch equal parts, and containing ſuch degrees as their columns ſhow.

Rad. inches.	Parts of a degree.	Parts in vernier.	Breadth of vernier.	Parts obſerved.	
3	1	15	$15\frac{1}{4}$	4′	0″
6	1	20	$20\frac{1}{4}$	3	0
9	2	20	$10\frac{1}{4}$	1	30
12	2	24	$12\frac{1}{4}$	1	15
15	3	20	$6\frac{3}{4}$	1	0
18	3	30	$10\frac{1}{4}$	0	40
21	4	30	$7\frac{1}{4}$	0	30
24	4	36	$9\frac{3}{4}$	0	25
30	5	30	$7\frac{1}{2}$	0	20
36	6	30	$5\frac{1}{4}$	0	20
42	8	30	$3\frac{7}{8}$	0	15
48	9	40	$4\frac{5}{9}$	0	10
60	10	36	$3\frac{7}{10}$	0	10
72	12	30	$2\frac{7}{12}$	0	10
84	15	40	$2\frac{3}{7}$	0	6
96	15	60	4	0	4

By altering the number of diviſions, either in the degrees or in the vernier, or in both, an angle can be obſerved to a different degree of accuracy. Thus, to a radius of 30 inches, if a degree be divided into 12 parts, each being five minutes, and the breadth of the vernier be 21 ſuch parts, or $1\frac{1}{4}^{\circ}$, and divided into 20 parts, then $\frac{1}{12}\times\frac{1}{20}=\frac{1^{\circ}}{240}=15''$: or taking the breadth of the vernier $2\frac{7}{12}^{\circ}$, and divided into 30 parts; then $\frac{1}{12}\times\frac{1}{30}=\frac{1^{\circ}}{360}$, or 10″: Or $\frac{1}{12}\times\frac{1}{50}=\frac{1^{\circ}}{600}=6''$; where the breadth of the vernier is $4\frac{1}{4}^{\circ}$.

VERONA, a city of Italy, capital of the Veroneſe, and in the territory of Venice; ſituated on the river Adige, in E. Long. 11. 24. N. Lat. 45. 26. It is ſeven miles in compaſs; and is ſtrongly fortified. It contains 57,400 inhabitants.

VERONESE, a territory of Italy, in the republic of Venice; bounded on the north by the Trentino, on the eaſt by the Vicentino and Paduano, on the ſouth by the Mantuano, and on the weſt by the Breſciano. It is about 35 miles in length, and 27 in breadth; and fertile in corn, wine, fruits, and cattle.

VERONESE. See CAGLIARI.

VERONICA, a genus of plants of the claſs of diandria; and in the natural ſyſtem arranged under the 40th order, *Perſonatæ*. See BOTANY *Index*.

VERSAILLES, a town of France, in the department of Seine and Oiſe, 10 miles weſt-ſouth-weſt of Paris. It contains 60,000 inhabitants, and ſince the Revolution has been created a biſhop's ſee. In the reign of Louis XIII. it was only a ſmall village. This prince built here a hunting-hut in 1630, which Baſſompierre calls "the paltry chateau of Verſailles." Although the ſituation was low and very unfavourable, Louis XIV. built a magnificent palace here, which was the uſual reſidence of the kings of France till the 6th of October 1789, when the late unfortunate Louis XVI. and his family were removed from it to the Thuilleries. The buildings and the gardens are adorned with a vaſt number of ſtatues, done by the greateſt maſters, and the water-works are all worthy of admiration. The great gallery is thought to be as curious a piece of workmanſhip of that kind as any in the world: nor is the chapel leſs to be admired for its fine architecture and ornaments. The gardens, with the park, are five miles in circumference, and ſurrounded by walls. There are three fine avenues to Verſailles; one of which is the common road to Paris, the other comes from Seaux, and the third from St Cloud. E. Long. 2. 12. N. Lat. 48. 48.

Verſailles || Vertumn

VERSE, in *Poetry*, a line conſiſting of a number of long and ſhort ſyllables, which run with an agreeable cadence.

VERSE is alſo uſed for a part of a chapter, ſection, &c.

VERSIFICATION, the art or manner of making verſe; alſo the tune and cadence of verſe. See POETRY, Part III.

VERSION, a tranſlation of ſome book or writing out of one language into another. See TRANSLATION.

VERT, in *Heraldry*, the term for a green colour. It is called *vert* in the blazon of the coats of all under the degree of nobles: but in coats of nobility it is called *emerald;* and in thoſe of kings *venus*. In engraving it is expreſſed by diagonals, or lines drawn athwart from right to left, from the dexter chief corner to the ſiniſter baſe.

VERTEBRÆ. See ANATOMY, N° 30.

VERTEX, in *Anatomy*, denotes the crown of the head. Hence vertex is alſo uſed figuratively for the top of other things: thus we ſay, the vertex of a cone, pyramid, &c.

VERTEX, is alſo uſed in *Aſtronomy* for the point of the heaven directly over our heads, properly called the *zenith*.

VERTICILLATÆ, the name of a claſs in Ray's and Boerhaave's Methods, conſiſting of herbaceous vegetables. It is alſo the name of the 42d order in Linnæus's Fragments of a Natural Method.

VERTICILLUS, a mode of flowering, in which the flowers are produced in rings at each joint of the ſtem, with very ſhort foot-ſtalks. The term is exemplified in mint, horehound, and the other plants of the natural order deſcribed above.

VERTICITY, is that property of the loadſtone whereby it turns or directs itſelf to one particular point.

VERTIGO, in *Medicine*. See there, N° 82.

VERTUMNUS, in *Mythology*, a god who preſided over gardens and orchards, honoured among the Etruſcans, from whom the worſhip of this deity was tranſmitted to the Romans.

Vertumnus had a temple near the market-place at Rome, being repreſented as one of the tutelar deities of the merchants. The commentators on Ovid ſay, that

Vertumnus ‖ Vespertilio.

that he was an ancient king of Hetruria, who, by his diligent and ſucceſsful cultivation of fruit and gardens, obtained the honour of being ranked among the gods.

VERUMONTANUM, in *Anatomy*, a ſmall eminence near the paſſages where the ſemen is diſcharged into the urethra.

VERVAIN. See VERBENA, BOTANY *Index*.

VERTOT D'AUBOEF, *Rene Aubert de*, a celebrated hiſtorian, was deſcended from a noble and ancient family in Normandy, and born in 1655. At 16 years of age he became a Franciſcan friar; afterwards he entered into the order of the Premonſtratenſes, in which he had ſeveral benefices: and at length was a ſecular eccleſiaſtic. He became ſecretary to the ducheſs of Orleans, member of the Academy of Inſcriptions, and hiſtoriographer of Malta. He died at Paris in 1735. His principal works are, 1. The Hiſtory of the Revolutions of Sweden. 2. The Revolutions of Portugal. 3. The Revolutions of the Romans. 4. The Hiſtory of Malta. Theſe works are written in elegant French, and tranſlated into moſt of the languages of Europe.

VERULAM. See BACON.

VESALIUS, ANDREAS, a celebrated phyſician and anatomiſt, was born at Bruſſels about the year 1512. He ſtudied phyſic at Paris under James Sylvius; but applied himſelf chiefly to anatomy, which was then very little known, diſſections being eſteemed unlawful and impious: and it appears from his work *De Humani Corporis Fabrica*, that he perfected himſelf in this uſeful knowledge very early. About the year 1537, the republic of Venice made him profeſſor in the univerſity of Padua, where he taught anatomy for ſeven years; Charles V. called him to be his phyſician, as he was alſo to Philip II. king of Spain. Veſalius was now at the height of his glory, when all of a ſudden he formed the deſign of taking a journey to Paleſtine; concerning which journey we are told the following ſtory. A young Spaniſh nobleman he attended, being believed to be dead, Veſalius obtained leave to open him to explore the true cauſe of his illneſs; but when he opened the breaſt, he perceived ſymptoms of life, and ſaw the heart beat. The parents, not ſatisfied with proſecuting him for murder, accuſed him of impiety to the inquiſition, in hopes that tribunal would puniſh him with greater rigour: but the king interpoſing, ſaved him on condition of his making a pilgrimage to the Holy Land. He was ſhipwrecked on his return, and thrown upon the iſland of Zante, where he periſhed, in 1564. He was the author of ſeveral works, the principal of which is *De Humani Corporis Fabrica*.

VESICATORIUM, a BLISTER; an application of an acrid nature made to any part of the body, in order to draw a flux of humours to that part, and thus elevate the ſcarfskin into a bliſter.

VESPA, the WASP; a genus of inſects belonging to the order of hymenoptera. See ENTOMOLOGY *Index*.

VESPASIAN, the 10th emperor of Rome; remarkable for his clemency and other virtues. See ROME, N° 332—339.

VESPERS, in the church of Rome, denote the afternoon ſervice; anſwering in ſome meaſure to the evening prayers of the church of England.

VESPERTILIO, the BAT; a genus of quadrupeds, belonging to the order of primates. See MAMMALIA *Index*.

Veſpertilio ‖ Veſtals.

VESSEL, a general name given to the different ſorts of ſhips which are navigated on the ocean, or in canals and rivers. It is, however, more particularly applied to thoſe of the ſmaller kind, furniſhed with one or two maſts. See SHIP.

VESTA, in pagan worſhip, the ſame with Cybele. See CYBELE.

VESTA the *Younger*, in pagan worſhip, the goddeſs of Fire, was the daughter of Saturn and Cybele, and the ſiſter of Ceres. She was ſo much in love with chaſtity, that on Jupiter's aſcending the throne and offering to grant whatever ſhe aſked, ſhe only deſired the preſervation of her virginity, which ſhe obtained.—Veſta was not repreſented in her temple by any image.

VESTA, one of the lately diſcovered planets, of which the elements have been determined by Dr Gauſs in a communication to the Royal Society of Gottingen.

Elements of Veſta.

Epoch of the longitude, meridian of Seeberg	108°	19′	34.7″		
Diurnal tropical motion			770″	85′	84
Annual	78	9	23		
Aphelion, 1806	326	37	59		
Annual motion	+	2	1.2		
Aſcending node, 1806	80	53	23		
Annual motion	+		1.5		
Inclination of the orbit, 1806	10	37	34		
Annual diminution			0.4		
Eccentricity, 1806	0.0783486				
Annual diminution	0.0000058				
Log. of the greater ſemiaxis	0.4420728				

Elements of Ceres by the ſame.

Epoch of the mean longitude at Bremen, March 29, 1807, at 12 o'clock, mean time	193°	8′	4.6″ *	* In the Mag. Encyclop. it is 192° 9′ 54″.
Longitude of its perihelion	249	7	41	
——— aphelion	69	57	52	
——— aſcending node on the ecliptic	103	8	36	
Inclination of its orbit	7	5	49.5†	† Ibid. 7° 8′ 34″.
Diurnal tropical motion	0	16	18.91	
Logarithm of the mean diſtance	0.3728428			
Eccentricity	0.097505			
Greateſt diſtance from the ſun	25.625			
Leaſt	21.514			
Period of its revolution	1321 days, 12 hours.			

VESTALIA, in Roman antiquity, a feſtival celebrated in honour of the goddeſs Veſta, on the 5th of the ides of June; that is, on the 9th of the month.

VESTALS, among the ancient Romans, were prieſteſſes of the goddeſs Veſta, and had the perpetual fire committed to their charge; they were at firſt only four in number, but afterwards increaſed to ſix; and it does not appear that their number ever exceeded ſix, among whom was one ſuperior to the reſt, and called *veſtalis maxima*.

The veſtals were choſen from ſix to ten years of age, and obliged to ſtrict continency for 30 years; the firſt 10 of which were employed in learning the ceremonies of religion, the next 10 in the performance of them, and the 10 laſt in teaching them to the younger veſtals.

The

Veſtals || Veſuvius.

The habit of the veſtals conſiſted of a head-dreſs, called *infula*, which ſat cloſe to the head, and from whence hung certain laces called *vitta;* a kind of ſurplice made of white linen, and over it a purple mantle with a long train to it.

VESTIBLE, or VESTIBULE, in *Architecture*, a kind of entrance into a large building; being an open place before the hall, or at the bottom of the ſtaircaſe.

VESTRY, a place adjoining to a church, where the veſtments of the miniſter are kept; and alſo a meeting at ſuch place, conſiſting of the miniſter, church-wardens, and chief men of moſt pariſhes, who make a pariſh veſtry or meeting. By cuſtom there are ſelect veſtries, being a certain number of perſons choſen to have the government of the pariſh, make rates, and take the accounts of church-wardens, &c.

VESUVIAN, a mineral ſubſtance. See MINERALOGY *Index*.

VESUVIUS, a celebrated volcano of Italy, ſix miles eaſt from the city of Naples. This mountain has two tops; one of which only goes by the name of *Veſuvius*, the other being now called *Somma;* but Sir William Hamilton is of opinion, that the latter is what the ancients called *Veſuvius*.

1 General deſcription of the mountain.

The perpendicular height of Veſuvius is only 3700 feet, though the aſcent from the foot to the top is three Italian miles. One ſide of the mountain is well cultivated and fertile, producing great plenty of vines; but the ſouth and weſt ſides are entirely covered with cinders and aſhes; while a ſulphureous ſmoke conſtantly iſſues from the top, ſometimes attended with the moſt violent exploſions of ſtones, the emiſſion of great ſtreams of lava, and all the other attendants of a moſt formidable volcano.

2 Account of the firſt eruption recorded in hiſtory.

The firſt of theſe eruptions recorded in hiſtory took place in the year 79; at which time the two cities of Pompeii and Herculaneum were entirely buried under the ſtones and aſhes thrown out. Incredible miſchief was alſo done to the neighbouring country, and numbers of people loſt their lives, among whom was Pliny the Elder.

It is the opinion of the beſt judges, however, that this eruption was by no means the firſt that had ever happened. The very ſtreets of thoſe cities which were at that time overwhelmed are ſaid to be partly paved with lava. Since that time 30 different eruptions have been recorded, ſome of which have been extremely violent. In the year 1538, a mountain, three miles in circumference, and a quarter of a mile in perpendicular height, was thrown up in the courſe of one night.

3 Of the eruption in 1767.

The firſt great eruption taken notice of by Sir William Hamilton was that of 1767, which, though very violent, was mild in compariſon with that of 1538.

4 Nine eruptions from 1767 to 1779.

From this time (1767) Veſuvius never ceaſed for ten years to ſend forth ſmoke, nor were there many months in which it did not throw out ſtones, ſcoriæ, and cinders; which, increaſing to a certain degree, were uſually followed by lava; ſo that from the year 1767 to 1779 there were nine eruptions, ſome of them very conſiderable. In the month of Auguſt that year, however, an eruption took place, which, for its extraordinary and terrible appearance, may be reckoned among the moſt remarkable of any recorded concerning this or any other volcano.

5 Account of the great eruption in 1779.

During the whole month of July the mountain continued in a ſtate of fermentation. Subterraneous exploſions and rumbling noiſes were heard; quantities of ſmoke were thrown up with great violence, ſometimes with red-hot ſtones, ſcoriæ, and aſhes; and towards the end of the month theſe ſymptoms increaſed to ſuch a degree as to exhibit, in the night-time, the moſt beautiful fireworks that can be imagined. Veſuvius.

On Thurſday 5th Auguſt the volcano appeared moſt violently agitated; a white and ſulphureous ſmoke iſſued continually and impetuouſly from its crater, one puff ſeeming to impel another; ſo that a maſs of them was ſoon accumulated, to appearance four times the height and ſize of the volcano itſelf. Theſe clouds of ſmoke were exceedingly white, ſo that the whole reſembled an immenſe accumulation of bales of the whiteſt cotton. In the midſt of this very white ſmoke, vaſt quantities of ſtones, ſcoriæ, and aſhes, were thrown up to the height of 2000 feet; and a quantity of liquid lava, ſeemingly very heavy, was lifted up juſt high enough to clear the rim of the crater, and take its way down the ſides of the mountain. This lava, having run violently for ſome hours, ſuddenly ceaſed, juſt before it had reached the cultivated parts of the mountain, near four miles from the ſpot whence it iſſued. The heat, all this day, was intolerable at the towns of Somma and Ottaiano; and was ſenſibly felt at Palma and Lauri, which are much farther off. Reddiſh aſhes fell ſo thick on the two former, that the air was darkened, and that objects could not be diſtinguiſhed at the diſtance of ten feet. Long filaments of a vitrified matter, like ſpun glaſs, were mixed, and fell with theſe aſhes; ſeveral birds in cages were ſuffocated, and the leaves of the trees in the neighbourhood of Somma were covered with white and very corroſive ſalt.

6 Extraordinary effuſion of fire by the approach of ſtormy clouds.

About 12 at night, on the 7th, the fermentation of the mountain ſeemed greatly to increaſe. Our author was watching the motions of the volcano from the mole at Naples, which has a full view of it. Several glorious pictureſque effects had been obſerved from the reflection of the deep red fire within the crater of Veſuvius, and which mounted high amongſt thoſe huge clouds on the top of it: when a ſummer ſtorm, called in that country a *tropea*, came on ſuddenly, and blended its heavy watery clouds with the ſulphureous and mineral ones, which were already like ſo many other mountains piled up on the top of the volcano. At this moment a fountain of fire was ſhot up to an incredible height, caſting ſo bright a light, that the ſmalleſt objects were clearly diſtinguiſhable at any place within ſix miles or more of Veſuvius. The black ſtormy clouds, paſſing ſwiftly over, and at times covering the whole or a part of the bright column of fire, at other times clearing away and giving a full view of it, with the various tints produced by its reverberated light on the white clouds above in contraſt with the pale flaſhes of forked lightning that attended the tropea, formed ſuch a ſcene as no power of art can expreſs. One of his Sicilian majeſty's gamekeepers, who was out in the fields near Ottaiano whilſt this ſtorm was at its height, was ſurpriſed to find the drops of rain ſcald his face and hands; a phenomenon probably occaſioned by the clouds having acquired a great degree of heat in paſſing through the above-mentioned column of fire.

On the 8th, the mountain was quiet till towards ſix o'clock in the evening, when a great ſmoke began to gather over its crater; and about an hour after a rumbling

Vesuvius. bling subterraneous noise was heard in the neighbourhood of the volcano; the usual throws of red-hot stones and scoriæ began and increased every instant. The crater, viewed through a telescope, seemed much enlarged by the violence of last night's explosions, and the little mountain on the top was entirely gone. About nine o'clock a most violent report was heard at Portici and its neighbourhood, which shook the houses to such a degree as made the inhabitants run out into the streets. Many windows were broken, and walls cracked by the concussion of the air on this occasion, though the noise was but faintly heard at Naples. In an instant a fountain of liquid transparent fire began to rise, and gradually increasing, arrived at last at the amazing height of ten thousand feet and upwards. Puffs of smoke, as black as can possibly be imagined, succeeded one another hastily, and accompanied the red-hot, transparent, and liquid lava, interrupting its splendid brightness here and there by patches of the darkest hue. Within these puffs of smoke, at the very moment of emission, a bright but pale electrical fire was observed playing briskly about in zig-zag lines. The wind was south-west, and, though gentle, was sufficient to carry these puffs of smoke out of the column of fire; and a collection of them by degrees formed a black and extensive curtain behind it; in other parts of the sky it was perfectly clear, and the stars bright. The fiery fountain, of such immense magnitude, on the dark ground just mentioned, made the finest contrast imaginable; and the blaze of it reflected from the surface of the sea, which was at that time perfectly smooth, added greatly to this sublime view.

7 Immense fountain of lava thrown up by Vesuvius

The lava, mixed with stones and scoriæ, having risen to the amazing height already mentioned, was partly directed by the wind towards Ottaiano, and partly falling, still red hot and liquid, upon the top of Vesuvius, covered its whole cone, part of that of the summit of Somma, and the valley between them. The falling matter, being nearly as inflamed and vivid as that which was continually issuing fresh from the crater, formed with it one complete body of fire, which could not be less than two miles and a half in breadth, and of the extraordinary height above mentioned, and cast a heat to the distance of at least six miles round. The brushwood on the mountain of Somma was soon in a blaze, and the flame of it being of a different colour from the deep red of the matter thrown out by the volcano, and from the silvery blue of the electrical fire, still added to the contrast of this most extraordinary scene.

The black cloud, increasing greatly, once bent towards Naples, and threatened the city with speedy destruction; for it was charged with electrical fire, which kept constantly darting about in bright zig-zag lines. This fire, however, rarely quitted the cloud, but usually returned to the great column of fire whence it proceeded; though once or twice it was seen to fall on the top of Somma, and set fire to some dry grass and bushes. Fortunately the wind carried back the cloud just as it reached the city, and had begun to occasion great alarm. The column of fire, however, still continued, and diffused such a strong light, that the most minute objects could be discerned at the distance of ten miles or more from the mountain. Mr Morris informed our author, that at Sorrento, which is 12 miles distant from Vesuvius, he read the title-page of a book by that volcanic light. Vesuvius.

All this time the miserable inhabitants of Ottaiano were involved in the utmost distress and danger by the showers of stones which fell upon them, and which, had the eruption continued for a longer time, would most certainly have reduced their town to the same situation with Herculaneum and Pompeii. The mountain of Somma, at the foot of which the town of Ottaiano is situated, hides Vesuvius from the view of its inhabitants; so that till the eruption became considerable it was not visible to them. On Sunday night, when the noise increased, and the fire began to appear above the mountain of Somma, many of the inhabitants flew to the churches, and others were preparing to quit the town, when a sudden and violent report was heard; soon after which they found themselves involved in a thick cloud of smoke and ashes; a horrid crashing noise was heard in the air, and presently fell a vast shower of stones and large pieces of scoriæ, some of which were of the diameter of seven or eight feet, which must have weighed more than 1000 pounds before they were broken, as some of the fragments which Sir William Hamilton found in the streets still weighed upwards of 60 pounds. When these large vitrified masses either struck against one another in the air, or fell on the ground, they broke in many pieces, and covered a large space of ground with vivid sparks of fire, which communicated their heat to every thing that was combustible. These masses were formed of the liquid lava; the exterior parts of which were become black and porous by cooling in their fall through such a vast space; whilst the interior parts, less exposed, retained an extreme heat, and were perfectly red. 8 Distress of the inhabitants of Ottaiano.

In an instant the town and country about it was on fire in many parts, for there were several straw huts in the vineyards, which had been erected for the watchmen of the grapes; all of which were burnt. A great magazine of wood in the heart of the town was all in a blaze; and had there been much wind, the flames must have spread universally, and all the inhabitants would have been burnt in their houses; for it was impossible for them to stir out. Some, who attempted it with pillows, tables, chairs, the tops of wine casks, &c. on their heads, were either knocked down or soon driven back to their close quarters under arches and in the cellars of their houses. Many were wounded, but only two persons died of their wounds.

To add to the horror of the scene, inceſſant volcanic lightning was whisking about the black cloud that surrounded them, and the sulphureous smell and heat would scarcely allow them to draw their breath. In this dreadful situation they remained about 25 minutes, when the volcanic storm ceased all at once, and Vesuvius remained sullen and silent.

Some time after the eruption had ceased, the air continued greatly impregnated with electrical matter. The duke of Cottofiano told our author, that having, about half an hour after the great eruption had ceased, held a Leyden bottle, armed with a pointed wire, out at his window at Naples, it soon became considerably charged. But whilst the eruption was in force, its appearance was too alarming to allow one to think of such experiments. —He was informed also by the prince of Monte Mileto, that 9 Vast quantity of electric matter in the air.

Vesuvius. that his son, the duke of Popoli, who was at Monte Mileto the 8th of August, had been alarmed by the shower of cinders that fell there; some of which he had sent to Naples weighing two ounces; and that stones of an ounce weight had fallen upon an estate of his ten miles farther off. Monte Mileto is about 30 miles from the volcano. The abbé Cagliani also related, that his sister, a nun in a convent at Manfredonia, had written to inquire after him, imagining that Naples must have been destroyed, when they, at so great a distance, had been alarmed by a shower of ashes which fell on the city at 11 o'clock at night, so much as to open all the churches, and go to prayers. As the great eruption happened at nine o'clock, these ashes must have travelled 100 miles in the space of two hours.

10 Damage done by the eruption at Ottaiano. Nothing could be more dismal than the appearance of Ottaiano after this eruption. The houses were unroofed, half buried under the black scoriæ and ashes; all the windows towards the mountain were broken, and some of the houses themselves burnt; the streets choked up with ashes, in some narrow places not less than four feet thick; and a few of the inhabitants who had just returned, were employed in clearing them away, and piling them up in hillocks, to get at their ruined houses. The palace of the prince of Ottaiano is situated on an eminence above the town, and nearer the mountain. The steps leading up to it were deeply covered with volcanic matter; the roof was totally destroyed, and the windows broken, but the house itself, being strongly built, had not suffered much.

11 Vast fragments of lava thrown out. An incredible number of fragments of lava were thrown out during the eruption, some of which were of immense magnitude. The largest measured by Sir William Hamilton was 108 feet in circumference and 17 in height. This was thrown at least a quarter of a mile clear of the mouth of the volcano. Another, 66 feet in circumference and 19 in height, being nearly of a spherical figure, was thrown out at the same time, and lay near the former. This last had the marks of being rounded, nay almost polished, by continual rolling in torrents or on the sea-shore. Our author conjectures that it might be a spherical volcanic salt, such as that of 45 feet in circumference mentioned by M. de St Fond, in his Treatise of Extinguished Volcanoes. A third of 16 feet in height and 92 in circumference was thrown much farther, and lay in the valley between Vesuvius and the Hermitage. It appeared also, from the large fragments that surrounded this mass, that it had been much larger while in the air.

Vesuvius continued to emit smoke for a considerable time after this great eruption, so that our author was apprehensive that another would soon ensue; but from that time nothing comparable to the above has taken place. From the time of this great eruption to the year 1784 our author kept an exact diary of the operations of Vesuvius, with drawings, showing, by the quantity of smoke, the degree of fermentation within the volcano. The operations of the subterraneous fire, however, appear to be very capricious and uncertain. One day there is the appearance of a violent fermentation, and the next every thing is tranquil; but whenever there has been a considerable ejection of scoriæ and cinders, it has been a constant observation, that the lava soon made its appearance, either by boiling over the crater, or forcing its way through the crevices in the conical part of the mountain. An eruption took place in the month of November 1784, and continued for some time, but without any remarkable circumstance. Vesuvius ‖ Victor.

VETCH. See VICIA, BOTANY *Index*.

VETERAN, among the ancient Romans, an appellation given to a *soldier* grown old in the service, or who had made a certain number of campaigns.

VETERINARY ART. See FARRIERY.

VEXILLUM, in *Botany*; the upper petal of a pea-bloom, or butterfly-shaped flower, which is generally larger than any of the others.

VIALES, in mythology, a name given among the Romans to the gods who had the care and guard of the roads and highways.

VIATICUM, in Roman antiquity, an appellation given in common to all officers of any of the magistrates; as *lictors*, *accensi*, *scribes*, *criers*.

VIBEX, is sometimes used by physicians, for a black and blue spot in the skin occasioned by an efflux or extravasation of blood.

VIBRATION, in *Mechanics*, a regular, reciprocal motion of a body, as a pendulum.

VIBURNUM, a genus of plants of the class pentandria; and in the natural system arranged under the 43d order, *Dumosæ*. See BOTANY *Index*.

VICAR, a person appointed as deputy to another, to perform his functions in his absence, and under his authority.

VICAR, in the canon-law, denotes a priest of a parish, the predial tithes whereof are impropriated or appropriated; that is, belong either to a chapter, religious house, &c. or to a layman who receives them, and only allows the vicar the small tithes, or a convenient salary. See the article *PARSON and Vicar*.

VICE, in ethics, is ordinarily defined an elective habit, denoting either an excess or defect from the just medium wherein virtue is placed.

VICE, in smithery and other arts conversant in metals, a machine or instrument serving to hold fast any thing they are at work upon, whether it is to be beaten, filed, or rivetted.

VICE is also used in the composition of divers words to denote the relation of something that comes instead or in the place of another; as vice admiral, vice-chancellor, &c. are officers who take place in the absence of admirals, &c.

VICEROY, a governor of a kingdom, who commands in the name and instead of a king, with full and sovereign authority.

VICIA, a genus of plants of the class diadelphia; and in the natural system arranged under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

VICISSITUDE, the regular succession of one thing after another; as the vicissitude of day and night, of the seasons, &c.

VICTIM, denotes a sacrifice offered to some deity, of a living creature, as a man or beast, which is slain to appease his wrath, or to obtain some favour.

VICTOR, SEXTUS AURELIUS, a Roman historian, who flourished under the emperors Constantius and Julian; as we learn from many passages in his own writings, and also from Ammianus Marcellinus. This historian relates, that Constantius made him consul, and honoured

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honoured him with a brazen ſtatue, on account of his excellent qualifications; although, as he owns of himſelf, he was born in an obſcure village, and of poor and illiterate parents. It is commonly believed that he was an African; it is certain, that he dwells much upon the praiſes of that country, which he calls the glory of the earth; *decus terrarum*. Two books of his are extant in the hiſtorical way: one *De viris illuſtribus urbis Romæ;* the other, *De Cæſaribus;* to which is prefixed *Libellus de origine gentis Romanæ*. The whole makes an abridged hiſtory of Rome, from its foundation down to the reign of Julian incluſive.

VICTORY, the overthrow or defeat of an enemy in war or combat.

VICTORY, in Pagan worſhip, is repreſented by Heſiod as the daughter of Styx and Pallas; and Varro calls her the *daughter of Heaven and Earth*. The Romans erected a temple to her, where they prayed to the gods to give ſucceſs to their arms. They painted her in the form of a woman, clad in cloth of gold. In ſome medals, ſhe is repreſented with wings flying through the air, holding a laurel crown in one hand and a palm in the other; but in other medals, ſhe is ſeen ſtanding upon a globe, with the ſame crown and branch of palm.

VIDA, MARCUS HIERONYMUS, biſhop of Alva, in Monſerrat, and one of the moſt excellent Latin poets that have appeared ſince the Auguſtan age, was born at Cremona in 1470. Having diſtinguiſhed himſelf by his learning and taſte for literature, he was made biſhop of Alva in 1552. After continuing two years with Pope Clement VII. at Rome, he went to reſide upon his ſee; where, for 30 years, he performed all the offices of a good biſhop and a good man; and though he was mild, gentle, and full of goodneſs, he was ſo far from wanting ſpirit, that when the city of Alva was beſieged by the French, he uſed all poſſible means to prevent its being given up, by ſtrenuouſly exhorting the people, and, when proviſions were ſcarce, by ſupplying them at his own expence. His Poetics, and poem on the ſilkworm, paſs for his maſterpiece; his poem on the game of cheſs is alſo greatly admired. He alſo wrote hymns, eclogues, and a poem entitled *Chriſtiados* in ſix books; all which are in Latin, and have gained him a great reputation. His works in proſe conſiſt of dialogues, ſynodical conſtitutions, letters, and other pieces. He died in 1556, ſoon after being made biſhop of Cremona.

VIENNA, the capital of the circle of Auſtria, in Germany, and of the whole German empire, is the place where the emperor reſides. The city itſelf is not of very great extent; nor can it be enlarged, it being limited by a very ſtrong fortification; but it is very populous. The ſtreets, in general, are narrow, and the houſes built high. Some of the public buildings are magnificent; but they appear externally to no great advantage, on account of the narrowneſs of the ſtreets. The chief of them are the imperial palace, the library, and the muſeum; the palaces of the princes Lichtenſtein, Eugene, &c. Vienna was twice ineffectually beſieged by the Turks; namely, in 1589 and 1683. At the latter period, the ſiege was raiſed by John Sobieſki, king of Poland, who totally defeated the Turkiſh army before the walls of this place. There is no great danger that Vienna will ever again be ſubjected to the inconveniences of a ſiege. Yet, in caſe that ſhould happen, a meaſure has been taken, which will prevent the neceſſity of deſtroying the ſuburbs; namely, no houſes without the walls are allowed to be built nearer to the glacis than 600 yards; ſo that there is a circular field of that breadth all round the town, which, excluſive of the advantage above mentioned, has a very beautiful and ſalutary effect. Theſe magnificent ſuburbs, and the town together, are ſaid to contain above 300,000 inhabitants; yet the former are not near ſo populous, in proportion to their ſize, as the town; becauſe many houſes in the ſuburbs have extenſive gardens belonging to them, and many families, who live during the winter within the fortifications, ſpend the ſummer in the ſuburbs. The cathedral is built of free-ſtone, is 114 yards long, and 48 broad, and the ſteeple is 447 feet high. Inſtead of a weathercock there was a Turkiſh creſcent, in memory of the ſiege in 1589; but, after the ſecond ſiege in 1683, it was changed for a golden croſs, which three months after was thrown down by a ſtorm. At preſent there is a black ſpread eagle, over which is a gilded croſs. Joining to this church is the archbiſhop's palace, the front of which is very fine. The univerſity had ſeveral thouſand ſtudents, who, when this city was beſieged, mounted guard, as they did alſo in 1741. Beſide this, there is the academy of Lower Auſtria; and the archducal library is much frequented by foreigners, as it contains above 100,000 printed books, and 10,000 manuſcripts. The academy of painting is remarkable for the fine pictures it produces. The archducal treaſury, and a cabinet of curioſities of the houſe of Auſtria, are great rarities. The inhabitants, in general, live in a ſplendid manner; and people of diſtinction have all ſorts of wines at their tables, which they are very free with to foreigners. There is a ſort of harbour on the Danube, where there are magazines of naval ſtores, and ſhips have been fitted out to ſerve on that river againſt the Turks. Vienna is an archbiſhop's ſee. It is ſeated at the place where the river Vienna or Wein, falls into the Danube, 30 miles weſt of Preſburgh, 350 north-north-eaſt of Rome, 520 ſouth-eaſt by ſouth of Amſterdam, 565 eaſt of Paris, and 680 eaſt-ſouth-eaſt of London. E. Long. 10. 20. N. Lat. 48. 13.

Vienna, Vigil.

VIGIL, in church hiſtory, is the eve or next day before any ſolemn feaſt; becauſe then Chriſtians were wont to watch, faſt, and pray, in their churches.

VIGILS of Plants, a term under which botaniſts comprehend the preciſe time of the day in which the flowers of different plants open, expand, and ſhut.

As all plants do not flower in the ſame ſeaſon, or month; in like manner, thoſe which flower the ſame day, in the ſame place, do not open and ſhut preciſely at the ſame hour. Some open in the morning, as the lip flowers, and compound flowers with flat ſpreading petals; others at noon, as the mallows; and a third ſet in the evening, or after ſunſet, as ſome geraniums and opuntias: the hour of ſhutting is equally determined. Of thoſe which open in the morning, ſome ſhut ſoon after, while others remain expanded till night.

The hours of opening, like the time of flowering, ſeem to vary, according to the ſpecies of the plant, the temperature of the climate, and that of the ſeaſon. Flowers, whoſe extreme delicacy would be hurt by the ſtrong impreſſions of an ardent ſun, do not open till night: thoſe which require a moderate degree of heat to elevate their juices; in other words, whoſe juices do not riſe but in

Vigil ‖ Villenage.

the morning or evening, do not expand till then; whilſt thoſe which need a more lively heat for the ſame purpoſe, expand at noon when the ſun is in his meridian ſtrength. Hence it is, that the heat of the air being greater betwixt the tropics than elſewhere, plants which are tranſported from thoſe climates into the cold or temperate climates of Europe, expand their flowers much later than in their native ſoil. Thus, a flower which opens in ſummer at ſix o'clock in the morning at Senegal, will not open at the ſame ſeaſon in France and England till eight or nine, nor in Sweden till ten.

Linnæus diſtinguiſhes by the general name of *ſolar* (*flores ſolares*) all thoſe flowers which obſerve a determinate time in opening and ſhutting. Theſe flowers are again divided, from certain circumſtances, into three ſpecies, or kinds:

Equinoctial flowers (*flores æquinoctiales*) are ſuch as open and ſhut at all ſeaſons, at a certain fixed or determinate hour.

Tropical flowers (*flores tropici*) are ſuch whoſe hour of opening is not fixed at all ſeaſons, but accelerated or retarded according as the length of the day is increaſed or diminiſhed.

Meteorous flowers (*flores meteorici*) are ſuch whoſe hour of expanſion depends upon the dry or humid ſtate of the air, and the greater or leſs preſſure of the atmoſphere. Of this kind is the Siberian ſow-thiſtle, which ſhuts at night if the enſuing day is to be clear and ſerene, and opens if it is to be cloudy and rainy. In like manner the African marigold, which in dry ſerene weather opens at ſix or ſeven in the morning, and ſhuts at four o'clock in the afternoon, is a ſure indication that rain will fall during the courſe of the day, when it continues ſhut after ſeven.

VIGO, a ſea-port town of Galicia in Spain, with an old caſtle and a fort. It is ſeated in a fertile country by the ſea-ſide. It was rendered famous by a ſea-fight between the confederate fleet commanded by Sir George Rook, and a ſquadron of French men of war, while the duke of Ormond with a body of land forces drove the Spaniards from the caſtles which defended the harbour. Admiral Hopſon having with infinite danger broken through the boom made acroſs the mouth of the harbour, the Engliſh took four galleons and five large men of war, and the Dutch five galleons and one man of war. Four galleons, with 14 men of war, were deſtroyed, with abundance of plate and other rich effects. W. Long. 8. 43. N. Lat. 42. 14.

VILLA FRANCA, the name of ſeveral towns; one in Piedmont, three miles eaſt of Nice; another of Catalonia, 18 miles weſt of Barcelona; a third, the capital of St Michael, one of the Azores; and a fourth, a town of Eſtremadura in Spain, 57 miles ſouth-eaſt of Salamanca.

VILLAGE, an aſſemblage of houſes inhabited chiefly by peaſants and farmers, and having no market, whereby it is diſtinguiſhed from a town. The word is French, formed of *vil* or *vilis*, "low, mean, contemptible:" or rather, from the Latin *villa*, a country-houſe or farm.

VILLAIN, or VILLEIN, in our ancient cuſtoms, denotes a man of ſervile or baſe condition, viz. a bondman or ſervant.

VILLENAGE, in *Law*. The folk-land or eſtates held in villenage, was a ſpecies of tenure neither ſtrictly feodal, Norman, or Saxon; but mixed and compounded of them all; and which alſo, on account of the heriots that uſually attend it, may ſeem to have ſomewhat Daniſh in its compoſition. Under the Saxon government there were, as Sir William Temple ſpeaks, a ſort of people in a condition of downright ſervitude, uſed and employed in the moſt ſervile works, and belonging, both they, their children, and effects, to the lord of the ſoil, like the reſt of the cattle or ſtock upon it. Theſe ſeem to have been thoſe who held what was called the *folk-land*, from which they were removeable at the lord's pleaſure. On the arrival of the Normans here, it ſeems not improbable, that they who were ſtrangers to any other than a feodal ſtate, might give ſome ſparks of enfranchiſement to ſuch wretched perſons as fell to their ſhare, by admitting them, as well as others, to the oath of fealty; which conferred a right of protection, and raiſed the tenant to a kind of eſtate ſuperior to downright ſlavery, but inferior to every other condition. This they called *villenage*, and the tenants *villeins*. Villena

Theſe villeins, belonging principally to lords of manors, were either villeins *regardant*, that is, annexed to the manor or land: or elſe they were *in groſs*, or at large, that is, annexed to the perſon of the lord, and transferable by deed from one owner to another. They could not leave their lord without his permiſſion; but if they ran away, or were purloined from him, might be claimed and recovered by action, like beaſts or other chattels. They held indeed ſmall portions of land by way of ſuſtaining themſelves and families: but it was at the mere will of the lord, who might diſpoſſeſs them whenever he pleaſed; and it was upon villein ſervices, that is, to carry out dung, to hedge and ditch the lord's demeſnes, and any other the meaneſt offices: and their ſervices were not only baſe, but uncertain both as to their time and quantity.

A villein could acquire no property either in lands or goods: if he purchaſed either, the lord might ſeize them to his own uſe; unleſs he contrived to diſpoſe of them again before the lord had ſeized them, for the lord had then loſt his opportunity.

In many places a fine was alſo payable to the lord, if the villein preſumed to marry his daughter to any one without leave from the lord: and by the common law, the lord might alſo bring an action againſt the huſband for damages in thus purloining his property. For the children of villeins were alſo in the ſame ſtate of bondage with their parents; whence they were called in Latin *nativi*, which gave riſe to the female appellation of a villein, who was called a *neife*. In caſe of a marriage between a freeman and a neife, or a villein and a freewoman, the iſſue followed the condition of the father, being free if he was free, and a villein if he was villein, contrary to the maxim of the civil law, that *partus ſequitur ventrem*. But no baſtard could be born a villein, becauſe by another maxim of our law he is *nullius filius*; and as he can *gain* nothing by inheritance, it were hard that he ſhould *loſe* his natural freedom by it. The law, however, protected the perſons of villeins againſt atrocious injuries of the lord: for he might not kill or maim his villein; though he might beat him with impunity.

Villeins might be enfranchiſed by manumiſſion. In proceſs of time they gained conſiderable ground on their lords; and in particular ſtrengthened the tenure of their eſtates to that degree, that they came to have in them an intereſt in many places full as good, in others better

Villenage. than their lords. For the good nature and benevolence of many lords of manors having, time out of mind, permitted their villeins and their children to enjoy their poſſeſſions without interruption, in a regular courſe of deſcent, the common law, of which cuſtom is the life, now gave them title to preſcribe againſt their lords; and, on performance of the ſame ſervices, to hold their lands in ſpite of any determination of the lord's will. For though in general they are ſtill ſaid to hold their eſtates at the will of the lord, yet it is ſuch a will as is agreeable to the cuſtom of the manor; which cuſtoms are preſerved and evidenced by the rolls of the ſeveral courts-baron in which they are entered, or kept on foot by the conſtant immemorial uſage of the ſeveral manors in which the lands lie. And as ſuch tenants had nothing to ſhow for their eſtates but thoſe cuſtoms, and admiſſions in purſuance of them, entered on theſe rolls, or the copies of ſuch entries witneſſed by the ſteward, they now began to be called *tenants by copy of court-roll*, and their tenure itſelf a *copyhold*.

Privileged VILLENAGE, a ſpecies of tenure otherwiſe called *villein-ſocage*. See TENURE.

Ancient demeſne conſiſts of thoſe lands or manors which, though now perhaps granted out to private ſubjects, were actually in the hands of the crown in the time of Edward the Confeſſor, or William the Conqueror; and ſo appear to have been, by the great ſurvey in the exchequer, called the *doomſday-book*. The tenants of theſe lands, under the crown, were not all of the ſame order or degree. Some of them, as Britton teſtifies, continued for a long time pure and abſolute villeins, dependent on the will of the lord; and common copyholders in only a few points. Others were in a great meaſure enfranchiſed by the royal favour; being only bound in reſpect of their lands to perform ſome of the better ſort of villein-ſervices, but thoſe determinate and certain; as, to plough the king's land for ſo many days, to ſupply his court with ſuch a quantity of proviſions, and the like; all of which are now changed into pecuniary rents: and in conſideration hereof they had many immunities and privileges granted to them; as, to try the right of their property in a peculiar court of their own, called a *court of ancient demeſne*, by a peculiar proceſs denominated a writ of right cloſe; not to pay toll or taxes; not to contribute to the expences of knights of the ſhire; not to be put on juries, and the like.

Theſe tenants therefore, though their tenure be abſolutely copyhold, yet have an intereſt equivalent to a freehold: for though their ſervices were of a baſe and villenous original, yet the tenants were eſteemed in all other reſpects to be highly privileged villeins; and eſpecially for that their ſervices were fixed and determinate, and that they could not be compelled (like pure villeins) to relinquiſh thoſe tenements at the lord's will, or to hold them againſt their own: *et ideo* (ſays Bracton) *dicuntur liberi*.

Lands holding by this tenure are therefore a ſpecies of copyhold, and as ſuch preſerved and exempted from the operation of the ſtatute of Charles II. Yet they differ from common copyholds, principally in the privileges before mentioned: as alſo they differ from freeholders by one eſpecial mark and tincture of villenage, noted by Bracton, and remaining to this day; viz. that they cannot be conveyed from man to man by the general common-law conveyances of feoffment, and the reſt; but muſt paſs by ſurrender to the lord or his ſteward, in the manner of common copyholds: yet with the difference, that, in the ſurrenders of theſe lands in ancient demeſne, it is not uſed to ſay, "to hold at the will of their lord," in their copies; but only, "to hold according to the cuſtom of the manor." Villenage || St Vincent.

VILLI, among botaniſts, a kind of down like ſhort hair, with which ſome trees abound.

VILLOSE, or VILLOUS, ſomething abounding with villi or fibres like ſhort hair; ſuch is one of the coats of the ſtomach.

VINCA, a genus of plants of the claſs pentandria; and in the natural ſyſtem arranged under the 30th order, *Contortæ*. See BOTANY *Index*.

ST VINCENT, one of the windward Caribbee iſlands, which received its name from being diſcovered on the 22d of January, the feaſt of that Saint. It is inhabited by a race of people, of whom Dr Robertſon gives this account: "There is a great diſtinction in character between the Caribbees and the inhabitants of the larger iſlands. The former appear manifeſtly to be a ſeparate race. Their language is totally different from that of their neighbours in the large iſlands. They themſelves have a tradition that their anceſtors came originally from ſome part of the continent, and having conquered and exterminated the ancient inhabitants, took poſſeſſion of their lands and of their women. Hence they call themſelves Banaree, which ſignifies a man come from beyond ſea. Accordingly, the Caribbees ſtill uſe two diſtinct languages, one peculiar to the men, and the other to the women. The language of the men has nothing common with that ſpoken in the large iſlands. The dialect of the women conſiderably reſembles it. This ſtrongly confirms the tradition which I have mentioned. The Caribbees themſelves imagine that they were a colony from the Galibis, a powerful nation of Guiana in South America. But as their fierce manners approach nearer to thoſe of the people in the northern continent, than to thoſe of the natives of South America, and as their language has likewiſe ſome affinity to that ſpoken in Florida, their origin ſhould be deduced rather from the former than from the latter. In their wars they ſtill preſerve their ancient practice of deſtroying all the males, and preſerving the women either for ſervitude or for breeding."

It remained a long time after it was diſcovered inhabited by theſe people, and by another race improperly ſtyled *Black Caribs*, who are in reality negroes deſcended, as is generally believed, from ſome who eſcaped out of a Guinea ſhip wrecked upon the coaſt, and gradually augmented by ſuch as from time to time fled thither from Barbadoes. Theſe nations were often at war; but when their quarrels were compoſed, they had a ſtrength ſufficient to prevent ſtrangers from ſettling by force. The French, about half a century ago, at the requeſt of the Caribs, made a deſcent from Martinico, and attacked the negroes, but were repulſed with loſs; and found it their intereſt to conciliate a friendſhip with both nations by means of preſents, and furniſhing them with arms and ammunition.

St Vincent was long a neutral iſland; but at the peace of 1763, the French agreed that the right to it ſhould be veſted in the Engliſh; who, in the ſequel, at the inſtance of ſome rapacious planters, engaged in an unjuſt war againſt the Caribbees, who inhabited the

St Vincent, Vinci.

windward ſide of the iſland, and who were obliged to conſent to a peace, by which they ceded a very large tract of valuable land to the crown. The conſequence of this was, that in the next war, in 1779, they greatly contributed to the reduction of this iſland by the French, who, however, reſtored it by the peace of 1783. Since that time it has continued in the poſſeſſion of Great Britain. During the French revolutionary war, the Caribs revolted; and, aſſiſted by the French, ſpread deſolation over the whole iſland; but by the exertions of the governor and the Britiſh forces in the Weſt Indies, the revolt was quelled.

St Vincent is in length about 24 miles, and about 18 in breadth. The climate is very warm. The country is in general hilly, in ſome places mountainous; but interſperſed with a variety of pleaſant valleys, and ſome luxuriant plains, the ſoil being everywhere very fertile, and the high grounds are at leaſt in general eaſy of aſcent. Few iſlands are ſo well watered with rivers and ſprings. The inhabitants raiſe all kinds of ground proviſions in plenty. The rivers ſupply them with variety of fiſh. W. Long. 61°. N. Lat. 13°.

VINCI, Leonardo da, an illuſtrious Italian painter, deſcended from a noble Tuſcan family, was born in the caſtle of Vinci, near Florence in 1445. He was placed under Andrea Vcrochia, a celebrated painter in that city; but ſoon ſurpaſſed him and all his predeceſſors ſo much, as to be reputed the maſter of the third or golden age of modern painting. But his ſtudies were far from terminating here; no man's genius was more univerſal: he applied himſelf to arts, to literature, and to the accompliſhments of the body; and he excelled in every thing which he attempted. Lewis Sforza duke of Milan prevailed on him to be director of the academy for architecture he had juſt eſtabliſhed; where Leonardo ſoon baniſhed all the Gothic faſhions, and reduced every thing to the happy ſimplicity of the Greek and Roman ſtyle. By the duke's order he conſtructed the famous aqueduct that ſupplies the city of Milan with water: this canal goes by the name of *Morteſana*, being above 200 miles in length, and conducts the water of the river Adda quite to the walls of the city. In 1479, he was deſired to conſtruct ſome new device for the entertainment of Louis XII. of France, who was then to make his entrance into Milan. Leonardo accordingly made a very curious automaton in the form of a lion, which marched out to meet the king, reared up on its hinder legs before him, and opening its breaſt, diſplayed an eſcutcheon with fleurs-de-lis quartered on it. The diſorders of Lombardy, with the misfortunes of his patrons the Sforzi, obliging Leonardo to quit Milan, he retired to Florence, where he flouriſhed under the Medici: here he raiſed the envy of Michael Angelo, who was his contemporary; and Raphael, from the ſtudy of his works, acquired his beſt manner of deſigning. At length, on the invitation of Francis I. he removed to France when above 70 years of age; where the journey and change of climate threw him into his laſt ſickneſs: he languiſhed for ſome months at Fontainbleau, where the king came frequently to ſee him; and one day riſing up in his bed to acknowledge the honour done him, he fainted, and Francis ſupporting him, Leonardo died in his arms. His death happened in 1520. Some of his paintings are to be ſeen in England and other countries, but the greateſt part of them are in Florence and France. He compoſed a great number of diſcourſes on curious ſubjects; but none of them have been publiſhed but his treatiſe on the Art of Painting.—For his anatomical knowledge, ſee Anatomy (hiſtory of), p. 669.

Vinci ‖ Virgil.

VINCULUM, in *Algebra*, a character in form of a line or ſtroke drawn over a factor, diviſor, or dividend, when compounded of ſeveral letters or quantities, to connect them, and ſhows that they are to be multiplied or divided, &c. together by the other term.

Thus $d \times \overline{a+b-c}$ ſhows that d is to be multiplied into $a+b-c$.

VINE. See Vitis, Botany *Index*.

VINEGAR, Acetum, an agreeable acid, prepared from wine, cyder, beer, and other liquors; of conſiderable uſe, both as a medicine and a ſauce. The word is French, *vinaigre*; formed from *vin*, "wine;" and *aigre*, "ſour." See Acetic *Acid*, and Chemistry *Index*.

Eels in VINEGAR. See Animalcule, N° 9.

VINEYARD, a plantation of vines. The beſt ſituation of a vineyard is on the declivity of a hill facing the ſouth.

VIO, Thomas de. See Cajetan.

VIOL, a muſical inſtrument of the ſame form with the violin, and, like that, ſtruck with a bow.

VIOLA, a genus of plants of the claſs ſyngeneſia; in the natural ſyſtem arranged under the 29th order, *Campanaceæ*. See Botany *Index*.

VIOLATION, the act of violating, that is, forcing a woman, or committing a rape upon her.—This term is alſo uſed in a moral ſenſe, for a breach or infringement of a law, ordinance, or the like.

VIOLET. See Viola, Botany *Index*.

Violet-Crab. See Cancer, Entomology *Index*.

VIOLIN, or Fiddle, a muſical inſtrument mounted with four ſtrings or guts, and ſtruck or played with a bow. The ſtyle and ſound of the violin is the gayeſt and moſt ſprightly of all other inſtruments; and hence it is of all others the fitteſt for dancing. Yet there are ways of touching it, which render it grave, ſoft, languiſhing, and fit for church or chamber muſic.—It generally makes the treble or higheſt parts in concerts. Its harmony is from fifth to fifth. Its play is compoſed of baſs, counter-tenor, tenor, and treble; to which may be added, a fifth part: each part has four fifths, which riſe to a greater ſeventeenth.

VIOLONCELLO, of the Italians, is properly our fifth violin; which is a little baſs violin half the ſize of the common baſs violin, and the ſtrings bigger and longer in proportion: conſequently its ſound is an octave lower than our baſs violin; which has a noble effect in concerts.

VIPER. See Ophiology *Index*.

VIRAGO, a woman of extraordinary ſtature and courage; who has the mien and air of a man, and performs the actions and exerciſes of men.

VIRGIL, or Publius Virgilius Maro, the moſt excellent of all the Latin poets, was the ſon of a potter of Andes, near Mantua, where he was born, 70 years B. C. He ſtudied firſt at Mantua; then at Cremona, Milan, and Naples; whence going to Rome, he acquired the eſteem of the greateſt wits and moſt illuſtrious perſons of his time; and among others of the emperor Auguſtus, Mæcenas, and Pollio. He was well ſkilled not only in polite literature and poetry, but alſo in philoſophy, the

Virgil. the mathematics, geography, medicine, and natural hiſtory. Though one of the greateſt geniuſes of his age, and the admiration of the Romans, he always preſerved a ſingular modeſty, and lived chaſte at a time when the manners of the people were extremely corrupt. He carried Latin poetry to ſuch a high perfection, that he was juſtly eſteemed the prince of Latin poets. He firſt turned himſelf to paſtoral; and being captivated with the beauty and ſweetneſs of Theocritus, was ambitious to introduce this new ſpecies of poetry among the Romans. His firſt performance in this way is ſuppoſed to have been written U. C. 709, the year before the death of Julius Cæſar, when the poet was in his 25th year: it is intitled *Alexis*. Poſſibly *Palæmon* was his ſecond: it is a cloſe imitation of the fourth and fifth Idylls of Theocritus. Mr Wharton places *Silenus* next; which is ſaid to have been publicly recited on the ſtage by Cytheris, a celebrated comedian. Virgil's fifth eclogue is compoſed in alluſion to the death and deification of Cæſar. The battle of Philippi in 712 having put an end to the Roman liberty, the veteran ſoldiers began to murmur for their pay; and Auguſtus, to reward them, diſtributed among them the lands of Mantua and Cremona. Virgil was involved in this common calamity; and applied to Varus and Pollio, who warmly recommended him to Auguſtus, and procured for him his patrimony again. Full of gratitude to Auguſtus, he compoſed the *Tityrus*, in which he introduces two ſhepherds; one of them complaining of the diſtraction of the times, and of the havock the ſoldiers made among the Mantuan farmers; the other rejoicing for the recovery of his eſtate, and promiſing to honour as a god the perſon who reſtored it to him. But our poet's joy was not of long continuance; for we are told, that when he returned to take poſſeſſion of his farm, he was violently aſſaulted by the intruder, and would certainly have been killed by him if he had not eſcaped by ſwimming haſtily over the Mincio. Upon this unexpected diſappointment, he returned to Rome to renew his petition; and during his journey ſeems to have compoſed his ninth eclogue. The celebrated eclogue, intitled *Pollio*, was compoſed U. C. 714, upon the following occaſion: The conſul Pollio on the part of Antony, and Mæcenas on the part of Cæſar, had made up the differences between them; by agreeing, that Octavia, half-ſiſter to Cæſar, ſhould be given in marriage to Antony. This agreement cauſed an univerſal joy; and Virgil, in his eclogue, teſtified his. Octavia was with child by her late huſband Marcellus at the time of this marriage; and whereas the Sibylline oracles had foretold, that a child was to be born about this time, who ſhould rule the world, and eſtabliſh perpetual peace, the poet ingeniouſly ſuppoſes the child in Octavia's womb to be the glorious infant, under whoſe reign mankind was to be happy, the golden age to return from heaven, and fraud and violence to be no more. In this celebrated poem, the author, with great delicacy at the ſame time, pays his court to both the chiefs, to his patron Pollio, to Octavia, and to the unborn infant. In 715, Pollio was ſent againſt the Parthini, a people of Illyricum; and during this expedition, Virgil addreſſed to him a beautiful eclogue, called *Pharmaceutria*. His tenth and laſt eclogue was addreſſed to Gallus.

In his 34th year, he retired to Naples, and laid the plan of his Georgics; which he undertook at the intreaties of Mæcenas, to whom he dedicated them. This Virgil. wiſe and able miniſter reſolved, if poſſible, to revive the decayed ſpirit of huſbandry; to introduce a taſte for agriculture, even among the great; and could not think of a better method to effect this, than to recommend it by the inſinuating charms of poetry. Virgil fully anſwered the expectations of his patron by his Georgics. They are divided into four books. Corn and ploughing are the ſubject of the firſt, vines of the ſecond, cattle of the third, and bees of the fourth.

He is ſuppoſed to have been in his 45th year when he began to write the Æneid; the deſign of which was to reconcile the Romans to the government of Auguſtus. Auguſtus was eager to peruſe this poem before it was finiſhed; and intreated him by letters to communicate it. Macrobius has preſerved to us part of one of Virgil's anſwers to the emperor, in which the poet excuſes himſelf: who, however, at length complied, and read himſelf the ſixth book to the emperor; when Octavia, who had juſt loſt her ſon Marcellus, the darling of Rome, and adopted ſon of Auguſtus, made one of the audience. Virgil had artfully inſerted that beautiful lamentation for the death of young Marcellus, beginning with—*O nate, ingentem luctum ne quære tuorum*—but ſuppreſſed his name till he came to the line—*Tu Marcellus eris*: upon hearing which, Octavia could bear no more, but fainted away, overcome with ſurpriſe and ſorrow. When ſhe recovered, ſhe made the poet a preſent of ten ſeſterces for every line, which amounted in the whole to above 2000l.

The Æneid being brought to a concluſion, but not to the perfection our author intended to give it, he reſolved to travel into Greece, to correct and poliſh it at leiſure. It was probably on this occaſion that Horace addreſſed that affectionate ode to him, *Sic te Divæ potens Cypri, &c.* Auguſtus returning victorious from the eaſt, met with Virgil at Athens, who thought himſelf obliged to attend the emperor to Italy: but the poet was ſuddenly ſeized with a fatal diſtemper, which being increaſed by the agitation of the veſſel, put an end to his life as ſoon as he landed at Brunduſium, in his 52d year. He had ordered in his will, that the Æneid ſhould be burnt as an unfiniſhed poem; but Auguſtus forbade it, and had it delivered to Varius and Tucca, with the ſtricteſt charge to make no additions, but only to publiſh it correctly. He died with ſuch ſteadineſs and tranquillity, as to be able to dictate his own epitaph in the following words:

Mantua me genuit: Calabri rapuere, tenet nunc
Parthenope: cecini Paſcua, Rura, Duces.

His bones were carried to Naples, according to his earneſt requeſt; and a monument was erected at a ſmall diſtance from the city.

Virgil was of a ſwarthy complexion, tall, of a ſickly conſtitution, and afflicted with frequent headachs, and ſpitting of blood. He was ſo very baſhful, that he often ran into the ſhops to prevent being gazed at in the ſtreets; yet was ſo honoured by the Roman people, that once coming into the theatre, the whole audience roſe up out of reſpect to him. He was of a thoughtful and melancholy temper; he ſpoke little, and loved retirement and contemplation. His fortune was affluent; he had a fine houſe and well furniſhed library near Mæcenas's gardens, on the Eſquiline mount at Rome, and alſo

Virgil, Virginia.

to a delightful villa in Sicily. He was so benevolent and inoffensive, that most of his contemporary poets, though they envied each other, agreed in loving and esteeming him. He revised his verses with prodigious severity; and used to compare himself to a she bear, which licked her cubs into shape.

The best edition of Virgil's works are those of Mosvicius, with the notes of Servius, printed at Lewarden in 1717, two vols 4to; and that of Burman, at Amsterdam, 1746, in four vols 4to. There are several English translations, which are well known.

VIRGIL, *Polydore*, an English historian, born at Urbino in Italy, was sent in the beginning of the 16th century by Pope Alexander VI. as sub-collector of the Papal tax, called *Peter-pence*, in this kingdom. He had not been long in England before he obtained preferment in the church; for in 1503 he was presented to the rectory of Church-Langton in the archdeaconry of Leicester. In 1507 he was collated to the prebend of Scamlesby in the church of Lincoln; and in the same year was made archdeacon of Wells, and prebendary of Hereford. In 1513, he resigned his prebend of Lincoln, and was collated to that of Oxgate in St Paul's, London. We are told, that on his preferment to the archdeaconry of Wells, he resigned the office of subcollector to the pope, and determined to spend the remainder of his life in England, the History of which kingdom he began in the year 1505, at the command of Henry VII. That work cost him 12 years labour. In 1526, he finished his treatise on Prodigies. Polydore continued in England during the whole reign of Henry VIII. and part of that of Edward VI. whence it is concluded that he was a moderate Papist. In 1550, being now an old man, he requested leave to revisit his native country. He was accordingly dismissed with a present of 300 crowns, together with the privilege of holding his preferments to the end of his life. He died at Urbino in the year 1555. As an historian, he is accused by some as a malignant slanderer of the English nation; yet Jovius remarks, that the French and Scotch accuse him of having flattered that nation too much: (See his *Elog.* cap. 135. p. 179.). Besides the above, he wrote, 1. *De Rerum Inventoribus;* of which an English translation was published by Langley in 1663. It was also translated into French and Spanish. 2. *De Prodigiis et Sortibus.* 3. *Epiſcoporum Angliæ Catalogus.* Manuscript. 4. *De Vita Perfecta*, Basil, 1546, 1553, 8vo. 5. *Epiſtolæ Eruditæ;* and some other works.

VIRGINIA, one of the United States of North America, is bounded on the east by the Atlantic ocean, on the north by Pennsylvania and the river Ohio, on the west by the Mississippi, on the south by North Carolina.

These boundaries include an area somewhat triangular of 121,525 miles, whereof 79,650 lie westward of the Alleghany mountains, and 57,034 westward of the meridian of the mouth of the Great Kanhaway. This state is therefore one third larger than the islands of Great Britain and Ireland, which are reckoned at 88,357 square miles.

The principal rivers in Virginia are, Roanoke, James river, which receives the Rivanna, Appammatox, Chickahominy, Nansemond, and Elizabeth rivers; York river, which is formed by the junction of Pamunky and Mattapony rivers; Rappahannock, and Patomack.

Virginia.

The mountains are not solitary and scattered confusedly over the face of the country; they commence at about 150 miles from the sea coast, and are disposed in ridges one behind another, running nearly parallel with the coast, though rather approaching it as they advance north-westerly. To the south-west, as the tract of country between the sea-coast and the Mississippi becomes narrower, the mountains converge into a single ridge, which, as it approaches the gulf of Mexico, subsides into plain country, and gives rise to some of the waters of that gulf. *Jefferson's Virginia.*

From the great extent of Virginia, it may be expected that the climate is not the same in all its parts. It is remarkable that, proceeding on the same parallel of latitude westwardly, the climate becomes colder in like manner as when you proceed northwardly. This continues to be the case till you attain the summit of the Alleghany, which is the highest land between the ocean and the Mississippi. From thence, descending in the same latitude to the Mississippi, the change reverses; and, if we may believe travellers, it becomes warmer there than it is in the same latitude on the sea-side. Their testimony is strengthened by the vegetables and animals which subsist and multiply there naturally, and do not on the sea-coast. Thus catalpas grow spontaneously on the Mississippi as far as the latitude of 37, and reeds as far as 38, degrees. Perroquets even winter on the Sioto in the 39th degree of latitude. In the summer of 1779, when the thermometer was at 90 degrees at Monticello, and 96 degrees at Williamsburg, it was 110 degrees at Kaskaskia. Perhaps the mountain, which overhangs this village on the north side, may by its reflection have contributed somewhat to produce this heat.

The number of free inhabitants in this state in 1790 was 454,983, and of slaves 292,627. The whole imports of the state of Virginia amounted in 1796 to 5,268,615 dollars.

The college of William and Mary is the only public seminary of learning in Virginia. It was founded in the time of King William and Queen Mary, who granted to it 20,000 acres of land, and a penny a pound duty on certain tobaccoes exported from Virginia and Maryland. The assembly also gave it by temporary law a duty on liquors imported, and skins and furs exported. From these resources it received upwards of 3000l. *communibus annis.* The buildings are of brick, sufficient for an indifferent accommodation of perhaps 100 students. By its charter it was to be under the government of 20 visitors, who were to be its legislators; and to have a president and six professorships, which at present stand thus:—A professorship for Law and Police; Anatomy and Medicine; Natural Philosophy and Mathematics; Moral Philosophy, the Law of Nature and Nations, the Fine Arts; Modern Languages; and a sixth, called the professorship of Brafferton, for the instruction of the Indians. In 1787, there were about 30 young gentlemen members of this college, a large proportion of which were law students. There are some flourishing academies in Virginia; one in Prince Edward county, one at Alexandria, one at Norfolk, one at Hanover, and others in other places.

The present denominations of Christians in Virginia are Presbyterians, who are the most numerous, and inhabit

Virginia. habit the weſtern parts of the ſtate; Epiſcopalians, who are the moſt ancient ſettlers, and occupy the eaſtern and firſt ſettled parts of the ſtate. Intermingled with theſe are great numbers of Baptiſts and Methodiſts. The bulk of theſe laſt-mentioned religious ſects are of the poorer ſort of people, and many of them are very ignorant (as is indeed the caſe with the other denominations), but they are generally a virtuous well-meaning ſet of people.

Virginia has produced ſome of the moſt diſtinguiſhed men that have been active in effecting the two late important revolutions in America, whoſe political and military character will rank among the firſt in the page of hiſtory. The great body of the people do not concern themſelves with politics; ſo that their government, though nominally republican, is in fact oligarchical or ariſtocratical. The Virginians who are rich, are in general ſenſible, polite, and hoſpitable, and of an independent ſpirit. The poor are ignorant and abject; all are of an inquiſitive turn, and in many other reſpects very much reſemble the people in the eaſtern ſtates. There is a much greater diſparity between the rich and the poor in Virginia than in any of the northern ſtates. A ſpirit for literary inquiries, if not altogether confined to a few, is, among the body of the people, evidently ſubordinate to a ſpirit of gaming and barbarous ſports. At almoſt every tavern or ordinary on the public road there is a billiard table, a backgammon table, cards, and other implements for various games. To theſe public houſes the gambling gentry in the neighbourhood reſort to kill time which hangs heavily upon them; and at this buſineſs they are extremely expert, having been accuſtomed to it from their earlieſt youth. The paſſion for cock-fighting, a diverſion not only inhumanly barbarous, but infinitely beneath the dignity of a man of ſenſe, is ſo predominant, that they even advertiſe their matches in the public newſpapers.

The executive powers are lodged in the hands of a governor choſen annually, and incapable of acting more than three years in ſeven. He is aſſiſted by a council of eight members. The judiciary powers are divided among ſeveral courts. Legiſlation is exerciſed by two houſes of aſſembly; the one called the *Houſe of Delegates*, compoſed of two members from each county, choſen annually by the citizens poſſeſſing an eſtate for life in 100 acres of uninhabited land, or 25 acres with a houſe on it, or in a houſe or lot in ſome town. The other called the *Senate*, conſiſting of 24 members, choſen quadrennially by the ſame electors, who for this purpoſe are diſtributed into 24 diſtricts. The concurrence of both houſes is neceſſary to the paſſage of a law. They have the appointment of the governor and council, the judges of the ſuperior courts, auditors, attorney-general, treaſurer, regiſter of the land office, and delegates to Congreſs.

Before the war, there was exported from this ſtate, *communibus annis*, to the amount of 850,000l. Virginia money, or 607,142 guineas.

The whole country before it was planted was one continued foreſt interſperſed with marſhes. No country now produces greater quantities of excellent tobacco; and the ſoil is generally ſo ſandy and ſhallow, that after they have cleared a freſh piece of ground out of the woods, it will not bear tobacco after two or three years unleſs well manured. The foreſts yield oaks, poplars, pines, cedars, cypreſſes, ſweet myrtles, cheſnuts, hickery, live oak, walnut, dog-wood, alder, hazel, chinkapins, locuſt-trees, ſaſſafras, elm, aſh, beech, with a great variety of ſweet gums and incenſe which diſtil from ſeveral trees; pitch, tar, roſin, turpentine, plank-timber, maſts, and yards. Virginia yields alſo rice, hemp, Indian corn, plenty of paſture, with coal, quarries of ſtone, and lead and iron ore. Virginia || Viſier.

VIRGO, in *Aſtronomy*, one of the ſigns or conſtellations of the zodiac.

VIRGULA DIVINATORIA, divining rod. See MINE.

VIRTUAL, or POTENTIAL; ſomething that has a power or virtue of acting or doing. The term is chiefly underſtood of ſomething that acts by a ſecret inviſible cauſe, in oppoſition to actual and ſenſible.

VIRTUE, a term uſed in various ſignifications. In the general it denotes power, or the perfection of any thing, whether natural or ſupernatural, animate or inanimate, eſſential or acceſſory. But, in its more proper or reſtrained ſenſe, virtue ſignifies a habit, which improves and perfects the poſſeſſor and his actions. See MORAL PHILOSOPHY, N° 84.

VIRTUOSO, an Italian term lately introduced into the Engliſh, ſignifying a man of curioſity and learning, or one who loves and promotes the arts and ſciences. But among us the term ſeems to be appropriated to thoſe who apply themſelves to ſome curious and quaint rather than immediately uſeful art or ſtudy; as antiquaries, collectors of rarities of any kind, microſcopical obſervers, &c.

VIRULENT, a term applied to any thing that yields a virus; that is, a contagious or malignant pus.

VISCERA, in *Anatomy*, a term ſignifying the ſame with entrails; including the heart, liver, lungs, ſpleen, inteſtines, and other inward parts of the body.

VISCIDITY, or VISCOSITY, the quality of ſomething that is viſcid or viſcous; that is, glutinous and ſticky like bird-lime, which the Latins call by the name of *viſcus*.

VISCOUNT (*Vice Comes*), was anciently an officer under an earl, to whom, during his attendance at court, he acted as deputy to look after the affairs of the country. But the name was afterwards made uſe of as an arbitrary title of honour, without any ſhadow of office pertaining to it, by Henry VI.; when in the 18th year of his reign, he created John Beaumont a peer by the name of *Viſcount Beaumont*; which was the firſt inſtance of the kind.

A viſcount is created by a patent as an earl is; his title is *Right Honourable*; his mantle is two doublings and a half of plain fur; and his coronet has only a row of pearls cloſe to the circle.

VISCUM, a genus of plants of the claſs dioecia, and in the natural ſyſtem arranged under the 48th order, *Aggregatæ*. See BOTANY *Index*.

VISHNOU, that perſon in the triad of the Bramins who is conſidered as the *preſerver* of the univerſe. *Brahma* is the creator, and *Siva* the deſtroyer; and theſe two, with Viſhnou, united in ſome inexplicable manner, conſtitute *Brahme*, or the ſupreme numen of the Hindoos. See POLYTHEISM, N° 36.

VISIBLE, ſomething that is an object of ſight or viſion; or ſomething whereby the eye is affected ſo as to produce this ſenſation.

VISIER, an officer or dignitary in the Ottoman empire,

Viſier || Ukraine.

pire, whereof there are two kinds; one called by the Turks *Viſier-azem*, that is, "grand viſier," is the prime miniſter of ſtate in the whole empire. He commands the army in chief, and preſides in the divan or great council. Next to him are ſix other ſubordinate viſiers, called *viſiers of the bench*; who officiate as his counſellors or aſſeſſors in the divan.

VISION, in *Optics*, the act of ſeeing or perceiving external objects by means of the organ of ſight, the eye. See ANATOMY, N° 142, and METAPHYSICS, N° 49—54.

VISTULA, or WEISEL, a large river of Poland, which taking its riſe in the mountains ſouth of Sileſia, viſits Cracow, Warſaw, &c. and continuing its courſe northward, falls into the Baltic ſea below Dantzic.

VISUAL, in general, ſomething belonging to viſion.

VITAL, in *Phyſiology*, an appellation given to whatever miniſters principally to the conſtituting or maintaining life in the bodies of animals: thus the heart, lungs, and brain, are called *vital parts*; and the operations of theſe parts by which the life of animals is maintained are called *vital functions*.

VITELLUS, the yolk of an egg.

VITIS, or VINE, a genus of the claſs pentandria, and in the natural ſyſtem arranged under the 46th order, *Hederaceæ*. See BOTANY *Index*; and for its culture, ſee GARDENING.

VITREOUS HUMOUR OF THE EYE. See ANATOMY, N° 142.

VITRIFICATION, in *Chemiſtry*, the converſion of a body into glaſs by means of fire. See GLASS.

VITRIOL, a compound ſalt, formed by the union of iron, copper, or zinc, with ſulphuric acid, hence called from the colours white, blue, and green, according to the metal. See CHEMISTRY.

VITRIOLATED, among chemiſts, ſomething impregnated, or ſuppoſed to be ſo, with vitriol or its acid.

VITRIOLIC ACID. See *SULPHURIC Acid* and CHEMISTRY *Index*.

VITRUVIUS POLLIO, MARCUS, a very celebrated Roman architect, was, according to the common opinion, born at Verona, and lived in the reign of Auguſtus, to whom he dedicated his excellent treatiſe on architecture, divided into ten books. William Philander's edition of this celebrated work is eſteemed. Claudius Perrault has given an excellent tranſlation of it in French, with learned notes. There are alſo ſeveral Engliſh tranſlations of Vitruvius.

VITUS's DANCE. See MEDICINE, N° 284.

VIVERRA, the WEASEL; a genus of quadrupeds belonging to the order of feræ. See MAMMALIA *Index*.

VIVES. See FARRIERY.

VIVIPAROUS, in *Natural Hiſtory*, an epithet applied to ſuch animals as bring forth their young alive and perfect; in contradiſtinction to thoſe that lay eggs, which are called *oviparous* animals.

UKRAINE, a large country of Europe, lying on the borders of Turkey in Europe, Poland, Ruſſia, and Little Tartary. Its name properly ſignifies a *frontier*. By a treaty between Ruſſia and Poland in 1693, the latter remained in poſſeſſion of all that part of the Ukraine lying on the weſt ſide of the river Dnieper, which is but indifferently cultivated; while the country on the eaſt ſide, inhabited by the Coſſacs, is in much better condition. The Ruſſian part is compriſed in the government of Kiof; and the empreſs of Ruſſia having obtained the Poliſh palatinate of Kiof, by the treaty of partition in 1793, the whole of the Ukraine, on both ſides of the Dnieper, belongs now to that ambitious and formidable power. The principal town is Kiof.

Ukraine || Ulſter.

ULCER, in *Surgery*. See SURGERY *Index*.

ULCER, in *Farriery*. See FARRIERY.

ULEX, a genus of plants of the claſs of diadelphia, and in the natural ſyſtem arranged under the 32d order, *Papilionaceæ*. See BOTANY *Index*.

ULIETEA, one of the Society iſlands in the South ſea. This iſland is about 21 leagues in circuit. Its productions are plantains, cocoa-nuts, yams, hogs, and fowl; the two latter of which are ſcarce. The ſoil on the top of one of the hills was found to be a kind of ſtone marle; on the ſides were found ſome ſcattered flints, and a few ſmall pieces of a cavernous or ſpongy ſtone lava, of a whitiſh colour, which ſeemed to contain ſome remains of iron, ſo that it may poſſibly be here lodged in the mountains in a great quantity. Nothing was ſeen on this iſland to diſtinguiſh either its inhabitants, or their manners, from the other neighbouring iſlands. The firſt Europeans who landed on this ſhore were Mr (now Sir Joſeph) Banks and Dr Solander; they were received by the natives in the moſt courteous manner, reports concerning them having been their harbingers from Otaheite. Every body ſeemed to fear and reſpect them, placing in them at the ſame time the utmoſt confidence: behaving, as if conſcious that their viſitors poſſeſſed the power of doing them miſchief without a diſpoſition to make uſe of it.

ULIGINOUS, in *Agriculture*, an appellation given to a moiſt, mooriſh, and fenny ſoil.

ULLAGE, in gauging, is ſo much of a caſk or other veſſel as it wants of being full.

ULM, a free and imperial city of Germany, in the circle of Swabia, ſeated on the river Iller. It is a pretty large place, defended by fortifications; and the inhabitants are Proteſtants. Here the archives of the circle are depoſited, and it carries on a very great trade. The elector of Bavaria became maſter of it in 1702, by a ſtratagem; but, in 1704, the French being vanquiſhed at the battle of Hochſtet, the Bavarians ſurrendered it by capitulation. The Roman Catholics have but two churches, all the reſt belonging to the Proteſtants. E. Long. 9. 59. N. Lat. 48. 25.

ULMUS, a genus of plants belonging to the claſs of pentandria; and in the natural ſyſtem arranged under the 53d order, *Scabridæ*. See BOTANY *Index*.

ULSTER, the moſt northerly province of Ireland. In Latin it is called *Ultonia*, in Iriſh *Cui Guilly*; and gives the title of *earl* to the dukes of York of the royal family. It is bounded by the Atlantic ocean on the weſt, St George's channel and the Iriſh ſea on the eaſt, the Deucaledonian ocean on the north, and on the ſouth and ſouth-weſt the provinces of Leinſter and Connaught. Its greateſt length is near 120 miles, its breadth about 100; and its circumference, including the windings and turnings, 460; containing 9 counties, 58 market-towns and boroughs, 1 archbiſhopric, 6 biſhoprics, and 214 pariſhes. Ulſter abounds in lakes and rivers, which ſupply it with variety of fine fiſh, eſpecially ſalmon, beſides what it has from the ſea, with which a great part of it is bounded. The ſouthern parts of it are rich, fertile,

tile, well cultivated, and incloſed; but the greater part of the northern is open and mountainous.—The towns of this province are in general the neateſt and beſt built of any in Ireland, as well as the farm-houſes; which in moſt parts of the kingdom are conſtructed of no better materials than clay and ſtraw. The inhabitants of Ulſter are alſo more like the Engliſh in their manners and dialect than thoſe of the other three provinces: for as it includes within itſelf the whole, or by far the greater part, of the linen manufactory, the beſt branch of trade in the kingdom, they have conſequently the greateſt intercourſe with England. An Engliſhman, in ſome parts of it, indeed, will imagine himſelf, from the ſimilarity of their language and manners, in his own country. This province had anciently petty kings of its own. It was firſt ſubjected to the Engliſh in the reign of Henry II. by John Courcy, the firſt who bore the title of *earl of Ulſter;* but it afterwards threw off the yoke, and was never entirely reduced till the reign of James I. when great numbers of Scots by his encouragement went and ſettled in it. Of theſe, moſt of the preſent inhabitants are the deſcendants. This province was the firſt and principal ſcene of the bloody maſſacre in 1641.

ULTERIOR, in *Geography*, is applied to ſome part of a country or province, which, with regard to the reſt of that country, is ſituated on the farther ſide of the river, mountain, or other boundary which ſeparates the two countries.

ULTRAMARINE, a beautiful blue colour uſed by the painters, prepared from the lapis lazuli by calcination. See LAZULITE, MINERALOGY *Index.*

ULTRAMONTANE, ſomething beyond the mountains. The term is principally applied in relation to France and Italy, which are ſeparated by the Alps.

ULVA, a genus of plants of the claſs of cryptogamia. See BOTANY *Index.*

ULUG BEIG, a Perſian prince and learned aſtronomer, was deſcended from the famous Tamerlane, and reigned at Samarcand about 40 years; after which he was murdered by his own ſon in 1449. His catalogue of the fixed ſtars, rectified for the year 1434, was publiſhed at Oxford by Mr Hyde, in 1665, with learned notes. Mr Hudſon printed in the Engliſh Geography Ulug Beig's Tables of the Longitude and Latitude of Places; and Mr Greaves publiſhed, in Latin, his Aſtronomical Epochas, at London, in 1650. See ASTRONOMY *Index.*

ULYSSES, king of Ithaca, the ſon of Laertes, and father of Telemachus, and one of thoſe heroes who contributed moſt to the taking of Troy. After the deſtruction of that city, he wandered for 10 years; and at laſt returned to Ithaca, where, with the aſſiſtance of Telemachus, he killed Antinous and other princes who intended to marry his wife Penelope and ſeize his dominions. He at length reſigned the government of the kingdom to his ſon Telemachus; and was killed by Telegonus, his ſon by Circe, who did not know him. This hero is the ſubject of the Odyſſey.

UMBELLA, an UMBEL, a ſpecies of receptacle; or rather a mode of flowering, in which a number of ſlender footſtalks proceed from the ſame centre, and riſe to an equal height, ſo as to form an even and generally round ſurface at top. See BOTANY.

UMBELLATÆ, the name of a claſs in Ray's and Tournefort's methods, conſiſting of plants whoſe flowers grow in umbels, with five petals that are often unequal, and two naked ſeeds that are joined at top and ſeparated below. Umbellatæ || Undecemvir.

The ſame plants conſtitute the 45th order of Linnæus's Fragments of a Natural Method. See BOTANY.

UMBELLIFEROUS PLANTS, are ſuch as have their tops branched and ſpread out like an umbrella.

UMBER, or UMBRE, a foſſil brown or blackiſh ſubſtance, uſed in painting. See MINERALOGY *Index.*

UMBILICAL, among anatomiſts, ſomething relating to the umbilicus or navel.

UMBRELLA, a moveable canopy, made of ſilk or other cloth ſpread out upon ribs of whale-bone, and ſupported by a ſtaff, to protect a perſon from rain, or the ſcorching beams of the ſun.

UMPIRE, a third perſon choſen to decide a controverſy left to arbitration.

UNCIA, in general, a Latin term, denoting the twelfth part of any thing; particularly the twelfth part of a pound, called in Engliſh an *ounce;* or the twelfth part of a foot, called an *inch.*

UNCTION, the act of anointing or rubbing with oil or other fatty matter.

UNCTION, in matters of religion, is uſed for the character conferred on ſacred things by anointing them with oil. Unctions are very frequent among the Hebrews. They anointed both their kings and high-prieſts at the ceremony of their inauguration. They alſo anointed the ſacred veſſels of the tabernacle and temple, to ſanctify and conſecrate them to the ſervice of God. The unction of kings is ſuppoſed to be a ceremony introduced very late among the Chriſtian princes. It is ſaid that none of the emperors were ever anointed before Juſtinian or Juſtin. The emperors of Germany took the practice from thoſe of the eaſtern empire: King Pepin of France was the firſt who received the unction. In the ancient Chriſtian church, unction always accompanied the ceremonies of baptiſm and confirmation. Extreme unction, or the anointing perſons in the article of death, was alſo practiſed by the ancient Chriſtians, in compliance with the precept of St James, chap. v. 14th and 15th verſes; and this extreme unction the Romiſh church has advanced to the dignity of a ſacrament. It is adminiſtered to none but ſuch as are affected with ſome mortal diſeaſe, or in a decrepit age. It is refuſed to impenitent perſons, as alſo to criminals. The parts to be anointed are the eyes, the ears, the noſtrils, the mouth, the hands, the feet, and the reins. The laity are anointed in the palms of the hands, but prieſts on the back of it; becauſe the palms of their hands have been already conſecrated by ordination.

The oil with which the ſick perſon is anointed repreſents the grace of God, which is poured down into the ſoul, and the prayer uſed at the time of anointing expreſſes the remiſſion of ſins thereby granted to the ſick perſon; for the prayer is this: "By this holy unction, and his own moſt pious mercy, may the Almighty God forgive thee whatever ſins thou haſt committed *by the ſight*," when the eyes are anointed; *by the hearing*, when the ears are anointed; and ſo of the other ſenſes *. * *The Sincere Chriſtian inſtructed from the Written Word.*

UNDECAGON, is a regular polygon of 11 ſides.

UNDECEMVIR, a magiſtrate among the ancient Athenians, who had 10 other colleagues or aſſociates joined

Undecemvir || Union.

joined with him in the same commission. The functions of the undecemviri at Athens were much the same with those of the late *prevots de marechaussé* in France. They took care of the apprehending of criminals; secured them in the hands of justice; and when they were condemned, took them again into custody, that the sentence might be executed on them. They were chosen by the tribes, each tribe naming its own; and as the number of the tribes after Callisthenes was but 10, which made 10 members, a scribe or notary was added, which made the number 11.

UNDERSTANDING. See METAPHYSICS and LOGIC.

UNDERWALDEN, a canton of Switzerland, and the sixth in rank. It is bounded on the north by the canton of Lucern and by the lake of the Four Cantons, on the east by the high mountains which separate it from the canton of Bern, and on the west by the canton of Bern. The religion of this canton is the Roman Catholic.

UNDULATION, in *Physics*, a kind of tremulous motion or vibration observable in a liquid, by which it alternately rises and falls like the waves of the sea.

UNGUENT, or OINTMENT, in *Medicine* and *Surgery*, a topical remedy or composition, chiefly used in the dressing of wounds or blisters. See MATERIA MEDICA.

UNICORN, an animal famous among the ancients, and thought to be the same with the rhinoceros.

Sparmann informs us, that the figure of the unicorn described by the ancients has been found delineated by the Snese Hottentots on the plain surface of a rock in Caffraria; and therefore conjectures, that such an animal either does exist at present in the internal parts of Africa, or at least once did so. Father Lobo affirms that he has seen it. Mr Barrow in his *Travels in Southern Africa*, affords additional reason to believe in the existence of this curious animal.

UNICORN-Fish. See MONODON, CETOLOGY *Index*.

UNIFORM, denotes a thing to be similar, or consistent either with another thing, or with itself, in respect of figure, structure, proportion, or the like; in which sense it stands opposed to difform.

UNIFORMITY, regularity, a similitude or resemblance between the parts of a whole. Such is that we meet with in figures of many sides, and angles respectively equal, and answerable to each other. A late ingenious author makes beauty to consist in uniformity, joined or combined with variety. Where the uniformity is equal in two objects, the beauty, he contends, is as the variety; and where the variety is equal, the beauty is as the uniformity.

UNIFORMITY, is particularly used for one and the same form of public prayers, and administration of sacraments, and other rites, &c. of the church of England, prescribed by the famous stat. 1 Eliz. and 13 and 14 Car. II. cap. 4. called the *Act of Uniformity*. See LITURGY.

UNION, a junction, coalition, or assemblage of two or more different things in one.

UNION, or *The Union*, by way of eminence, is more particularly used to express the act by which the two separate kingdoms of England and Scotland were incorporated into one, under the title of *The kingdom of Great Britain*. This union, in vain attempted by King James I. was at length effected in the year 1707, 6 Annæ, when 25 articles were agreed to by the parliament of both nations; the purport of the most considerable being as follows: Union.

1. That on the first of May 1707, and for ever after the kingdoms of England and Scotland shall be united into one kingdom, by the name of *Great Britain*.

2. The succession to the monarchy of Great Britain shall be the same as was before settled with regard to that of England.

3. The united kingdom shall be represented by one parliament.

4. There shall be a communication of all rights and privileges between the subjects of both kingdoms, except where it is otherwise agreed.

9. When England raises 2,000,000l. by a land tax, Scotland shall raise 48,000l.

16, 17. The standards of the coin, of weights, and of measures, shall be reduced to those of England throughout the united kingdoms.

18. The laws relating to trade, customs, and the excise, shall be the same in Scotland as in England. But all the other laws of Scotland shall remain in force; but alterable by the parliament of Great Britain. Yet with this caution, that laws relating to public policy are alterable at the discretion of the parliament; laws relating to private right are not to be altered but for the evident utility of the people of Scotland.

22. Sixteen peers are to be chosen to represent the peerage of Scotland in parliament, and 45 members to sit in the house of commons.

23. The 16 peers of Scotland shall have all privileges of parliament; and all peers of Scotland shall be peers of Great Britain, and rank next after those of the same degree at the time of the union, and shall have all privileges of peers, except sitting in the house of lords, and voting on the trial of a peer.

These are the principal of the 25 articles of union, which are ratified and confirmed by statute 5 Ann. c. 8. in which statute there are also two acts of parliament recited; the one of Scotland, whereby the church of Scotland, and also the four universities of that kingdom, are established for ever, and all succeeding sovereigns are to take an oath inviolably to maintain the same; the other of England, 5 Annæ, c. 6. whereby the acts of uniformity of 13 Eliz. and 13 Car. II. (except as the same had been altered by parliament at that time), and all other acts then in force for the preservation of the church of England, are declared perpetual; and it is stipulated, that every subsequent king and queen shall take an oath inviolably to maintain the same within England, Ireland, Wales, and the town of Berwick-upon-Tweed. And it is enacted, that these two acts "shall for ever be observed as fundamental and essential conditions for the union."

Upon these articles and act of union, it is to be observed, 1. That the two kingdoms are so inseparably united, that nothing can ever disunite them; except the mutual consent of both, or the successful resistance of either, upon apprehending an infringement of those points which, when they were separate and independent nations, it was mutually stipulated should be "fundamental and essential conditions of the union." 2. That whatever else may be deemed "fundamental and essential conditions," the preservation of the two churches, of England and Scotland, in the same state that they were in at the time of the union, and the maintenance of

of the acts of uniformity which eſtabliſhed the liturgy, are expreſsly declared ſo to be. 3. That therefore any alteration in the conſtitution of either of theſe churches, or in the liturgy of the church of England (unleſs with the conſent of the reſpective churches, collectively or repreſentatively given), would be an infringement of theſe "fundamental and eſſential conditions," and greatly endanger the union. 4. That the municipal laws of Scotland are ordained to be ſtill obſerved in that part of the iſland, unleſs altered by parliament; and as the parliament has not yet thought proper, except in a few inſtances, to alter them, they ſtill, with regard to the particulars unaltered, continue in full force.

For an account of the union of Ireland with Great Britain, thus forming the *united kingdom of Great Britain and Ireland*, ſee IRELAND, N° 120.

UNISON, in *Muſic*. See INTERVAL.

UNIT, or UNITY, in *Arithmetic*, the number one; or one ſingle individual part of diſcrete quantity.

UNITARIANS, in eccleſiaſtical hiſtory, a name given to thoſe who confine the glory and attribute of divinity to the One only great and ſupreme God, and Father of our Lord Jeſus Chriſt.

UNITED BRETHREN, or *Unitas Fratrum*, a ſociety of Chriſtians, whoſe chief reſidence is at Herrnhut in Saxony. They are commonly called Moravians from their original country, and Herrnhuters, from their chief place of reſidence. Some account of this ſociety has already been given under HERRNHUT; but as that account may, by ſome, not be deemed ſufficiently full, we ſhall here add a ſummary of their inſtitutes, derived from a communication by one of their own clergy.

Though the church of the United Brethren is epiſcopal, their biſhops poſſeſs no elevation of rank or preeminent authority, their church being governed by ſynods or conſiſtories from all the congregations, and by ſubordinate bodies, called conferences. The ſynods are generally held once in ſeven years. In the firſt ſitting a preſident is choſen; and the elders appointed by the former ſynod to ſuperintend the unity, lay down their office, though they ſtill form a part of the aſſembly, as well as the biſhops, the lay elders, and thoſe miniſters who have the inſpection of ſeveral congregations in one province.

Queſtions of importance, or of which the conſequences cannot be foreſeen, are decided by lot, though this is never uſed till after mature deliberation and fervent prayer. In the ſynods, the ſtate of the unity, and the concerns of the congregations and miſſions, are taken into conſideration.

Towards the concluſion of every ſynod, a kind of executive board is appointed, called the *elders conference of the unity*, conſiſting of 13 elders, and divided into four committees or departments, one for ſuperintending miſſions into heathen countries; a ſecond for watching over the conduct of congregations; a third for managing the economical concerns of the unity, and a fourth for maintaining the diſcipline of the ſociety. Theſe conferences, however, are amenable to a higher committee, called the elders conference, the powers of which are very extenſive. It appoints and removes every ſervant in the unity, authoriſes the biſhops to ordain preſbyters or deacons, and to conſecrate other biſhops, and in ſhort, poſſeſſes the ſupreme executive power over the whole ſociety.

United Brethren. United Provinces.

A biſhop of the United Brethren can diſcharge no office but by the appointment of the ſynod, or of the elders conference. Indeed their deacons can perform every office of the biſhops, except ordination, and appear to confirm young perſons when they firſt become candidates for the communion. Even female deacons are employed for the purpoſe of privately admoniſhing their own ſex, and viſiting them in caſes of ſickneſs. There are alſo lay elders, whoſe buſineſs it is to watch over the conſtitution and diſcipline of the unity; to enforce the obſervance of the laws of the country in which miſſions are eſtabliſhed, and to guard the privileges conferred on the brethren by the government under which they live.

On Sunday, beſides the public prayers, one or two ſermons are preached in every church, and after the morning ſervice, an exhortation is given to the children. Previous to the holy communion, which is adminiſtered on ſome Sunday once a month, and on Maunday Thurſday, each perſon before he communicates, muſt converſe on the ſtate of his ſoul with one of the elders. Love feaſts are frequent, and on Maunday Thurſday the ſociety have a ſolemn footwaſhing.

Our limits will not permit us to give a ſyſtematic view of the doctrinal tenets of the Brethren. Though they acknowledge no other ſtandard of truth than the ſacred ſcriptures, they adhere to the Augſburg confeſſion, and ſpeak reſpectfully of the 39 articles of the church of England. They profeſs to believe that the kingdom of Chriſt is not confined to any particular party, community, or church; and they conſider themſelves as ſpiritually joined in the bond of Chriſtian love to all who are taught of God, and belong to the univerſal church of Chriſt, however much they may differ in forms, which they deem non-eſſentials. For a fuller account of this ſociety, ſee Crantz's Ancient and Modern Hiſtory of the Proteſtant Church of the United Brethren, London 1780, and An Expoſition of Chriſtian Doctrine, as taught in the Proteſtant Church of the United Brethren, London 1784.

1 Situation and extent.

UNITED PROVINCES, otherwiſe called the *Republic of Holland*, or the *Batavian republic*, a maritime country of Europe, occupying that part of the Netherlands which lies between Auſtrian Flanders and Brabant, now the French departments of *Lys*, *Eſcaut*, *Deux Nethes* and *Dyle* on the ſouth, and the diſtrict of Eaſt Frieſland on the north-eaſt; being bounded on the north and weſt by the German ocean or North ſea, and on the eaſt by the kingdom of Weſtphalia. They are ſituated between the parallels of 51° 10′, and 53° 35′ N. Lat. and between 3° 10′, and 7° 5′ E. Long. In Britiſh miles the length of this country, from north to ſouth, is eſtimated at 165, its breadth from weſt to eaſt about 100, and its area at 10,000 ſquare miles.

2 Diviſion.

Before the French revolution, this part of the Low Countries was divided into ſeven provinces, viz. GUELDERLAND or GELDERS, HOLLAND, ZEALAND, UTRECHT, FRIESLAND, OVERYSSEL and GRONINGEN, beſides the dependencies of *Dutch* BRABANT and *Dutch* FLANDERS. Of late the whole has formed eight departments, which, except that called the Generalité lands, were diſtinguiſhed by the old names. The following table gives a general view of the ſubdiviſions, area in geographical miles, population and chief towns of theſe provinces.

United Provinces.

Provinces.	Subdiviſions.	Area.	Population in 1796.	Chief Towns.
I. GUELDERLAND.	Nimeguen Zutphen Arnheim	1840	217,828	NIMEGUEN, Zutphen, Arnheim.
II. HOLLAND.	North Holland South Holland	2000	828,542	AMSTERDAM, Rotterdam, Hague, Leyden, Haarlem, Helvoetſluys and Alkmaer.
III. ZEALAND.	Weſt Zealand Eaſt Zealand	uncertain	82,212	MIDDLEBURG, Fluſhing.
IV. UTRECHT.	Emeland Abhoude Montfort Wyk	510	92,904	UTRECHT, Amersfort.
V. FRIESLAND.	Ooſtergo Weſtergo Zevenwolde Northern iſlands	1155	161,513	LEEWARDEN, Dockum, Franeker, Harlingen, Bolſwert.
VI. OVERYSSEL.	Salland Twenthe Woollenhoven Drenthe	1792	135,060	DEVENTER, Zwol, Campen, Coeverden.
VII. GRONINGEN.	Groningen Ommeland	640	114,555	GRONINGEN, Winchoten.
GENERALITY lands (A)	Drent Dutch Brabant	2000	247,849	Bois-le-duc, Breda, Bergen-op-Zoom.
			1,880,563	

A great part of theſe provinces is compoſed of iſlands formed by the mouths of the large rivers which here diſembogue their waters into the German ocean. The principal iſlands are *Walcheren*, *Jooſtland*, *South* and *North Beveland*, and *Wolferſdyk*, compoſing Weſt Zealand; *Schowen*, *Duiveland*, *Fertholen*, and *St Phillipsland*, forming Eaſt Zealand; *Goeree* in *South Holland*, the *Texel*, *Vlieland*, and *Ameland*, to the weſt and north of Frieſland.

3 Colonies. The Dutch had formerly conſiderable colonial territory; but this is now reduced to part of Java, Sumatra, and the Molucca iſlands, with ſome other ſettlements in the Eaſt Indies; ſome trifling factories on the Guinea coaſt; St Euſtatius and part of Surinam in South America.

4 Surface, ſoil, &c. The face of the country is, in general, extremely uniform, conſiſting of large tracts of marſhy paſtures, or ſandy heaths, interſperſed with ſeveral large rivers, and numerous canals. There are a few hills in the eaſtern diſtricts, but the coaſts are ſo low, that, but for the *dykes* or ſea walls, they would be inundated by the ſea. The ſoil conſiſts almoſt entirely of *alluvial* earth and vegetable mould, and is very productive. The climate is moiſt, inconſtant, and peculiarly inſalubrious to ſtrangers; intermittent fevers and ſimilar diſeaſes, the attendants on a marſhy and watery ſoil, being extremely frequent. The winters are colder and the ſummers hotter than in Britain.

5 Rivers and lakes. The principal rivers of the United Provinces are the Rhine, the Maeſe or Meuſe, and the Eſcaut or Scheldt, which ſeparates them from French Flanders. There are few lakes of any note, except the ſea of Haerlem, near the Zuyder Zee.

6 Produce and agriculture. There is little intereſting in the natural hiſtory of Holland; the animals and plants reſembling thoſe of the adjacent countries of France and Germany, and its mineral products being extremely few. Its chief artificial products are flax, tobacco, madder and flower roots, butter and cheeſe. The ſtate of agriculture is but little advanced; as almoſt the whole country is under graſs, and the corn produced is not nearly ſufficient for home conſumption.

7 Progreſſive geography. The changes which the coaſts of the Dutch provinces have undergone, in conſequence of the ſhifting of the beds of rivers, the encroachments or retiring of the ſea, and tempeſts from the German ocean, render their progreſſive geography an intereſting object. We find that in the latter periods of the Roman empire, the river Rhine divided itſelf into two great branches at Burginaſium, the modern Schenk, about five miles north-weſt of Colonia Trajana, near the preſent Cleves. The ſouthern branch joined the Meuſe at the town of Moſa or Muvi, while the northern branch paſſed by Durſtadt, Utrecht, and Leyden, to the ocean. The northern branch of the Rhine was joined to the Yſſel by the canal of Druſus (ſee *BATAVORUM Inſula*), while this latter river flowed into a conſiderable lake called Flevo, now a ſouthern portion of the Zuyder Zee. When the canal of Druſus was

(A) See each of theſe articles in the general alphabet.

United Provinces.

was neglected, the waters of the Rhine poured into the Yſſel with ſuch violence as to increaſe the lake of Flevo to a great expanſe of waters, ſo that inſtead of a river which once ran from that lake to the ſea for nearly 50 Roman miles, there was opened the wide gulf which now forms the entrance. In the mean time, the northern branch of the Rhine became much diminiſhed, and the canal of Druſus gradually diſappeared. The eſtuaries of the Meuſe and the Scheldt being open to great inroads from the ſea, have alſo materially changed their figure and poſition; and the latter in particular, which once formed merely a triangular iſland, divided into four or five ſmaller branches, which are now extenſive creeks, dividing the iſlands of Zealand and South Holland. In the beginning of the 15th century, the eſtuary of the Meuſe ſuddenly formed a vaſt lake to the ſouth-eaſt of Dort, overwhelming 72 villages, and 100,000 inhabitants. By a ſubſequent change, the Rhine was again ſubdivided, the northern branch falling into the Leck, while the ſouthern formed the modern Waal.

The early hiſtory of theſe provinces, from their ſubjection by the Romans, till they fell under the dominion of the Spaniſh monarchy, has been already given under the article NETHERLANDS, ſo that we have here to relate only thoſe tranſactions which have taken place ſince the acceſſion of Philip II. to the crown of Spain (B).

8 At the death of Charles V. the Dutch provinces were in a very flouriſhing condition. In this ſmall tract were then reckoned not fewer than 350 large walled cities, and 6300 conſiderable towns or large villages, all become rich by their application to arts and commerce. 1556. The ſame application had diffuſed a ſpirit of independence among the inhabitants, who were jealouſly alive to every invaſion of their rights and privileges. The reformed religion had made conſiderable progreſs among all ranks, and the doctrines of Calvin had been embraced by a great majority of the people. Hence, nothing could be more impolitic than the meaſures taken by Philip to advance the cauſe of popery, and to enforce obedience to the tyrannical acts of his deputies. The eſtabliſhment of a court of inquiſition, the increaſe of the number of biſhoprics, the appointment of Cardinal Grandvele to be chief counſellor to the ducheſs of Parma, then regent of the Netherlands, and the enormous taxes levied to ſupport the Spaniſh forces, were no trifling grievances, and created ſuch a ſpirit of diſaffection, that when the ducheſs aſſumed the reins of government, in the year 1560, the murmurs of the people could no longer be ſuppreſſed.

A deputation of the malcontents, at the head of whom were William prince of Orange, and his brother Louis of Naſſau, with the counts of Egmont and Horn, waited on the ducheſs at Bruſſels, and inſiſted either on the diſmiſſal of Cardinal Grandvele, or the calling of an aſſembly of the ſtates-general. 1564. The ducheſs thought proper to comply with the former of theſe requeſts, but as that miniſter was ſucceeded by two of his creatures, who trod exactly in his footſteps, and in particular increaſed the religious perſecutions, and the power of the inquiſition, the popular ferment became greater than ever. The patriots ſent Count Egmont to Madrid, to lay their grievances before the king; but that monarch with his accuſtomed inſincerity, returned a favourable anſwer to their remonſtrances, without changing any of the obnoxius meaſures of the government at Bruſſels. In the mean time the diabolical combination that had been formed between Charles IX. of France and Iſabella of Spain, for the maſſacre of the proteſtants, which ſoon after took place, had been whiſpered in the Low Countries, and in conſequence a general aſſociation was formed for the purpoſe of aboliſhing the court of inquiſition. This aſſociation, headed by Henry de Brodenrode, a deſcendant of the earls of Holland, waited on the regent in ſuch a formidable body, that ſhe was obliged to promiſe the exertion of her utmoſt influence towards obtaining their demands. It is ſaid, however, that ſhe could obtain no better terms from the bigotted Philip than that heretics ſhould in future be hanged inſtead of burnt.

10 The people break out into open rebellion.

As the people found that their dutiful remonſtrances could obtain no redreſs, they determined to take into their own hands the neceſſary reformation. In ſeveral towns in Flanders, the people aſſembled, deſtroyed churches, pulled down images, and committed other acts of violence. The principal inhabitants, however, while they were preparing to reſiſt the oppreſſive acts of the government, behaved with more temperance and moderation; a new oath of allegiance had been exacted, and this the counts of Egmont and Horn, probably with a view to temporiſe, were induced to take, but the prince of Orange ſteadily refuſed, and retired into Germany, whither he was followed by great numbers of all ranks and conditions, ſo that within a few days 100,000 families had left the Low Countries. This emigration ſo much alarmed the ducheſs of Parma, that ſhe reſigned the regency.

11 Duke of Alva appointed governor of the Netherlands.

The ducheſs was ſucceeded by the duke of Alva, who had been ſent into the Netherlands with an army of 10,000 veteran troops, to intimidate the people, and enforce obedience to the civil power. We have already drawn the character of this bloody man (ſee ALVA), and have ſhewn how well he was calculated to execute the orders of a tyrannical and bigotted maſter. He no ſooner entered on his government than the whole country was filled with terror; Counts Egmont and Horn were ignominiouſly executed, and the eſtates of the prince of Orange were confiſcated.

12 The prince of Orange takes the command of the patriots.

This prince and his brother had been labouring to ſupport the cauſe of their injured countrymen among the German

(B) There is no part of the hiſtory of nations more intereſting in itſelf, or more replete with uſeful leſſons to rulers and to ſubjects, than that which records the ſtruggles of a brave people to preſerve or regain their liberties and independence. Hence the glorious conteſt which the Dutch provinces maintained againſt the power of Spain, and by which they finally triumphed over tyranny and oppreſſion, might well deſerve a much fuller detail than our confined limits will enable us to afford. In the compendious view which we have here given of theſe tranſactions, we have endeavoured to catch the more prominent features, and thus in ſome meaſure preſerve the ſpirit of the picture. We may refer our readers for a minute account of theſe events to *The Modern Univerſal Hiſtory*, vol. xxxi. and Watſon's *Hiſtory of the Reigns of Philip II. and Philip III.*

United Provinces.

German princes, and had raiſed a detachment of Germans, by which they were enabled to make head againſt the regent. The prince of Orange, who had been always a favourite with the people, was now rendered more popular in conſequence of his ſufferings in their cauſe, and was invited to take the command of the armed bodies which were preparing to reſiſt the duke of Alva.

13 Commencement of hoſtilities. An. 1569.

The prince firſt penetrated into Brabant, and attempted to ſurpriſe Ruremond, but was defeated by a detachment of the Spaniſh army; but his brother ſoon after overpowered a body of Spaniards, and killed 600. In a ſubſequent engagement, however, with the main body of Alva's army, Prince Louis was entirely defeated, and all his infantry cut in pieces. The prince of Orange finding that he could not at preſent keep the field againſt ſo formidable an enemy, and that his ſoldiers deſerted in conſequence of his ill ſucceſs and want of pay, was, in 1569, obliged to diſband his army, and return to Germany.

14 Cruelty of the duke of Alva.

The duke of Alva did not fail to make the moſt of his ſucceſs. All the priſoners taken in the laſt campaign were put to death, and the 100th part of every man's eſtate, with a tenth of all merchandiſe, were exacted as an annual payment from the inhabitants, under the penalty of military execution. The ſtates offered to pay an annual ſubſidy of 2,000,000 florins, in place of theſe taxes; but theſe offers were rejected with diſdain.

15 A fleet fitted out by the patriots. An. 1571.

The people thus driven to deſpair, were reſolved to ſtrain every nerve to reſiſt theſe oppreſſive acts. The tradeſmen in the towns ſhut their ſhops, and the peaſants refuſed to bring proviſions to the markets. In the mean time a ſquadron of ſhips, which is known by the name of *gueux*, had been fitted out by the prince of Orange, and the command given to Lumey. The trifling ſucceſs of this ſquadron, which had captured Briel, in the iſland of Voorn, and repulſed a force ſent againſt it by the duke of Alva, induced the Zealanders to collect all their ſhips, and alſo oppoſe the enemy at ſea. A conſiderable advantage was gained by this fleet, againſt a Spaniſh ſquadron commanded by the duke of Medina Celi. The duke was entirely defeated, many of his ſhips were taken, and the Zealanders carried off a booty of nearly 1,000,000 of livres.

16 Succeſſes of the Orange party.

To increaſe his army, the governor had draughted men from the garriſons of moſt of the fortified towns, and thus expoſed theſe to the attacks of the patriots. Accordingly, Lewis of Naſſau ſurpriſed Mons, the count de Bergues gained poſſeſſion of ſeveral towns in Overyſſel, Guelderland, and Frieſland; while another party of the malcontents made themſelves maſters of North Holland. The duke of Alva now began to feel that he had gone too far, and attempted, when too late, to conciliate the good opinion of the people. He publiſhed an edict conſenting to remit the moſt oppreſſive taxes, if the ſtate could ſuggeſt any other method of raiſing the neceſſary ſupplies, and he convoked the ſtates-general of the Provinces to aſſemble at the Hague. His promiſes and his threats were, however, now diſregarded; and the ſtates who, in contempt of his authority had aſſembled at Dordrecht, openly eſpouſed the cauſe of their country, declared the prince of Orange commander of the national forces, and raiſed a conſiderable ſum for the payment of his troops.

The prince's forces now amounted to 15,000 foot and 7000 horſe, with which he advanced into Brabant, and took Ruremond by aſſault. He then poſſeſſed himſelf of Mechlin, Oudenarde, and Dendermond, and having levied contributions on thoſe inhabitants who adhered to the government, he marched towards Mons, then beſieged by the duke of Alva, with an intention to raiſe the ſiege, by bringing the duke to a general action. This, however, Alva declined, and Mons was obliged to capitulate. United Provinces.

17 Reverſes.

In the midſt of theſe ſucceſſes, a damp was thrown over the ardour of the patriots, by the news of the horrid maſſacre of St Bartholomew *, and in the ſame degree the ſpirits of the Spaniards revived. The prince of Orange found himſelf obliged to retire to the province of Holland, leaving the cities which he had taken at the mercy of the army. Mechlin opened its gates, and was pillaged without mercy, while the other towns were evacuated by the garriſons, and loaded with heavy impoſitions. In a ſhort time nothing remained to the patriots, but the provinces of Holland and Zealand; but theſe ſtood firm in the cauſe of liberty, and ſoon became the ſeat of a ſanguinary warfare. Frederick de Toledo was detached by the duke of Alva to reduce the inſurgents in theſe quarters. He quickly reduced Waerden, where his ſoldiers committed the moſt horrid acts of barbarity. The capture of this place was followed by that of Haerlem after an obſtinate reſiſtance.

* See *France*, N° 142.

18 Naval victories of the Zealanders.

To balance this ill ſucceſs by land, however, the Zealanders obtained many important advantages by ſea. They attacked the harbour of Antwerp, and carried off ſeveral ſhips; and when the governor equipped a ſquadron to oppoſe them, it was thrice encountered by Wertz, the Zealand admiral, and totally defeated. In the mean time the Spaniſh forces, under Frederick of Toledo, conſiſting of 16,000 veterans, ſat down before Alkmaer, the capital of Holland, a town without regular fortifications, and defended only by 300 burghers and 800 ſoldiers, in great want of proviſions, and without any proſpect of ſpeedy relief; yet this place, though attacked with great vigour, by a battery of 20 pieces of heavy cannon, which effected a breach in one of the walls, held out againſt every attempt, and the Spaniſh ſoldiers who attempted to ſtorm the place by the breach, were repulſed with great ſlaughter, and Frederick was at length compelled to raiſe the ſiege.

19 Heroic defence of Alkmaer.

Notwithſtanding theſe partial ſucceſſes, the affairs of the patriots were ſtill in a precarious ſituation. Don Louis de Requeſnes, who had ſucceeded the duke of Alva in the government, was directed to carry on the war with the utmoſt vigour. The prince of Orange had, after a long ſiege, made himſelf maſter of Middleburgh, but had ſuſtained a great loſs by the defeat and death of his brother Louis. The patriotic cauſe derived ſome advantage, however, from a mutiny which took place in the Spaniſh army, but this advantage was of a tranſient nature.

20 The States apply for aſſiſtance to Elizabeth of England. An. 1575.

In the commencement of the year 1575, an attempt at negociation took place between the contending parties, but they could come to no terms of accommodation, and the war was continued with great virulence. Though much diſtreſſed in his finances, Philip made extraordinary efforts to cruſh the patriots, and ſucceeded ſo far, that they almoſt deſpaired of ultimate ſucceſs. In this dilemma they ſent a deputation to Queen Elizabeth of England, offering to become her ſubjects, if ſhe would

would afford them her protection; but from political reaſons ſhe declined the offer. The diſtreſſes which Philip now experienced, and the death of his deputy Requeſnes, did more for the cauſe of the patriots than all their own exertions.

Profiting by thoſe events, in the latter end of this year they attacked and carried the citadel of Ghent; while the inhabitants of Antwerp, in revenge for having been pillaged by the Spaniſh garriſon that held the citadel, united in the common cauſe, by what was called the pacification of Ghent.

A ſecond application to Queen Elizabeth met with more ſucceſs, and ſhe advanced them the ſum of 20,000l. ſterling, on condition that they would not invite the French into their territories, that they would liſten to any reaſonable terms of accommodation, and repay the loan in the courſe of the enſuing year. Agreeably to theſe conditions, a ceſſation of hoſtilities was granted to the ſtates by Don John of Auſtria, the preſent governor, and a treaty was entered into with him for diſbanding the foreign troops. The weak ſtate of the government required ſome conceſſions, and Don John acceded to the pacification of Ghent, by which moſt of the demands of the patriots were granted. The provinces of Holland and Zealand, however, conceiving that by this treaty the other provinces had conceded too much, refuſed their concurrence, and hoſtilities ſoon recommenced.

The king of Spain diſſatisfied with the conceſſions of Don John, recalled that governor, and appointed the archduke Matthias in his room, while he made additional preparations for a vigorous proſecution of the war. The ſtates general in their turn made another application to Queen Elizabeth, and obtained from her, not only a promiſe of 100,000l. ſterling, but of a body of forces conſiſting of 5000 foot, and 1000 horſe; in return for which, the ſtates agreed to put into her poſſeſſion certain fortified towns, and to tranſport and pay the forces. Theſe ſupplies, however, Elizabeth afterwards declined ſending, though ſhe profeſſed all poſſible good will towards the provinces and their cauſe. A change of meaſures which about this time took place in the ſtates of Guelderland and Groningen, in favour of the proteſtant intereſt, contributed not a little to aid the general cauſe of the patriots, though ſeveral of the provinces were ſtill torn by inteſtine diſſenſions and jarring intereſts. At laſt the prince of Orange, perceiving that little confidence was to be placed in the unanimity of provinces rent by faction, different in religion, and divided by ambition, political maxims, and private intereſt, formed the ſcheme of more cloſely uniting the provinces of which he was governor, and cementing them with thoſe more contiguous, in which the proteſtant intereſt prevailed. Such an alliance was ſubject to fewer difficulties than attended the more general one of uniting all the provinces; it was in fact the only meaſure that could be propoſed with ſafety, and it was proſecuted with that alacrity and addreſs for which William was deſervedly celebrated.

On the 23d of January 1579, deputies from the provinces of Holland, Zealand, Utrecht, Frieſland, Groningen, Overyſſel, and Guelderland, met at Utrecht, and ſigned the alliance ever ſince known by the name of the *Union of Utrecht*, the baſis of that commonwealth ſo renowned by the appellation of the *United Provinces*. This treaty of alliance was founded on the infraction of the pacification of Ghent ſolemnly acceded to by Philip, and the late invaſion of certain towns in Guelderland. It was not hereby intended to divide the ſeven provinces from the other ten, or to renounce the pacification of Ghent; its object was to preſerve the liberty ſtipulated in that pacification, by more vigorous operations, and united councils. The chief articles of this union were the following. United Provinces.

That the ſeven provinces ſhall unite themſelves in intereſt as one province, never to be ſeparated or divided by teſtament, donation, exchange, ſale, or agreement; reſerving to each particular province and city all its privileges, rights, cuſtoms, and ſtatutes. In all diſputes ariſing between either of the provinces, the reſt ſhall interpoſe only as mediators. They ſhall aſſiſt each other with life and fortune againſt every foreign attempt upon any particular province, whether to eſtabliſh ſovereignty, the Catholic religion, arbitrary meaſures, or whatever elſe may appear inconſiſtent with the liberties of the province, and the intention of the alliance. All frontier towns belonging to the United Provinces ſhall, if old, be fortified at the expence of the provinces; if new, at the joint expence of the union. That the public impoſts and duties ſhall be farmed for three months to the higheſt bidder, and employed with the king's taxes in the public ſervice. No province, city, or member of the union, ſhall contract an alliance with any foreign prince or power, without the concurrence of all the other members. That foreign powers ſhall be admitted into the alliance, only by conſent of all the contracting parties. As to religion, the provinces of Holland and Zealand ſhall act in that particular as they think adviſable: the reſt ſhall adhere to the purport of the edict publiſhed by the archduke Matthias, which preſcribed, that no man ſhould be oppreſſed on account of conſcience. All the inhabitants, from the age of 18 to 60, ſhall be trained and diſciplined to war. That peace and war ſhall be declared by the unanimous voice of all the provinces; other matters that concern the internal policy ſhall be regulated by a majority. That the ſtates ſhall be held in the uſual conſtitutional manner, and coinage ſhall be deferred to future determination. Finally, the parties agree, that the interpretation of theſe articles ſhall remain in the ſtates-general; but in caſe of their failing to decide, in the ſtadtholder.

24 Heroic behaviour of the prince of Orange.

Soon after the union of Utrecht, King Philip did all in his power to detach the prince of Orange from the new confederation. He offered to reſtore him to all his eſtates, to indemnify him for all his loſſes, and give him the firſt place in his eſteem and favour; but William was too wiſe to rely on the promiſes of a prince who had already ſhewn himſelf perfidious, and too generous to abandon a cauſe in which he had embarked from no intereſted motives. He determined to ſhare the fate of the United Provinces, and not to diſappoint the hopes which they had conceived of his conduct.

25 Succeſſes of the duke of Parma againſt the United Provinces.

In the mean time the duke of Parma was doing his utmoſt to diſconcert the projects of the prince of Orange, and to reduce the provinces to their obedience to Spain. He beſieged and took the town of Marſien; inveſted Maeſtricht, and carried it after a ſiege of four months, and reduced the republican general La Noue to ſuch ſtraits, that he was glad to retreat under the cannon of Antwerp. At length the Provinces, by the advice of the prince of Orange, reſolved to ſolicit the aſſiſtance

United Provinces.

assistance and protection of the duke of Anjou, to whom they had formerly applied in vain, and to offer him the sovereignty of their territories. Accordingly, in 1580, they solemnly renounced their allegiance to Philip, and acknowledged as their sovereign, Francis Hercules de Vallois, duke of Alençon and Anjou; and in the following year they published an edict, entitled the abdication of Philip king of Spain, for ever excluding that monarch from any right or authority over the Netherlands.

26 Inauguration of the duke of Anjou as duke of Brabant. An. 1582.

In the beginning of the year 1582, the duke of Anjou, who had already taken an active part in favour of his new subjects, and had opposed the duke of Parma with some success, arrived in Holland from England; and in the month of February he was solemnly installed at Antwerp as duke of Brabant. It appears, however, that the prince of Orange, though he had been the great promoter of this measure, and even placed the ducal coronet on the head of the new sovereign, still possessed the greatest influence and authority in the United Provinces.

27 Assassination of the prince of Orange. An. 1584.

When Philip of Spain found that he could not bribe the prince of Orange to his interests, he resolved to use every method to rid himself of so dangerous an opponent. Soon after the signing of the union of Utrecht, Philip had proscribed the prince, and offered a reward of 25,000 crowns to any person that should bring him dead or alive to Madrid. The greatness of the reward, and a bigotted regard for the interests of the Catholic religion, prompted several to attempt murdering the prince of Orange. He narrowly escaped assassination in 1582; but, two years after, he met his unmerited fate at Delft, by the hands of one Guion, or, as he is commonly called, Balthazar Gerrard. About the same time the duke of Anjou died in France; and the provinces of Holland and Zealand appointed Maurice, son of the late prince of Orange, to be their stadtholder and captain general. For an account of the actions of this great man, see the article *MAURICE of Nassau*.

28 A truce for twelve years concluded with Spain. An. 1609.

Philip II. died in 1598, and Philip III. prosecuted the war with the United Provinces with as much rancour as his predecessors, but with much worse success. The great defeat sustained by the archduke Albert in 1600, and many subsequent disasters, induced the court of Madrid at length to listen to terms of accommodation. In 1607 a suspension of hostilities took place, and the year following a treaty on terms favourable to the Provinces was concluded for 12 years.

29 Renewal of hostilities. An. 1621.

At the expiration of the truce, both parties prepared for a renewal of hostilities; but now the Spaniards fought with considerable disadvantage: From a strange policy, which they have since frequently practised, in their contests with the powers of Europe, the Dutch contrived to advance their commercial interests at the expence of their enemy. A very lucrative trade took place between the principal Dutch ports and those of Spain, by which the Spaniards were supplied by their enemies even with ammunition and warlike stores. At the same time the Dutch enriched themselves by numerous prizes taken from the Spaniards, and, in particular, gave a severe blow to the resources of the court of Madrid, by capturing the flota from Mexico, a prize valued at 15,000,000 of livres.

30 Conclusion of peace. An. 1648.

These repeated losses of the Spaniards proved the inutility of their continuing the war against a people so determined as the Dutch. Accordingly, in 1648, they agreed to a treaty of peace, by which his Catholic majesty renounced all right and sovereignty over the states-general of the United Provinces; and these provinces were henceforth declared a free and independent republic. It was also agreed between the contending powers, that each should remain in unmolested possession of those places which they severally held at the signing of the treaty. United Provinces.

31 Flourishing state of the republic.

From this time to the year 1670 we meet with nothing very remarkable in the history of the United Provinces. By invariably pursuing the maxims of prudence, industry, and frugality, the republic had attained the highest pitch of grandeur. Amsterdam was become the emporium of Europe, and the richest city in the universe. The population of the provinces, especially of Holland, was much greater than at any former or subsequent period, though it is scarcely credible that, as some authors affirm, Holland alone should then contain 3,000,000 of inhabitants. The states despatched ministers and consuls to China, Siam, and Bengal; to the Great Mogul, the king of Persia, and the khan of Tartary, the grand signior, the czar of Russia, and the princes of Africa. They were considered as an important weight in the scale of Europe; and no treaty was concluded without the concurrence of their ambassadors.

32 Dispute with France. An. 1670

It is not surprising that the successes of the Dutch, and the prosperous condition in which they now beheld themselves, should have rendered them rather arrogant towards the neighbouring states. Louis XIV. of France had conceived himself affronted by a foolish boast of one of the Dutch ministers, and he was particularly jealous of the advantage which the new republic had acquired over his subjects in the trade to India. The triple alliance formed about this time between England, Sweden, and the United Provinces, was an additional motive with the French king to break off all intercourse with the Dutch, and to curb their growing power. He began by prevailing on Charles II. of England to abandon the triple alliance; a request to which that worthless monarch, alive to nothing but his pleasures and his avarice, readily agreed, on condition of being well paid for his treachery. Louis also persuaded several of the German princes to unite their forces with his against the republic, and of all the Germanic body, only the elector of Brandenburg interested himself for the safety of the states-general. The French king assembled an army of 100,000 men, which he divided into four columns, one commanded by himself in person, with the assistance of Marshal Turenne; another by the prince of Condé; a third by General Crequi, and a fourth under the conduct of the duke of Luxemburg. Such an army drawing towards the frontiers could not but terrify the Dutch, now torn with civil and religious factions. The partisans of the Orange family were for abolishing the perpetual edict, and raising William prince of Orange to the dignity enjoyed by his predecessors; but the De Witt faction opposed him violently, though they could not prevent the young prince from being chosen captain-general and high-admiral. Many hoped that William's new dignity would incline his uncle Charles II. to return to the triple alliance; but that hope was frustrated by the conduct of his majesty, who, in conjunction with the most Christian king, declared

United Provinces.

clared war againſt the ſtates-general on the 7th of April. A month after, the elector of Cologne and biſhop of Munſter followed the example of the two kings. The Dutch put themſelves in the beſt poſture of defence that circumſtances would admit. Maeſtricht was ſtrongly garriſoned; the prince of Orange had aſſembled an army of 25,000 men, with which he advanced to the banks of the Yſſel; and the Dutch fleet cruiſed off the mouth of the Thames, to prevent the junction of the naval forces of England and France, which amounted to 150 ſhips. All Europe watched the firſt motions of the two powerful kings, ſeconded by the beſt generals of the age.

Commencement of hoſtilities.

Holland could be attacked only by the Rhine or the Meuſe, and the French generals and miniſters differed by which of theſe inlets the firſt impreſſion ſhould be made. At length, after much deliberation, it was determined to attack the Dutch on both theſe ſides at the ſame time, in order the more to diſconcert their councils. The campaign began with the ſiege of Rhinberg, Veſel, Orſoi, and Rurick, four towns well fortified, and deemed the keys of Holland. Nothing could oppoſe armies ſo well appointed, led by generals ſo ſkilful and ſo experienced. The four towns were compelled to ſurrender within a few days of each other; and a ſevere defeat ſuſtained by a body of Dutch troops, in attempting to defend the paſſage of the Rhine, by the prince of Condé, ſerved ſtill more to diſhearten the troops of the ſtates-general.

Rapid ſucceſſes of the French.

It is almoſt incredible with what rapidity towns and fortreſſes yielded to the fortune of his majeſty's arms. The reduction of Betau, the moſt fruitful country of the United Provinces, and the ſurrender of Tolhuſfert, obliged the prince of Orange to abandon the Yſſel, leſt he ſhould be attacked in the rear, and to retire to the very heart of the country, as far as Rhenen in the province of Utrecht. By this means the town of Arnheim, the forts of Knotſemborough, Voorn, St André, and Shenck, this laſt the ſtrongeſt in the Netherlands, with a variety of other forts and towns, ſurrendered as ſoon as ſummoned; and at laſt Nimeguen, a town ſtrong from the nature of the works and fortifications, and garriſoned by 8000 fighting men, including the inhabitants, was inveſted. After the citizens had for eight days exhibited ſignal proofs of courage in defence of their liberties, they were forced to yield to the ſuperior ſkill of Turenne.

The Dutch compelled to inundate their country.

The only means by which the Dutch could arreſt the progreſs of the enemy was, to open the ſluices and inundate the country. The town of Utrecht ſet the example, which was ſoon followed by many others, and in a ſhort time Holland, Brabant, and Dutch Flanders, formed one vaſt lake, the towns riſing like iſlands in the midſt of the waters. An embaſſy was alſo ſent to the king of England, to requeſt that he would prevail on Louis to relax in the ſeverity of his attack. Charles pretended a compliance with this requeſt; but as his interference produced no effect, it is probable that he was not ſincere. In the ſpace of three months, Louis conquered the provinces of Guelderland, Overyſſel, and Utrecht, took about 50 towns and forts, and made 24,000 priſoners. The latter, however, were ſoon releaſed for a trifling ranſom. The very ſucceſſes of the conquerors tended to weaken their force, as they were compelled to leave behind them ſeveral ſtrong bodies of troops, to garriſon the captured towns. This induced the French to liſten to propoſals for a negociation, which, however, came to nothing.

United Provinces.

Marſhal Turenne, now appointed generaliſſimo of the king's army on his majeſty's return to Paris, marched to oppoſe the elector of Brandenburg and the German general Montecuculi, who had joined their forces, and were about to paſs the Rhine. For three whole months were the elector and Montecuculi employed in abortive attempts to effect a paſſage at Mentz, Coblentz, Straſburg, and other places. This anſwered the purpoſe of making a powerful diverſion in favour of the Dutch, though they could not accompliſh their deſign of joining the prince of Orange. After repeated diſappointments, the imperial army directed its march to Weſtphalia; and Turenne followed, in order to keep the biſhop of Munſter ſteady to his engagements. For half the compaign he, with a body of 16,000 men, baffled every ſtratagem of the elector and Montecuculi, the latter the moſt renowned general of the empire, at the head of an army near triple his ſtrength. He obliged them to go into winter quarters, in a country haraſſed and exhauſted; and confirmed the biſhop of Munſter in the alliance of France, at the very time he was on terms with the emperor. He obliged the elector of Brandenburg, who took the chief command during Montecuculi's illneſs, to abandon the ſiege of Warle, took Unma Kamen, Altena, Berkemham, and ſeveral other towns and fortreſſes. By continuing his operations, he forced the elector out of his winter quarters again into the field, chaſed him from poſt to poſt, until he obliged him to quit Weſtphalia, repaſs the Weſer, and retire with precipitation into the biſhopric of Hilderſheim. After taking poſſeſſion of the elector's towns in Weſtphalia, he purſued him into the biſhopric of Hilderſheim, and at length, by mere dint of ſuperior genius, forced him to ſeek ſhelter in his hereditary dominions. All this was effected after Louvois had appointed the marſhal's army quarters in Alſace and Lorrain, amidſt the rigours of a ſevere winter, oppoſed by a ſuperior enemy, by the artifices of Louvois, and ſeconded only by his own prudence, and the affection of his troops, which he maintained in defiance of all the difficulties, hardſhips and dangers, they encountered. It was indeed ſuppoſed, that Montecuculi was prevented from giving Turenne battle by the remonſtrances of Prince Lobkovitz, the emperor's ambaſſador, influenced by the gold of Louis. Certain indeed it is, that Montecuculi's illneſs aroſe from his chagrin at ſeeing all his projects fruſtrated by the unſteady dilatory conduct of the court of Vienna. Louis's negociations diſturbed Europe no leſs than his arms. His tools and creatures ſwarmed in every court. Leopold could not be prevented from declaring in favour of Holland; but his miniſters were bought off from ſeconding the emperor's intentions. The whole Engliſh nation exclaimed againſt the alliance of their kingdom with France; but Charles ſtood in need of French gold to ſupply his extravagance and profligacy. The elector of Bavaria had indeed been compelled by Louis to retire to his capital; but it was by dint of intrigue that he was forced from his alliance with Holland, and conſtrained to make a peace with France.

While the French generals were thus carrying all before them, the combined fleets of France and England

United Provinces.

were ſcarcely leſs ſucceſsful againſt the maritime power of the Dutch. The Engliſh ſquadron under the duke of York, uniting to that of France under D'Eſtrees, thrice engaged the Dutch fleet commanded by De Ruyter; and though neither party could boaſt of much advantage, the check ſuſtained by the Dutch admiral was of eſſential ſervice to the cauſe of the allies.

36 Tranſactions of the Dutch at ſea

37 Change of fortune,

At length the tide of fortune began to turn in favour of the United Provinces. The court of Spain, jealous of the growing power of France, embraced the cauſe of the Dutch; and ſent an army of 10,000 men to the aſſiſtance of the prince of Orange, while the mercenary king of England was compelled by his parliament to withdraw from his unnatural alliance with the French king; and the late ill ſucceſs among the allied troops of France and Germany cooled the elector of Cologne and the biſhop of Munſter, in their friendſhip towards Louis. Thus that monarch, forſaken by his allies, was compelled to maintain ſingly a war againſt the empire, Spain, and the United Provinces. The acceſſion of the prince of Orange to the throne of England, in 1688, gave an additional blow to the French power, by bringing on an intimate connection between England and Holland.

38 and conſequent peace with France. An. 1697.

At length Louis was compelled to negociate for peace, which was concluded in 1697, by a treaty extremely favourable to the United Provinces.

39 Summary of the Dutch affairs from the end of the 17th to the beginning of the 19th century.

After the copious detail which we have elſewhere given of the military tranſactions of Europe, ſince the acceſſion of William III. to the crown of England, in which the Dutch bore a conſpicuous part, it will be here ſufficient for us to give a very brief ſummary of the principal events. After the death of William III. the ſame plan of humbling the French king, was, in conjunction with the ſtates-general, purſued by his ſucceſſor Queen Anne; and the numerous and important victories of the duke of Marlborough and Prince Eugene, led to the famous treaty of Utrecht, in 1713. See BRITAIN, N° 340—371. In 1747, the office of ſtadtholder was declared hereditary in the princes of Orange. In the war that took place in 1756, between France and England, a French party was formed in Holland, in oppoſition to the ſtadtholder, who favoured the alliance with England. Hence aroſe a jealouſy between the two allies, which, during the American war, increaſed to an open rupture. See BRITAIN, N° 427, and N° 598, *et ſeq.* In 1787, ſome diſputes took place between the ſtadtholder and the ſtates-general, which induced the former to require the aſſiſtance of the king of Pruſſia. That monarch accordingly ſent an army of 18,000 Pruſſians to Amſterdam, under the duke of Brunſwick, who, in 1788, brought the whole country into ſubjection, and reinſtated the ſtadtholder in his authority. See PRUSSIA, N° 73. In 1794 the republican armies of France having overrun the greater part of Flanders, took poſſeſſion of the Dutch provinces, which they converted into the Batavian republic. The ſtadtholder found refuge in England, and the allied armies of Germany and Pruſſia retreated into Germany. See FRANCE, N° 409, et ſeq. In the ſummer of 1799, a conſiderable Britiſh force landed in the Texel iſland, made themſelves maſters of the Dutch fleet, and, in conjunction with a body of Ruſſians, gained ſome advantages on the continent. Being oppoſed, however, by a ſuperior French force, the army was obliged to reimbark, and return to England. See BRITAIN, N° 1069. By the treaty of Amiens, concluded in March 1802, all the colonies taken by the Britiſh were reſtored to Holland, except the iſland of Ceylon. On the renewal of hoſtilities in 1803, the Batavian republic was again compelled to take an active part againſt Britain, and in conſequence again loſt the Cape of Good Hope, and ſeveral other colonies, beſides having her trade entirely ruined. Soon after the imperial diadem of France was conferred on Napoleon Bonaparte, the Dutch republic was elevated to the rank of a kingdom, and the emperor's brother, Louis, was appointed the firſt king of Holland.

United Provinces.

With reſpect to the preſent ſtate of this unfortunate country, we know very little that can be relied on. The people are evidently in a ſtate of complete ſubjection to the French government; and though the late rumours of their avowed annexation to the empire of France may be premature, there can be little doubt of their being eventually confirmed.

40 Population of the United Provinces.

According to the ſtatiſtical table given in N° 2, the population of the United Provinces in the year 1796, appears to amount to 1,880,469 individuals; though it is generally eſtimated at about 2,000,000. Suppoſing this latter number to be correct, and that the area of the Dutch territory comprehends 10,000 ſquare miles, there will be 200 individuals to each ſquare mile; a proportion exceeding any thing that is to be found in any other part of Europe.

41 Conſtitution and government.

In the late republic of Holland, previous to the French revolution, the ſtates-general formed the great council of the nation. That aſſembly was formed by deputies from the provincial ſtates, and was inveſted with the ſupreme legiſlative power. It could not, however, make peace or war, form new alliances, or levy taxes, without the conſent of the provincial ſtates, nor could theſe determine any point of importance, without the conſent of each of the cities that had a voice in their aſſembly. The ſtadtholder exerciſed a conſiderable part of the executive power, though in later times his power became very limited. The grand penſionary was properly a miniſter or ſervant of the province; and though he poſſeſſed great influence, being a perpetual member of the ſtates-general, and of the ſecret committee, he was conſidered as inferior in rank to all the deputies.

The leading features in the conſtitution of the kingdom of Holland are, the guarantee of the payment of the public debt; the free and unqualified exerciſe of religion; the predominant authority veſted in the king; the eſtabliſhment of the Salique law, excluding females from the throne; the declaration that the minority of any future king ſhall expire on his attaining his 18th year; that only natives ſhall be eligible to any offices of ſtate, excluſive of thoſe immediately appertaining to the king's houſehold; that the yearly revenue of the king ſhall be 2,000,000 florins, and that the royal reſidences ſhall be the palaces of the Hague, in the Wood, and at Soeſt dyke. The council of ſtate is to conſiſt of 13 members; the general government of the kingdom is to be committed to four miniſters of ſtate; and the legiſlative body is to be compoſed of 38 members choſen for five years *.

* *Playfair Geography*, vol. ii.

42 Revenues.

The revenues of the United Provinces aroſe principally from taxes impoſed on each province and city, according

United Provinces.

cording to their ability. Theſe conſiſted chiefly of a general exciſe, a land-tax, a poll-tax, and hearth money; and are ſuppoſed to have amounted to 3,000,000l. ſterling.

Military ſtrength.

Before the French revolution, the Dutch maintained a peace eſtabliſhment of 30,000 men, which in war was augmented to above 50,000, chiefly by mercenary troops from Germany. Their naval eſtabliſhment was highly reſpectable; and at the end of the 17th century it exceeded that of any other maritime power in Europe. Before the late war they could muſter 40 ſail of the line, 40 frigates, and 10 cutters. Since the celebrated engagement off the Dogger Bank during the American war, the Dutch have been ſcarcely able to cope with the Engliſh at ſea; and the victory off Camperdown in October 1797, with the ſubſequent loſs of the Texel fleet in 1799, proved the deathblow to the naval power of Holland.

Religion.

Before the late change of government, the eſtabliſhed religion of Holland was Preſbyterianiſm, according to the doctrines of Calvin; though all ſects of Chriſtians were tolerated. The church was governed by conſiſtories, claſſes, and ſynods, from which there was an appeal to one great national ſynod, ſubject to the controul of the ſtates-general.

Language and literature.

The Dutch language is a dialect of the German, and in many reſpects bears a conſiderable reſemblance to the Old Engliſh and Lowland Scotch. The literature of the United Provinces has long been reſpectable; and the univerſities of Leyden, Utrecht, Groningen, Harderwyck, and Franeker, have produced many eminent and celebrated men in almoſt every department of ſcience. Grotius, Eraſmus, Boerhaave, Leuwenhoeck, Swammerdam, Græevius, Burrman, Hooguween, &c. are names mentioned with admiration and reſpect in the annals of literature.

Manufactures

The Dutch manufactures conſiſt principally of fine linens, earthen ware, chiefly manufactured at Delft, eſpecially white and painted tyles, tobacco-pipes, borax, oil, ſtarch, paper, leather, woollen and cotton cloths, ſnuff, tobacco, and gin.

Commerce.

The commerce of the Dutch was formerly more extenſive than that of any other country in Europe. They carried on a trade with every quarter of the globe, and in particular their Eaſt India Company was perhaps the richeſt ſociety of merchants in the world. Holland was almoſt the excluſive centre of the ſpice trade; and the extenſive fiſheries on the coaſt of Greenland and in the North ſea, ſupplied the greater part of Europe with whale oil and herrings. Beſides this external commerce, they carried on a conſiderable inland traffic with the interior of Germany, from which they brought immenſe quantities of timber. Vaſt rafts of trees, many hundred feet in length, ſet out annually from the foreſts of Andernach, and other places on the Rhine, and proceeding down the river under the direction of a great body of labourers, that formed a village of huts on the ſurface of the raft, ſailed down the Rhine and the Waal to Dort, where the timber was diſpoſed of, and where one raft has been ſold for 30,000l. ſterling. All the foreign trade of Holland may now be conſidered as annihilated, but the inland traffic in wood and ſpirits ſtill continues.

The inland commerce of the United Provinces is greatly promoted by the facility of conveyance from one part of the country to another, by means of the numerous canals.

48 Character of the Dutch.

The Dutch are, by conſtitution, a cool, or rather phlegmatic people, laborious, patient, obſtinate, and perſevering. When ſtimulated by any predominant paſſion, as avarice, or formerly love of liberty, they are capable of great exertions. Economy and order in the management of their pecuniary concerns are common among all claſſes, with whom it is an eſtabliſhed maxim to ſpend leſs than their income. Intereſt and love of money regulate all their actions, and appear to ſupplant in their breaſts every noble and generous feeling. Theſe prominent features in the national character are, of courſe, modified by the rank or ſituation of the different orders in ſociety. The higher ranks value themſelves much on their diſtinctions, are reſerved to ſtrangers, but affable and obliging to thoſe with whom they have had an opportunity of becoming acquainted; friendly, candid, and ſincere. The mercantile men and traders are, in general, fair and honeſt in their tranſactions; though their natural thirſt of gain ſometimes tempts them to deceive and overreach their cuſtomers. The lower ranks are ignorant, dull, and ſlow of apprehenſion, but open to conviction, and patient of fatigue and labour.

49 Manners and cuſtoms.

Dreſs, among the Dutch, is regulated leſs by faſhion, than by an attention to climate and ſeaſon. The moiſture and inconſtancy of theſe require a greater quantity of clothing than is found neceſſary in other countries under the ſame latitude; and, among the ordinary claſſes, broad hats, large breeches and thick boots and ſhoes, are ſtill almoſt univerſal. Moſt of the women wear hats with low crowns and very broad rims, with jerkins and ſhort petticoats; and, what appears exceedingly ridiculous to ſtrangers, the boys and girls wear the ſame dreſs as the men and women.

A cloſe attention to regularity and neatneſs in the ſtreets and the interior of the houſes prevails throughout the United Provinces, but is moſt conſpicuous in North Holland. This was at firſt rendered neceſſary by the nature of the climate, to prevent ruſt and mouldineſs from deſtroying their utenſils and furniture, and has ſince become a habit, conducive at once to comfort and to health. The manner of living in Holland was, till of late, not a little groſs. Their diet conſiſted much of high-ſeaſoned and ſalted meats, butter, cheeſe, and ſpirituous liquors. In no country was gormandizing reduced more to a ſyſtem. Convivial entertainments were extremely frequent; and the interval between the more ſubſtantial meals of dinner, tea, and ſupper, were filled up with cakes, fruits, jellies, and other light things; not to mention ſmoking and drinking, which ſupplied the place of converſation (c). If we may rely on the report of a late writer on the ſtatiſtics of Holland*, the ſtyle of living is now much changed, though not much improved

* *Meteleramp.* See *Month. Mag. for Nov.* 1801.

(c) We muſt admit, that, in ſo moiſt and cold a climate, a full and generous diet may be ſafe if not neceſſary; but the Dutch, like many of our own countrymen, abſurdly carried the ſame ſyſtem into their tropical colonies.

The

United Provinces || University.

improved. Animal food is become extremely rare, and its place is ſupplied by a greater proportion of gin, tea, and coffee. The prevailing amuſements in winter are dramatic entertainments and ſkaiting, in which latter they are exceedingly expert.

The Dutch taſte for formal gardens, ſtraight walks, trees and hedges clipped into fantaſtic ſhapes, and flower roots, has long been proverbial, and has been treated with more contempt and ridicule than it deſerves. At worſt, theſe are but harmleſs propenſities; and, if indulged in moderation, are well ſuited to relieve the ſameneſs and inactivity of a retirement from the buſy ſcenes of trade and commerce.

UNITY, in *Poetry*. There are three unities to be obſerved, viz. the unity of action, that of time, and that of place. In the epic poem, the great, and almoſt the only, unity, is that of the action. Some regard indeed ought to be had to that of time; for that of place there is no room. The unity of character is not reckoned among the unities. See POETRY, Part II. Sect. 3.

UNIVERSAL, ſomething that is common to many things; or it is one thing belonging to many or all things.

UNIVERSE, a collective name, ſignifying the whole world; or the aſſemblage of heaven and earth, with all things therein. See ASTRONOMY and GEOGRAPHY.

UNIVERSITY, is the name of a corporation formed for the education of youth in the liberal arts and ſciences, and authorized to admit ſuch as have ſtudied in it, to certain *degrees* in different faculties, which not only ſerve as certificates of proficiency in ſcience, but alſo confer on thoſe who obtain them conſiderable privileges within the univerſity, as well as ſome rank in the ſtate without it. Univerſities generally comprehend within them one or more colleges: but this is not always the caſe; for the univerſity of St Andrew's was in being before either of its colleges was founded, and it would continue in being, with all its privileges, though both its colleges were levelled with the duſt.

In every univerſity with which we are acquainted, there are four faculties, viz. *Theology*, *Law*, *Phyſic*, and the *Arts and Sciences*, comprehending mathematics, natural and moral philoſophy, &c.: and in Oxford, Cambridge, and ſome other univerſities, *Muſic* is conſidered as a fifth faculty. In each of theſe there are two degrees, thoſe of *Bachelor* and *Doctor*; for though in the univerſities of Great Britain and Ireland we have no ſuch degree as *Doctor in Arts and Sciences*, our *Maſter of Arts* anſwers to the degree of *Doctor in Philoſophy*, which is conferred by many of the univerſities on the continent.

Univerſities in their preſent form, and with their preſent privileges, are inſtitutions comparatively modern. They ſprang from the convents of regular clergy, or from the chapters of cathedrals in the church of Rome, where young men were educated for holy orders, in that dark period when the clergy poſſeſſed all the little erudition which was left in Europe. Theſe convents were ſeminaries of learning probably from their firſt inſtitution; and we know with certainty, that in Old Aberdeen there was a monaſtery in which youth were inſtructed in *theology*, the *canon law*, and the *ſchool philoſophy*, at leaſt 200 years before the univerſity and King's College were founded. The ſame was doubtleſs the caſe in Oxford and Cambridge, and probably in every town in Europe, where there is now a univerſity which has any claim to be called ancient; for it was not till the more eminent of the laity began to ſee the importance of literature and ſcience, that univerſities diſtinct from convents were founded, with the privilege of admitting to degrees, which conferred ſome rank in civil ſociety. Theſe univerſities have long been conſidered as lay corporations; but as a proof that they had the eccleſiaſtical origin which we have aſſigned to them, it will be ſufficient to obſerve, that the pope arrogated to himſelf the right of veſting them with all their privileges; and that, prior to the Reformation, every univerſity in Europe conferred its degrees in all the faculties by authority derived from a papal bull. University

It is perhaps no improbable conjecture, that the church of Rome derived her idea of academical honours from the Jews, among whom literary diſtinctions extremely ſimilar ſubſiſted before the nativity of our Saviour. Among them, the young ſtudent, with reſpect to his learning, was called a *diſciple*; from his minority a *junior*; and the *choſen* or *elected*, on account of his election into the number of diſciples. When he had made ſome progreſs in knowledge, and was deemed worthy of a degree, he was by impoſition of hands made חבר, *a companion* to *a Rabbi*, the perſon who officiates uſing this form, *I aſſociate thee*, or, *Be thou aſſociated*; and as ſoon afterwards as he was thought worthy to teach others, the *aſſociate* was raiſed to the rank of *Rabbi*. Whether this proceſs ſuggeſted the idea or not, it has certainly ſome reſemblance to that by which a young man in our univerſities paſſes through the degree of *Bachelor* to that of *Maſter of Arts* or *Doctor*.

The moſt ancient univerſities in Europe are thoſe of OXFORD, CAMBRIDGE, PARIS, SALAMANCA, and BOLOGNA; and, in the two Engliſh univerſities, the firſt colleges are thoſe of *Univerſity*, *Baliol*, and *Merton*, in the former, and *St Peter's* in the latter. Oxford and Cambridge, however, were univerſities, or, as they were then called, *ſtudies*, ſome hundreds of years before colleges or ſchools were built in them; for the former flouriſhed as a ſeminary of learning in the reign of Alfred the Great, and the other, could we believe its partial partizans, at a period ſtill earlier. The univerſities of Scotland are four, St ANDREWS, GLASGOW, ABERDEEN, and EDINBURGH. In Ireland there is but one univerſity, viz. that of DUBLIN, founded by Queen Elizabeth, and very richly endowed.

An idle controverſy has been agitated, whether the conſtitution of the Engliſh or of the Scotch univerſities be beſt adapted to anſwer the ends of their inſtitution; and, as might be expected, it has been differently decided, according to the partialities of thoſe who have written on the ſubject. Were we to hazard our own opinion, we ſhould ſay, that each has its advantages and diſadvantages; and that while the Engliſh univerſities, aided

The account given by a late traveller (ſee Barrow's *Voyage to Cochin-China*) of the luxurious mode of living at Batavia, affords a melancholy, but accurate picture of Dutch gluttony.

rſity aided by their great ſchools, to which we have nothing that can be compared, are unqueſtionably fitted to carry their young members fartheſt in the knowledge of the learned languages, the mode of teaching in our own univerſities is better adapted to the promotion of arts and ſciences, and the communication of that knowledge which is of moſt importance in active life.

UNIVERSITY-Courts, in England. The two univerſities enjoy the ſole juriſdiction, in excluſion of the king's courts, over all civil actions and ſuits whatſoever, where a ſcholar or privileged perſon is one of the parties; excepting in ſuch caſes where the right of freehold is concerned. And then by the univerſity charter they are at liberty to try and determine, either according to the common law of the land, or according to their own local cuſtoms, at their diſcretion; which has generally led them to carry on their proceſs in a courſe much conformed to the civil law.

This privilege, ſo far as it relates to civil cauſes, is exerciſed at Oxford in the chancellor's court; the judge of which is the vice-chancellor, his deputy, or aſſeſſor. From his ſentence an appeal lies to delegates appointed by the congregation; from thence to other delegates of the houſe of convocation; and if they all three concur in the ſame ſentence, it is final, at leaſt by the ſtatutes of the univerſity, according to the rule of the civil law. But if there be any diſcordance or variation in any of the three ſentences, an appeal lies in the laſt reſort to judges delegates appointed by the crown, under the great ſeal in chancery.

As to the juriſdiction of the univerſity courts in criminal matters, the chancellor's court at Oxford, and probably alſo that of Cambridge, hath authority to try all offences or miſdemeanors under the degree of treaſon, felony, or mayhem; and the trial of treaſon, felony, and mayhem, by a particular charter, is committed to the univerſity juriſdiction in another court, namely, the court of the lord high ſteward of the univerſity.

The proceſs of the trial is this. The high ſteward iſſues one precept to the ſheriff of the county, who thereupon returns a panel of 18 freeholders; and another precept to the bedells of the univerſity, who thereupon return a panel of 18 matriculated laymen, *laicos privilegio univerſitatis gaudentes:* and by a jury formed *de medietate*, half of freeholders and half matriculated perſons, is the indictment to be tried; and that in the guildhall of the city of Oxford. And if execution be neceſſary to be awarded in conſequence of finding the party guilty, the ſheriff of the county muſt execute the univerſity proceſs; to which he is annually bound by an oath.

VOCABULARY, in *Grammar*, denotes the collection of the words of a language, with their ſignifications, otherwiſe called a *dictionary*, *lexicon*, or *nomenclature*. See DICTIONARY.

A vocabulary is properly a ſmaller kind of dictionary, which does not enter ſo minutely into the origin and different acceptations of words.

VOCAL, ſomething that relates to the voice or ſpeech; thus vocal muſic is that ſet to words, eſpecially verſes, and to be performed by the voice; in contradiſtinction to inſtrumental muſic, compoſed only for inſtruments, without ſinging.

VOCATIVE, in *Grammar*, the fifth ſtate or caſe of nouns. See GRAMMAR.

VOETIUS or VOET, GISBERT, an eminent divine of the 16th century, was profeſſor of divinity and the Oriental tongues at Utrecht, where he was alſo miniſter. He aſſiſted at the ſynod of Dort; and died in 1676, aged 87. He wrote a great number of works; and was the declared enemy of Des Cartes and his philoſophy. His followers are called *Voetians*. Voetius had two ſons, *Daniel* and *Paul*, both authors. *John Voetius*, the ſon of Paul, was doctor and profeſſor of law at Herborn, and wrote a commentary on the Pandects. Voetius || Volga.

VOICE, a ſound produced in the throat and mouth of an animal, by peculiar organs.

Voices are either articulate or inarticulate. Articulate voices are thoſe whereof ſeveral conſpire together to form ſome aſſemblage or little ſyſtem of ſounds: ſuch are the voices expreſſing the letters of an alphabet, numbers of which joined together form words. Inarticulate voices are ſuch as are not organized, or aſſembled into words; ſuch is the barking of dogs, the braying of aſſes, the hiſſing of ſerpents, the ſinging of birds, &c.

For a deſcription of the organs of the voice, ſee ANATOMY; ſee alſo PHYSIOLOGY *Index*.

VOICE, in *Grammar*, a circumſtance in verbs, whereby they come to be conſidered as either active or paſſive, *i. e.* either expreſſing an action impreſſed on another ſubject, as, *I beat;* or receiving it from another, as, *I am beaten*. See GRAMMAR.

VOICE, in matters of election, denotes a vote or ſuffrage.

VOICE, in *Oratory*. See DECLAMATION; READING, N° 5.; and ORATORY, N° 129—131.

VOLANT, in *Heraldry*, is when a bird, in a coat of arms, is drawn flying, or having its wings ſpread out.

VOLATILE, in *Phyſics*, ſomething that is eaſily diſſipated by fire or heat.

VOLATILE Alkali. See AMMONIA, CHEMISTRY *Index*.

VOLATILISATION, the art of rendering fixed bodies volatile, or of reſolving them by fire into a vapour.

VOLCANO, a name given to burning mountains, or to vents for ſubterraneous fires. See GEOLOGY *Index*, ÆTNA, HECLA, &c.

VOLERY, a bird-cage, of ſuch a ſize that the birds have room to fly up and down in it.

VOLGA, the largeſt river in Europe, derives its origin from two ſmall lakes in the foreſt of Volkonſki about 80 miles from Tver, a town in Ruſſia. It is navigable a few miles above that town. This noble river waters ſome of the fineſt provinces in the Ruſſian empire, and at laſt falls into the Caſpian ſea by ſeveral mouths, below Aſtracan.

The Volga is ſubject to annual inundation. In the year 1774, the inundations exceeded the loweſt watermark by nearly 40 feet, ſince which period they have been rather on the decline; for in 1775, they roſe only to 39 feet 2 inches above that mark; in 1782, they roſe to 26 feet; in 1785, to 25 feet 2 inches; and in the year 1791, their height was the ſame. Pallas is of opinion that this phenomenon may have originated from the diminiſhed quantity of ſnow and rain which had fallen in the higher countries; from the greater evaporation of the Caſpian ſea, and the gradual extenſion of the different mouths of the river, or perhaps from the joint operation of all theſe cauſes.

VOLITION,

Volition || Voltaire.

VOLITION, an act of willing. See METAPHYSICS.

VOLLEY, a military salute, made by discharging a great number of fire arms at the same time.

VOLONES, in Roman antiquity, slaves who in the Punic war voluntarily offered their service to the state, which is the reason of the appellation; upon which they were admitted to citizenship, as none but freemen could be soldiers.

VOLT, in the manege, a round or circular tread; and hence, by the phrase *to make volts*, is understood a gate of two treads, made by a horse going sidewise round a centre, in such a manner that these two treads make parallel tracks; one larger, made by the fore-feet, and another smaller, made by the hind-feet; the croup approaching towards the centre, and the shoulders bearing out.

VOLTAIRE, FRANCIS AROUET DE, a celebrated French author, was born at Paris, February 20. 1694. His father, Francis Arouet, was *ancien notaire au Chatelet*, and treasurer of the chamber of accounts; his mother, Mary-Margaret Daumart. At the birth of this extraordinary man, who lived to the age of 85 years and some months, there was little probability of his being reared, and for a considerable time he continued remarkably feeble. In his earliest years he displayed a ready wit and a sprightly imagination; and, as he said of himself, made verses before he was out of his cradle. He was educated, under Father Poré, in the college of Louis the Great; and such was his proficiency, that many of his essays are now existing, which, though written when he was between 12 and 14, show no marks of infancy. The famous Ninon de l'Enclos, to whom this ingenious boy was introduced, left him a legacy of 2000 livres to buy him a library. Having been sent to the equity schools on his quitting college, he was so disgusted with the dryness of the law, that he devoted himself entirely to the muses. He was admitted into the company of the abbé Cheaulieu, the marquis de la Fare, the duke de Sully, the grand prior of Vendome, Marshal Villars, and the chevalier du Bouillon; and caught from them that easy taste and delicate humour which distinguished the court of Louis XIV. Voltaire had early imbibed a turn for satire; and, for some philippics against the government, was imprisoned almost a year in the Bastile. He had before this period produced the tragedy of *Oedipus*, which was represented in 1718 with great success; and the duke of Orleans happening to see it performed, was so delighted, that he obtained his release from prison. The poet waiting on the duke to return thanks; "Be wise (said the duke), and I will take care of you." "I am infinitely obliged (replied the young man); but I intreat your royal highness not to trouble yourself any farther about my lodging or board."

He began his *Henriade* before he was 18. Having one day read several cantos of this poem when on a visit to his intimate friend, the young president de Maisons, he was so teased with objections, that he lost patience, and threw his manuscript into the fire. The president Henaut with difficulty rescued it. "Remember (said Mr Henaut to him, in one of his letters) it was I that saved the Henriade, and that it cost me a handsome pair of ruffles." Some years after, several copies of this poem having got abroad, while it was only a sketch, an edition of it was published, with many chasms, under the title of *The League*. Instead of fame and friends, the author gained only enemies and mortification, by this first edition. The bigots took fire at it, and the poet was considered as highly criminal for praising Admiral Coligny and Queen Elizabeth. Endeavours were even used to get the piece suppressed; but this strange design proved abortive. His chagrin, on this occasion, first inspired him with the thought of visiting England, in order to finish the work, and republish it in a land of liberty. He was right; for King George I. and more particularly the princess of Wales, afterwards queen of England, raised an immense subscription for him. Their liberality laid the foundation of his fortune; for on his return to France in 1728, he put his money into a lottery established by M. Desfortes, comptroller-general of the finances. The adventurers received a rent charge on the *Hotel-de-Ville* for their tickets; and the prizes were paid in ready money; so that if a society had taken all the tickets, it would have gained a million of livres. He joined with a numerous company of adventurers, and was fortunate. Voltaire.

His *Lettres Philosophiques*, abounding in bold expressions and indecent witticisms against religion, having been burnt by a decree of the parliament of Paris, and a warrant being issued for apprehending the author in 1733, Voltaire prudently withdrew; and was sheltered by the marchioness du Chatelet, in her castle of Cirey, on the borders of Champagne and Lorraine, who entered with him on the study of the system of Leibnitz, and the Principia of Newton. A gallery was built, in which Voltaire formed a good collection of natural history, and made an infinite number of experiments on light and electricity. He laboured in the mean time on his Elements of the Newtonian Philosophy, then totally unknown in France, and which the numerous admirers of Des Cartes were little desirous should be known. In the midst of these philosophic pursuits he produced the tragedy of *Alzira*. He was now in the meridian of his age and genius, as was evident from the tragedy of *Mahomet*, first acted in 1741; but it was represented to the procureur-general as a performance offensive to religion; and the author, by order of Cardinal Fleury, withdrew it from the stage. *Merope*, played two years after, 1743, gave an idea of a species of tragedy, of which few models had existed. It was at the representation of this tragedy, that the pit and boxes were clamorous for a sight of the author; yet it was severely criticised when it came from the press. He now became a favourite at court, through the interest of Madame d'Etiole, afterwards marchioness of Pompadour. He was appointed a gentleman of the bed-chamber in ordinary, and historiographer of France. He had frequently attempted to gain admittance into the Academy of Sciences, but could not obtain his wish till 1746, when he was the first who broke through the absurd custom of filling an inaugural speech with the fulsome adulation of Richelieu; an example soon followed by other academicians. From the satires occasioned by this innovation he felt so much uneasiness, that he was glad to retire with the marchioness du Chatelet to Luneville, in the neighbourhood of King Stanislaus. The marchioness dying in 1749, Voltaire returned to Paris, where his stay was but short. The king of Prussia now gave Voltaire an invitation to live with him, which he accepted towards the end of Au-

gust

Voltaire. guſt 1750. On his arrival at Berlin, he was immediately preſented with the *Order of Merit*, the *key of chamberlain*, and a *penſion* of 20,000 livres. From the particular reſpect that was paid to him, his time was now ſpent in the moſt agreeable manner; his apartments were under thoſe of the king, whom he was allowed to viſit at ſtated hours, to read with him the beſt works of either ancient or modern authors, and to aſſiſt his majeſty in the literary productions by which he relieved the cares of government. But a diſpute which aroſe between him and Maupertuis ſoon brought on his diſgrace. Maupertuis was at ſome pains to have it reported at court, that one day while General Manſtein happened to be in the apartments of M. de Voltaire, who was then tranſlating into French the Memoirs of Ruſſia, compoſed by that officer, the king, in his uſual manner, ſent a copy of verſes to be examined, when Voltaire ſaid to Manſtein, "Let us leave off for the preſent, my friend; you ſee the king has ſent me his dirty linen to waſh, I will waſh yours another time." A ſingle word is ſometimes ſufficient to ruin a man at court; Maupertuis imputed ſuch a word to Voltaire, and ſucceeded. It was about this very time that Maupertuis publiſhed his very ſtrange Philoſophical Letters; and M. de Voltaire did not fail to heighten, with his utmoſt powers of raillery, every thing which he found, or could make ridiculous, in the projects of M. Maupertuis, who was careful to unite his own cauſe with that of the king; Voltaire was conſidered as having failed in reſpect to his majeſty; and therefore, in the moſt reſpectful manner, he returned to the king his chamberlain's key, and the croſs of his Order of Merit; accompanied with four lines of verſe, in which he, with great delicacy, compares his ſituation to that of a jealous lover, who ſends back the picture of his miſtreſs. The king returned the key and the ribbon; but they were not followed by an immediate reconciliation. Voltaire ſet out to pay a viſit to her highneſs the ducheſs of Gotha, who honoured him with her friendſhip as long as ſhe lived. While he remained at Gotha, Maupertuis employed all his batteries againſt him: Voltaire was arreſted by the king's orders, but afterwards releaſed.

He now ſettled near Geneva; but afterward being obliged to quit that republic, he purchaſed the caſtle of Ferney in France, about a league from the lake of Geneva. It was here that he undertook the defence of the celebrated family of Calas; and it was not long before he had a ſecond opportunity of vindicating the innocence of another condemned family of the name of *Sirven*. It is ſomewhat remarkable, that in the year 1774, he had the third time a ſingular opportunity of employing that fame zeal which he had the good fortune to diſplay in the fatal cataſtrophe of the families of Calas and Sirven.

In this retreat M. Voltaire continued long to enjoy the pleaſures of a rural life, accompanied with the admiration of a vaſt number of wits and philoſophers throughout all Europe. Wearied at length, however, with his ſituation, or yielding to the importunities of friends, he came to Paris about the beginning of the year 1778, where he wrote a new tragedy called *Irene*. By this time his underſtanding ſeems to have been impaired, either through the infirmities of age, or continued intoxication by the flattery of others; and he ridiculouſly ſuffered himſelf to be crowned in public with laurel, in teſtimony of his great poetical merit. He did not long ſurvive this farce: for having overheated himſelf with receiving viſits, and exhauſted his ſpirits by ſupplying a perpetual fund of converſation, he was firſt ſeized with a ſpitting of blood; and at laſt becoming reſtleſs in the night-time, he was obliged to uſe a ſoporific medicine. Of this he unluckily one night took ſo large a doſe, that he ſlept 36 hours, and expired a very ſhort time after awakening from it. Voltaire II Vote.

VOLUME, in matters of literature, a book or writing of a juſt bulk to be bound by itſelf. The name is derived from the Latin *volvere*, "to roll up;" the ancient manner of making up books being in rolls of bark or parchment. See BOOK.

VOLUNTARY, in *Muſic*, a piece played by a muſician extempore, according to his fancy. This is often uſed before he begins to ſet himſelf to play any particular compoſition to try the inſtrument, and to lead him into the key of the piece he intends to perform.

VOLUNTEERS, perſons who, of their own accord, for the ſervice of the prince or ſtate, ſerve in the army without being enliſted, to gain honour and preferment.

VOLVOX, a genus of animals belonging to the *vermes infuſoria*. See HELMINTHOLOGY *Index*.

VOLUSENUS. See WILSON.

VOLUTA, a genus of ſhell-fiſh. See CONCHOLOGY *Index*.

VOLUTE, in *Architecture*, a kind of ſpiral ſcroll uſed in Ionic and Compoſite capitals, whereof it makes the principal characteriſtic and ornament.

VOMICA, in *Medicine*, an abſceſs of the lungs. See MEDICINE, N° 186.

Nux VOMICA, in *Pharmacy*. See MATERIA MEDICA *Index*.

VOMIT. See EMETIC, MATERIA MEDICA *Index*.

VOMITING, a retrograde ſpaſmodic motion of the muſcular fibres of the œſophagus, ſtomach, and inteſtines, attended with ſtrong convulſions of the muſcles of the abdomen and diaphragm; which when gentle create a nauſea, when violent a vomiting.

VOORN, one of the iſlands of Holland, bounded by the river Maes, which divides it from the continent, and the iſland of Iſlemunde, on the north; by the ſea called *Bies boſch*, on the eaſt; by another branch of the Maes, which divides it from the iſlands of Goree and Overflackee, on the ſouth; and by the German ſea on the weſt; being about 24 miles long, and five broad.

VORTEX, in *Meteorology*, a whirlwind, or ſudden, rapid, and violent motion of the air in circles; or that motion of the water called an *eddy* or whirlpool.

VORTEX, in the Carteſian philoſophy, is a ſyſtem or collection of particles of matter moving the ſame way, and round the ſame axis.

VORTICELLA, an animalcule. See MICROSCOPE.

VOSSIUS, JOHN GERARD, a moſt learned and laborious writer of the 17th century, was of a conſiderable family in the Netherlands; and was born in 1577, in the palatinate, near Heidelberg, at a place where his father John Voſſius was miniſter. He was made director of the college of Dort, and afterwards profeſſor of eloquence and chronology at Leyden, from whence he was called in 1633 to Amſterdam, to fill the chair of profeſſor of hiſtory. He died in 1649.

VOTE, the ſuffrage or reſolve of each of the members of an aſſembly, where any affair is to be carried by

Vote ‖ Ur.

a majority; but more particularly uſed for the reſolves of the members of either houſe of parliament.

VOTIVE MEDALS, thoſe on which are expreſſed the vows of the people for the emperors or empreſſes. See MEDAL.

VOW, a ſolemn and religious promiſe or oath. See OATH.

The uſe of vows is found in moſt religions. They make up a conſiderable part of the Pagan worſhip, being made either in conſequence of ſome deliverance, under ſome preſſing neceſſity, or for the ſucceſs of ſome enterpriſe. Among the Jews, all vows were to be voluntary, and made by perſons wholly in their own power; and if ſuch perſon made a vow in any thing lawful and poſſible, he was obliged to fulfil it. If he appointed no particular time for accompliſhing his vow, he was bound to do it inſtantly, leſt by delay he ſhould prove leſs able, or be unwilling, to execute his promiſe. Among the Romaniſts, a perſon is conſtituted a religious by taking three vows; that of poverty, chaſtity, and obedience.

Vows, among the Romans, ſignified ſacrifices, offerings, preſents, and prayers made for the Cæſars, and emperors, particularly for their proſperity and the continuance of their empire. Theſe were at firſt made every five years, then every 15, and afterwards every 20, and were called *quinquennalia*, *decennalia*, and *vincennalia*.

VOWEL, in *Grammar*, a letter which affords a complete ſound of itſelf, or a letter ſo ſimple as only to need a bare opening of the mouth to make it heard, and to form a diſtinct voice. The vowels are ſix in number, viz. A, E, I, O, U, Y.

VOWEL, *John*. See HOOKER.

UPHOLSTER, UPHOLSTERER, or *Upholder*, a tradeſman that makes beds, and all ſorts of furniture thereunto belonging, &c.

UPLAND, denotes high ground, or, as ſome call it, *terra firma*, by which it ſtands oppoſed to ſuch as is mooriſh, marſhy, or low.

UPLAND, a province of Sweden, bounded on the north-eaſt by the Baltic ſea, on the ſouth by the ſea of Sudermania, and on the weſt by Weſtmania and Geſtricia, from which it is ſeparated by the river Dela. It is about 70 miles in length and 45 in breadth, and contains mines of iron and lead. Stockholm is the capital.

UPSAL, a rich and conſiderable city of Sweden, in Upland, with a famous univerſity, and an archbiſhop's ſee. The town is pretty large, and as ſtraight as a line; but moſt of the houſes are of wood, covered with birch bark, with turf on the top. On an eminence, to the ſouth of the town, is a ruined caſtle. Thoſe that view the town from hence would take it to be a garden, whoſe ſtreets repreſent the alleys; and the houſes, which are covered with turf, the graſs-plots. It was formerly the reſidence of the kings, and is now the uſual place where they are crowned. It is ſeated on the river Sala, over which there are two bridges. It is 26 miles north-weſt of Stockholm. E. Long. 17. 48. N. Lat. 59. 52.

UPUPA, a genus of birds belonging to the order of *Picæ*. See ORNITHOLOGY *Index*.

UR, in *Ancient Geography*, a citadel of Meſopotamia, ſituated between the Tigris and Niſibis; taken by ſome for Ur of the Chaldees, the reſidence of Abraham. What ſeems to confirm this is, that from Ur to Haran, the other reſidence of the patriarch, the road lies directly for Paleſtine. And it is no objection that Ur is ſaid to be in Meſopotamia; becauſe the parts next the Tigris were occupied by the Chaldeans, as ſeems to be confirmed from Acts vii. 2, 4. It is called *Orche*, in Strabo; *Orchoe*, in Ptolemy.

Ur ‖ Urine.

URALIAN CHAIN, a range of mountains which form part of the boundaries of Aſia, and anciently known by the name of *Riphæi Montes*. See *RIPHÆI Montes*, and GEOLOGY *Index*.

URANIA, in fabulous hiſtory, one of the nine Muſes, was ſuppoſed to preſide over aſtronomy. She is commonly repreſented in an azure robe, crowned with ſtars, and ſupporting a large globe with both hands.

URANIUM, one of the lately diſcovered metals. See CHEMISTRY and MINERALOGY *Index*.

URANOSCOPUS, a genus of fiſhes belonging to the order of *jugulares*. See ICHTHYOLOGY *Index*.

RAPHAEL D'URBINO. See RAPHAEL.

URCHIN, or HEDGEHOG. See ERINACEUS, MAMMALIA *Index*.

Sea URCHIN. See ECHINUS, HELMINTHOLOGY *Index*.

UREA. See CHEMISTRY.

URETERS. See ANATOMY, N° 101.

URETHRA. See ANATOMY, N° 107.

URIC Acid. See CHEMISTRY *Index*.

URIM and THUMMIM, among the ancient Hebrews, a certain oracular manner of conſulting God, which was done by the high-prieſt dreſſed in his robes, and having on his pectoral or breaſt-plate.

Various have been the ſentiments of commentators concerning the urim and thummim. Joſephus, and ſeveral others, maintain, that it meant the precious ſtones ſet in the high-prieſt's breaſt-plate, which by extraordinary luſtre made known the will of God to thoſe who conſulted him. Spencer believes that the urim and thummim were two little golden figures ſhut up in the pectoral as in a purſe, which gave reſponſes with an articulate voice. In ſhort, there are as many opinions concerning the urim and thummim as there are particular authors that wrote about them. The ſafeſt opinion, according to Broughton, ſeems to be, that the words *urim* and *thummim* ſignify ſome divine virtue and power annexed to the breaſt-plate of the high-prieſt, by which an oraculous anſwer was obtained from God when he was conſulted by the high-prieſt; and that this was called *urim* and *thummim*, to expreſs the clearneſs and perfection which theſe oracular anſwers always carried with them; for urim ſignifies "light," and thummim "perfection:" theſe anſwers not being imperfect and ambiguous, like the heathen oracles, but clear and evident. The uſe made of the urim and thummim was to conſult God in difficult caſes relating to the whole ſtate of Iſrael; and ſometimes in caſes relating to the king, the ſanhedrim, the general of the army, or ſome other great perſonage.

URINAL, in *Medicine*, a veſſel fit to receive and hold urine, and uſed accordingly for the convenience of ſick perſons. It is uſually of glaſs, but ſometimes of metal.

URINE, a fluid, ſeparated from the blood, and carried by the emulgent arteries to the kidneys, from whence it deſcends to the bladder by the ureters, and is from time to time emitted thence by the canal of the urethra. See ANATOMY, N° 107. For the properties of urine, ſee CHEMISTRY *Index*.

URN,

URN, a kind of vaſe, of a roundiſh form, but biggeſt in the middle, like the common pitchers; now ſeldom uſed but in the way of ornament over chimney-pieces, in buffets, &c. The great uſe of urns among the ancients, was to preſerve the aſhes of the dead after they were burnt; for which reaſon they were called *cinerariæ*, and *urnæ cinerariæ*, and were placed ſometimes under the tombſtone whereon the epitaph was cut; and ſometimes in vaults in their own houſes. Urns were alſo uſed at their ſacrifices to put liquid things in.

UROGALLUS. See TETRAO, ORNITHOLOGY *Index*.

URSA, in *Aſtronomy*, the name of two conſtellations in the northern hemiſphere.

URSULINES, in church hiſtory, an order of nuns, founded originally by St Angela of Breſcia, in the year 1537; and ſo called from St Urſula, to whom they were dedicated.

URSUS, the BEAR, a genus of quadrupeds belonging to the order of *feræ*. See MAMMALIA *Index*.

URTICA, a genus of plants of the claſs of monœcia; and in the natural ſyſtem claſſed under the 53d order, *Scabridæ*. See BOTANY *Index*.

URTICA Marina. See *ANIMAL-Flower*.

USANCE, in *Commerce*, is a determined time fixed for the payment of bills of exchange, reckoned either from the day of the bills being accepted, or from the day of their date; and thus called becauſe regulated by the uſage and cuſtom of the places whereon they are drawn.

USE, in *Law*, the profit or benefit of lands and tenements; or a truſt and confidence repoſed in a perſon for the holding of lands, &c. that he to whoſe uſe the truſt is made ſhall receive the profits.

USHANT, an iſland of France, 15 miles weſt of the coaſt of Britanny, at the entrance of the Britiſh channel.

USHER, an officer or ſervant who has the care and direction of the door of a court, hall, chamber, or the like.

USHER of the Black Rod, the eldeſt of the gentlemen uſhers, daily waiters at court, whoſe duty is to bear the rod before the king at the feaſt of St George, and other ſolemnities.

USK, a river of Wales, which riſes on the weſt of Brecknockſhire, and runs ſouth-eaſt through that county and Monmouthſhire, falling into the mouth of the Severn.

USQUEBAUGH, a ſtrong compound liquor, chiefly taken by way of dram.

There are ſeveral different methods of making this liquor; but the following is eſteemed one of the beſt: To two gallons of brandy, or other ſpirits, put a pound of Spaniſh liquorice, half a pound of raiſins of the ſun, four ounces of currants, and three of ſliced dates; the tops of baum, mint, ſavory, thyme, and the tops of the flowers of roſemary, of each two ounces; cinnamon and mace well bruiſed, nutmegs, aniſeeds, and coriander ſeeds, bruiſed likewiſe, of each four ounces; of citron or lemon, and orange-peel, ſcraped, of each an ounce: let all theſe infuſe 48 hours in a warm place, often ſhaking them together; then let them ſtand in a cool place for a week: after which the clear liquor is to be decanted off, and to it is to be put an equal quantity of neat white port, and a gallon of canary; after which it is to be ſweetened with a ſufficient quantity of double refined ſugar.

USTION, in *Pharmacy*, the preparing of certain ſubſtances by burning them.

USUFRUIT, in the *Civil Law*, the uſe or enjoyment of any lands or tenements; or the right of receiving the fruits and profits of an inheritance, or other thing, without a power of alienating or changing the property thereof.

USURER, a perſon charged with a habit or act of uſury.

USURIOUS CONTRACT, is any bargain or contract whereby a man is obliged to pay more intereſt for money than the ſtatute allows.

USURPATION, in *Law*, is an injurious uſing or enjoyment of a thing for continuance of time, that belongs of right to another.

USURY, an unlawful contract upon the loan of money, to receive the ſame again with exorbitant increaſe. Under the article INTEREST, it was obſerved, that by ſtatute 37 Hen. VIII. c. 9. the rate of intereſt was fixed at 10l. per cent. per annum: which the ſtatute 13 Eliz. c. 8. confirms, and ordains, that all brokers ſhall be guilty of a *præmunire* who tranſact any contracts for more, and the ſecurities themſelves ſhall be void. The ſtatute 21 Jac. I. c. 17. reduced intereſt to 8l. per cent.; and it having been lowered in 1650, during the uſurpation, to 6 per cent. the ſame reduction was re-enacted after the Reſtoration by ſtatute 12 Car. II. c. 13. and, laſtly, the ſtatute 12 Annæ, ſt. 2. c. 16. has reduced it to 5 per cent. Wherefore not only all contracts for taking more are in themſelves totally void, but alſo the lender ſhall forfeit treble the money borrowed. Alſo if any ſcrivener or broker take more than 5s. per cent. procuration-money, or more than 12d. for making a bond, he ſhall forfeit 20l. with coſts, and ſhall ſuffer impriſonment for half a-year.

UTERUS. See ANATOMY, N° 108.

UTICA, in *Ancient Geography*, a town of Africa Propria, on the Mediterranean: a Tyrian colony, and older than Carthage, (Sil. Italicus); its name, according to Bochart, denoting *old:* reckoned ſecond to it; but after the deſtruction of Carthage, became the capital and centre of all the Roman tranſactions in Africa, according to Strabo; who adds, that it ſtood on the ſame bay with Carthage, at one of the promontories called *Apollonium*, bounding the bay on the weſt ſide, the other to the eaſt called *Hermeia*, being at Carthage. It became famous by the death of Cato, who thence was called *Uticenſis*.

UTRECHT, one of the ſeven United Provinces or States of Holland, wholly ſurrounded by Holland and Guelderland, excepting a ſmall part of it that borders on the Zuyder Zee. Its greateſt length is about 32 miles, and breadth about 22. It enjoys a good air; and in moſt places the ſoil is fruitful, but in ſome ſandy, or what is called *turf-ground*, and in others overrun with wood. It is watered by the Leck, Rhine, Vecht, and other ſmaller rivers, beſides ſeveral canals; of which that extending from the village of Vreeſwyk to Utrecht is one of the chief.

UTRECHT, in Latin *Ultrajectum*, *Trajectum vetus* or *inferius*, or *Trajectum Rheni*, capital of a province of the ſame name, ſo called from its ancient ferry or paſſage here over the Rhine; the word being compounded of *trecht*, which in Dutch ſignifies "a ferry," and *ud*

Utrecht || Vulcan.

or *olt*, i, e. "old." It is a fair, large, and populous city, ſituated 19 miles from Amſterdam, 25 from Rotterdam, and 27 from Leyden. Here is a ſtately townhouſe, with a commandery of the Teutonic order, and a celebrated univerſity, which was founded in 1630, ſince which it hath flouriſhed greatly, though it has not all the privileges of moſt other univerſities; being wholly ſubject to the magiſtrates of the city. The mall without the town, having five rows of lofty limes on each ſide, is very pleaſant: and the phyſic-garden belonging to the univerſity is extremely curious. There are five churches here that have chapters; but the members of theſe purchaſe the places, of which ſome coſt 6000 or 7000 guilders. The ſtreams which run through ſeveral of the ſtreets, contribute much to the beauty and cleanlineſs of the town; and the canal that is cut from the Leck, and paſſes through it to Amſterdam, will carry ſhips of any burden. Pope Adrian VI. was a native of this city. Here, in 1579, the memorable union was formed between the ſeven provinces; and, in 1713, the celebrated peace concluded between France on the one part, and the allies on the other. The Papiſts have a nominal archbiſhop of this city; and there is a ſilk manufactory carried on in it, which employs a number of hands. The inhabitants are ſuppoſed to amount to 30,000. E. Long. 5. 8. N. Lat. 52. 7.

UTRICULARIA, a genus of plants of the claſs of diandria; and in the natural ſyſtem arranged under the 24th order, *Corydales*. See BOTANY *Index*.

UVA URSI. See ARBUTUS, BOTANY *Index*.

VULCAN, in Pagan worſhip, the god of ſubterraneous fire and metals, was the ſon of Jupiter and Juno; and was ſaid to be ſo remarkably deformed, that his father threw him down from heaven to the iſle of Lemnos, in which fall he broke his leg, and there he ſet up his forge, and taught men how to ſoften and poliſh braſs and iron. Thence he removed to the Liparian iſles, near Sicily, where, by the aſſiſtance of the Cyclops, he made Jupiter's thunderbolts, and armour for the other gods. Notwithſtanding the deformity of his perſon, he had a paſſion for Minerva, and by Jupiter's conſent made his addreſſes to her, but without ſucceſs. He was, however, more fortunate in his ſuit to Venus; who, after marriage, choſe Mars for her gallant; when Vulcan expoſed them to the ridicule of the other gods, by taking them in a net. Vulcan || Uzbeck

VULGATE, a very ancient Latin tranſlation of the Bible, and the only one acknowledged by the church of Rome to be authentic. See BIBLE.

VULNERARY, in *Medicine*, an epithet formerly given to remedies ſuppoſed to poſſeſs virtues for the cure of wounds and ulcers.

VULTUR, a genus of birds belonging to the order of *Accipitres*. See ORNITHOLOGY *Index*.

VULVA. See ANATOMY, N° 132.

UVULA. See ANATOMY, N° 102.

UZ, or UTZ, the country and place of reſidence of Job. In the genealogy of the patriarchs there are three perſons called *Uz*, either of which might give this diſtrict its name. The firſt was the grandſon of Sem, by his ſon Aram (Gen. xxii. 23.), who, according to Joſephus, occupied the Trachonitis, and Damaſcus, to the north of Paleſtine: but Job was among the ſons of the Eaſt. Another *Uz* was the ſon of Nahor, Abraham's brother (Gen. x. 21.), who appears to have removed, after paſſing the Euphrates, from Haran of Meſopotamia to Arabia Deſerta. The third *Uz* was a Horite, from Mount Seir (Gen. xxxvi. 28.), and thus not of Eber's poſterity. Now the queſtion is, from which of theſe Job's country, Uz, took its name: Not from the firſt, as is already ſhown; nor from the ſecond, becauſe his country is always called *Seir*, or *Edom*, never *Uz*; and then called a *ſouth*, not an *eaſt*, country, in Scripture. It therefore remains, that we look for the country and place of reſidence of Job in Arabia Deſerta; for which there were very probable reaſons. The plunderers of Job are called *Chaldeans* and *Sabeans*, next neighbours to him. Theſe Sabeans came not from Arabia Felix, but from a nearer Sabe in Arabia Deſerta (Ptolemy); and his friends, except Eliphaz the Themanite, were of Arabia Deſerta.

UZBECK TARTARY. See TARTARY.

W.

W.

W or w, is the 21ſt letter of our alphabet; and is ſo compoſed, as its name implies, of two v's. It was not in uſe among the Hebrews, Greeks, or Romans; but chiefly peculiar to the northern nations, the Teutones, Saxons, Britons, &c. But ſtill it is not uſed by the French, Italians, Spaniards, or Portugueſe, except in proper names, and other terms borrowed from languages in which it is originally uſed, and even then it is ſounded like the ſingle v. This letter is of an ambiguous nature; being a conſonant at the beginning of words, and a vowel at the end. It may ſtand before all the vowels except *u*; as *water*, *wedge*, *winter*, *wonder*: it may alſo follow the vowels *a*, *e*, *o*, and unites with them into a kind of double vowel, or diphthong; as in *ſaw*, *few*, *cow*, &c. It alſo goes before *r*, and follows *ſ* and *th*; as in *wrath*, *ſwear*, *thwart*: it goes before *h* alſo, though in reality it is ſounded after it; as in *when*, *what*, &c. In ſome words it is obſcure, as in *ſhadow*, *widow*, &c. W || Wachendorfia.

WAAG, a river of Hungary, which riſes in the Carpathian mountains, and falls into the Danube oppoſite to the iſland of Schut.

WAAL, a river of the United Netherlands, being one of the branches of the Rhine, which runs from eaſt to weſt, through Guelderland; paſſing by Nimeguen, Tiel, Bommel, and Gorcum; and, uniting with the Maes, falls into the German ſea below the Briel.

WACHENDORFIA, a genus of plants of the claſs of

Wa- en- da W e.

of triandria; and arranged in the natural method under the 6th order, *Enſatæ*. See BOTANY *Index*.

WADD, or WADDING, is a ſtopple of paper, hay, ſtraw, or the like, forced into a gun upon the powder, to keep it cloſe in the chamber; or to put up cloſe to the ſhot, to keep it from rolling out.

WADSET, in *Scots Law*. See LAW, N° clxix. 1.

WAFERS, or *Sealing WAFERS*, are made thus: Take very fine flour, mix it with glair of eggs, iſinglaſs, and a little yeaſt; mingle the materials; beat them well together; ſpread the batter, being made thin with gum-water, or even tin plates, and dry them in a ſtove; then cut them out for uſe.

You may make them of what colour you pleaſe, by tinging the paſte with braſil or vermilion for red; indigo or verditer, &c. for blue; ſaffron, tumeric, or gamboge, &c. for yellow.

WAGER *of LAW*. See (*Wager of*) LAW.

WAGER of Battel. See (*Wager of*) BATTEL.

WAGGON, a wheel-carriage, of which there are various forms, accommodated to the different uſes they are intended for. The common waggon conſiſts of the ſhafts or rods, being the two pieces which the hind horſe bears up; the welds; the ſlotes, or croſs pieces, which hold the ſhafts together; the bolſter, being that part on which the fore-wheels and the axle-tree turn in wheeling the waggon acroſs the road; the cheſt or body of the waggon, having the ſtaves or rails fixed thereon; the bales, or hoops which compoſe the top; the tilt, the place covered with cloth, at the end of the waggon. See MECHANICS, Sect. iv.

WAGTAIL. See MOTACILLA, ORNITHOLOGY *Index*.

WAIFS, BONA WAVIATA, are goods ſtolen, and waived or thrown away by the thief in his flight, for fear of being apprehended. Theſe are given to the king by the law, as a puniſhment upon the owner for not himſelf purſuing the felon, and taking away his goods from him. And therefore if the party robbed do his diligence immediately to follow and apprehend the thief (which is called *making freſh ſuit*), or do convict him afterwards, or procure evidence to convict him, he ſhall have his goods again. Waived goods do alſo not belong to the king till ſeized by ſomebody for his uſe; for if the party robbed can ſeize them firſt, though at the diſtance of 20 years, the king ſhall never have them. If the goods are hid by the thief, or left anywhere by him, ſo that he had them not about him when he fled, and therefore did not throw them away in his flight; theſe alſo are not *bona waviata*, but the owner may have them again when he pleaſes. The goods of a foreign merchant, though ſtolen and thrown away in flight, ſhall never be waifs: the reaſon whereof may be, not only for the encouragement of trade, but alſo becauſe there is no wilful default in the foreign merchant's not purſuing the thief, he being generally a ſtranger to our laws, our uſages, and our language.

WAIGATS STRAITS, ſituated between Nova Zembla and Ruſſia, through which the Dutch ſailed to the north, as high as 75°, in order to diſcover a north-eaſt paſſage to China and the Eaſt Indies.

WAINSCOT, in building, the timber-work that ſerves to line the walls of a room, being uſually made in pannels, and painted, to ſerve inſtead of hangings.

WAIVE, in *Law*, a woman that is put out of the protection of the law. She is called *waive*, as being forſaken of the law; and not an *outlaw* as a man is; by reaſon women cannot be of the decenna, and are not ſworn in leets to the king, nor to the law, as men are; who are therefore within the law; whereas women are not, and ſo cannot be outlawed, ſince they never were within it. Waive, Wake.

WAKE, the print or track impreſſed by the courſe of a ſhip on the ſurface of the water. It is formed by the re-union of the body of water which was ſeparated by the ſhip's bottom whilſt moving through it; and may be ſeen to a conſiderable diſtance behind the ſtern, as ſmoother than the reſt of the ſea. Hence it is uſually obſerved by the compaſs, to diſcover the angle of lee-way.

A ſhip is ſaid to be in the wake of another when ſhe follows her on the ſame track, or a line ſuppoſed to be formed on the continuation of her keel.

Two diſtant objects obſerved at ſea are called in the wake of each other, when the view of the farthеſt is intercepted by the neareſt; ſo that the obſerver's eye and the two objects are all placed upon the ſame right line.

WAKE is the eve-feaſt of the dedication of churches, which is kept with feaſting and rural diverſions.

Mr Whitaker, in his Hiſtory of Manchеſter, has given a particular account of the origin of wakes and fairs. He obſerves, that every church at its conſecration received the name of ſome particular ſaint: this cuſtom was practiſed among the Roman Britons, and continued among the Saxons; and in the council of Cealchythe, in 816, the name of the denominating ſaint was expreſsly required to be inſcribed on the altars, and alſo on the walls of the church, or a tablet within it. The feaſt of this ſaint became of courſe the feſtival of the church. Thus Chriſtian feſtivals were ſubſtituted in the room of the idolatrous anniverſaries of heatheniſm: accordingly, at the firſt introduction of Chriſtianity among the Jutes of Kent, Pope Gregory the Great adviſed, what had been previouſly done among the Britons, viz. Chriſtian feſtivals to be inſtituted in the room of the idolatrous, and the ſuffering day of the martyr whoſe relics were repoſited in the church, or the day on which the building was actually dedicated, to be the eſtabliſhed feaſt of the pariſh. Both were appointed and obſerved; and they were clearly diſtinguiſhed at firſt among the Saxons, as appears from the laws of the Confeſſor, where the *dies dedicationis*, or *dedicatio*, is repeatedly diſcriminated from the *propria feſtivitas ſancti*, or *celebratio ſancti*. They remained equally diſtinct to the Reformation; the dedication-day in 1536 being ordered for the future to be kept on the firſt Sunday in October, and the feſtival of the patron ſaint to be celebrated no longer. The latter was, by way of pre-eminence, denominated the *church's holiday*, or its peculiar feſtival; and while this remains in many pariſhes at preſent, the other is ſo utterly annihilated in all, that Biſhop Kennet (ſays Mr Whitaker) knew nothing of its diſtinct exiſtence, and has attributed to the day of dedication what is true only concerning the ſaint's day. Thus inſtituted at firſt, the day of the tutelar ſaint was obſerved, moſt probably by the Britons, and certainly by the Saxons, with great devotion. And the evening before every ſaint's day, in the Saxon Jewiſh method of reckoning the hours, being an actual hour of the day,

Wake. and therefore like that appropriated to the duties of public religion, as they reckoned Sunday from the firſt to commence at the ſunſet of Saturday; the evening preceding the church's holyday would be obſerved with all the devotion of the feſtival. The people actually repaired to the church, and joined in the ſervices of it; and they thus ſpent the evening of their greater feſtivities in the monaſteries of the North, as early as the concluſion of the ſeventh century.

Theſe ſervices were naturally denominated from their late hours *wæcan* or *wakes*, and *vigils* or *eves*. That of the anniverſary at Rippon, as early as the commencement of the eighth century, is expreſsly denominated the *vigil*. But that of the church's holiday was named *cyric wæcan*, or church-wake, the church-vigil, or church eve. And it was this commencement of both with a wake, which has now cauſed the days to be generally preceded with vigils, and the church-holiday particularly to be denominated the *church-wake*. So religiouſly was the eve and feſtival of the patron ſaint obſerved for many ages by the Saxons, even as late as the reign of Edgar, the former being ſpent in the church, and employed in prayer. And the wakes, and all the other holidays in the year, were put upon the ſame footing with the Octaves of Chriſtmas, Eaſter, and of Pentecoſt. When Gregory recommended the feſtival of the patron ſaint, he adviſed the people to erect booths of branches about the church on the day of the feſtival, and to feaſt and be merry in them with innocence. Accordingly, in every pariſh, on the returning anniverſary of the ſaint, little pavilions were conſtructed of boughs, and the people indulged in them to hoſpitality and mirth. The feaſting of the ſaint's day, however, was ſoon abuſed; and even in the body of the church, when the people were aſſembled for devotion, they began to mind diverſions, and to introduce drinking. The growing intemperance gradually ſtained the ſervice of the vigil, till the feſtivity of it was converted, as it now is, into the rigour of a faſt. At length they too juſtly ſcandalized the Puritans of the laſt century, and numbers of the wakes were diſuſed entirely, eſpecially in the eaſt and ſome weſtern parts of England; but they are commonly obſerved in the north, and in the midland counties.

This cuſtom of celebrity in the neighbourhood of the church, on the days of particular ſaints, was introduced into England from the continent, and muſt have been familiar equally to the Britons and Saxons; being obſerved among the churches of Aſia in the ſixth century, and by thoſe of the weſt of Europe in the ſeventh. And equally in Aſia and Europe, on the continent and in the iſlands, theſe celebrities were the cauſes of thoſe commercial marts which we denominate *fairs*. The people reſorted in crowds to the feſtival, and a conſiderable proviſion would be wanted for their entertainment. The proſpect of intereſt invited the little traders of the country to come and offer their wares; and thus, among the many pavilions for hoſpitality in the neighbourhood of the church, various booths were erected for the ſale of different commodities. In larger towns, ſurrounded with populous diſtricts, the reſort of the people to the wakes would be great, and the attendance of traders numerous; and this reſort and attendance conſtitute a fair.—Baſil expreſsly mentions the numerous appearance of traders at theſe feſtivals in Aſia, and Gregory notes the ſame cuſtom to be common in Europe. And as the feſtival was obſerved on a feria or holyday, it naturally aſſumed to itſelf, and as naturally communicated to the mart, the appellation of *feria* or fair. Indeed ſeveral of our moſt ancient fairs appear to have been uſually held, and have been continued to our time, on the original church-holydays of the places: beſides, it is obſervable, that fairs were generally kept in church-yards, and even in the churches, and alſo on Sundays, till the indecency and ſcandal were ſo great as to need reformation. Wake || Wales.

Wake-Robin. See Arum, Botany *Index*.

WALACHIA, a province of Turkey in Europe, bounded on the north by Moldavia and Tranſylvania, on the eaſt and ſouth by the river Danube, and on the weſt by Tranſylvania. It is 225 miles in length, and 125 in breadth; and was ceded to the Turks by the treaty of Belgrade, in 1739. It abounds in good horſes and cattle; and there are mines of ſeveral kinds. The ſoil is ſo fertile, that it is capable of producing any thing; and there are good paſtures, with wine, oil, and all manner of European fruits. The inhabitants are chiefly of the Greek church.

WALCHEREN, an iſland of the Low Countries, and one of the principal of thoſe of Zealand; ſeparated from Dutch Flanders by the mouth of the Scheldt. It is about nine miles in length, and eight in breadth; and though it lies low, has good arable and paſture land. The chief town of this iſland and the whole province is Middleburgh. But the principal ſea port is Fluſhing, which is ſtrongly fortified. Walcheren was taken by the Britiſh forces in Auguſt 1809; but it ſoon after was abandoned, the troops having ſuffered ſeverely by ſickneſs.

WALDEN, a town of Eſſex, commonly called *Saffron Walden*, with a market on Saturdays, and two fairs on Midlent Saturday for horſes, and November 1ſt for cows. It is remarkable for the plenty of ſaffron that grows about it. This town was incorporated by Edward VI. and is governed by a mayor and 24 aldermen. It is 27 miles north-weſt-by-north of Chelmsford, and 43 north-eaſt of London. E. Long. 0. 20. N. Lat. 52. 4.

WALDENSES. See Waldo.

WALDO, a merchant of Lyons in the latter part of the 12th century, who applying himſelf to the ſtudy of the Scriptures, and finding no warrant there for ſeveral of the Romiſh doctrines, particularly that of tranſubſtantiation, publicly oppoſed them. His followers, who from him were called *Waldenſes*, being chaſed from Lyons, ſpread over Dauphiné and Provence; upon which Philip II. is ſaid to have razed 300 gentlemen's ſeats, and deſtroyed ſeveral walled towns to ſtop their growth: but this, inſtead of ſuppreſſing, ſpread them over a great part of Europe. The articles of their faith, which they drew up and dedicated to the king of France, agreed in moſt points with thoſe of the preſent Proteſtants. In the year 1200, thoſe of them who dwelt in the province of Albigeois in Languedoc, from whence they were called *Albigenſes*, ſtood upon their defence; upon which Philip drove them into Bohemia, Savoy, and England. The cruſade againſt them is ſaid to have conſiſted of 500,000 men, who wore their croſſes on their breaſts, to diſtinguiſh themſelves from thoſe who went to the Holy Land, and wore them on their ſhoulders.

WALES, a country ſituated in the ſouth-weſt part of

Wales. of Britain, into which the ancient Britons retired from the perſecution of the Saxons. Anciently it was of greater extent than it is at preſent, and comprehended all the country beyond the Severn; that is, beſides the 12 counties included in it at preſent, thoſe of Herefordſhire and Monmouthſhire, which now are reckoned a part of England, were then inhabited by three different tribes of the Britons, namely, the Silures, the Dimetæ, and the Ordovices. The Romans were never able to ſubdue them, till the reign of Veſpaſian, when they were reduced by Julius Frontinus, who placed garriſons in their country to keep them in awe. Though the Saxons made themſelves maſters of all England, they never could get poſſeſſion of Wales, except the counties of Monmouthſhire and Herefordſhire, formerly a part of Wales. About the year 870, Roderic king of Wales divided it among his three ſons; and the names of theſe diviſions were, *Demetia*, or *South-Wales; Poveſia*, or *Powis-Land;* and *Venedotia*, or *North Wales*. Another diviſion is mentioned afterwards in the records, viz. North Wales, South Wales, and Weſt Wales; the laſt comprehending the counties of Monmouth and Hereford. The country derived the name of *Wales*, and the inhabitants that of *Welſh*, from the Saxons, who by thoſe terms denote a country and people to which they are ſtrangers; for the Welſh, in their own language, call their country *Cymry*, and their language *Cymraeg*. They continued under their own princes and laws from the above-mentioned period, and were never entirely ſubjected to the crown of England till the reign of Edward I. when Llewellin ap Gryffith, prince of Wales, loſt both his life and dominions. Edward, the better to ſecure his conqueſt, and to reconcile the Welſh to a foreign yoke, ſent his queen to lie in at Caernarvon, where ſhe was delivered of a prince; to whom the Welſh, on that account, the more readily ſubmitted. Ever ſince that time, the eldeſt ſons of the kings of England have commonly been created princes of Wales, and as ſuch enjoy certain revenues from that country.

As to the character of the Welſh, they are ſaid to be a brave, hoſpitable people; and though very jealous of affronts, paſſionate, and haſty, yet are eaſily reconciled. The common people look with a ſuſpicious eye on ſtrangers, and bear a hereditary grudge to the Engliſh nation, by whom their anceſtors were expelled from the fineſt parts of the iſland. The gentlemen are apt to value themſelves upon the antiquity of their families; and with ſome reaſon, as they can generally trace them much higher than the inhabitants of moſt other countries.

All the better ſort, both in town and country, can ſpeak Engliſh, eſpecially in the counties bordering upon England. The common people, in general, only ſpeak their own language, which is the ancient Britiſh; and not only differs entirely from the Engliſh, but has very little affinity with any of the weſtern tongues, unleſs we ſhould except the Gaelic, Erſe, or Iriſh. It is ſaid to be a dialect of the ancient Celtic, and in many reſpects to reſemble the Hebrew. Moſt of the clergy are natives of the country, and underſtand Engliſh ſo well, that they could exerciſe their functions in any part of Britain. The public worſhip, however, is as often performed in Welſh as in Engliſh, excepting in the towns, where the latter is the prevailing language. The inhabitants are computed at about 300,000. Wales || Wall.

The country, though mountainous, eſpecially in North Wales, is far from being barren or unfruitful; the hills, beſides the metals and minerals they contain, feeding vaſt herds of ſmall black cattle, deer, ſheep, and goats, and their valleys abounding in corn, as their ſeas and rivers do in fiſh. Here are alſo wood, coal, and turf, for fuel, in abundance.

Wales is bounded on all ſides by the ſea and the Severn; except on the eaſt, where it joins to the counties of Cheſter, Salop, Hereford, and Monmouth. Its length, from the ſouthernmoſt part of Glamorganſhire to the extremity of Flintſhire north, is computed at about 113 miles; and its greateſt breadth, from the river Wye eaſt to St David's in Pembrokeſhire weſt, is nearly of the ſame dimenſions, being about 90 miles.

After the conqueſt of Wales by Edward I. very material alterations were made in their laws, ſo as to reduce them nearer to the Engliſh ſtandard, eſpecially in the forms of their judicial proceedings: but they ſtill retained very much of their original polity, particularly their rule of inheritance, viz. that their lands were divided equally among all the iſſue male, and did not deſcend to the eldeſt ſon alone. By other ſubſequent ſtatutes their provincial immunities were ſtill farther abridged: but the finiſhing ſtroke to their dependency was given by the ſtatute 27 Hen. VIII. c. 26. which at the ſame time gave the utmoſt advancement to their civil proſperity, by admitting them to a thorough communication of laws with the ſubjects of England.—Thus were this brave people gradually conquered into the enjoyment of true liberty; being inſenſibly put upon the ſame footing, and made fellow-citizens, with their conquerors.

It is enacted by the 27 Hen. VIII. 1. That the dominions of Wales ſhall be forever united to the kingdom of England. 2. That all Welſhmen born ſhall have the ſame liberties as other king's ſubjects. 3. That lands in Wales ſhall be inheritable according to the Engliſh tenures and rules of deſcent. 4. That the laws of England, and no other, ſhall be uſed in Wales; beſides many other regulations of the police of this principality. And the 34 and 35 Hen. VIII. c. 26. confirms the ſame, adds farther regulations, divides it into 12 ſhires, and, in ſhort, reduces it to the ſame order in which it ſtands at this day; differing from the kingdom of England in only a few particulars, and thoſe too of the nature of privileges (ſuch as having courts within itſelf, independent of the proceſs of Weſtminſter-hall), and ſome other immaterial peculiarities, hardly more than are to be found in many counties of England itſelf.

New WALES. See *New* BRITAIN.

New South WALES. See *New* HOLLAND.

Prince of WALES. See *ROYAL Family*.

WALKING Leaf, an inſect. See *MANTIS Sycifolia*, ENTOMOLOGY *Index*.

WALL, in *Architecture*, the principal part of a building, as ſerving both to incloſe it, and to ſupport the roof, floors, &c.—Walls are diſtinguiſhed into various kinds, from the matter whereof they conſiſt; as plaſter or mud walls, brick walls, ſtone walls, flint or boulder walls, and boarded walls. See ARCHITECTURE.

Cob or *Mud* WALL. In thoſe parts of England where ſtone is ſcarce, it is uſual to make walls and houſes of mud,

Wall || Waller.

mud, or, as it is called in Devonſhire, *cob*; which is a compoſition of earth and ſtraw, wet up ſomewhat like mortar, but well beat and trod together. When a wall is making, after being raiſed to a certain height, it is allowed time to pitch or ſettle before the work is reſumed. Some value themſelves on their ſkill in building with this compoſition; the price, when materials are found, is generally in Devonſhire 3s. per perch of 16½ feet; but a ſtone foundation coſts more. Houſes built with this, being covered with thatch, are very dry and warm; a cob wall, if in a good ſituation, will laſt 50 or 60 years or more. When pulled down, they are uſed as manure, and new earth employed to rebuild with.

WALLACE. Sir William, a gallant general of the Scots, who endeavoured to reſcue his country from the Engliſh yoke; but being taken priſoner, he was unjuſtly tried by the Engliſh laws, condemned, and executed as a traitor to Edward I. in 1304. See Scotland, N° 103, *et ſeq.*

WALLACHIA. See Walachia.

WALLER, Edmund, a celebrated Engliſh poet, was the ſon of Robert Waller, Eſq. of Agmondeſham in Buckinghamſhire, by Anne, the ſiſter of the great Hamden who diſtinguiſhed himſelf ſo much in the beginning of the civil wars. He was born in 1605; and his father dying when he was very young, the care of his education fell to his mother, who ſent him to Eton ſchool. He was afterwards ſent to King's college in Cambridge, where he muſt have been very aſſiduous in his ſtudies, ſince, at ſixteen or ſeventeen years of age, he was choſen into the laſt parliament of King James I. and ſerved as burgeſs for Agmondeſham. He began to exerciſe his poetical talent ſo early as the year 1623; as appears from his verſes "upon the danger his majeſty (being prince) eſcaped in the road of St Andero;" for there Prince Charles, returning from Spain that year, had like to have been caſt away. It was not, however, Mr Waller's wit, his fine parts, or his poetry, that ſo much occaſioned him to be firſt publicly known, as his carrying off the daughter and ſole heireſs of a rich citizen, againſt a rival whoſe intereſt was eſpouſed by the court. It is not known at what time he married his firſt lady; but he was a widower before he was 25, when he began to have a paſſion for Sachariſſa, which was a fictitious name for the lady Dorothy Sidney, daughter to the earl of Leiceſter, and afterwards wife to the earl of Sunderland. He was now known at court, careſſed by all who had any reliſh for wit and polite literature; and was one of the famous club of which Lord Falkland, Mr Chillingworth, and other eminent men, were members. He was returned burgeſs for Agmondeſham in the parliament which met in April 1640. An intermiſſion of parliaments having diſguſted the nation, and raiſed jealouſies againſt the deſigns of the court, which would be ſure to diſcover themſelves whenever the king came to aſk for a ſupply, Mr Waller was one of the firſt who condemned the preceding meaſures. He ſhowed himſelf in oppoſition to the court, and made a ſpeech in the houſe on this occaſion; from which we may gather ſome notion of his general principles in government; wherein, however, he afterwards proved very variable and inconſtant. He oppoſed the court alſo in the long parliament which met in November following, and was choſen to impeach Judge Crawley, which he did in a warm and eloquent ſpeech, July 16th 1641. This ſpeech was ſo highly applauded, that 20,000 copies of it were ſold in one day. In 1642, he was one of the commiſſioners appointed by the parliament to preſent their propoſitions of peace to the king at Oxford. In 1643, he was deeply engaged in a deſign to reduce the city of London and the Tower to the ſervice of the king; for which he was tried and condemned, together with Mr Tomkins his brother-in-law, and Mr Challoner. The two latter ſuffered death; but Mr Waller obtained a reprieve: he was, however, ſentenced to ſuffer a year's impriſonment, and to pay a fine of 10,000l. After this, he became particularly attached to Oliver Cromwell, upon whom he wrote a very handſome panegyric. He alſo wrote a noble poem on the death of that great man.

Waller, Wallis.

At the Reſtoration, he was treated with great civility by Charles II. who always made him one of the party in his diverſions at the duke of Buckingham's and other places. He wrote a panegyric upon his majeſty's return; which being thought to fall much ſhort of that he had before written on Oliver Cromwell, the king one day aſked him in raillery, "How is it, Waller, that you wrote a better encomium on Cromwell than on me?" "May it pleaſe your majeſty," anſwered he, "we poets generally ſucceed beſt in fiction." He ſat in ſeveral parliaments after the Reſtoration, and continued in the full vigour of his genius to the end of his life, his natural vivacity bearing him up, and making his company agreeable to the laſt. He died of a dropſy in 1687, and was interred in the churchyard of Beaconsfield, where a monument is erected to his memory. Mr Waller has been honoured as the moſt elegant and harmonious verſifier of his time, and a great refiner of the Engliſh language. The beſt edition of his works, containing poems, ſpeeches, letters, &c. is that publiſhed in quarto by Mr Fenton, to 1730.

WALLIS, Dr John, a celebrated mathematician, was educated at Cambridge; where he became fellow of Queen's college, and continued ſo till, by his marriage, he vacated his fellowſhip. In 1640, he received holy orders, and became chaplain to the lady Vere. While he lived in this family, he cultivated the art of deciphering; and it is ſaid that the elector of Brandenburg, for whom he explained ſeveral letters written in ciphers, ſent him a gold chain and medal. In 1643 he publiſhed, "Truth tried; or Animadverſions on the Lord Brooke's treatiſe, called *The Nature of Truth*, &c." The next year he was choſen one of the ſcribes or ſecretaries to the aſſembly of divines at Weſtminſter. Dr Peter Turner, Savilian profeſſor of geometry in Oxford, being ejected by the parliament-viſitors in 1649, Mr Wallis was appointed to ſucceed him in that place. In 1653 he publiſhed at Oxford a Grammar of the Engliſh Tongue in Latin. In 1655 he entered the liſts with Mr Hobbes; and their controverſy laſted a conſiderable time. In 1657 the Doctor publiſhed his Mathematical Works. Upon the death of Dr Langbaine, he was choſen cuſtos archivorum of the univerſity. After the Reſtoration he met with great reſpect, the king himſelf entertaining a favourable opinion of him on account of ſome ſervices he had done both to his royal father and himſelf. He was therefore confirmed in his places, admitted one of the king's chaplains in ordinary, and appointed one of the divines empowered to review the book of common prayer. He complied with the

Wallis Walpole. terms of the act of uniformity, and continued a ſteady conformiſt till his death. He was one of the firſt members of the Royal Society, and correſponded with many learned men. In 1697, the curators of the univerſity preſs at Oxford thought it for the honour of the univerſity to collect the mathematical works of the Doctor, which had been printed ſeparately, ſome in Latin, ſome in Engliſh, and publiſhed them all together in the Latin tongue, in three vols, folio. He died in 1703. He ſpeaks of himſelf thus: "It hath been my endeavour all along to act by moderate principles, being willing whatever ſide was uppermoſt, to promote any good deſign for the true intereſt of religion, of learning, and of the public good." Beſides the works above mentioned, he publiſhed many others.

WALLOONS, a name for the inhabitants of a conſiderable part of the Netherlands, viz. Artois, Hainault, Naum, Luxemburgh, and part of Flanders and Brabant.

WALNUT-TREE. See JUGLANS, BOTANY *Index*.

WALPOLE, SIR ROBERT, earl of Orford, was born at Houghton in Norfolk, September 6th, 1674, and educated on the foundation at Eton ſchool. Thence he was elected to King's College in Cambridge; but, ſucceeding to the family eſtate by the death of his elder brother, he reſigned his fellowſhip. In 1700, he was choſen member of parliament for King's Lynn, and repreſented that borough in ſeveral ſucceeding parliaments. In 1705, he was nominated one of the council to Prince George of Denmark, lord high admiral of England; in 1707, appointed ſecretary at war; and, in 1709, treaſurer of the navy. In 1710, upon the change of the miniſtry, he was removed from all his poſts, and held no place afterwards during the queen's reign. In 1711 he was expelled from the houſe of commons for what they called notorious corruption in his office as ſecretary at war. The borough of Lynn, however, re-elected him; and, though the houſe declared the election void, yet they perſiſted in the choice. In the well-known debate relating to Steele for publiſhing the Criſis, he greatly diſtinguiſhed himſelf in behalf of liberty, and added to the popularity he had before acquired.

On the death of the queen, a revolution of politics took place, and the Whig party prevailed both at court and in the ſenate. Walpole had before recommended himſelf to the houſe of Hanover by his zeal for its cauſe, when the commons conſidered the ſtate of the nation with regard to the Proteſtant ſucceſſion: and he had now the honour to procure the aſſurance of the houſe to the new king (which attended the addreſs of condolence and congratulation), "That the commons would make good all parliamentary funds." It is therefore not to be wondered at, that his promotion ſoon took place after the king's arrival; and that in a few days he was appointed receiver and paymaſter-general of all the guards and garriſons, and of all other the land forces in Great Britain, paymaſter of the royal hoſpital at Chelſea, and likewiſe a privy counſellor. On the opening of a new parliament, a committee of ſecrecy was choſen to inquire into the conduct of the late miniſtry, of which Walpole was appointed chairman; and, by his management, articles of impeachment were read againſt the earl of Oxford, Lord Bolingbroke, the duke of Ormond, and the earl of Straf-

Walpole. ford. The eminent ſervice he was thought to have done the crown, by the vigorous proſecution of thoſe miniſters who were deemed the chief inſtruments of the peace, was ſoon rewarded by the extraordinary promotions to the offices of firſt commiſſioner of the treaſury, and chancellor and under treaſurer of the exchequer.

In two years time he reſigned all his offices, on account of a miſunderſtanding which took place between him and the reſt of the miniſtry about certain ſupplies demanded for the ſupport of his majeſty's German dominions. On the day of his reſignation he brought in the famous ſinking-fund bill, which he preſented as a country gentleman, ſaying, that he hoped it would not fare the worſe for having two fathers; and that his ſucceſſor Mr Stanhope would bring it to perfection. His calling himſelf the father of a project, which hath ſince been ſo often employed to other purpoſes than were at firſt declared, gave his enemies frequent opportunity for ſatire and ridicule; and it hath been ſarcaſtically obſerved, that the father of this fund appeared in a very bad light when viewed in the capacity of a nurſe. In the next ſeſſion of parliament, Walpole oppoſed the miniſtry in every thing; and even Wyndham or Shippen did not exceed him in patriotiſm. Upon a motion in the houſe for continuing the army, he made a ſpeech of above an hour long, and diſplayed the danger of a ſtanding army in a free country, with all the powers of eloquence. Early in 1720 the rigour of the patriot began to ſoften, and the complaiſance of the courtier to appear; and he was again appointed paymaſter of the forces, and ſeveral of his friends were found ſoon after in the liſt of promotions. No doubt now remained of his entire converſion to court meaſures; for before the end of the year, we find him pleading as ſtrongly for the forces required by the war-office as he had before declaimed againſt them, even though at this time the ſame pretences for keeping them on foot did not exiſt.

It was not long before he acquired full miniſterial power, being appointed firſt lord commiſſioner of the treaſury, and chancellor of the exchequer; and, when the king went abroad in 1723, he was nominated one of the lords juſtices for the adminiſtration of government, and was ſworn ſole ſecretary of ſtate. About this time he received another diſtinguiſhed mark of the royal favour; his eldeſt ſon then on his travels being created a peer, by the title of Baron Walpole of Walpole. In 1725 he was made knight of the Bath, and the year after knight of the Garter. The meaſures of his adminiſtration, during the long time he remained prime or rather ſole miniſter, have been often canvaſſed with all the ſeverity of critical inquiry. It is difficult to diſcern the truth through the exaggerations and miſrepreſentations of party. He has indeed been accuſed of employing the ſinking fund for the purpoſes of corruption, of which it was long the faſhion to call him the father; but the man who reflects on the tranſactions of Charles II. and his infamous cabal, will acquit him of the latter part of this charge. He was an enemy to war, and the friend of commerce; and becauſe he did not reſent ſome petty inſults of the court of Spain ſo ſuddenly as the fiery part of the nation thought he ſhould have done, a formidable oppoſition was formed againſt him in the houſe, which had influence enough

to

Walpole.

to employ in its cauſe almoſt all the wit of the nation. Pulteney and Pitt were the great leaders of the party in the houſe of commons; while Bolingbroke and Pope and Johnſon, and almoſt every man of genius, exerted themſelves without doors to enlighten, by pamphlets in proſe and verſe, the minds of the people, and ſhow the neceſſity of a Spaniſh war. This he ſtrenuouſly oppoſed, becauſe he knew that the foreign ſettlements of that power are very remote, and in a climate deſtructive to Engliſhmen; and that ſuch of them as we might be able to take, we could not poſſibly retain. The oppoſition however prevailed. The nation was indulged in a war, of which it ſurely had no cauſe to boaſt of the ſucceſs; and it is now univerſally known, that the greater part of thoſe who with honeſt intentions had, either in parliament or out of it, been engaged to run down the miniſter, lived to repent of their conduct, and do juſtice to the man whom they had ſo pertinaciouſly vilified.

In order to encourage commerce and improve the revenue, Sir Robert projected a ſcheme for an extenſion of the exciſe, as the only means of putting a ſtop to the frauds of merchants and illicit traders. This was another ground of clamour to the orators within, and the wits without, doors; and while the oppoſition repreſented it as a meaſure big with public miſchief, Swift and Pope occaſionally alluded to it as an oppreſſion calculated to deprive private life of all its comforts. The miniſter was therefore obliged to abandon the ſcheme; but in a ſucceeding adminiſtration it was partly carried into execution, at the expreſs ſolicitation of the principal perſons concerned in that article of trade which it was ſuggeſted would be moſt affected by it; and afterwards the moſt popular miniſter that ever directed the councils of this country declared in full ſenate, that if a time ſhould ever arrive which was likely to render the project feaſible, he would himſelf recommend an extenſion of the exciſe laws as a meaſure of the greateſt advantage to commerce, to the revenue, and to the general intereſts of the kingdom.

In 1742 the oppoſition prevailed; and Sir Robert being no longer able to carry a majority in the houſe of commons, reſigned all his places, and fled for ſhelter behind the throne. He was ſoon afterwards created earl of Orford; and the king, in conſideration of his long and faithful ſervices, granted him a penſion of 4000l. per annum. The remainder of his life he ſpent in tranquillity and retirement, and died, in 1745, in the 71ſt year of his age.

He has been ſeverely, and not unjuſtly, cenſured for that ſyſtem of corruption by which he almoſt avowed that he governed the nation; but the objects which he had in view are now acknowledged to have been in a high degree praiſe-worthy. Johnſon, who in the earlier part of his life had joined the other wits in writing againſt his meaſures, afterwards honoured his memory for the placability of his temper, and for keeping this country in peace for ſo many years; and Mr Burke has * declared, that his only defect as a miniſter was the want of ſufficient firmneſs to treat with contempt that popular clamour, which, by his yielding to it, hurried the nation into an expenſive and unjuſt war. But his rancorous proſecution of Atterbury biſhop of Rocheſter (ſee ATTERBURY), by a bill of pains and penalties, may be conſidered as ſomething worſe than a defect: it was a fault for which no apology can be made; becauſe, whether that prelate was innocent or guilty, of his guilt no legal proof ever appeared. In that inſtance the conduct of the miniſter was the more extraordinary, that on other occaſions he choſe to gain over the diſaffected by mildneſs and beneficence, even when he had ſufficient proofs of their guilt. Of this the following anecdote, communicated by Lord North to Dr Johnſon, is a ſufficient proof. Sir Robert having got into his hands ſome treaſonable papers of his inveterate enemy Shippen, ſent for him, and burnt them before his eyes. Some time afterwards, while Shippen was taking the oaths to the government in the houſe of commons, Sir Robert, who ſtood next to him, and knew his principles to be the ſame as ever, ſmiled; upon which Shippen, who had obſerved him, ſaid "Egad, Robin, that's hardly fair."

Walpole II Wilmington.

To whatever objections his miniſterial conduct may be liable, in his private character he is univerſally allowed to have had amiable and benevolent qualities. That he was a tender parent, a kind maſter, a beneficent patron, a firm friend, an agreeable companion, are points that have been ſeldom diſputed; and ſo calm and equal was his temper, that Pulteney, his great rival and opponent, ſaid, he was ſure that Sir Robert Walpole never felt the bittereſt invectives againſt him for half an hour.

About the end of Queen Anne's reign, and the beginning of George I.'s, he wrote the following pamphlets. 1. The Sovereign's Anſwer to the Glouceſterſhire Addreſs. The Sovereign meant Charles duke of Somerſet, ſo nicknamed by the Whigs. 2. Anſwer to the Repreſentation of the Houſe of Lords on the State of the Navy, 1709. 3. The Debts of the Nation ſtated and conſidered, in four Papers, 1710. 4. The Thirty-five Millions accounted for, 1710. 5. A Letter from a foreign Miniſter in England to Monſieur Pettecum, 1710. 6. Four Letters to a Friend in Scotland upon Sacheverell's Trial; falſely attributed in the General Dictionary to Mr Maynwaring. 7. A Short Hiſtory of the Parliament. It is an account of the laſt ſeſſion of the queen. 8. The South-Sea Scheme conſidered. 9. A Pamphlet againſt the Peerage Bill, 1719. 10. The Report of the Secret Committee, June 9th, 1715.

WALRUS. See TRICHECUS, MAMMALIA *Index*.

WALSH, WILLIAM, an Engliſh critic and poet, the ſon of Joſeph Walſh, Eſq. of Abberley in Worceſterſhire, was born about the year 1660. He became a gentleman commoner of Wadham college, Oxford, but left the univerſity without taking a degree. His writings are printed among the works of the Minor Poets, printed in 1749. He was made gentleman of the horſe in Queen Anne's reign; and died in 1708. He was the friend of Mr Dryden and of Mr Pope; the former of whom eſteemed him the beſt critic then living; and Mr Pope has celebrated his character in the Eſſay on Criticiſm.

* *Letters on a Regicide Peace.*

WALSINGHAM, a town of Norfolk, with a market on Fridays, and a fair on Whit-Monday, for horſes and pedlars ware; it is ſeated not far from the ſea; and in former times was famous for its college of canons, and was greatly frequented by pilgrims who went to pay their devotions to the image of the Virgin Mary at the chapel, where there are two fine ſprings, called the

the *Virgin Mary's wells*. Not many years ago there were found here by a husbandman, 100 urns full of ashes, which were supposed to be those which the Romans filled with the ashes of the dead. It is 22 miles north-west of Norwich, and 117 north-north-east of London. E. Long. 0. 53. N. Lat. 52. 56.

WALSINGHAM, *Thomas*, an English Benedictine monk of the monastery of St Alban's, who lived about the year 1440. He applied himself to the history and antiquity of his country, in quality of historiographer to the king; and composed the History of King Henry VI. with other works.

WALSINGHAM, *Sir Francis*, minister and secretary of state during the reign of Queen Elizabeth, and one of the greatest politicians of his time, was descended from a noble and ancient family at Chiselhurst. After having made great progress in his studies at Cambridge, he was twice sent ambassador to France, and at his return to England was employed in the most important affairs, became secretary of state, and was one of the commissioners for the trial of Mary queen of Scotland. Sir Francis was undoubtedly one of the most refined politicians and most penetrating statesman that any age ever produced. He had an admirable talent, both in discovering and managing the secret recesses of the heart. He had his spies in most courts in Christendom, and allowed them a liberal maintenance; for it was his maxim, That knowledge cannot be bought too dear. In 1587 the king of Spain having made vast preparations, which surprised, and kept all Europe in suspense, Walsingham employed his utmost endeavours for the discovery of that important secret; and accordingly procured intelligence from Madrid, that the king had informed his council of his having dispatched an express to Rome, with a letter written with his own hand to the pope, acquainting him with the true design of his preparations, and begging his blessings upon him; which for some reasons he could not disclose till the return of the courier. The secret being thus lodged with the pope, Walsingham, by means of a Venetian priest, whom he retained at Rome as a spy, got a copy of the original letter, which was stolen out of the pope's cabinet by a gentleman of the bed-chamber, who took the key out of the pope's pocket while he slept. After this, by his dexterous management, he caused the Spaniards bills to be protested at Genoa, which should have supplied them with money for their extraordinary preparations; and by this means he happily retarded this formidable invasion for a whole year. In short, he spent his whole time and faculties in the service of Queen Elizabeth; on which account her majesty was heard to say, "That in diligence and sagacity he exceeded her expectations." However, after all his eminent services to his country, this man gave a remarkable proof at his death, which happened on the 6th of April 1590, how far he preferred the public interest to his own; he being so poor, that excepting his library, which was a very fine one, he had scarcely effects enough to defray the expence of his funeral. His principal works are, 1. Memoirs and Instructions for the use of Ambassadors, with his Letters and Negociations. 2. Political Memoirs. Walsingham || Wapentake.

WALTHERIA, a genus of plants in the class monadelphia, and in the natural system arranged under the 37th order, *Columniferæ*. See BOTANY *Index*.

WALTON, BRYAN, Bishop of Chester, a learned English divine, who gained great reputation by his edition of the Polyglot bible, with his Prolegomena in the beginning; which is more exact, says Father Simon, than any other which had been published on that subject. He died in 1661.

WAMPUM, the money used by the North American Indians. It is much used in all their treaties as a symbol of friendship. It is made of a shell of a particular species of VENUS.

WAPENTAKE, is the same with what is called a *hundred*; especially used in the north counties beyond the river Trent. The word seems to be of Danish original, and to be so called for this reason: When first this kingdom, or part thereof, was divided into wapentakes, he who was the chief of the wapentake or hundred, and who is now called a *high constable*, as soon as he entered upon his office, appeared in a field on a certain day on horseback with a pike in his hand, and all the chief men of the hundred met him there with their lances, and touched his pike; which was a sign that they were firmly united to each other by the touching their weapons. But Sir Thomas Smith says, that anciently musters were made of the armour and weapons of the several inhabitants of every wapentake; and from those that could not find sufficient pledges for their good abearing, their weapons were taken away and given to others; from whence he derives the word.

WAR.

INTRODUCTION.

Division of the subject. IN treating the subject of war, we may consider it first in a *political* and *moral* point of view, as one of those powerful engines employed by civil governments, to bring about some ends which they deem beneficial to the community over which they preside; and secondly, in a *theoretical* and *practical* point of view, as a *science* or an *art*, which the necessities or the follies of mankind have rendered an important object of consideration, not only to certain individuals, but in some measure to society at large.

2 Political objects and causes of war.

From the numerous calamities incident to war, it should be presumed that no wise or good government would have recourse to means so dangerous and expensive, till after all other means of producing the ends they have in view had failed of success. The ostensible objects for which a nation or community engages in a war, are usually to prevent or repel the assaults, encroachments, or invasions of its neighbours; to revenge some insult or injury which the community, its allies, or dependents, may have sustained; to compel some other nation or community to respect what are called the *law of nations*, and the *rights of civil society*; or to

Introduction.

preſerve that due and equable *balance of power* among neighbouring ſtates, which has of late been conſidered as an eſſential point in the political economy of civilized nations. We ſay that theſe are uſually the *oſtenſible* objects of war; for though it will ſcarcely be denied that ambition, avarice, religious bigotry, a deſire of dominion, and a thirſt of military fame, have been the real cauſes of many of thoſe long and bloody wars which have deſolated the face of nature, and heaped miſery and wretchedneſs on millions of human beings, we believe few heroes and conquerors, either of ancient or modern times, have had the honeſty or effrontery to avow theſe as the real motives of their military expeditions. Yet, if we examine the pages of hiſtory, we ſhall ſcarcely find a war, from the Battle of the Kings recorded by the ſacred hiſtorian, to the preſent conteſt which has for 17 years involved all Europe in confuſion and bloodſhed, and reduced many of its faireſt ſtates and provinces under the ſubjection of a ſingle monarch, in which *one* or other of theſe latter motives has not, at leaſt to one party, been a principal inducement.

Among the political objects of war, we muſt not omit to mention one which, though perhaps leſs openly avowed than any other, has, in monarchical and ariſtocratical governments, always formed a material part of the ſtate policy;—we mean the object of preventing tumults and commotions among the people, by engaging them in a foreign war. It was long ago obſerved by a good judge of human nature*, "that no body can be healthful without exerciſe, neither natural body nor politic;" and that "to a kingdom or a ſtate, a juſt and honourable war is the true exerciſe." That politicians have often acted on theſe principles, is certain. On the juſtice of the principles themſelves, we preſume not to decide, though we may ſafely expreſs a doubt whether the remedy be not worſe than the diſeaſe, and whether theſe popular commotions might not be prevented with equal eaſe, and with more advantage to the nation, by employing the populace in ſuch works of improvement as may advance the manufactures, commerce, or internal comforts of the ſtate.

* *Bacon.*

3 Exuberant population regarded as a primary cauſe of war.

An able and ingenious writer conſiders a redundance of population as one of the chief primary cauſes of war. "One of its firſt cauſes and moſt powerful impulſes, was undoubtedly an inſufficiency of room and food; and, greatly as the circumſtances of mankind have changed ſince it firſt began, the ſame cauſe ſtill continues to operate, and to produce, though in a ſmaller degree, the ſame effects. The ambition of princes would want inſtruments of deſtruction, if the diſtreſſes of the lower claſſes did not drive them under their ſtandards. A recruiting ſerjeant always prays for a bad harveſt, and a want of employment, or, in other words, a redundant population †." This redundance he propoſes to obviate, and thus to counteract one of the principal cauſes of war, by throwing obſtacles in the way of marriage. Without calling in queſtion the juſtneſs of his poſition, we do not ſee the neceſſity of the remedy which he propoſes. We muſt acknowledge ourſelves ſuch friends to the increaſe of population as to think that every encouragement ought to be given to it, inſtead of throwing obſtacles in its way. There are few countries ſo populous, or ſo completely cultivated, as to render it neceſſary to plunge them into wars, in order to diminiſh the number of inhabitants, which might be abundantly ſupported, were agriculture encouraged, and gluttony repreſſed.

† *Malthus on Population*, Edit. 1803, p. 500.

Introduction.

Whatever may be the objects for which a nation goes to war; whatever the cauſes which have induced her to have recourſe to ſuch an expedient, we may venture, from hiſtory and experience, to affirm that ſhe will gain little ſolid advantage by the conteſt. She may drive an invading enemy from her dominions, and purſue him to his own; ſhe may acquire plunder and territory, and may raiſe her name among the neighbouring ſtates by her victories and proweſs; but all theſe, except the *firſt*, will ſcarcely compenſate for the blood and treaſure which ſhe has expended, and for the check given to her agriculture, manufactures and commerce, by drawing off many of the labouring part of the community to ſupply the fleets and armies of the ſtate. Theſe are the inevitable conſequences even of a ſucceſsful war; and ſhould it prove otherwiſe, the calamities and diſtreſſes of the vanquiſhed may readily be conceived. Even to the eſtabliſhed government of a ſtate, war, while it appears to ſtrengthen their hands and increaſe their influence, is fraught with difficulty and danger. No ſituation of affairs is ſo well calculated to ſhow the abilities or inſufficiency of a cabinet as this, and melancholy is the fate of that nation whoſe adminiſtration is then conducted by a weak, inexperienced, or profligate miniſtry; but be they ever ſo able or ſo upright, ſtill the want of ſucceſs, or a reverſe of fortune, will lower them in the opinion of the people, and will compel them at laſt to conclude a diſadvantageous, perhaps a diſhonourable peace, or quit their poſts and leave the taſk to a more popular or ſucceſsful adminiſtration.

4 Impolicy of war.

The evils of war do not terminate on the return of peace. Many of the burdens which it had impoſed on the people muſt ſtill continue, to diſcharge the debt contracted by the ſtate; while the ſudden diſbanding of the fleets and armies pours into the community numbers of idle and diſſipated men, averſe to labour, and accuſtomed to ſcenes of confuſion, ſlaughter and rapine. At no time are robberies, murders, or ſeditions ſo frequent as on the termination of a long protracted war; at none are the internal peace and quiet of a nation in ſo much danger.

5 Morale of war.

On the *moral* evils of war we ſurely need not enlarge. In itſelf, when undertaken without neceſſity, it is an act of the moſt criminal and atrocious nature; and the aggreſſors are accountable for all the horrid conſequences which may attend it. "The pomp and circumſtances of glorious war" may form a deſirable ſubject for the poet and the hiſtorian; but the Chriſtian and the philoſopher muſt regard it with horror and deteſtation, as the greateſt evil with which providence has been pleaſed to arm the hands of its miniſters to puniſh and afflict mankind. A late amiable and learned prelate has laboured to prove that "the frequency, duration, and cruelty of wars (in Chriſtendom) are leſs now than in ancient times;"* but we think that neither his reaſoning nor his examples are capable of eſtabliſhing the firſt part of this poſition. If we take the laſt 700 years, and compare it with an equal period of ancient hiſtory; if we recollect the *cruſades*, the almoſt-continual ſtruggles between France and Britain, the civil diſſenſions in both theſe mighty empires, the wars between the Ruſſians and their neighbours, the Turks, the Poles, and the Swedes; if we advert to the reigns of

6 War ſcarcely leſs frequent now than formerly.

* *Porteus's Sermons*, Serm. xi.

Edward

Edward III. of England, Charles V. and Philip II. of Spain, Louis XIV. of France, Guſtavus Adolphus and Charles XII. of Sweden, Frederick II. of Pruſſia, and Catherine II. of Ruſſia; and laſtly, if we turn our attention to the long and ruinous conteſts which diſtinguiſh our own times, we ſhall find little cauſe to boaſt of having profited by the pacific leſſons of our Saviour, whoſe great object was to promote "*peace on earth*," *and good will and brotherly love among the children of men.*

Introduction.

There is indeed one conſolatory circumſtance with reſpect to the modern ſyſtem of warfare, that our wars are now leſs ſanguinary than thoſe of ancient times. The immenſe ſlaughter which attended ſome of the battles in the Greek and Roman wars, where the greater part of the vanquiſhed army was frequently put to the ſword, is familiar to our claſſical readers; but in modern warfare, even of the large armies that have appeared in the field on the continent of Europe, we ſeldom find ſo many as 30,000 killed and wounded on both ſides, a number vaſtly inferior to what fell of the Romans at Cannæ, and by no means equal to the loſs of the Carthaginians at the battle of Zama. This diminiſhed ſlaughter is attributed, and we believe with juſtice, to the uſe of fire-arms; and it is computed that in this mode of fighting not more than one muſket ball in 40 takes effect, and not more than one in 400 proves fatal. The introduction of theſe weapons, therefore, however it may be declaimed againſt by theoriſts, muſt be conſidered as a real improvement in the art of war; and it is ſincerely to be regretted that the uſe of them ſhould be laid aſide. If, however, the preſent practice of deciding battles by the bayonet and the ſabre be continued, it is to be feared that we ſhall ſoon rival the ancients as much in the ſanguinary nature of our wars as in their frequency.

After what we have ſaid on the impolicy of war, and the moral evils which attend it, it will ſcarcely be expected that we ſhould allow it to be juſtifiable, except in caſes of neceſſity. Indeed we think that war can be juſtified only on the principles of ſelf-defence. When a nation is invaded, or attacked in relation to her undoubted rights and principles, it is then, and then only, that ſhe has a pretence for war. We will not, indeed, go ſo far as to aſſert, that ſhe ought to await the attack. While ſhe takes the beſt methods for defending her territories at home, it is doubtleſs proper, eſpecially for a maritime ſtate, to meet the enemy half-way, and by a timely and ſpirited reſiſtance, endeavour to avert thoſe greater evils which would attend a ſyſtem of puſillanimity and neglect.

In the preſent ſtate of human nature, war muſt be regarded as a neceſſary evil, and as it is ſometimes unavoidable, the principles and practice of it muſt be ſtudied by thoſe who are to ſuperintend or to conduct its operations. It is this neceſſity that has given occaſion to the art of war, the practice of which is to form the ſubject of the preſent article.

Before we enter on the immediate object of this eſſay, however, it may not be improper to enumerate thoſe branches of knowledge which conſtitute the *principles* of the military art, and of which no officer who expects to have a principal command in military operations ſhould be ignorant. We ſhall firſt mention thoſe ſciences which ſhould form a part of the education of every commanding officer, whether military or naval; and we ſhall then diſtinguiſh between thoſe which are moſt applicable to the land and the ſea ſervice.

Among the firſt branches of a military education muſt be enumerated the modern languages of French and German; GEOGRAPHY, by which we would underſtand, not merely the deſcription of countries, ſtates, and kingdoms, but a knowledge of their political conſtitution, reſources, and productions, and of the manners, cuſtoms, and character of their inhabitants; HISTORY, eſpecially that of modern Europe, and of the Greeks and Romans. Among particular hiſtories we would recommend thoſe of Polybius, Xenophon, Tacitus, with the Commentaries of Cæſar, in ancient hiſtory; and Davila's account of the civil wars of France, Guicciardini's hiſtory of the Italian wars, the hiſtory of the ſeven years war by Frederick the Great, with a particular attention to the beſt hiſtories of his own country, and of the wars in which ſhe has been engaged. After theſe preliminary branches follow the rudiments of mathematics, including common and logarithmic ARITHMETIC, the elements of theoretical and practical GEOMETRY, plane and ſpherical TRIGONOMETRY, the principles of SURVEYING, CONIC SECTIONS, and their application to PROJECTILES; certain parts of natural philoſophy, eſpecially MECHANICS; and the principles of DRAWING plans, maps, and charts.

Beſides theſe, a military officer ſhould be inſtructed in FORTIFICATION and GUNNERY, the nature of military exerciſes, and the duties of the various officers attached to an army; while the naval officer ſhould particularly attend to ASTRONOMY, HYDRODYNAMICS, NAVIGATION, the principles of SEAMANSHIP, and of SHIP-BUILDING.

Practice of war.

There is perhaps no art or profeſſion, in the practice of which the ſuperiority of *example* over *precept* is more apparent than in war, inſomuch that we may lay it down as an axiom, that no man can be a ſoldier or a ſailor from theory alone. It is not from books that we are to learn the art of war, though there is no doubt that they may greatly aſſiſt and improve the ſkill and experience acquired in the field or on the ocean. In theſe active ſcenes have been formed the great commanders, whoſe lives and actions are peruſed with ſo much avidity; and the only method of ſucceſsfully imitating their exploits, and emulating their fame, is to encounter the dangers and the hardſhips to which they were expoſed, and to learn how to command, by firſt learning to obey. A conſiderable ſhare of the mechanical part of war may be acquired in a well-regulated military or naval ſchool; but the experience neceſſary for a commander is to be gained only in actual ſervice.

The practical part of war is uſually divided into *military tactics*, and *naval tactics*; a diviſion which we ſhall here adopt, though we have thought proper to bring the whole under one article. As the ſpace, which we had originally allotted to theſe ſubjects, has unavoidably been reduced one half, we ſhall be able to give little more than a general outline, eſpecially of *military tactics*, reſerving the fuller diſcuſſion for *naval tactics*, which, to a nation whoſe chief dependence is on her fleets, muſt be the moſt uſeful and the moſt intereſting part of the ſubject.

It would be vain for us to attempt any hiſtorical ac-

Introduction.

count of the progreſſive improvements that have been made in the art of war. Indeed this would be to repeat much of what has already been detailed under the principal hiſtorical articles of this work; for the hiſtory of nations, as it is commonly treated, is little more than a hiſtory of their wars. We might, no doubt, bring forwards much curious information reſpecting the offenſive and defenſive weapons of different ages and countries, and the character and organization of their armies; but for thoſe and other matters of a ſimilar nature, we may refer our readers to the following reſpectable authorities: Vegetius *De re militari;* Polybius's *Hiſtory, with the Commentaries of* Folard; Salmaſius *De re militari Romanorum;* Tacitus's *Vita Agricolæ;* Rollin's *Ancient Hiſtory;* Potter's *Grecian Antiquities;* Kennet's and Adam's *Roman Antiquities;* Goguet's *Origin of Laws, Arts, &c.;* Daniel *Hiſtoire de la Milice Françoiſe;* Gough's *Sepulchral Monuments;* Aſcham's *Toxophilus,* and Groſe's *Hiſtory of the Engliſh Army, and Eſſay on Ancient Armour.*

At a period like the preſent, when the two greateſt powers of Europe are ſtruggling for glory and dominion, it will not be thought unintereſting, or irrelevant to the ſubject of the preſent article, if we offer a comparative ſtatement of the preſent military and naval eſtabliſhments of theſe two mighty empires, with a ſketch of the military character of their armies; and with theſe we ſhall conclude our preliminary obſervations.

II Preſent military eſtabliſhment of the French.

According to a ſtatement made to the French government at the commencement of 1805, the grand total of the French armies conſiſted of 570,964 men; viz. infantry of the line, 341,412; light infantry, 100,130; cavalry, 77,488; artillery, 46,489; engineers, 5445. Since that time, more than 100,000 have been added, and, according to the beſt authority, the preſent total does not fall ſhort of 700,000 men *. This vaſt body is divided into companies for both cavalry and infantry; a certain number of companies forming a battalion of infantry, or a ſquadron of cavalry. The denomination of regiment is appropriated to the cavalry and artillery, while a ſimilar body of infantry is called a half brigade. The commanding officer of a regiment is called colonel; but the commander of a large body of infantry is called chief of brigade. The names of lieutenant-colonel and major are changed for thoſe of chief of a battalion and chief of a ſquadron. Thoſe general officers which in other armies are called major-generals, are, in the French ſervice, denominated generals of brigade, and lieutenant-generals are there generals of diviſion.

* *Edin. Review,* vol. xiii. p. 455.

The corps of engineers has for its officers 8 inſpectors general, 34 directors, 124 captains of the firſt claſs, 117 captains of the ſecond claſs, 33 lieutenants of the firſt claſs, 21 of the ſecond claſs, and 20 pupils under the lieutenants. Attached to this corps are 6 companies of miners, commanded by a chief of battalion. Each company is officered by a captain-commandant, a ſecond captain, firſt and ſecond lieutenant. Twelve battalions of miners; each battalion, containing 8 companies, forming in all 1606 men, including officers. The battalion ſtaff is compoſed of a chief of battalion, an adjutant major, and an adjutant. Each company is officered by a captain, a lieutenant, and ſub-lieutenant.

To raiſe and recruit this great military force, the Freneh government has, ſince the year 1798, had recourſe to one of the moſt tyrannical meaſures which was ever adopted by a deſpotic monarchy, we mean that of *conſcription*, by which every man within a certain age, is made liable, under circumſtances of the greateſt rigour, to ſerve in the armies of the ſtate. This ſyſtem of conſcription is exceedingly complex; but we are enabled, from a reſpectable periodical publication, to preſent ſuch a ſummary of it as will be readily underſtood. France is divided into about 30 military governments, ſubject to a general of diviſion and his ſtaff, to which commiſſaries are attached as executive officers. The civil diviſion conſiſts of 122 departments; 24 of which have been aequired ſince the overthrow of the monarchy, exeluſive of Tuſcany, not included in any part of this ſtatement. The departments are divided into diſtricts or *arrondiſſements*, from three to five in number; the *arrondiſſements* into cantons, and the cantons into municipalities, amounting to about 55,000. Each department is governed by a prefect and his counceil, compoſed of a commiſſary of police, a mayor, and certain inſpectors, denominated *counſellors of prefecture;* the diſtrict or *arrondiſſement*, by a ſubprefect and his council, of a ſimilar formation. The cantons and municipalities are under the ſuperviſion of an adminiſtration, compoſed of the civil authorities, with a preſident at their head. A mayor, a commiſſary of police, and two officers of the government, ſtyled *adjuncts*, are allotted to each diviſion having a population above 5000 ſouls. Theſe ſeveral authorities are in ſtrict ſubordination to each other, and at the controul of the prefects and ſubprefects, who, themſelves, are charged with a weighty and inflexible reſponſibility as to the military levies.

Introduction.

By the code *de la conſcription*, all Frenchmen, between the ages of 20 and 25, are liable to ſerve. They are divided into five claſſes, from which the municipal adminiſtration draws up the liſts for the ballot. Theſe are tranſmitted to the prefects, by whom they are ſent to the war miniſter, and when properly adjuſted, the ſubprefect proceeds to the drawing of the quota impoſed on each diſtrict. The conſcripts drawn are formed into three diviſions, the firſt called *conſcripts for actual ſervice*, the ſecond the *reſerve*, and the third *ſupplementary conſcripts*. They are marched in companies of 100 men, to the places which are eſtabliſhed as depots, where they are furniſhed with their arms and clothes. After this they are trained and exerciſed, ſo as to be inured to unremitting labour and fatigue.

What gives peculiar energy to the French military ſyſtem, is the circumſtance that their officers riſe by merit and experienee, and not by intereſt. By a law of the directory, no perſon (with the exception of engineers) could become officers, who had not ſerved three years in a ſubordinate capacity. The revolution naturally opened the way to merit; and, ſeconded by this admirable policy, has filled all the poſts of their army with men, who unite in themſelves the qualities of the ſoldier, with the excellencies that qualify for command. It is not hazarding too much to aſſert, that nine-tenths of the preſent French officers have ſprung from the ranks. Educated in diſtant camps, they know no other country, and, habituated by long devotion to the trade of war, it has become their element and their paſſion. Their whole fortune is ſtaked on the ſword; and their attachment is therefore neceſſarily ſecured, under the

ſuſpicious

Introduction.

auſpicious influence of a leader, whoſe indefatigable ambition occupies them in their favourite purſuits, and whoſe *liberal impartiality* feeds the hope of preferment, and divides the fruits of conqueſt. To their credit and example is due much of that ſpirit, which, notwithſtanding the cauſes of alienation hitherto obſerved, ſeems to animate the whole frame of the army; and no ſmall ſhare of that portentous ſucceſs which has attended the courſe of the French arms. Of the eighteen *marechaux d'empire*, fourteen have either emerged from the ranks, or aſcended from the loweſt employments. Moſt of the generals of diviſion, and others who hold the principal commands, have the ſame origin, and ſufficiently prove, that war is an experimental ſcience, and that military renown is not the prerogative of birth, but the harveſt of toil, or the bounty of fortune *.

Ibid, p. 451.

12 The naval eſtabliſhment.

We have no certain means of aſcertaining the preſent naval eſtabliſhment of the French empire, though, as it may be ſaid to have the command of the navies of Holland, Ruſſia, and the remains of that of Denmark, it muſt ſtill be regarded as of no trifling ſtrength. The principal fleets are indeed kept blocked up by thoſe of Britain, in the harbours of Breſt, Rochefort, Toulon, the Scheldt, and the Texel; but the eſcape of any of theſe might be the means of conveying a conſiderable military force to the remaining colonies, or to the leſs powerful allies of France. In 1791, the French fleet conſiſted of 73 ſhips of the line, 67 frigates, 19 corvettes, and 67 ſmall craft, making a total of 226. Since that time, however, have taken place the great naval victories of Howe, St Vincent, Duncan, and Nelſon, by which the greater part of *that* navy has been carried into Britiſh ports.

13 Preſent military eſtabliſhment of Britain.

In eſtimating the military eſtabliſhment of Britain, we ſhall, for the ſake of more accurate compariſon, firſt take the ſame period of 1805. The Britiſh land forces then conſiſted of 21,223 cavalry, 124,878 infantry (including 20,747 men for limited ſervice, and 21,208 belonging to foreign and provincial corps in Britiſh pay), 89,809 militia, 8559 artillery, beſides about 430,000 volunteers, making a total of 674,469. To theſe muſt be added the royal artillery, the horſe brigade, the brigade of gunners and drivers, and companies of foreign artillery, amounting to 16,670, and the corps of artificers and labourers, including 704 men. Thus the whole military force of Britain, in 1805, amounted to 691,843 †.

Playfair's Geography, vol. ii.

Since the paſſing of Mr Windham's act, this number is ſomewhat diminiſhed, though our military force is now probably more effective. At the end of 1808 it ſtood as follows. Two regiments of life-guards, one regiment of royal horſe guards, 7 of dragoon guards, 25 of dragoons, 3 battalions of riflemen, 7 battalions of foot-guards, 5 of light infantry, 176 battalions of infantry, a corps of royal horſe artillery, a regiment of royal foot artillery, a corps of royal engineers, a brigade of artillery drivers, and a waggon train. The dragoons, independent of the royal life and horſe guards, amounted to 19,200; the battalions of riflemen and light infantry to 8000; the infantry of the line to 149,600; the king's German legion to about 20,000; excluſive of about 96,000 regular militia, 250,000 local militia, and about 50,000 volunteers; making an effective force of about 580,000 men.

Each regiment of not more than 500 men is officered by a colonel, a lieutenant-colonel, a major, 10 captains, 10 lieutenants, 8 enſigns, an adjutant, quartermaſter, paymaſter, a ſurgeon and aſſiſtant ſurgeon; a ſergeant-major, a quartermaſter-ſergeant, with 30 ordinary ſergeants, 30 corporals, a drum-major and 20 drummers. If the regiment amount to 750 men, it has uſually an addition of ſecond lieutenant-colonel, a ſecond major, 10 ſergeants, and 10 corporals.

The gradation of rank among the officers of the Britiſh army is as follows. Under the king, who commands the whole as *captain-general*, is the *commander in chief*, then follow the *field-marſhals*, *generals*, *lieutenant-generals*, *major-generals*, *brigadier-generals*, *colonels*, *lieutenant-colonels*, *majors*, *captains*, and *ſubalterns*. The different departments of the army are under the ſuperintendence of an *adjutant-general*, a *quartermaſter-general*, a *barrack-maſter-general*, a *commiſſary-general*, a *paymaſter-general*, a *board of ordnance*, and a *medical board*. See ADJUTANT, QUARTERMASTER, &c.

The army of the line is recruited by enliſtment; the recruits receive a bounty, and are engaged to ſerve for a limited period, or for life. The militia is filled up by ballot, in the ſeveral counties to which it belongs, and alſo receives recruits by enliſtment or by proxy. Hence the Britiſh ſoldier, while he conſiders himſelf as the ſervant of the king and the ſtate, juſtly boaſts of partaking in the general liberty of the ſubject. He is protected by fixed and definite laws, againſt the diſcretionary power of his commanding officer, and is encouraged to perform his duty by the liberality of his country; and not, as in France, compelled to it by the fear of puniſhment. His diſcipline indeed is ſtrict; but he feels none of that ſevere and tyrannical coercion which ſeems to be the firſt principle of motion in the armies of Napoleon.

14 Naval eſtabliſhment.

In its naval eſtabliſhment, Britain juſtly boaſts of being ſuperior to every nation in the world. The number of her fleets, and the courage and diſcipline of her ſeamen, have given her the unrivalled dominion of the ſeas, of which it would be difficult for the whole combined navy of Europe to deprive her. In 1809, the naval force of Britain conſiſted of 157 ſhips of the line, 19 from 50 to 44, 184 frigates, 181 ſloops, 308 brigs, making a *total* of 849 in commiſſion; beſides 56 of the line, 12 50's, 56 frigates, 44 ſloops, 24 brigs, *total* 192 in ordinary and refitting; and 50 ſhips of the line, 20 frigates, 20 ſloops, 10 brigs, *total* 100, building: making a grand *total* of 1141.

The progreſſive advance of our navy will appear by attending to the following recital of its tonnage at different periods, from the reign of Henry VIII. to the preſent time.

	Year.	Tons about
At the death of Henry VIII.	1547	12,400
Edward VI.	1553	11,000.
Mary,	1558	7000
Elizabeth,	1603	17,000
James I.	1625	19,000
Rebellion,	1641	22,400
At the death of Charles I.	1649	uncertain.
At the Reſtoration,	1660	57,460
At the death of Charles II.	1685	103,558
Abdication of James II.	1688	101,900

At

Introduction.

	Year.	Tons about
At the death of William III.	1702	159,000
Anne,	1714	167,170
George I.	1727	170,860
George II.	1760	321,200
31ſt December,	1788	413,660
	1806	776,000
	1809	800,000

It appears, however, that notwithſtanding the vaſt increaſe of our navy, not a ſingle dockyard has been added to it ſince the reign of William III. about 109 years ago, at which time the tonnage of the naval force of this kingdom amounted to nearly 160,000 tons; it is now nearly 800,900 tons, or about five times as large *.

* *Statement by Lord Melville.*

In ſketching the military character of the French and Britiſh armies at the commencement of the 19th century, we ſhall avail ourſelves of the obſervations of an anonymous, but able and apparently impartial publication, which appeared ſoon after the peace of Amiens, entitled *The Military Character of the European Armies at the Peace of Amiens.*

15 Military character of the French army.

The aſtoniſhing ſucceſs which has attended the French arms on the continent of Europe, is to be attributed partly to the regular organization and ſevere diſcipline eſtabliſhed by the *Code de la Conſcription*, but it is ſtill more to be aſcribed to the ſkill, experience, and activity of their officers. The French generals early diſcovered the advantages reſulting from diſpatch. The alertneſs of the ſoldiers, the lightneſs of their baggage, and their inattention to regularity in time of action, enabled them to execute their movements with a celerity which has frequently enſured ſucceſs. In an open country, lines could not be preſerved without difficulty. The French armies were therefore formed in columns. Brigade ſucceeded brigade, and when one diviſion was repulſed, and fell back on the columns in the rear, thoſe in their turn attacked the enemy, or ſuſtained his ſhock, and freſh troops perpetually came forward, to ſupply the place of thoſe which had been defeated.

The French battalions have no field-pieces attached to them; but this want is amply compenſated by their flying artillery, which is compoſed of the flower of the French ſoldiers, and by its boldneſs and rapidity of movement, ſupplies the place of that large train of artillery with which the other European armies are uſually burdened. It is a conſtant maxim in the French armies to have a body of reſerve, compoſed of their beſt troops, and under the command of an able general. If the main body ſhould be beaten, the reſerve covers their retreat, and on more than one occaſion it has ſnatched the victory from the hands of the enemy.

The French generals, like rich and bold gameſters, are inceſſantly tempting fortune. They look upon their loſſes as nothing, provided they ſucceed in the end. The little value at which they eſtimate their men, the certainty of being able to replace them, the perſonal ambition of their chief, and the cuſtomary ſuperiority of their numbers, afford them an advantage which cannot be counteracted but by great ſkill, conduct and activity.

Introduction.

16 Military character of the Britiſh army.

The ſoldiers of Britain are as intrepid by land as her ſailors by ſea. Their want of ſucceſs on the continent cannot be aſcribed to their want of bravery, but rather to the organization of the Britiſh armies, their inferiority of numbers, or the inexperience of the officers by whom they are commanded. Moſt of their commanding officers, inſtead of conforming to general regulations, follow their own particular plans and ideas, according to their ſeveral geniuſes, acquirements, and prejudices. In a nation, which from the ſpirit of its conſtitution and the habits of its people, is formed rather for naval than military operations, a miniſtry, however enlightened, ſcarcely poſſeſſes that authority which is neceſſary to give uniformity to the different departments of the army, to conſtitute a regular and correſponding whole, and to ſurmount thoſe obſtacles which are thrown in the way of all uniformity of military ſyſtem, by the diſtance and diſtribution of the troops. The ſmall numbers in which Britiſh troops are generally compelled to act on the continent, and their mixture with thoſe of other nations, to which they are ſometimes even ſubſervient, are circumſtances extremely diſadvantageous.

In a military life, good faith, honour, and courage, are the principal qualifications, and theſe are eminently conſpicuous in the Britiſh army. Their military ardour is greater than what is ſeen in any other ſervice, but this is in a great meaſure damped among the officers by the difficulty of promotion. Intereſt with miniſters, and the neceſſity of raiſing money to defray the expences of the different departments of the ſtate, though far from being the moſt equitable, are here unhappily among the firſt means of military promotion.

The ſoldiers of the Britiſh army are poſſeſſed of elements to enable them, under a commander of abilities and officers of experience, to be the beſt troops in the world. They require neither brandy nor ſelf-conceit to make them brave; their courage is innate; it is a national inſtinct. Their officers too uſually poſſeſs much greater information on general topics than thoſe of all other European nations, as education is more cultivated in Britain than elſewhere. They are attached to their profeſſion, and follow it rather from generous motives and military ſpirit, than like mercenaries from a view of intereſt and profit.

On the political and moral principles of war, ſee Cicero *De Officiis*, Grotius *De Jure Belli et Pacis*, Puffendorff's *Law of Nature and Nations*, and Machiavel's *Diſcorſi*; and on the principles of war conſidered as a *ſcience*, ſee a *memoir* by Maizeroy, in the 40th volume of *Hiſtoire de l'Academie des Inſcriptions et Belles Lettres*, and Folard's *Commentaries on Polybius*.

PART I. MILITARY TACTICS.

17 Nature and object of military tactics.

SOME writers on the military art diſtinguiſh *tactics* from what they call *ſtrategy*; underſtanding by the latter the ſcience of military movements when not in ſight of the enemy, or at leaſt out of the range of their ſhot; while they deſcribe the former to be the ſcience of military movements in ſight of an enemy, or within the range

Military Tactics.

range of cannon shot. We do not see the necessity of this distinction; and under the head of military tactics we shall consider whatever relates to military operations on land.

It is not possible for us, within the very scanty limits to which we are now reduced, to give any thing like a regular treatise on the military art. We shall therefore endeavour to select the most useful and interesting topics, and supply the place of disquisition by numerous plates with appropriate explanations.

The science of military tactics comprehends the disposition and arrangement of troops, whether on marches, in camps, or in line of battle; the attack and defence of posts; the construction and superintendence of the works by which they are to be defended; the conducting of sieges; and the defence of besieged places. These are the principal operations of a soldier, and these we shall briefly consider nearly in the order in which we have enumerated them,

To direct the march of an army is not one of the least difficult parts of a general's duty. To do this with ability, he must be well acquainted with the nature of the country through which his troops are to pass, with the obstacles which are likely to oppose them in their progress, and with the disposition of the inhabitants. Our business here is only with the first of these considerations. There are three descriptions of countries which may become the theatre of war; an open country intersected by rivers, a mountainous, and a woody country. The march of an army through the first, as far as respects the face of the country alone, is seldom difficult, except in the passage of rivers, which we shall consider by and bye; and the last description of country is now so uncommon in Europe, that we need not dwell on it. A mountainous country, however, presents numerous difficulties to call forth the abilities and experience of a commander, as in such a country, not only are the roads winding and difficult of access, but the unevenness of the ground, and the intervals between the hills, render it very easy for an enemy, with a small force, to oppose and distress a numerous army.

The plan in Plate DXLIV. is intended to illustrate the march of an army through a mountainous country. At A is shown the position of the army previous to its march, with the artillery and baggage P, drawn up under their proper escorts, in front of the camp. At B are parties of hussars constituting the advanced guard of the army on its march; and at C are parties of infantry forming the advanced guard of the columns in which the army is disposed. D represents the infantry forming the head of the columns; E the park of artillery and waggons attached to it; F, battalions of artillery, G the cavalry, H the baggage of the army, and I their escort. At K are parties of hussars, and at L parties of dragoons. M represents the infantry of the reserve forming the rear guard, and N plattoons of infantry sent forward upon the heights, to cover the flanks of the principal columns. At O are villages in front of the position where the army is to encamp, and which have been taken possession of by the light infantry.

The number of columns into which the marching army is to be divided, will depend on the number of roads or accessible approaches that lead to the position which it is to take up. In the present case there are only two principal roads, each leading across the river, and winding through the valleys to the principal heights, so that the army must march in two divisions. The usual disposition of the columns is as follows. Four or five brigades of infantry, according to the number which composes the army, should be placed at the head of each column; the same partition should be made with regard to the artillery, which must follow the infantry; the cavalry must march next, and the baggage of each column, well escorted by infantry, must follow the cavalry, then the rest of the corps of light horse which are not detached; and the dragoons are placed the last, in order to dismount, and sustain the rear-guard in case it shall be attacked.

Of the passage of rivers.

An army seldom proceeds far without encountering a river in its march, and as it commonly happens in a country which has become the seat of war, that the bridges are destroyed or rendered impassable, the army must cross the river, either by swimming, at some ford, or by temporary bridges thrown over for the purpose. It is most advantageous to cross a river at some part where the stream is divided by small islands, unless the river be so shallow that it may be easily forded. If it be necessary to construct a bridge, this is best done by means of boats or pontoons, and all the necessary apparatus should be ready at the place of crossing at an appointed hour, and every measure should be taken to avoid confusion, and to be prepared for the enemy, who will probably dispute the passage. The two heads of the bridge when constructed should be entrenched, and well furnished with troops, and, if possible, the islands in the neighbourhood should be fortified by proper works, to prevent the enemy from destroying the bridge, or incommoding the labourers employed in its construction.

If the river be narrow, it is best to cross at some place where it makes an angle, especially if, as commonly happens, one of its banks be higher than the opposite bank, so that the higher ground may be defended by a battery. If the river be fordable by infantry, care should be taken beforehand to clear the bed at the ford, and render the banks easy of access.

Plate DXLV. fig. 2.

The lower figure of Plate DXLV. illustrates the passage of a river. AAA represent bridges of boats; B, redoubts by which the bridges are protected; C, a battery, under cover of which the infantry work at the construction of the redoubts; D, a battery, to prevent the enemy from annoying the army on its march; E, the march of the army; F, the artillery distributed among the brigades of infantry; G, infantry forming in columns to open on the opposite side through the intervals of the redoubts; H, march of the columns in the front of the redoubts, where they halt to give time for a part of the cavalry to form upon its flanks; I, a battery erected to facilitate the forming of the cavalry; K, cavalry, which, in gaining the opposite shore, forms in order of battle, and posts itself upon the flanks of the infantry; L, eight battalions in column upon the right wing of the army, to go and examine the village, and attack the enemy in it, in case he should be possessed of it; M, hussars and dragoons, who have taken possession of the height which is on the left wing of the army; N, a brigade of infantry posted next the height, covering the left wing of the cavalry; O, the disposition of the army marching up to the enemy.

It is in general a very difficult task to defend the pas-

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Military Tactics.

sage of a river againſt an army that is determined on croſſing it. Indeed, if the river be of ſuch a nature as to preſent ſeveral points by which an enemy can croſs, and if the defending army be not of ſuch ſtrength as to meet their opponents in the field, ſuch a defence will be almoſt impracticable. Where it can be attempted, however, and where ſufficient notice can be procured of the enemy's approach, all the boats and barks found on the river ſhould be removed or deſtroyed, to prevent the enemy from uſing them in conſtructing his bridges. Both banks of the river ſhould be carefully reconnoitred, that the fords and other acceſſible points of paſſage may be ſufficiently obſtructed; and the ground which might protect the enemy's paſſage, ſhould in particular be attended to. Roads ſufficiently wide to admit of many columns, ſhould be made along the ſide of the river to be defended, that a great number of troops may be advantageouſly diſpoſed. It muſt be confeſſed, however, that if the acceſſible points extend along a conſiderable tract of country, and if the bank of the river next the enemy overhang that on the oppoſite ſide, a defence will be nearly impoſſible.

21 To defend the paſſage of a river.

Fig. 1. The upper figure of Plate DXLV. ſhews the manner of diſpoſing the troops to defend the paſſage of the river. A, the march of the main army in three parts to defend the river; B, the camp of the light horſe, infantry, and dragoons, on the wings of the army; C, caſtle and village, guarded by light infantry; D, a town occupied by the infantry belonging to the army; E, bridge broken down; F, iſlands occupied by infantry; G, poſts of infantry diſtributed along the ſide of the river; H, batteries eſtabliſhed along the ſide of the river; I, poſts of cavalry, to keep the communication between the camps; K, bridges conſtructed to preſerve the communication of the iſlands; L, bridges for the communication of the camps.

22 Baſis of modern military operations.

Modern warfare is diſtinguiſhed from that of the ancients, not more with reſpect to the arms which it employs, than the multitude of ſtores, ammunition, and proviſions neceſſary for a campaign. The number of horſes now employed for drawing the artillery, and the ammunition waggons, as well as to mount the great increaſe of cavalry, conſiderably adds to the quantity of military ſtores required by the troops. This has produced the neceſſity for magazines, eſtabliſhed in ſuch number, and at ſuch diſtances from each other, as may moſt expedite the operations of the campaign; and theſe magazines require not only to be fortified themſelves, but to be ſtrengthened by forts or redoubts in their vicinity. To theſe magazines modern writers on the art of war have appropriated the term of *baſis of military operations*, and the roads by which an army receives its ſubſiſtence from the magazines, are called *lines of operation*. The ſituation of the principal magazine, and the length and direction of the lines of operation, are conſidered as of the higheſt importance. With reſpect to the firſt and ſecond of theſe, we muſt refer to Templehoff's Hiſtory of the Seven Years War, where the queſtion is conſidered with great minuteneſs and ſcientific accuracy. The direction of a line of operations may be illuſtrated by the firſt ſeven figures of Plate DXLVI.

Plate DXLVI. fig. 1. Fig. 1. repreſents a line of operation forming the ſegment of a circle, having a line of poſts ACB towards the enemy's country, and two principal fortreſſes DE within the ſegment. As this circular ſegment is ſuppoſed to ſurround a part of the enemy's territory, and is ſtrengthened by the two fortreſſes AB, at the extremities of the baſis, it is eſteemed the moſt advantageous form. On the other hand, if the ſegment had its circumference directed towards the enemy, as in fig. 2. it would form the worſt poſſible direction for a baſis; for here the fortreſſes CD, placed in the circumference, are very much expoſed, and might be eaſily taken by detachments from the columns E and F. The only way of preventing this would be to detach troops from A and B laterally, to incommode the columns E and F, and to take up a ſtrong poſition either at *g* or *h*. The more the ſegment approaches to the elliptical form, as in fig. 3. it is the leſs ſuſceptible of defence, as is evident from the relative poſition of the three fortreſſes A, C, and B.

Fig. 2. Fig. 3.

The line of operation repreſented by fig. 4. conſiſting of ſalient and obtuſe angles, ſuch as A *c* B, B *d* G, conſtitutes an excellent form, as it reſembles the outworks of a fortreſs, and it is as impracticable for an enemy to enter into the interior of this baſis, as to carry a curtain between two flanks. The two fortreſſes *c d* are not nearly ſo much expoſed as C in fig. 3. as if one of them were attacked, it would be eaſy to make a diverſion from the other into the enemy's country. If the points which terminate the baſis advance as in fig. 5. it will be a favourable circumſtance, eſpecially if the moſt advanced poſt were bounded by the ſea, or by a large river.

Fig. 4. Fig. 5.

The baſis which we have been conſidering conſiſts of curved or angular lines. Now, let us ſuppoſe two baſes, the one A *h* B, fig. 6. forming merely a ſtraight line, while the other *c e g d f*, has two of its lines *e c* and *d f* advanced towards the enemy. This latter is the more advantageous, as it expoſes ſo much more of the enemy's country. In general, it is a good rule to conſtruct fortreſſes oppoſite to thoſe of the enemy, as here the fortreſs *g*, if moderately ſtrong, is capable of protecting the whole line from *e* to *d*, againſt the three oppoſite forts A *h* B. It is a great fault for any part of a baſis to recede, as *d c* from the line of the enemy AB, fig. 7. ſo as to form an angle with it, as here all the country between A and *c* is expoſed to the hoſtile attacks of A and B; but, if the line were parallel to that of the enemy, as *d e*, it would be a good poſition.

Fig. 6. Fig. 7.

23 Eſtabliſhment of camps.

Next to the eſtabliſhing of magazines, and providing for their ſecurity, and that of the lines by which they are connected, it is of the higheſt importance for a general when he takes the field, to ſelect the proper poſitions where he may encamp his army, ſo as to be readily defended againſt the attacks of a ſuperior enemy, and have an eaſy communication with his own poſts. In ſelecting ſuch a ſituation he muſt be guided partly by the nature of the country, and partly by the ſituation of the enemy; but if poſſible, he ſhould chooſe a poſition which is rather elevated, and which may be protected on the flanks or rear, either by the natural ſituation of the ground, or by works thrown up for that purpoſe. It ſhould not be too near the bank of a river, though it may be of advantage to have ſuch an object in front. The encampment of an army in ſuch a ſituation is pointed out by Plate DXLVII.; where A is the camp of the main body of the army; B, an advanced camp, compoſed of dragoons and huſſars, in order to cover the right of the army, to guard the paſſes by which the enemy might make incurſions upon the flanks and rear of the army, moleſt the convoys, and cut off the communications

Plate DXLVII.

Military Tactics.

nications; C, villages and bridges, guarded by the light infantry; D, posts of dismounted dragoons in the front of their camp; E, posts of dragoons on horseback, to secure the communication between their camp and that of the main body of the army; F, bridges built to keep up the communication between the grand and the advanced camp; G, bridges and villages guarded by detachments of infantry; H, grand guards of horse; I, guards of infantry; K, bridge, village, and mill, guarded by the infantry belonging to the army; L, camp of dragoons and hussars, covering the left of the army, and supporting the light infantry; M, villages and bridges guarded by the light infantry; N, posts of dismounted dragoons in the front and on the flanks of their camp; O, posts of dragoons on horseback; P, posts and detachments of hussars, to patrole in front and on the flanks of the army and their camp.

Intrenched camp

It often becomes necessary, either from an inferiority of numbers, or from the nature of the ground, to intrench or fortify a camp. In general this is done by digging deep ditches round the most defenceless part; driving pallisades in front of this ditch; forming an embankment of felled trees, with their unlopped branches pointing towards the enemy; or, where there is time for such an operation, and where the proper materials can be obtained, constructing redoubts or regular outworks, capable of being defended by artillery.

Plate DXLVIII.

Plate DXLVIII. represents a camp intrenched in an open country, without any peculiar advantages of defence. A, the main body of the army encamped behind its intrenchments; B, the camp of the troops of reserve; C, camp of the dragoons, to secure the rear of the army; D, camp of hussars, to cover the ground on the right of the army; E, villages and redoubts guarded by the light infantry, to secure the camp of the hussars; F, bridges built to secure the communication of the army with the ground on the right, and to favour the retreat of the troops posted on the opposite side; G, brigades of artillery distributed on the flanks, and along the whole front of the army; H, the park of artillery; I, a bridge intrenched, to secure the communication between the army and the ground on the left; K, villages and farm houses, guarded by detachments of hussars and light infantry, to patrole in front of the army.

Plate DXLIX. Fig. 1.

In Plate DXLIX. are shown other methods of intrenching a camp in the neighbourhood of a town or village, and in situations where the camp can be protected by inundations. Fig. 1. represents an intrenched camp in the neighbourhood of a town. A, a deep marshy valley, with an unfordable rivulet across it. B, a redoubt constructed on a mountain, by which the right wing is *appuyed*. C, a small wood in front of the mountain. D, a line which connects two fleches together at the foot of the mountain, where the village of Weilheim is situated. E, a rivulet, over which are thrown bridges of communication, to facilitate an intercourse between the camp and the redoubt on the hill. F, an eminence with a gentle declivity, at the foot of which is the village of Mansfeld, surrounded by defiles and hollow roads. G, defiles and hollow roads. H, lines which run along the circumference of the heights about Weilheim, forming a retrenchment. I, close works. L, a redoubt which masks the entrance into Stemmern. M, a small wood, cut down in order to have a full view in front of Stemmern. N, a thick wood which covers some high mountains by which the left wing is supported. O, an abattis which is made across the wood for greater security. P, infantry pickets. Q, a redoubt on a small eminence, constructed for the purpose of covering the opening behind the left wing of the camp. R, a line of communication from the last redoubt to the left of the intrenchment. S, several passages 30 feet broad and closed in by chevaux-de-frize, to afford an opportunity for the cavalry to advance, should the enemy be foiled in his attack against any part of the works. T, the infantry and cavalry encamped behind the retrenchments; the infantry in the first line, and the cavalry in the second. U, X, Y, Z, four roads behind the camp to facilitate the retreat of the army, should it be pressed.

Military Tactics.

Fig. 2, 3.

Fig. 2. and 3. represent an intrenched camp with inundations in front. Fig. 1. *a b*, two dykes 40 paces long, 5 broad, and as many high. CD two rows of stakes from 4 to 5 inches thick. E, the coffin formed by means of stakes filled up. It is 8 feet broad. F, the adjacent country, inundated by the rivulet being forced out of its current by the last dyke and by *a* and *b*. G and H, the outlets which the rivulet seeks, to continue its course. I, small creeks or ends of ditches dug about the ground. Fig. 3. represents the current of a rivulet, with a dyke to occasion inundations. Camp, with the several dykes in front, which are calculated to produce inundations. The spaces between these dykes are called coffins, viz. 1, 2, 3, 4, 5.

25 Construction of redoubts.

We have mentioned the works by which field posts are fortified, and which are usually called *redoubts*. As the construction of redoubts is generally a work of the moment, and falls within the province of the commanding officer of a detachment, it is proper that we should here describe the most useful and expeditious methods of raising such works. These methods are illustrated by the plans in the upper part of Plate DL.

Plate DL.

Fig. 1.

Fig. 1. shows the plan of the ordinary square redoubt which is constructed in the following manner: When a proper spot has been chosen, a line *a* AE is drawn of a sufficient length, and at one extremity *a* is drawn *a* C perpendicular to it. Then from *a* towards C and E are set off the dimensions proposed for each side of the parapet within the fort, allowing 2 or $2\frac{1}{2}$ fathoms for 30 men, 4 fathoms for 50, and so in proportion for a greater number. These lines being ascertained, a picket is placed at C, with a cord attached to it, and with the length *a* C is described an arch, and from the point E, with the same distance, another arch is described, intersecting the former in F. Then joining EF and CF, the square forming the inner parapet is completed. Within this square, at the distance of 2 or 3 feet, is described another square, I, L, M, N, having its sides parallel to those of the former. This marks the breadth of the banquette, where the men are to be drawn up. Again, on the outside of the first square at about 8 or 9 feet distance is drawn a third square O, P, Q, R, determining the outer side and thickness of the parapet. This thickness is only calculated to resist musket balls; as, if it is to stand against cannon, it should be at least 18 feet. Lastly, at rather a greater distance from this third square is drawn a fourth S, T, V, X, marking the breadth of a ditch that is to surround the redoubt.

Military Tactics.

The lines being finiſhed, *faſcines* or faggots of bruſh-wood are to be laid between the two innermoſt ſquares, as a foundation to ſupport the earth of the banquette; a ſecond range is laid on the lines AB, GH, to ſupport the inſide of the parapet, and a third on the ſquare O, P, Q, R, to ſtrengthen the outſide of the parapet, leaving a ſpace through all the *faſcines* to the ditch, on the ſide leaſt expoſed to the enemy, as at B, for an entrance. It is ſometimes convenient to make this entrance take a winding direction, as is ſhown at T, fig. 2.

Fig. 2.

Fig. 3.

Fig. 3. exhibits a ſection of theſe works, where AB is the breadth of the ditch at the top; MN its breadth at the bottom; FN its ſlope, on a line with the outſide of the parapet, called the *ſcarp*, and GM its ſlope towards the open country, called the *counterſcarp*. AL and ID repreſent the *faſcines* forming the outer and inner ſlopes of the parapet, the interval between them being filled with earth trodden down hard. At E is the banquette. DC is the thickneſs of the parapet below, and IL its thickneſs above, which forms a ſlope for the more convenient firing of muſketry.

In this ſquare redoubt it is evident that the men muſt fire ſtraight forward in lines perpendicular to the ſides

Fig. 4.

of the ſquares, as in fig. 4. As it is often of great conſequence that the directions of firing ſhould croſs each other, the better to flank the enemy, the banquette

Fig. 5.

is ſometimes formed with angles, as in fig. 5. ſo that the men may ſtand two together in little *redans*. As, however, ſuch a conſtruction takes up too much time and labour for ordinary occaſions, M. Le Cointe prefers a

Fig. 6.

circular redoubt, ſuch as is repreſented at fig. 6. where the men may fire from every part of the circumference. The conſtruction of ſuch a redoubt is extremely ſimple, and differs only in its firſt ſtep, viz. deſcribing the concentric circles, which is done with a cord faſtened at one end by a picket at a central point C.

The ſtrength of the redoubt will be much increaſed, if the ditch can be filled with water, as by turning into it the ſtream of a rivulet. See Q, fig. 7. If the ground be uneven, ſo that the water will not run equally into every part of the ditch, dams muſt be raiſed, as C, to keep up the water in the higher parts, whence it may run to the lower, after the former are full.

Fig. 7.

Fig. 7. repreſents a plan of the ſquare redoubt, with a wet ditch, when completed. A, the inner ground of the redoubt; B, the bottom of the ditch; CDE, the dam of earth; F a dam of boards, planks or faſcines; G the upper part of the redoubt, made with faſcines or with earth thrown out of the ditch; H, the lower part of the redoubt cut into the earth; I, the berme or ſpace left at the outer bottom of the parapet, to keep up the earth; L, the entrance of the redoubt; M, the inſide of the parapet; N, the outſide of the parapet; O, the banquette; P, the glacis; Q, the river introduced to fill the ditch with water.

26

Of detachments ſent to attack or defend a poſt.

The attack and defence of poſts are among the moſt important departments of what the French call *la petite-guerre*, and in a country where fortified towns are rare, conſtitute a conſiderable part of field operations. We ſhall conſider them rather more at large than we have the preceding parts of military tactics.

When an officer is detached either to attack or to guard a poſt, he ſhould provide himſelf with a cord regularly divided, for the purpoſe of deſcribing lines, and raiſing temporary works, and ſhould procure a ſkilful and confidential guide, from whom he may derive the requiſite information reſpecting the nature of the country, and the breadth and goodneſs of the roads. He ſhould diſpoſe his party in ſuch a manner that an advanced guard of cavalry, as A, fig. 8. Plate DL, ſhould

Fig. 8

ſet out firſt, preceded by a ſmall detachment of about ſix horſemen, headed by a corporal, as B, C, C; two horſemen in the middle, and two on each ſide. While the main body is moving along the principal road, as from H to F, a detachment of about 8 or 12 horſemen, according to the ſtrength of the corps, ſhould be ſent about 50 paces on each ſide, by way of wings, as DD; and from each of theſe wings 2 men ſhould keep 50 paces farther out, as at EE, by which means the country will be properly examined, and ſurpriſes from the enemy prevented. On coming near a wood, as at NN, the cavalry ſhould ſpread, the better to ſcour the outſkirts and the wood itſelf. When the corps is numerous, the cavalry ſhould be formed into ſquadrons, as G, G, G, and the infantry into platoons, as F, F, F, marching alternately along the road.

If, on the march, the advanced guard come to a croſs road, or the entrance of a hollow way, as at I, I, where it is likely they may be met by a party of the enemy, they ſhould immediately prepare for an attack; and if the commander of the main body obſerve his advanced guard in action, he ſhould immediately draw off his platoons of infantry, and form them on the ſide of the road, as at L, L, L, or on ſome neighbouring height, as at M, M, that they may be out of the way of the enemy's cavalry, and ready to engage if occaſion ſhould require it.

On the march the party ſhould carefully avoid villages, and rather halt or refreſh his men in a wood, or ſome other concealed ſpot.

2

On reconnoitring.

The commander of a detached party muſt take the ſafeſt and moſt effectual methods to reconnoitre the country through which he is to paſs, without being obſerved or ſuſpected by the enemy. The method of doing this recommended by M. Jeney will frequently ſucceed, and is as follows: He ſuppoſes himſelf with his party at Soeſt in Weſtphalia A (fig. 2. Plate DLI), and the enemy poſted at Bervick B, two leagues from him. To know the ſituation of this place without ſtiring from Soeſt, he takes the map of the country; and from Soeſt as the centre, he draws a circle, whoſe circumference paſſes half a league beyond Bervick. He draws a circle of the ſame ſize upon a leaf of paper, to make his plan, as in fig. 2. and then places Soeſt in the centre A, and marks all the villages which he finds in the map near the circumference upon his plan, with the diſtances and bearings as they are repreſented in the map, making uſe of a pencil to mark the places DDD, ſo as to correct the errors more eaſily which the map may have led him to make.

Pl. DI fig.

Having thus formed his plan, with a ſcale of two leagues, he goes to the burgomaſter of the town of Soeſt, where he cauſes ſome of the moſt intelligent inhabitants to come, and ſpeaking to them freely and openly, induces them to communicate all the information for which he has occaſion.

The better to conceal his deſigns, he begins his reconnoitring by Brockhuſen, a village diſtant from the enemy. He aſks the diſtance from Soeſt to Brockhuſen;

Military Tactics.

sen; if they say it is a league and three-fourths, he corrects the distance of his plan, which made it two leagues; then he informs himself of all that is to be found on the road from Soest to Brockhusen, chapels, houses, woods, fields, orchards, rivers, rivulets, bridges, mills, &c. If they say that a league from Soest they pass the village of Kinderking, he marks that place upon his plan. He asks if the road from Soest to Kinderking be crossed by any other road; if there be any morass or heath; if the road be inclosed, paved, or straight; if there be any bridges to pass, and at what distance. He takes care to mark every thing on his plan, forgetting nothing, even to mills, bushes, gibbets, gullies, fords, and every thing that can be got from their information; which will probably be perfect, because one always knows more than another. He continues his questions from Kinderking to Brockhusen, and advancing by little and little, observes the same method on the roads of the other villages round, marked DDD. In this manner he cannot fail to acquire an entire knowledge of all the places; besides, he finds himself imperceptibly instructed in the position of the enemy, by seeing the different routes by which he can approach with the greatest security.

Attack of posts.

For the attack of an enemy's post, such men should be selected as are brave, cool, and experienced; or if the affair require a considerable number, the detachment should be divided into platoons, some composed of picked men for the real attack, and others of ordinary soldiers for feints. The men should be provided, besides their arms, with such instruments as may be necessary for pulling down or scaling the enemy's works, such as shovels and pickaxes for fascine parapets; hatchets for pallisadoes or chevaux de frize, and scaling ladders for stone or brick work. Having made the proper dispositon for his attack, and procured the necessary guides, the commander of the detachment should set out in the night, so as to be at the place of attack two or three hours before daybreak, taking care to march with as little noise or parade as possible.

If the post to be attacked be an ordinary redoubt, such as we have described in N° 25. on hearing the signal previously agreed on, all the divisions are to rise at once from the place where they should have lain concealed; the first ranks should leap into the ditch, and soon after the second should follow, and both together assist in undermining the angles of the scarp, or cutting away the stakes which may impede their progress. If the parapet be faced with stone or brick work, care should be taken that the ladders be not too short, and great expedition should be used in mounting them, and especially in following the leading men in the assault, if they should be knocked down by the fire of the enemy.

Should the ditch be filled with water, and too deep to be waded, it may be crossed on temporary bridges made of planks, supported on empty casks, or the ditch may be filled up with casks full of earth. If, as often happens, the ground be obstructed with caltrops, these must be swept away by dragging trees with their leaves and branches over the ground (A).

In attacking posts of considerable magnitude, such as villages, it is best to divide the attack, and to make a feint on those parts which seem best defended, while the true attacks are reserved for those situations which seem most difficult of access, and where consequently, the enemy is least upon his guard. As soon as part of the village has been carried, some divisions of the detachment should hasten to strengthen their position, by possessing themselves of some church, or high ground, from which they annoy the enemy.

25 Defence of posts.

When a post is once occupied, if it be thought of sufficient consequence to retain it, the best methods should immediately be taken to protect it against an attack of the enemy. The infantry to remain under arms in the middle of the place, the cavalry to patrole without, while the commanding officer, escorted by a dozen horsemen, goes to examine the environs to make his arrangements; having sent several small detachments before, to cover him in time of reconnoitring.

Having remarked the places proper for his guard, defence, and retreat, as well as the dangerous ones by which the enemy can make approaches secretly to surprise him, he should choose the most convenient in the front of his post to fix his grand guard D, (fig. 1. Plate DLI.), which must face the enemy. He must mark the heights for this guard to place their vedettes EEEE, and regulate the number according to the exigencies of the situation. In a covered country you must not be sparing of them, and must reinforce every guard. At 50 paces from the front of the grand guard a non-commissioned officer with eight horsemen should be always ready to set out at K, to go and reconnoitre, when the vedettes have observed any party. Plate DLI. fig. 1.

If the post to be defended be merely a redoubt, it will be proper to keep in readiness a number of trees cut down with their branches, to stop up any breaches made by the enemy's shot. The men employed in the defence should stand in three ranks, the front and centre ranks with fixed bayonets, and the third rank provided with long pikes, so as to project as far as the bayonets of the front rank. On the enemy's approach, the men should reserve their fire till the enemy come up to the glacis, and the rear rank should be furnished with hand grenades, or lighted faggots, to throw among the enemy, when they attempt to scale the parapet.

In the defence of a village or small town, guards should be posted at the entrance of the principal streets; trenches should be cut across the streets, and cannon planted behind them, while a detachment of cavalry should occupy the market-place, or broadest street, to attack the enemy, if they force an entrance. If the advanced guards are driven in, they should retire with coolness and deliberation, defending their posts from house to house, till proper support can be given them from the body of the detachment.

If there be any dangerous place capable of covering the approaches of the enemy in the environs of the post,

(A) The principal engines employed in the attack of posts, are represented in Plate DLV. to which we shall presently refer.

Military Tactics.

and out of the circuit of the patroles, there ſhould be a guard placed there, more or leſs ſtrong according to the importance of the place, and care ſhould be taken to preſerve the communication. The guards and picquets being placed, the detachment that was ſent out on the roads muſt be called in, and then go to work to lodge the party in the gardens that open upon the country, and the commanding officer's quarters; beating down hedges, filling up ditches, and levelling a piece of ground large enough to draw up the whole corps. The horſes to be put under cover in barns contiguous to the gardens; but in caſe there are no barns, they may ſubſtitute ſheds open on one ſide, that the horſes may go out together in caſe of an alarm. The officers ſhould occupy the houſes in the neighbourhood of the ſheds, and one of each company remain day and night with the company, to prevent any of the men from entering the village without leave, upon any pretence. The commanding officer muſt acquaint the officers of his having choſen the place M for the rendezvous in caſe of a retreat; which ought to be at ſome diſtance from the village, and on the ſide he judges moſt convenient for retiring to the army. At ſunſet the grand guard are to return to the poſt and join the picquet, the half of each to mount alternately till daybreak, and then the grand guard to return to the place which they poſſeſſed the day before. The ſentries and vedettes ſhould be doubled, and all the paſſages ſhut up with waggons placed in two rows, except one for ſallying out at in caſe of a retreat, made wide enough for the paſſage of the patroles or the whole cavalry.

The corporals of the ordinary guard ſhould lead the relief of the vedettes every hour, ſetting off together; but when they come to the paſſage of the poſt A, they muſt ſeparate into two parties, the one to the right to relieve the vedettes BBB, the other to the left for the vedettes CCC; then each of them, with the parties they have relieved, ſhould go on at their head a quarter of a league by the two routes pointed out in the plan, to examine the environs, ſuppoſing an hour to each. Beſides this reconnoitring, the captain of the grand guard ſhould ſend two patroles in the night. To fill up the intervals, they ſhould ſet one about half an hour after the corporals, and make the ſame round.

30 Mode of fortifying villages.

In defenſive operations in an open country, the fortifying of a village or a church-yard may often prove of importance, as ſuch poſts well defended may obſtruct the movements of the enemy, and give time for a ſufficient force to collect to meet them in the field. We ſhall therefore deſcribe the moſt approved mode of ſtrengthening theſe poſitions.

When it is propoſed to fortify a village, inquiry ſhould firſt be made reſpecting the ſurrounding country, whether there are woods, hills, or rivers near the village, whether the roads be acceſſible, whether proviſions can be eaſily obtained, &c. If the village is to be occupied as a poſt of defence merely, the woods, rivers, ravines, or heights, may afford advantageous outpoſts or ſituations for batteries or ambuſcades; but if it is to be poſſeſſed as an advanced poſt on the eve of a battle, the woods next the army ſhould be cut down, the hollows filled up, and every thing removed which may obſtruct the freeſt communication between the village and the main army; while on the ſide of the enemy, every obſtruction by works, trees, &c. ſhould be thrown in the way of his approach. The roads ſhould be broken up or interſected with deep ditches.

Military Tactic

If there be good hedges or deep roads parallel to the village, or in ſuch a ſituation as to front the enemy, theſe will ſerve as breaſtworks, and for ſhelter. The hedges ſhould be cut down to within four feet of the bottom, their tops ſloping towards the country, and deep ditches ſhould be dug in front. If the roads are deep, *banquettes* or *ſteps* muſt be thrown up next the hedge to raiſe the men to the proper height for firing. For want of ſuch natural means of defence, it will be neceſſary to throw up intrenchments on the ſide next the enemy and on the flanks.

Plate DLII. fig. 1

Fig. 1. Plate DLII. will explain the method of doing this in a village, under ordinary circumſtances. The village ſtands in a plain, and in front of the army, which is diſtant from it about 600 paces, *a*. The front of the intrenchment conſiſts of three fleeches or arrows, *b*, *c*, *d*, joined together by lines. There are wolf-holes before the works that cover the left flank *e*: the line *g*, which croſſes ſome ſwampy grounds, is broken in ſeveral places *i*; and the grove of wood *l*, is cut down, to prevent the enemy from approaching under cover of it. As the right flank, conſiſting of a level plain, is more expoſed than any other quarter, in addition to the works made of earth, which are thrown up at *m*, trees are collected, and heaped up in the form of an abattis, *n*. Theſe are defended by a diſcharge of muſquetry from the intrenchments, whoſe lines are raiſed as high as poſſible behind the growing hedges *o*, which incloſe the gardens. It has however been judged neceſſary to throw the works up in a forward poſition *p*, and to have an interval between them and the hedges, leſt the houſes ſhould be ſet on fire by the enemy, and the troops be expoſed to it. Every thing is left clear and open at the back of the village, in order to ſecure a free intercourſe with head-quarters.

Other meaſures, however, muſt be adopted in the fortifying of villages which lie at ſo great a diſtance from the camp, that the enemy might ſurpriſe and take poſſeſſion of them before any ſuccours could be ſent; for in that caſe, intrenchments muſt be thrown up throughout the whole of their circumference. If, on the contrary, one of the wings of the army ſhould be ſupported by ſuch a poſt, it would be more judicious to put the flank in a ſtate of defence, and to lengthen the works in that quarter, to prevent the enemy from turning it.

If it ſhould be judged expedient, under the circumſtances of the army being cantoned, to fortify a village which lies in a plain, other means muſt be uſed; for in that caſe there would not be troops enough to defend it. Should there be a ſufficiency of men, intrenchments muſt be thrown up in the manner we have deſcribed, and fleeches muſt be adopted to cover them behind, with lines to connect the vacant intervals; but if there be a ſcarcity of ſoldiers, nothing but what is abſolutely neceſſary muſt be done; for it is highly impolitic to attempt more than can be eaſily defended. Under theſe circumſtances you muſt be ſatisfied with erecting ſmall works, or uſing barricadoes to maſk the entrances; here and there likewiſe fleeches muſt be conſtructed, whoſe communication will be kept up by the garden hedges. If the village ſhould ſtand on an eminence, it

Military Tactics.

may be fortified with more facility, and many things may be omitted, as the natural ſituation is itſelf a reſpectable poſt.

Should there be a very great diſproportion between the extent of the village, and the number of men intended for its defence, and the latter ſhould be too ſmall, a part only muſt be fortified, and the remainder of the houſes muſt be ſecured by lines. Sometimes indeed it is found neceſſary to burn or deſtroy them, to prevent the enemy from approaching the fortified parts, under cover of the buildings.

But if the garriſon ſhould not be ſufficiently ſtrong even to defend a part of the village, you muſt be contented with fortifying the church and church-yard, or the caſtle if there be one. If any of theſe poſts be thought defenſible, troops muſt occupy them on the firſt alarm; but this muſt be done in perfect ſafety, and without the ſoldiers being expoſed to be cut off on their march. This precaution is above all others neceſſary where villages are ſo long and open that the cavalry may enter them at every opening. On this account the ordinary roads and avenues muſt not only be obſtructed, but the garden hedges muſt be repaired, and every opening muſt be cloſed, which may be eaſily done by driving ſtakes into the earth, and nailing boards acroſs them, which will prevent any ſudden irruption of the cavalry, from which alone any danger is to be apprehended on occaſions of this ſort; for the infantry would ſcarcely advance, except by ſurpriſe, before the garriſon could occupy its ſtation. If any apprehenſions are formed of an attack, the ſoldiers muſt not be abſent from their poſt, either in the duſk of the evening, or at night; they muſt, on the contrary, be aſſembled in the intrenchments during that period, to be ready in the neighbouring houſes, always clothed and accoutred.

31 Method of fortifying a church.

A church and church-yard afford an admirable poſt of defence, eſpecially if, as uſually happens, they are ſeated on an elevation. In fortifying ſuch a poſt, we ſhould firſt block up every road and bye way leading to it, by means of waggons or carts, with their wheels taken off and loaded with dung or earth; trees laid acroſs, or chevaux de frize. The narrow paths may be barricadoed with rails, with their points ſtanding upwards, and a little outwards, having behind them thick branches of trees, or logs of wood, with a ditch in front. Theſe previous precautions being taken, the doors of the church ſhould be pierced in ſeveral places, about eight feet from the bottom, with holes large enough to admit the muzzle of the muſquet, and platforms ſhould be raiſed with ſteps within for the men to fire from. Other loop holes ſhould be made at the bottom of the doors, juſt above the level of the ground, and a ditch muſt be dug within, about three feet deep, ſo as to admit of men firing from thence through theſe lower loop-holes. See fig. 2. The doors muſt alſo be ſecured by barricadoes, conſiſting of palliſades driven ſeveral feet into the ground, and ſet extremely thick, ſome being deeper than others, ſo as to leave ſpaces between them and the top for loop-holes. See *a*, *a*, fig. 3. This barricado is technically called *tambour*. The walls of the church muſt alſo be pierced in various places as directed for the doors, ſee fig. 3. and ditches muſt be dug within them, and ſcaffolding erected as before.

Again, on the outſide of the church, a ditch is to be dug as cloſe to the walls as is conſiſtent with ſafety to the foundation, about 12 feet in breadth at the top, and four in depth; and from the further ſide of this ditch the ground ſhould be gradually ſloped towards the open country. Through the main door of the church an opening ſhould be made about two feet above the ground, ſufficiently large to admit of one man paſſing through without much difficulty, ſo that when the church-yard becomes untenable, the garriſon may retreat into the church.

It muſt not be forgotten to ſecure the means of a croſs fire. If the church be built in the form of a croſs, croſs firings may be eaſily procured through the proper loop-holes; but when this is not the caſe, loop-holes ſhould be made through every ſalient angle of the building, or tambours, ſuch as repreſented in fig. 3. muſt be formed wherever it can be conveniently done.

Men muſt be diſtributed in the upper part of the building. Theſe men will take out the tiles or ſlates in different places, in order to obſerve the approaches of the enemy, and to fire upon him when he comes within muſket-ſhot. The lower windows of the tower or ſteeple muſt likewiſe be barricadoed, and have loop-holes made in them. The pavement of the church muſt be taken up, and the ſtones or brieks be carried to the top of the building, to enable the beſieged to let them drop upon the enemy, when he gets ſufficiently near. In order to render the defence as practicable as poſſible, you muſt alſo collect ſome large barrels or tubs, and keep them conſtantly at hand filled with water, for the purpoſe of extinguiſhing any fire which might break out in the church, or be effected by the enemy's ſhells.

Fig. 4. ſhows a plan of the church and church-yard thus fortified. *a*, *a*, *a*, *a*, the wall of the church-yard; *b*, *c*, tambour work in the front of the entrances; *d*, the church; *e*, *f*, tambour work conſtructed oppoſite the doors; *g*, the ſacriſty or veſtry. Fig. 4.

32 Of ambuſcades.

Connected with the attack and defence of poſts is the ſubject of ambuſcades, which we muſt now briefly conſider.

Ambuſcades may be formed in any place where a party may lie concealed, to ſurpriſe the enemy in paſſing. They are eaſily carried into execution in woods, hollow places, and large deſerted buildings; but the placing of an ambuſcade in any ſituation requires previous accurate information with reſpect to the movements of the enemy. When the commander of a party has been directed to form an ambuſcade, to ſurpriſe a convoy of artillery, baggage, or proviſions, or a body of recruits going to reinforce the enemy, he ſhould firſt make every neceſſary inquiry reſpecting the route which the enemy is to take; the ſituation of the places near which he is to paſs, and the poſt to which he is about to march. He muſt alſo inquire with ſeeming anxiety about the roads which lead in an oppoſite direction, on which he ſhould ſeem more intent than on his main object. Having concerted his plan, he ſhould ſet out at the head of his detachment if poſſible, and leaving his poſt on the ſide oppoſite to his true route, the better to conceal his deſign. If the place where he intends to plant his ambuſcade be not far diſtant, he ſhould come into his true route about half way, and there place half his infantry in ambuſh to favour his retreat. But when the country where he propoſes going is diſtant, and the

march

Military Tactics.

march requires at leaſt two nights, he muſt conduct his party by meandring from wood to wood, if there be any. He muſt not forget to provide neceſſary refreſhments for the day, which muſt be paſſed in ſome concealed place where he may not be perceived, and muſt cauſe three rations of oats to be carried for each horſe.

Proper precautions having been taken to guard any croſs road or bridge that may lie near the place of ambuſcade, the commanding officer ſhould take care to be at leaſt two hours before the enemy, and to place the ambuſcade on that ſide, by which, if worſted, he may retire with the greateſt ſafety.

Plate DLIII. fig. 2.

Plate DLIII. fig. 2. will illuſtrate the proper method of laying an ambuſcade. A repreſents the infantry of the ſurpriſing party, which ought to be placed at leaſt 600 paces behind B, the cavalry, ſo that, if purſued, they may both fall back to A, and make good their retreat to the guard at the bridge or croſs road; or to another party of infantry placed in ambuſh half way. If the ambuſcade be placed in a wood, an intelligent non-commiſſioned officer ſhould be choſen to get upon a high tree C, from which he can ſee the march of the enemy, and give notice of the moſt eſſential circumſtances. The firſt of theſe is the ſeeing the advanced guard; the ſecond is the approach of the corps, and the third is the time when their front is advanced as far as the ambuſcade B; for which the commanding officer ſhould inſtruct the obſerver what ſignals he is to make from the top of the tree, to communicate the neceſſary information without ſpeaking, which may be done by means of a ſmall cord D, of a brown or green colour, ſo as to be leaſt perceptible. Let this cord be placed as in the plan, ſo that no branch interrupt it, with one end in the hand of the obſerver, and the other in the commanding officer's hand in the ambuſcade B.

As ſoon as the advanced guard appears, the obſerver muſt pull the cord, and the commanding officer cauſe the party to mount and remain in deep ſilence. If by a ſtratagem, which is practiſed for particular reaſons, the advanced guard is immediately followed by the corps, which may be eaſily known by their being more numerous than ordinary, and not followed by any other corps, that the commander may not be deceived by the enemy, the cord ſhould be drawn a ſecond time, and a third time when their front is advanced as high as the ambuſcade. At that inſtant the party muſt ruſh out, and furiouſly attack the flanks of their centre in the following manner.

If the advanced guard E is formed only of an ordinary number, they ſhould be allowed to paſs; and at the approach of the principal part or convoy F, the chief to be informed by the ſecond pulling of the cord. At the moment the head of the convoy ſhall be advanced as high as B, the cord muſt be pulled the third and laſt time; and at this ſignal the party muſt ruſh out without being perceived, and ſuddenly attack the centre on the flank, engaging only with their ſwords, and making ſuch a noiſe as to prevent the enemy from hearing the orders of their officers. They muſt diſarm all whom their bravery ſhall throw in their way, taking care not to ſcatter or purſue too far, unleſs it be certain that they are ſo far from their army or parties, on account of which they cannot be affected; for in either of theſe caſes they will not fail to run at the noiſe, and diſturb the retreat.

Military Tactics.

In all ſecret expeditions, great circumſpection ſhould be uſed, that the party be not ſeen or betrayed; as if they be diſcovered by the advanced guard before the blow be ſtruck, the enterpriſe muſt be immediately abandoned, and the party retire. When the guide, or any one of the party deſerts, and cannot be catched, a retreat muſt immediately be thought of, or the ambuſcade muſt be placed ſomewhere elſe; but to prevent ſuch a misfortune, the officers ſhould be charged to examine frequently whether they have all their men.

An ambuſcade ſhould never be formed for cutting off the enemy's retreat, as this will drive him to deſpair, and make him rally and attack the party with deſperate reſolution. There may be an exception to this, when it is pretty certain that the whole party of the enemy may be cut off or taken priſoners, either from the ſmallneſs of their number, or from the peculiar ſituation of the place of ambuſcade.

Several ambuſcades ſhould not be formed at once, except for the purpoſe of ſeizing foragers, in which caſe they ſhould be diſpoſed ſo that the ſentinels may ſee from one to another. Then the firſt guard which ſees the foragers, ſhould commence the attack, and can ſoon be aſſiſted by the reſt of the party,

In all ambuſcades, no ſentries ſhould be placed but officers or non-commiſſioned officers. On downs, behind mountains, or in gullies, the ſentries ſhould lie with their bellies on the ground, and their feet towards the ambuſcade, the body covered with a gray or green cloak, according to the colour of the ground, with their heads a little raiſed and wrapped in a handkerchief of ſtraw green colour, or white in time of ſnow, ſo as not to be eaſily perceived. The number of ſentinels cannot be determined, but they ſhould be diſpoſed ſo as to watch on all ſides of the ambuſcade, and ſtop every one who may inadvertently approach too near. The ſentries ſhould give notice of what they diſcover by geſtures, to which all the officers ſhould be very attentive. In countries where there are no woods, vineyards, or hedges, an ambuſcade may be placed in a field of hemp or corn, or ſome ſort of grain, provided it be high enough to cover the men, at leaſt with the help of art. When the ſtalk of the corn is not high enough, ſome of the infantry muſt be ſet to work with ſpades and pickaxes, which they muſt have brought along with them, for the purpoſe of digging holes in the field deep enough to make up for the defective height of the corn.

An ambuſcade often forms part of a ſtratagem for bringing on an action with a party of the enemy which would be ſuperior, were it not for ſome advantage of this kind, as in the following caſe. See Plate DLIII. fig. 1. Suppoſe the whole party to ſet out from A, marching under the conduct of a truſty guide by covered ways at a diſtance from the enemy. Being come to the place C, which ought to be in the environs, and as high as the field of battle, the infantry ſhould be concealed out of the road far from the ſight of paſſengers. This muſt be the centre of correſpondence with the army, the rendezvous of the booty, and ſupport the retreat of all the cavalry, of which there ſhould be as many detachments as there are attacks propoſed to be made. We ſhall ſuppoſe ſix of 100 men each, and they

Fig. 1.

iltary actics.

must go ſecretly by particular routes to their reſpective poſts, E, D, F, G, H, I. Neither trouble nor expence ſhould be ſpared to procure good guides. Each detachment ſhould lie in ambuſh half a league, if neceſſary, from the object of the attack BKKKK.

The noiſe of the muſketry in the armies is to be the ſignal for their irruption; and then bravery, intrepidity, and courage will give wings to the people. The ſecond detachment D will glance imperceptibly between the villages, and fall like thunder on the camp B; and while 80 attack all whom they meet, the other 20 ſhould light their torches at the fires that are to be found everywhere, and ſpread the flames rapidly to the ſtraw of the tents. As they cannot fail to have the picquet of the camp ſoon at their heels, they muſt ſtrike their blow with all poſſible expedition, without ſtopping to plunder, being content with the glory of having excited a general alarm, capable of confounding the whole army, and contributing to the gaining of a battle.

At the ſame time that the detachment D attacks the camp B, the others, E, F, G, H, muſt with equal violence attack the villages K, K, K, K, which they have in front, doing the ſame the firſt did in camp, except that they may ſeize as plunder every thing which they can conveniently carry off, with which theſe villages are commonly filled, ſeizing the beſt horſes, hamſtringing others with the ſtroke of a ſword, and ſetting fire to all the places which contain the enemy's baggage. Each detachment ſhould cauſe ſome horſemen to advance beyond the village, to obſerve the motion of the troops, who will not fail to run to their aſſiſtance. As ſoon as they perceive them, they muſt make their retreat as faſt as poſſible by the routes which the commanding officer has preconcerted, and which are repreſented in the plate by the coarſe lines. The ſixth detachment I, in ambuſh on the ſide of the road leading from the camp, ſhould remain there, to ſeize all the enemy who think of ſaving themſelves by flight.

33 Retreats.

When the commander of a detachment finds himſelf obliged to abandon a poſt, or that it is not worth defending, it becomes neceſſary for him to prepare for his retreat. This is often a difficult and dangerous affair, and requires much prudence as well as bravery on the part both of officers and men. If poſſible, he ſhould retreat on that ſide which forms a communication with the general baſis or line of poſts occupied by his party. The following obſervations on lines of retreat, connected with the lines of operation deſcribed in N° 22, will be found of importance.

Plate CXLVI. fig. 8.

A retreat on a ſingle line is a fault of the utmoſt magnitude, for it is evident that if the army C (fig. 8. Plate DXLVI.) retire from it towards B, along the line AB, the enemy may ſend beſides, two corps *a*, *d*, againſt the flanks of this army, which would ſeparate it at the point B, and in this caſe it would be ſurrounded. Nor is this the only diſadvantage, for all the country ſituated to the right and left of the line AB, would fall into the hands of the enemy; while, in a retreat, it is always a rule to cover as much of the country as poſſible.

A concentric retreat is of ſuch a nature, that in an extenſive poſition they fall back to one more confined, ſo that the two lines of operation at the extremities AB, (fig. 9.) unite at the object of retreat C, forming an acute angle, or as at fig. 10. an obtuſe angle; ſuch a retreat would have no better iſſue than the former. The ſame diſadvantages which reſult from retreats on a ſingle line would likewiſe attend this. There is one circumſtance which might induce a general to retreat in this manner, and that is, with the view of covering any important place, a capital, for example, by taking an advantageous poſition, which is indicated by C, in the figures; the important place required to be covered would probably be at D. But nevertheleſs this meaſure would be ineffectual if the enemy were at all verſant in the art of war, and operated on the flanks of the army they were purſuing. The beſt method of covering a country, which is in our rear, is to proceed againſt the flanks of the enemy which is advancing; and by this intrepid and bold movement, to change our defenſive operations into thoſe of an attack.

9. 10.

A retreat conducted in parallel lines, as the baſis AB, in four corps, 1, 2, 3, 4, or the lines AC, EG, FH, BD, is doubtleſs better than the concentric retreats which we have juſt conſidered. In the firſt place, the country is better covered by means of the parallel lines; ſecondly, the enemy cannot ſo eaſily inſult the flanks of the retreating army, provided that this is in a condition to perform the ſame manœuvre with regard to them, and thus obſtruct their progreſs; laſtly, they would be afraid of advancing with too much precipitation, from the moment their attention is divided by the attempt which may be made againſt them. But there might be ſomething ſtill better attending it, viz. to retire in an eccentric direction, as we ſhall ſhow preſently. Fig. 11.

The excellence of parallel retreats is maintained from the idea that they cover a country better, and likewiſe ſtop the progreſs of an enemy, when oppoſed in a direct line. Certainly this appears evident to the eye; but the ſight is often the medium only of error. It is the *ignis fatuus*, which leads us into the mire, and the preſent inſtance is a proof of it. This opinion was not indeed well founded among our predeceſſors, and ſtill leſs is it ſo among the moderns. We do not now arreſt the progreſs of the enemy, by preſenting ourſelves to their ſtrongeſt part, viz. their front; but on the contrary, by intercepting their flanks, which are the weakeſt parts; by haraſſing their rear; by menacing their proviſions and their communication with the ſources of their vigour and power. It follows from hence, that eccentric retreats are the beſt. An army (fig. 12.) who retires from *a*, *b*, *c*, *d*, *e*, towards *f*, *g*, *h*, *i*, *k*, runs no riſk of ſeeing the enemy advance in the ſegment *f*, *k*; for he would, by ſuch a movement, be in danger of being ſurrounded.

We may lay it down as a rule, that it is eſſentially neceſſary, in all retreats, to divide into different columns, in order to divert the attention of the enemy; and it is fully demonſtrated that there is not in war a more important maxim. We might ſhow that this method of attracting the attention of the enemy to many different points at once is, properly ſpeaking, exciting a degree of apprehenſion with regard to his flanks and rear. But it naturally reſults from all that has been ſaid relative to the inutility of diverging offenſive operations, as well as thoſe which are directed by a ſingle line, or by an acute angle, that eccentric retreats are of all others the moſt preferable. Since concentric operations are the moſt advantageous in attacking, eccentric ones muſt neceſſarily poſſeſs the ſame advantages in defence; every

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Military Tactics.

thing ſhould be in oppoſition, in two different kinds of warfare, which are in their nature and intereſts contradictory.

In conducting a retreat, as in all other field operations, an army ſhould aſſume, as the principal object, its own magazines, and the ſafety of its lines of convoy, rather than the army of the enemy; and it ſhould never take a poſition oppoſite the enemy, but rather on one ſide of him.

54 Of battles.

We have hitherto conſidered military operations in the field, as they are ſubſervient, or preparatory to, that moſt important conſequence of war, a *battle*. We muſt now examine what are the cauſes which ſhould induce a general to hazard or avoid a battle; and if he determine on a general action, what are the beſt methods of diſpoſing the troops under his command.

At preſent, actions in the field are diſtinguiſhed into two kinds, according as they are more or leſs general. When the whole of the adverſe armies are engaged, it is called a *battle*; but where only a part of each is concerned, a *combat*. The latter of theſe, however deſperate, does not in general involve ſuch important conſequences as the former; but as in a general engagement, the vanquiſhed party uſually loſe the greater part of their artillery and baggage, and are compelled to retire and leave the country behind them at the mercy of the victors, a prudent general never hazards ſuch loſſes without important reaſons.

35 Reaſons for hazarding a battle.

When an army is ſuperior to its opponents in number or diſcipline; when diſcord prevails among the chiefs of the adverſe army; when a neglect of the ordinary precautions in marching, encamping, or other obvious duties, demonſtrate their incapacity; when it is neceſſary to relieve a conſiderable town or poſt that is beſieged by the enemy; when it is apprehended that the army will be diſperſed or ruined, without a general engagement; when intelligence has been received that reinforcements are approaching to the enemy, which will render him ſuperior; when the enemy has received, in ſome preceding action, a conſiderable check which he has not yet recovered, or when the army whoſe general is thus canvaſſing the advantages and diſadvantages of a battle, is in ſuch a ſtate, that every thing ought to be hazarded for its relief, the commander is warranted in giving battle to the enemy.

36 Reaſons for avoiding a general action.

On the contrary, when leſs is to be hoped for from a victory than feared from a defeat; when the army is inferior either in number, courage, or diſcipline, to the enemy; when it is in expectation of being reinforced by a ſtrong detachment of freſh troops; when the enemy is ſo advantageouſly poſted that it would be impoſſible to bring him to an engagement on equal terms, or to force his entrenchments; or when there is a proſpect, by temporiſing and declining battle, of ruining the army of the enemy by diſeaſe, famine, or deſertion, it would be wrong to place the fortune of the campaign on the iſſue of a battle.

37 Preparation for a battle.

When a general engagement has been reſolved on, the general is to deviſe the means of carrying it into execution, ſo as to have the ſtrongeſt preſumption of ſucceſs. He is to arrange, with the officers of his ſtaff, the manner in which the troops are to be divided and diſpoſed, or what is called the order of battle; he ſhould aſſign to his ſeveral officers their reſpective poſts, and ſee that copies of the order of battle be given to thoſe that have a ſeparate command. The proper officers ſhould take care that the troops under their command be properly armed and equipped, and that they are allowed time to reſt and refreſh themſelves before the engagement. The heavy baggage, and every thing that might encumber the operations of the troops, ſhould be removed, and placed at a diſtance under a proper guard. A reſerve ſhould be formed near the park of artillery, conſiſting of ſome of the braveſt and beſt diſciplined troops, headed by the moſt experienced officers.

Military Tactics.

38 Circumſtances to be attended during the action.

In time of action, the commander in chief ſhould be ſo ſituated as to be able to iſſue his orders with the leaſt difficulty, and to obſerve as far as poſſible the operations of his troops, and more eſpecially the effects of the firſt attack. Every other general officer muſt keep his own ſtation, to direct the charge of the troops, or to rally and re-form thoſe which have been routed and diſperſed. When the action becomes general, and is obſtinately conteſted, the commander-in-chief ſhould direct the principal efforts of his troops againſt that part of the enemy's line which makes the greateſt reſiſtance, and ſhould himſelf haſten to this ſpot, to animate his men to greater activity and exertion by his preſence and exhortations.

The artillery of the army ſhould accompany the firſt line, and the remainder of the troops ſhould follow the movements of thoſe before them, ſo as to preſerve the proper diſtance between the lines, and march with the leaſt poſſible diſorder and confuſion. If the firſt line give way, the ſecond ſhould march up to its relief, and either charge the enemy, or keep him employed till the firſt line has time to rally and re-form. If, however, as often happens, the other lines are ſtruck with a panic on obſerving the repulſe of their predeceſſors, the reſerve ſhould be brought up, and it is probable that their courage and reſolution will reanimate the ſcattered troops, and turn the fortune of the day.

39 Order of battle.

In forming the order of battle, regard muſt be paid to the nature and ſituation of the place where the battle is to be fought; to the number and quality of the troops engaged, and to the mode of fighting which is moſt likely to take place during the action, or to decide the victory. There are two principal methods of forming troops in order of battle, the column and the line. The former of theſe was moſt in uſe among the ancients, has been greatly recommended by Folard in his commentaries on Polybius, and practiſed with the moſt brilliant ſucceſs by the French armies ſince their portentous revolution. This order of battle is adapted chiefly to caſes where the activity of the troops can be relied on, and where much firing with muſketry or artillery is not expected to take place, and where of courſe the affair is to be decided principally by the pike or the bayonet. It is alſo well calculated for a body of infantry who are to reſiſt the attack of cavalry. It is obvious that from the cloſe arrangement of troops in column, this diſpoſition muſt expoſe them more to the fire of a line, and muſt endanger their being flanked or ſurrounded by an enemy whoſe front is more extended. The relative advantages and diſadvantages of the column and the line, will be more readily perceived by attending to the following principles.

From the order of battle as a baſis are deduced many inſtructive

instructive principles relating to what are called *lines of marching* and *lines of firing*, which constitute a considerable part of the elements of modern tactics. Military Tactics.

There are as many lines of marching arising from the order of battle, as there are soldiers in the first rank of the line or column, and as the soldiers approach towards the enemy, these lines of marching, at least in the infantry, produce lines of firing. It is the nature and relative advantages of different lines of marching and firing that we now propose to consider.

Let us suppose two lines of troops, A and B, fig. 13. extended opposite to each other, of which A is considerably longer than B at each extremity, or, as it is termed, outflanks it. It is evident that B may be surrounded by A, as from the superior numbers of A, B may be attacked in flank and rear. It is therefore evident that when the numbers are unequal, and the contest is to be decided by firing, the greater number must prevail, if both are arranged in lines.

Again, the line AB (fig. 14.) being attacked by the line *c d*, the flank B cannot extend itself parallel to *c d*, if this line advances always in front towards A. The line attacked is surrounded, and even so pressed upon, that they must all take flight towards A. If any troops by chance should endeavour to form upon the line *e f*, they would not have time; taken in front and in flank by the enemy's fire, they could never resist such an attack. The cavalry would experience the same disadvantages in a similar case. Horsemen attacked to the right, to the left, and in front, could not defend themselves; the celerity of the horses, no doubt, would enable them to deploy quicker than the infantry; but, by the same reasoning, the enemy's cavalry, which is advanced upon their flank, would likewise advance the quicker from the point B, towards the opposite wing A, which a corps of infantry could not possibly do. Thus it would be equally difficult to form the line *e f*; every thing would be overthrown, and they must retire in the greatest disorder towards A. It is hence clear that every effort should be made by an army in line of battle, to turn the enemy's flanks with its front.

Concentric lines of marching and firing well executed, are exceedingly important. Hence it is that a fortress must yield when it is besieged, as the fire from the fortress is *eccentric*, while that of the besiegers is *concentric*. Hence, too, sorties from a garrison rarely succeed, because they are eccentric operations.

When an army is much weaker than its opponent, if the former be compelled to an action, it should throw itself on the enemies flanks; and to do this with effect, the enemy's front should be kept occupied, so as to draw off his attention from his flanks. If the line were long, he would have time to convey all that part opposite to the side attacked, as A (fig. 15.) into the line *e f*, before the attacking army *e d* could entirely overthrow and repulse the flank B, which would be the object of their efforts. In this case, things would again be equal; for an engagement in front would take place, the issue of which is always doubtful. If, however, they occupy the line AB, by corps sent for that purpose, as *g* and *h*, while, with a greater force, they attack in flank, then it would be impossible for any part of AB to throw themselves into the line *e f*, before having beaten *g h*; and the time would probably be too short for this operation, if *c d* pushed in front in a vigorous manner. From this it follows that the army AB, though the stronger, can do nothing better at this time than quit the field of battle, as it will otherwise be surrounded. Now, the attacking army have nothing to do but to effect an eccentric retreat; namely, to fall back with the left wing upon *i k*, and with the right upon *l m*, provided CD do not obstruct the passage; for in that case, the retreat of the right wing, or of that part of the army nearest the flank B, would be on *n*, in order to create in the enemy *c a* some solicitude for his left flank *d*. It is by such eccentric retreats that the pursuit of the enemy is prevented. They dare not venture it, if they do not wish to be taken in flank themselves, and to become in their turn exposed to an escalade and a concentric fire, and consequently a terrible havoc. Eccentric retreats in tactics are equally as advantageous as in strategy. The latter kind alarm the enemy with regard to his lines of operation, and consequently prevent him from advancing; the former make him afraid of exposing his flanks and rear, and hinder him from pursuing.

From these considerations it appears that it is no great misfortune for an army to be attacked in its centre, and divided. If the army be divided in two at the centre, it will retire eccentrically on *e* and *f* (fig. 16.). Fig. 16. By this movement it will throw an obstacle in the way of all farther progress on the part of the enemy, who has divided in the middle the dotted line AB. It is impossible for the enemy *c d* to advance in front between *e* and *f*; they would take him in flank on both sides: he must therefore advance in front towards *e* and *f*, both at the same time. In this position *e* and *f* might detach forces to the rear of *c d*, and operate at once on its provisions and in its country. It would be sufficient for that to send some corps from their flanks to the points A, B. It is likewise possible for them to advance entirely to the left and right, if they have any magazines at *g* and *h*, which nevertheless would not be exposed by the marching of the flanks towards A and B, and would always be sheltered from the enterprises of *c d*. A third combination likewise would be to attack immediately *c d*, which, from its position, would be exposed on both its flanks. In this last case, *c d* would have no other resource than to operate on that part of the flanks *e* and *f*, which are opposite to the points A, B, to compel *e f* to retreat, and replace its front in the direction of A, B.

It does not require a great body of men to occupy the front of the enemy, while the rest of the army attacks the flanks. It is best done by means of a scattered troop, or what the French call *tirailleurs*, consisting of light infantry, which are usually instructed in the following manner. The troop, formed into two ranks, divides in such a manner that there may be a space between the two, as indicated in fig. 17. The second Fig. 17. rank, placed behind the intervals left by the first, secures its flanks. When they attack, the second rank, CD, passing through the intervals of the first AB, advances to the line EF, and fires. The great advantage arising from this, is that of forming a more extensive front than when they are wedged in elbow to elbow; secondly, they keep up a more fatal fire with their musketry, because each soldier, being unmolested by the one next to him, aims better, and continues his firing without interruption; thirdly, a less number of men is lost, because many

Military Tactics.

many of the enemy's balls fall in the intervals, and are consequently harmless; but in the following method all these advantages are united in a more eminent degree. Here the dispersed soldiers do not move in right lines, but circularly, as represented in fig. 18. When the first rank has fired, the men make a little turn to the left, and run to the place occupied by the second rank, the men of which advance rapidly in front to the place which the former had quitted, and fire, while the other rank is charging. Thus, each rank alternately advancing and retiring in circles, a constant fire is kept up on the enemy, with little hazard to the men. It must be allowed, however, that this method will succeed only when the enemy stand firm; for if they fly, the former method is to be preferred.

Fig. 18.

If the attacking army be forced to retire, the *tirailleurs* that succeed them should stop at N° 2. fig. 19. instead of proceeding as far as N° 1.; while those that are already at N° 1. in retiring fall back farther than N° 2. thus each rank successively falling farther and farther back, contesting every inch of ground.

Fig. 19.

It may perhaps be maintained, that it is better in attack to adopt close order, because the lines of firing being more approximate, they can keep a better fire; but it may be replied, that if they are once on the flanks of the enemy, and sufficiently near to use the musket, it is then of little importance whether they attack with close ranks, or *en tirailleurs*, because in either case the enemy must be beaten if they charge with vigour. In such a position, it would be difficult to throw one's self in the line *ef* (fig. 20.), particularly if it be occupied in front, as it ought to be, and it is necessary that the cavalry should be near, in order to sustain this attack.

Fig. 20.

The retreats of the infantry intended to occupy the front AB (fig. 21.), need not be either eccentric or in flank, the principal object being to direct the attention of the army AB from his flanks, which it is intended to attack; but these retrograde movements must be conducted directly upon *lf*. If the retreat be serious, and it be really intended to abandon the front AB, and to prevent the pursuit by creating in the enemy a solicitude for his flanks, then the retreat should be executed eccentrically up *g h*.

Fig. 21.

Suppose an army collected in an oblique position, as at CD, fig. 22. and suppose it is to make an attack on another army AB, coming round upon its flank. This manœuvre has been recommended by Folard, and was practised long ago by Epaminondas, and in modern times by Frederick the Great. It is however generally considered as inferior to the mode of attack illustrated in fig. 15. and AB might easily avoid the danger by moving along in line towards *f*, or taking the position A *g*. Indeed AB is itself, by its right wing A, in some degree enabled to act on the offensive against the left wing of CD, by moving round in the columns *h i*. The consequence of this mutual manœuvring would be, that CD takes AB on its flank B, while it is itself taken by AB on its own flank C; the two parts attacked will be probably beaten by the attacking army, and after the combat they will both remain opposite to each other, though a little obliquely with respect to their former front.

Fig. 22.

It is not always necessary to re-form the ranks. Suppose AB (fig. 23.) is attacked by the line CD, the left wing might run dispersed towards *e f*, and there make a little turn to the right at a certain signal, return quickly, attack the left flank D, and give it a rolling fire from three sides, before D, in order to defend himself, could take the form of an axe (*d'une hatche*) D *g*. But, in order for such an attack to succeed, the enemy's cavalry must not be near. In case there be any to be apprehended, the precaution to be adopted would be to form into columns. If, therefore, attacks and retreats take place in this manner, and, above all, if care has not been taken to sustain and cover them with a numerous cavalry, the greater part of the tactical evolutions of the infantry are rendered useless. It is, however, indispensably necessary that the troops should always know how to deploy from a column into a line of battle.

Fig. 23.

Captain Rösch, a Prussian officer, has discovered a method of deploying, which appears to be by far the easiest and the best yet known. During the march, the divisions proceeding on the line AB (fig. 24.) observe the necessary distances. As soon as the division 1 enters into the line of direction AB, it is commanded to the right or left, according to the side which they wish to face; the following division arrives, without changing its step, to the very place where the preceding one has made its *quart de conversion*, and performs a similar one; the third, the fourth, and all the rest follow the example. Each division having thus traversed its distance, reaches the line of direction, when that which marches directly in front has already made room.

Fig. 24.

This method is a step further towards the perfection of deploying, which is to advance in front, for the division 1 is obliged to make a *quart de conversion* to the left, before presenting in front to the line, whilst, according to the method of Captain Rösch, this line is formed merely by a *halt-front*. At the same time, a conversion is a movement which always requires many paces, because it is performed in the segment of a circle.

In the two methods of deploying represented at fig. 24. and 25. the divisions traverse the two smallest sides of a right-angled triangle (see fig. 25.). The Prussians have introduced a method, in which only the hypothenuse is described: it is called the *adjutant's step*. The adjutants, who know from experience the length of the front of their battalions, measure with the gallop of their horses on the line of direction, the space necessary for appearing in battle (fig. 26.). Each battalion separates from the column, and marches by the nearest road to where their adjutants stand, at the numbers 1, 2, 3, 4, as intermediate points on the line of direction AB. As soon as the first division arrives at the adjutant, it immediately deploys according to the method already described. If the officers who measure the front do not make any great mistake, the march in front must be executed much more quickly than by the preceding method.

Fig. 25.

Fig. 26.

Let us now examine the best method of throwing back a wing into a line, so that it may not be turned. Suppose an oblique line at *c d* (fig. 27.) with a crotchet *d e* formed to prevent being taken by the flank *d*; and at the same time, to have a line ready to repulse every attack which the enemy AB, might attempt on the left against this flank. Such is the first modification which this kind of position offers to our examination. After this line, *en crochet*, has dispersed every thing which opposed

Fig. 27.

Military Tactics.

posed its progress, it turns, till it arrive at the prolongation of the oblique front CD, and then takes the enemy in flank.

* *Prussia* No. 35.

At the battle of Lissa *, some battalions of grenadiers were placed at the extremity of the right wing of the cavalry; they overthrew the troops of Wirtemburg, and performed other essential services. But such a position has this defect, that it offers a flank to the enemy, which can be enfiladed by his cannon. This would Fig. 28. happen to *c d* (fig. 28.), as well as *d e*, if the line AB extended beyond, and turned the oblique front *c d*. It would be possible, by means of a square battalion, as *d, e, f, g*, to cover the flank which is attacking in the oblique order, but two sides of this square would be enfiladed by the cannon of the enemy. The defence of a parallelogram is therefore much weaker than that of a perfect square.

Fig. 29. Fig. 29. represents what the Prussians call a *cremaillière*, a form extremely complicated, and liable to be enfiladed by the enemy. Another and still more com-
Fig. 30. plicated form of this order of battle is seen at fig. 30.

Fig. 31. Figs. 31. and 32. represent the order of battle in a square, a form which is well adapted both to strength and convenience. When it is intended to reinforce the square battalion against cavalry, the third rank separates from the two others, and forms by itself a lesser square, within that formed by the front and centre ranks. When this is done, if the enemy's cavalry should penetrate into one of the angles of the first square, the inner square forms a salient angle by conversions to the right
Fig. 32. and left, as represented by the dotted lines fig. 32, so as by a cross fire to drive the enemy back again.

Many have proposed to conduct retreats in various square battalions; but it is necessary that they should be small squares, composed at the utmost of two or three battalions; and it is requisite, that, during the march, whether by angles or squares, they should observe between each other such a position, that the fire of the one flank should reach to the sides of the other in order
Fig. 33. to protect it (fig. 33. N° 1, 2, 3.). This last battalion 3 reaches the front 1, which last performs the same service to the rear of 3, and to the front of 2; 2, on its side, protects the rear both of 1 and 3. It would be difficult in the field, for these different squares to preserve such a compressed position, and they would be in danger of wounding or killing each other by their cross firing. Men well experienced in war have, however, preferred retreats of infantry in square battalions, having the cannon in the centre or on the flanks, as represented in fig.
Fig. 34. 34. In executing this movement, however, the distances are scarcely ever preserved, especially when it is necessary for a wing to deploy by a conversion during a
Fig. 35. retreat, see fig. 35. in order to prevent the pursuit of the enemy. In every other respect these retreats being eccentric, are founded on good principles. See N° 33.

When, after a discharge of musketry, an army has to retire, this movement cannot be expected to be executed in order. In this case a flight always takes place, for otherwise there would be no reason for quitting the field of battle. In this situation it is necessary to have a line of cavalry behind the infantry, to sustain them; and then it is not so bad as is generally imagined, to fly hastily into the midst of the cavalry. It is only necessary that this scattered infantry should reform immediately in the most convenient place, in a wood, or on an elevation; and if they return quickly to the charge, they will display more courage than in falling back, step by step, and losing a number of men; for in the first instance it is a real and useful intrepidity, but in the second it is nothing. If there be no cavalry to sustain them in an open place, they must then remain united, or otherwise be cut in pieces.

When it is possible to effect a regular retreat, the best and easiest method is to make a half-turn to the right with the whole line, and to march thus, progressively falling back; by this means they will sooner escape from the fire of the enemy than in any other manner, and the order is much more easily kept, which is of importance, and deserves to be properly appreciated. There is not a more pitiable object than a square battalion surrounded by *tirailleurs*, (fig. 36.). All their Fig. 36. shot are concentric, and consequently eminently effective, while those of the squares are eccentric, which renders them almost nugatory. The ranks of this unhappy square would soon be thinned by a well-directed fire, which could not miss its aim; and a battalion, in this position, would find it impossible to escape destruction.

The most celebrated modification of the oblique front, is that made by Frederick the Great, viz. the oblique attack in rounds. Experience has not yet proved what there is peculiarly excellent in this manner of attacking; and Captain Rösch has shewn that it is not tenable in theory. He demonstrates that each *échellon* would be received by the enemy with a superior fire; for the one *c d* (fig. 37.) if it approach the Fig. 37. line AB, within musket shot, would be caught in its flank *c*; which being turned, and exposed to a side fire, would insensibly describe an arch in its rear, to have its adversary in front. The division of the line AB, which in this case would pour upon the flank *c* of the *échellon*, *c d*, such a fatal fire, would be in no way hindered by the second *e f*, which is too far off to fire; and, besides, the first two divisions of the wing *f* dare not fire, at least not with safety, if the *échellon* were 300 paces distant, for fear of reaching them in the flank *c*. Thus, the two divisions of the line AB, which are opposite to the *échellon*, *c d*, would continue their fire upon the fatal rank *c*, without the least interruption. If they be not more than 50 or 100 paces distant, these inconveniences will not take place; but at the same time, the advantages which were expected to result from an attack *en échellon* will be lost. These advantages are, that, by dividing the front, only one part is liable to be beaten, as the others would be neglected; while on the contrary, in an oblique line, without any interruption, the disorder rapidly spreads through its whole extent. It would be possible, in order to derive every advantage from this manœuvre, to augment considerably the fire of the first *échellon*, as well as the one immediately subsequent, by doubling their lines, and leaving the others weaker. Hence it is evident, that this mode of attack is eligible only when we are a-head of an enemy stronger than ourselves; for if we have a superior force, it is certain that the most energetic method would be to attack at once the adversary in front and both flanks.

There is scarcely an instance previous to the battle of Marengo, in which a second line of infantry has renewed the combat, by taking the place of the first which has been beaten. If the combat be continued with

Military Tactics.

bayonets, it would be ſufficient for a diviſion of the line AB to make a converſion on the flank of the *échellon c d*, while they are fighting in front, and overthrow it before *e f*, 300 paces diſtant, or even the ſecond line of the *échellon*, could come up to afford it any aſſiſtance. Thus, according to all appearances, the line AB would conquer all the *échellons* ſucceſſively, and this the more eaſily as they would be taken in flank as ſoon as *c d* is obliged to fly.

The moſt uſeful, and in fact the only proceſs for reinforcing an attack, is to have a ſecond line of cavalry behind a firſt of infantry; in caſe of bad ſucceſs they ſecure and cover their retreat, and complete the diſorder of the enemy's infantry, if they come to an engagement.

When the infantry is ranged *en echiquier*, a firſt line when beaten, may retreat by files through the lines in the rear, without creating any diſorder in the ſecond, on account of the extenſive ſpaces; but it is not the ſame with the long phalanx in open order. The cavalry, placed immediately behind the infantry, protects an attack much better than if there were between them a ſecond line of infantry; for in the firſt inſtance, there would be no hindrance to their haſtening to the ſuccour of the runaways, and receiving them in their boſom. Hence there ſhould be only two lines, one of infantry, and one of cavalry; and this is the more important, becauſe the two lines of infantry cannot be uſeful, except in as far as they are beyond the ſhot of the cannon; it is evident, therefore, that they ſhould be conſidered rather as a reſerve of freſh troops than as a ſecond line of combatants. Hence, the ſuperadded ſtrength which is ſuppoſed to be given to the *échellons*, by double lines of infantry, is quite illuſory.

Cannons which fire concentrically, aſſiſt greatly the efficacy of an attack; but this meaſure may be employed as well for right lines as for the *échellons:* in an attack of the latter kind, the batteries ſhould not be placed before the diviſion *c d*, but before *e f*, to enfilade that part of the line AB, which would attempt to fall back to make a converſion, in caſe it were attacked in flank by *c d*.

It is impoſſible to take the enemy in flank by the diagonal or ſide-ſtep, executed during the march, if, previous to commencing their march, they are not already conſiderably by their wings; for they would completely fruſtrate that ſcheme, if they made directly with their flanks a movement to the ſide. During the ſame time they would paſs over a more conſiderable extent of ground than with an oblique ſtep, becauſe they move in a direct line, and in front, and obliquely, both at the ſame time, which would conſiderably ſhorten their diſtance; and likewiſe becauſe they march on one of the ſides and you on the hypothenuſe, which is longer. It is therefore impoſſible to ſucceed in ſtretching beyond the wings of the enemy, while they are advancing in front in the order of battle, if they know how to conduct themſelves.

There is, however, one advantage to be noticed, which the *échellons* poſſeſs over the uninterrupted oblique front, which is, not expoſing the flank to the enemy advancing in front. The *échellons* naturally poſſeſs this advantage, while the oblique front cannot obtain it without being much more extenſive than the enemy's front; for the oblique line, formed into *échelons*, changes into a number of parallel lines by a converſion (fig. 38.), and they may, by this movement, defend their flanks againſt the enemy. But ſtill the beſt way is to attack him in his own flanks, whilſt his front is amuſed with detached corps, and the columns ſhould be prepared for the principal attack out of ſight of the enemy, in the ſame manner as an admiral adopts at a conſiderable diſtance, his meaſures for gaining the windward of the enemy. No manœuvres within cannon-ſhot can poſſibly be attended with ſucceſs, if the enemy be ſkilful.

Military Tactics.

Fig. 38.

41 Liſt of remarkable battles.

Much uſeful military inſtruction may be derived from peruſing the accounts of the moſt celebrated battles, detailed by writers of ancient and modern hiſtory; and we could here enumerate a long liſt of theſe engagements, many of which have been deſcribed in the hiſtorical articles of this work. A few, however, muſt ſuffice. Of ancient battles we may notice thoſe of MARATHON * in 490 B. C.; Platæa, 479; LEUCTRA*, 371; the GRANICUS*, 334; ARBELA*, 331; the Thraſymene Lake †, 217; CANNÆ*, 216; ZAMA*, 202; Magneſia ‡, 190; Nepheris, 147; PHARSALIA*, 48; and PHILIPPI*, 42. Of modern battles, the moſt important are thoſe of HASTINGS*, A. D. 1066; the Indus ||, 1221; Bannockburn §, 1314; CRESSY*, 1346; POICTIERS*, 1356; AGINCOURT*, 1415; Boſworth**, 1485; Flodden §, 1513; Pavia, 1525; Narva ††, 1700; BLENHEIM*, 1704; RAMILLIES*, 1706; Pultava ††, 1709; MALPLAQUET*, 1709; Fontenoy ‡‡, 1745; Prague and Colin ||||, 1757; Liſſa or Leuthen ||||, 1757; Minden, 1759; Freyburg, 1762; Jemappe, 1792; Tirlemont, 1793; Fleurus, 1794; Lodi, 1796; Zurich, 1799; Ulm, 1800; Marengo, 1800; Auſterlitz, 1805; and Wagram, in 1809.

* See *theſe articles.*
† See *Carthage*, N° 113.
‡ See *Syria.*
|| See *Gazna.*
§ See *Scotland*, N° 192. and 405.
** See *England*, N° 237.
†† See *Ruſſia*, N° 107. and 118.
‡‡ See *Britain*, N° 414.
|||| See *Pruſſia*, N° 26, 35.

By way of illuſtrating the modern French tactics, and more fully explaining what has been ſaid on the order of battle, we ſhall here give a detail of the battle of Jemappes, in which Dumourier entirely defeated General Clairfayt, by enticing him from a ſituation where he was impregnable.

42 Battle of Jemappes. Plate DLIV.

In the beginning of November 1792, when Dumourier arrived with his army in the vicinity of Mons, he found the Auſtrian general Clairfayt occupying a ſtrong poſition on the heights near the village of Jemappes, where he had entrenched himſelf, and was defended by nearly 100 pieces of cannon. The poſition of the Auſtrians was extremely formidable. Their right extended to the village of Jemappes, and formed a ſquare with their front and left, which ſtretched to the cauſeway of Valenciennes. They were poſted on a woody mountain, where they had erected, in an amphitheatre, three tiers of redoubts. Their whole force amounted to about 16,000 infantry, and 3000 cavalry.

The army of Dumourier was much more numerous than that of Clairfayt, but not ſo well ſupplied with artillery. The elevation of the Auſtrian batteries, too, gave them ſuch an advantage, that the French cannon could produce but little effect.

On the 5th of November, Dumourier had fully reconnoitred the Auſtrian camp, and, by way of feint, made an attack with his infantry on the village of Carrignon, while he kept up a briſk cannonade on their left. Towards evening the French army encamped oppoſite to Jemappes, with its left wing extending to Hoorne, and its right to Fremery. As Dumourier reſolved

Military Tactics.

solved to make a decisive attack on the heights of Jemappes the next morning, he ordered his troops to abandon the village of Carrignon which was commanded by the enemy's cannon.

On the morning of the 6th, he ordered his artillery to be advanced and disposed along the front of the line. It was soon found, however, that little was to be done with artillery, and that the great object was, to entice the Austrian general from his strong position, and draw him to the plain. For this purpose, at noon of the 6th, the French infantry formed in columns, and advanced with the greatest spirit and rapidity to the Austrian intrenchments. The lower tier of redoubts was instantly carried; but, as the centre of the French became endangered, and the Austrian cavalry appeared descending from the heights, and preparing to enter the plain, with an evident intention of flanking the French columns, Dumourier despatched the duke of Orleans to lead those columns against the second tier of redoubts, while a detachment of chasseurs and hussars flew to check the progress of the Austrian cavalry. Some smart skirmishing between the cavalry on both sides now ensued, and while this diversion was taking place, the left division of the French army possessed themselves of the village of Jemappes, while its centre obtained entire possession of the second tier of redoubts. In the mean time the whole of the Austrian cavalry had quitted the heights, and engaged the French on the plain below Jemappes. This was the point to which Dumourier had wished to bring them, and now the superior numbers and activity of the French quickly decided the fortune of the day. The Austrians were routed at every point, and forced to abandon the field of battle, leaving 5000 of their dead, with the greater part of their artillery. The loss of the French, however, was considerably greater, and is, on good authority, estimated at 14,000; but this loss appeared trifling to Dumourier, as by this victory he acquired possession of the whole of the Austrian Netherlands.

The positions of the French and Austrian forces in this battle are represented in Plate DLIV. 1, The centre of the Austrian army, commanded by Clairfayt. 2, A part of this army commanded by General Lilien. 3, Another part under the command of General Beaulieu. 4, Redoubts on the heights of Jemappes. 5, Austrian intrenchments. 6, French columns advancing to attack the intrenchments. 7, A battery. 8, Columns of cavalry. 9, Columns attacking the eminences above Mons. 10, Battery on the height of Fremery. 11, The wood of Fresnee. 12, The plain on which the French and Austrian cavalry were engaged. 13, Austrian detachment.

The columns N° 9. were first engaged; and N° 6. having obtained some advantage, Dumourier ordered the battery, N° 7. to be erected, by which the redoubts, N° 4. were silenced. In the mean time the French advanced against the intrenchments, 5, and attacked in front. From the left of the French army, as far as the centre, the cavalry fought hand to hand, in the plain, 12, with the Austrian horse, which was dreadfully cut up in the wood of Du Fresnee, 11. The right of the Austrians, being totally routed, gave way and fell back on Mons. The superiority of the French in numbers is evident from inspecting the columns in the plan.

After having dwelt so long on that part of military tactics which relates to operations in the field, we must be extremely brief with respect to the attack and defence of fortified towns. Indeed our principal object in this part will be to explain the nature of a siege, and the various circumstances that may occur, both on the part of the besiegers, and on that of the besieged, rather than to lay down a system of instructions for either party. With this view, we shall first enumerate the principal instruments and engines employed in the attack or defence of a fortress, and explain the nature and construction of the works constructed by the besiegers, either for the purpose of making their approaches to the place, or for undermining its walls or outworks.

43 Of sieges.

44 Instruments employed in sieges. Plate DLV. Fig. 1—20.

In Plate DLV. are represented the principal instruments employed in sieges. Fig. 1. is a fascine for the construction of redoubts or temporary defence of a detachment. Figs. 2. 3. and 4. exhibit various views of what are called *gabions*, or cylindrical cases of wicker work, open at both ends, for sticking into the ground, as seen at fig. 4. when they are filled with earth, and fascines, &c. laid on them. Fig. 2. is a section of the gabion; fig. 3. shews its hollow inside, and fig. 4. is its elevation. Fig. 5. and 6. represent bags for holding sand, the former empty, the latter full; and fig. 7. represents the manner in which they are usually disposed for the protection of the men. Fig. 8. is a fauciſſon, or very long close faggot, for laying over gabions. Fig. 9. is the outline of a blind, which is stuck into the earth by the sharp stakes at its extremity, and hides the workmen from the besieged. Fig. 10. represents what is called a chandelier, and fig. 11. two of these with fascines piled up across them. Fig. 12. is a cheval de frize; fig. 13. 14. 15. exhibit various views of a *mantlet*, or moveable blind placed on two wheels, used both to protect and conceal the workmen of the besiegers. Fig. 13. is a plan of the mantlet; fig. 14. a side view of it, and fig. 15. a view of its front next the enemy. Fig. 16. is a madrier or screen with two leaves, moveable on wheels; and fig. 17. represents a gate with orgues or lattice work on one side, and a portcullis on the other. Fig. 18. is a hook, and fig. 19. a fork used in sapping. Fig. 20. represents three caltrops or crows feet, used to scatter over the ground, to prevent the approach of cavalry, by laming their horses feet. For a fuller explanation of these instruments, see the several articles in the general alphabet.

45 Of investing.

When a town is about to be besieged, it is first *invested*; that is, a considerable body of troops, usually cavalry, encamp in its neighbourhood, and take possession of all the avenues till the army arrive, which is to carry on the regular operations of the siege.

46 Of lines of circumvallation. Fig. 21.

When the army has *sat down* before the place, its first object is, to ascertain the lines or direction of the works to be thrown up for the attack of the place. These are called *lines of circumvallation*, and their direction is to be determined by the plan of the fortification about to be besieged. After ascertaining, in the manner explained under FORTIFICATION, the number of sides of which the polygon of the place consists, and the length of each, as well as the radius of a circle to be drawn round the place, concentric with its works, the polygon of the circumvallation is easily described. This being traced, the engineer takes on each of the extremities of its sides the lines BD and BE, fig. 21. each of 15 fathoms, and from the points D and E, taken

Military Tactics.

taken for the centre and diſtance of 25 fathoms, he deſcribes two arcs cutting each other at F, whence are drawn the lines FD, FE, for the faces of the redans of the line of circumvallation; thus are formed the ſalient parts EFD of this line, which ſerve to flank it. The ſame operation is performed on every ſide of the circumvallation, and then the principal line is traced. The parapet within muſt be ſix or eight feet deep, and without is made a ditch parallel to all its parts, three or four fathoms in breadth. The parapet of the circumvallation will be $7\frac{1}{2}$ feet high, and the depth of the ditch equal to the height of the parapet.

To make the profile of the circumvallation, let AB, Fig. 22. fig. 22. be a line level with the country, and CD the ſcale of the profile. Let A be the ſide of the town, and B that of the country; take AE of ſix feet; from the point E, raiſe the perpendicular EF, of three feet, and draw the line AF, which will be the talus or ſlope of the banquette.

Draw FG parallel to AB, three feet from F to G, and the line FG will be the breadth of the banquette. On the point G raiſe the perpendicular GH, on the line FG, $4\frac{1}{2}$ feet. Draw from the point H, HK parallel to AB; make HK $7\frac{1}{2}$ feet, HI, $1\frac{1}{2}$ foot; draw GI, which will be the inſide of the parapet of circumvallation.

From the point K, let fall on the line AB the perpendicular KM; take KL $1\frac{1}{2}$ foot, and draw IL, which will be the upper part of the parapet of the line of circumvallation. Take MN equal to five feet, and from the point N draw the perpendicular NO, and ſet off $7\frac{1}{2}$ feet from N to O. Draw OR parallel to AB, making the diſtance equal to 18 feet from O to R; draw LN, and produce it to P, and LP will be the ſcarp. From the point R raiſe RS, perpendicular to OR, or parallel to ON. Make QR=OP, and draw QS, which produce beyond S, three feet to V; then take SX equal to ſix feet, and draw VX, and the profile of the circumvallation is completed; VQ being the counterſcarp, and VX the glacis.

At A and A (fig. 21.) are ſmall half moons before the gates of the circumvallation in the middle of the curtains.

Plate DLVI. fig. 1. 2. 3. In Plate DLVI. at fig. 1. is repreſented the manner in which the lines of circumvallation were drawn at the ſiege of Philipſburg in 1734. In theſe lines regular baſtions were conſtructed, as ſeen in fig. 2.

Fig. 4. 5. Fig. 4. and 5. of the ſame plate repreſent another line of circumvallation drawn round the city of Arras, when it was beſieged by the Spaniards in 1654. Before the circumvallation were dug a great number of holes, two feet in diameter, and $1\frac{1}{4}$ foot deep, in which were faſtened ſtakes for obſtructing the approach of cavalry.

47 Of the trenches and parallels.

While the lines of circumvallation, which are intended to protect the beſiegers from the enemy without, are conſtructed, all materials neceſſary for the trenches are got ready, and the figure and direction of theſe are determined. If the place be regularly fortified, and ſtand on level ground, it is indifferent on which ſide the beſiegers commence their attack. Suppoſe C, fig. 2. Plate DLVII. to be the place beſieged, and A and B two baſtions to be attacked. The beſiegers begin with indefinitely producing towards the field the capitals of theſe two baſtions; in like manner the capital of the half moon oppoſite the curtain between theſe two baſtions is produced. Eight hundred fathoms are ſet off from the ſalient angles D and E of the covert-way of F and G. This done, the lines DH and DI are drawn, each equal to 300 fathoms, and about the centre C with the radius CH or CI, is deſcribed an arch produced beyond H and I, and on this arch HI is conſtructed the firſt parallel. Then on the ſame lines DF, EG, are taken the points M and N, each 140 fathoms diſtant from H and I; and through theſe points M and N, about the centre C, is deſcribed another arch, on which is conſtructed the ſecond parallel. This ſecond arch will cut the produced capital of the half-moon in the point L, which is to be obſerved, in order to begin from hence a trench which may extend to the ſalient angle of the covert-way before this half-moon. Laſtly, through the points O and P, the diſtance of 20 or 25 fathoms from the angles D and E, a third arch is deſcribed from the centre C, on which the third parallel is conſtructed. The firſt parallel is terminated by producing the faces *a b*, *a b*, of the half-moons 1 and 2, collateral to the baſtions A and B; but the parallel is extended 15 or 20 fathoms beyond the interſection of this prolongation. The ſecond parallel will be leſs extended than the firſt, by about 30 fathoms on each ſide, and the third leſs than the ſecond by the ſame diſtance.

The trenches or approaches are now to be traced. For this purpoſe, the engineer takes a long ruler, and lays it on the point G, ſo that it may make with the produced capital EG of the baſtion B, an angle EGS, whoſe ſide GS being produced, ſhall meet no part of the covert-way, and ſhall be diſtant about 10 or 12 fathoms from the angles to which it approaches neareſt. GS is taken of any extent, and the ruler is put on the point S; ſo that it ſhall make with GS ſuch an angle GST, as that the ſide ST produced ſhall not fall on any part of the covert-way, but be 10 or 12 fathoms diſtant from the moſt ſalient parts. This ſide is terminated in T; and now the angle STI is made, whoſe ſide TI ſhould terminate at the point I, where it meets the firſt parallel. The ſame operation being performed on FH, the outline of the trenches is completed as far as the firſt parallel.

Fig. 1. of this plate illuſtrates the method of conſtructing what are called *lines of countervallation*. Theſe are drawn nearer the town than the lines of circumvallation, but are conſtructed on the ſame principles. They are employed chiefly when the garriſon of the place is ſo ſtrong as to diſturb the operations of the beſieging army by ſallies.

In ſieges where the garriſon is ſtrong, it is often neceſſary to cut parts of trenches, as VV (fig. 2.) between the ſecond and third parallels, ſo as to communicate with the main trench. Theſe parts of parallels are denominated *half parallels*, or places of arms, and are conſtructed in the following manner. Let ABCDFGMQ (fig. 1. Plate DLVIII.) be a part of the trenches, and let AB be one of the ſides oppoſite to the enemy; produce AB, ſo that BE ſhall be five or ſix fathoms, and in FG take alſo five or ſix fathoms from I to L, which will give the ends of the trench BFLI, the uſe of which is to cover the *boyace* or branch IOMG, whereby the enemy will not know the place where it falls into the trench AB, and to make room for withdrawing thoſe who are in this part of the trench-

Plate DLVII. fig. 2.

Plate DLVIII. fig. 1.

es,

Military Tactics.

es, and that the paſſage may be free at all the angles. In like manner produce the ſide GM from M to N, and the ſide IC from O to P, and this will give the end of the trench MNOP, which will cover the branch DCOQ. The ſame is to be done at all the angles of the trench. The parapet of the trench being made to cover it, ought to change ſides alternately. If, for inſtance, AE, in the preceding figure, be towards the place, it is evident that the ſide GN will be towards it alſo, and likewiſe the ſide CD; and therefore the parapet of the trench is ſucceſſively conſtructed from the right ſide to the left, and from the left to the right.

Figs. 2. 3. 4. of this plate repreſent profiles of the regular trenches and the places of arms, and require no particular explanation.

In tracing the trenches, it is of the greateſt conſequence to aſcertain the diſtance of the extremity of the line of direction to the top of the ſalient angle of the covert-way. The following ſimple method of doing this is given by Vauban. Let A (fig. 5.) be the vertex of the ſalient angle of the covert-way, and AB the line of direction of the trench whoſe length is required. At the point B, draw BC perpendicular to AB, to which give any meaſure, and at the point C draw CD perpendicular to BC. In CD take any point E, and in the line of direction between it and the angle A place a picquet G in the line BC. Meaſure GC and CE, and ſay, as GC : BG :: CE : AB.

When in carrying on the trenches towards the town, the workmen begin to be much annoyed by the fire of the beſieged, recourſe is had to what is called *ſapping*, which may be thus explained. Let ABC be the part of the trenches advanced to A (fig. 6. Plate DLVIII.), ſo near the town as to render it impoſſible, without evident danger, to work any longer at the approaches, unleſs the men have ſome cover againſt the fire of the place; and let the branch AD be traced by the engineer, not with a cord, as at the opening of the trenches, but with ſome pickets, which he has taken care to place in the direction this branch ought to have, to ſerve as a guide to the workmen. A cut is made in the parapet BA of the trenches, and then the men deſigned to work by ſap, who are therefore called ſappers, will move forward through the opening A ſucceſſively, eight in number. Fig. 7. of Plate DLVIII. and fig. 1. of Plate DLIX. will illuſtrate the mode of operation. The firſt ſapper rolls a mantlet before him, and places a gabion on the line AD, fig. 6. He then makes a ſmall excavation about ſix inches from the gabion, of about one foot and a half in depth, and as much in breadth, emptying the earth which he digs up into the gabion. He then puſhes forward his mantlet, fixes another gabion, and continues his trench as long as he is able. He is followed by a ſecond, who widens the trench ſix inches in breadth away from the gabion, and ſix in depth. The reſt follow this ſecond, till the trench is made three feet wide, and as many deep, and as ſoon as the gabions are filled with earth, faſcines or ſauciſſons are placed on their top, and the ſuperfluous earth is thrown over them, and on the oppoſite ſide, by way of parapet.

Cannon are made uſe of at a ſiege for two different purpoſes; the firſt to drive away the enemy from their defences, and the ſecond to diſmount their guns. To produce theſe two effects, the batteries ſhould not be above the mean reach of cannon-ſhot from the place; that is, above 300 fathoms. Therefore there is no poſſibility of conſtructing them till the firſt parallel be formed; and as the diſtance of this firſt parallel from the place is generally 300 fathoms, the batteries muſt be on this line, or beyond it, nearer the town. They muſt always be placed, when the ground will permit, on the produced faces of the works attacked. Let Z be the centre of the place attacked (fig. 3. Plate DLIX.), and the trenches as well as the parallels completed. To find a proper poſition for erecting batteries, produce the faces AD, AC, BE, BF, of the two baſtions attacked, till their prolongation cuts the firſt parallel. Produce alſo the two faces OM and OL of the half-moon MOL of the front attacked, and the faces HG and IK of the two collateral half-moons 1 and 2, to the firſt parallel, and erect batteries on thoſe produced faces, as is ſeen in P, Q, R, S, T, U, X, and Y. They are advanced beyond the firſt parallel 40 or 50 fathoms; and are parted from the trenches, that they may be uſed with greater eaſe and convenience, and leſs trouble to the workmen.

50 Of traverſes.

When the works of the beſiegers approach the glacis, they are continued in a zig-zag direction, by ſhort angular trenches, but from the foot of the glacis they are continued in the following manner. Two ſets of ſappers, protected by their mantlets, make a ſap on each ſide of the ridge of the glacis, with a deeper ditch than uſual, and a parapet on each ſide. This is called a double ſap, and has acroſs it traverſes or banks three fathoms thick (ſee Plate DLX. fig. 1.), with ſmall paſſages on one ſide (ſee fig. 4.) to preſerve the communication. Theſe traverſes are conſtructed ſo near to each other, as to be a ſufficient cover, by their elevation and diſtance, againſt the fire of the place. In order to guard againſt the effect of grenades, on coming within their reach, or within 14 or 15 fathoms of the covert-way, care muſt be taken to cover this trench with blinds, or to cover the upper part of it. Fig. 1. and 2. of Plate DLX. ſhew this direct trench. The firſt exhibits the plan, and the ſecond the profile, which paſſes over one of the traverſes. This being done, and the third parallel finiſhed in the manner ſuppoſed, they advance from this parallel on the glacis to each of the ſalient angles of the covert-way of the front attacked, and begin with making two or three ſhort turnings, as marked on Plate DLX. fig. 6. along the ridge of the glacis, ſo as to occupy about one-third of it. Theſe are to be made as deep as is neceſſary, to be a ſhelter againſt the fire of the covert-way; afterwards they may proceed directly along the ridge of the glacis by a deep ditch, to the ſalient angle of the covert-way. M. Vauban obſerves, that if we follow directly the ridge of the glacis, this trench is made without much danger; for the paliſade which is placed at the ſalient angle of the covert-way, and the other two next it, do not preſent directly to the ridge, but only oppoſite to the faces, where at moſt there is only room for one or two fuſileers to ſee the head of the trenches, and who are eaſily ſilenced by the fire of the third parallel, which ought to be well ſerved, and likewiſe by that of the ricochet. On coming to the middle, or two-thirds of the glacis, two new ſaps are made, *b b*, *ibid.* which embrace both ſides of the covert-way, to which they are almoſt parallel. Their length is 18 or 20 fathoms, and about five broad.

Plate DLX. fig. 1.

Fig. 6.

Military Tactics.

broad. They are covered at the end with crochets and winding traverſes, which prevent the fire of the covert-way from enfilading them eaſily.

In this way is gradually effected a *lodgement* on the covert-way, as is repreſented in fig. 5. where AAAA, is the trench, with BBBB its traverſes.

Fig. 5. Plate DLXI. fig. 5.

Plate DLXI. fig. 5. repreſents a profile of theſe works, with three banquettes next the trench, by which the parapet is raiſed, ſo that the ſoldiers may fire over into the covert-way. This work is called by Vauban, the *cavalier of the trench.*

51 Of batteries on the covert-way.

When the beſieged are entirely driven out of the covert-way, the next thing to be done is the erecting of batteries, in order to ruin the defences of the place, and to make a breach. As it is neceſſary for the beſiegers to make themſelves maſters of the half-moon C, (Plate DLX. fig. 6.) before they can come to the body of the place, which is defended by part of the faces of the baſtions A and B oppoſite to its ditch, they muſt begin with erecting batteries on the covert-way oppoſite to theſe parts. They are marked on the plan *e e.* Batteries muſt alſo be erected to make a breach on the half-moon. But, before they are erected, it will be proper to conſider what part of the face of the half-moon is to be attacked, or what part of the half-moon is to be entered. It muſt not be at its flanked angle, becauſe an opening towards the point would not afford a ſufficient ſpace to make a lodgement able to withſtand the enemy, and the troops would be ſeen in their paſſage by the two faces of the baſtions by which its flanked angle is defended. The moſt favourable paſſage is towards the third part of its face, reckoning from its flanked angle, becauſe by battering at the ſame time the two faces near this part, the whole point of the half-moon may be deſtroyed, and a large opening made there eaſier than anywhere elſe. Thus the batteries for making a breach in the half-moon C will be placed in *d* and *b*, and will occupy almoſt one-third of each of the faces of the half-moon from its flanked angle. Theſe batteries are each to conſiſt of four or five pieces of cannon. When the faces of the baſtions A and B are well enfiladed by ricochet batteries, there will be no farther occaſion for the batteries *e, e*, and when the half-moon is taken, the faces of the baſtions A and B may be deſtroyed, by uſing the batteries *d, d*, placing them in the ſituation of *e, e*. Batteries muſt alſo be erected to deſtroy the flanks of the demibaſtions in the front of the attack; and it is evident that they can be placed nowhere but at *i, i*, on the covert-way. Beſides theſe batteries, others are erected in the re-entering places of arms of the covert-way, as in *k*; and in *k* they ſerve to batter the tenaille when there is one, the curtain, and the faces of the baſtions. Sometimes they are of mortars for throwing ſtones.

Plate DLX. fig. 6.

52 Deſcent and paſſage over the ditch of the half-moon.

While the workmen are employed in erecting batteries on the covert-way, preparations are made for paſſing the ditch of the half-moon. This is often a difficult and dangerous undertaking, as this ditch is commonly very deep, is well defended, and either filled with water, or in general capable of being ſo filled. The deſcent into the ditch is commonly effected by ſubterraneous paſſages or galleries, made like thoſe of miners, and erected in ſuch a manner, that its opening into the ditch may be oppoſite to the breach where it is intended to make the aſſault. Theſe galleries are ſloping, and in general there are ſeveral for the ſame paſſage. The paſſage is made on each ſide of the faces of the half moon. See *m m*, fig. 6. Plate DLXI.

Milita Tacti

As the buſineſs of forming theſe galleries is liable to be obſtructed by mines from the beſieged, the workmen are protected by a guard of grenadiers. At fig. 1. Plate DLXI. is ſeen a plan of the deſcent under ground, and of its opening into the dry ditch; and fig. 2. gives a profile of the ſame paſſage; fig. 3. gives a perſpective view of the opening of this deſcent, ſeen from the bottom of the glacis, and fig. 4. a ſimilar view of the opening of the ſame deſcent, ſeen from the top of the breach.

Plat DLX fig. 1-

At Plate DLXII. fig. 1. is ſeen the plan of the paſſage over a wet ditch in the open air; that is to ſay, the gallery of which is an open ſap. A is the opening of it; at B, towards its opening, are ſeen the blinds laid on its upper part, to ſupport the faſcines with which it is covered. On theſe blinds, at firſt, is laid a bed of faſcines, ranged according to the length of the gallery: over this firſt bed a ſecond is laid, whereon the faſcines are ranged according to the breadth of the gallery, as is ſeen at B and C. D is the epaulement of faſcines, which covers the paſſage againſt the fire of the place by which it is flanked. E is part of the bridge of faſcines; and F is an elevation alſo of faſcines, intended to cover the head of the work, and to ſecure it from the immediate fire of the place. Fig. 2. repreſents the profile of this deſcent into the ditch. Fig. 3. gives its opening ſeen in perſpective from the country; and fig. 4. its opening into the ditch, alſo in perſpective, as it appears from the top of the breach.

Plat DLX fig. 1-

The following references will explain fig. 5. of Plate DLXII. *a*, cavaliers of the trenches. *b*, batteries of ſtone mortars. *c*, batteries to breach the half-moon before the hornwork. *d*, batteries againſt the defence of this half-moon. *e*, paſſages over the ditch before this half-moon. *f*, lodgement in it. *g*, batteries againſt the flanks of the hornwork. *h*, batteries to breach the half baſtions of the hornwork. *i*, batteries againſt its curtain. *l*, lodgements in the half baſtions, and in the hornwork. *m*, paſſages over the ditch before the retrenchments in the hornwork. *n*, lodgements in theſe retrenchments. *o*, batteries againſt the defences of the collateral half-moons. *p*, batteries to breach thoſe half-moons. *q*, paſſages over the ditch before theſe works. *r*, lodgements in the ſame. *s*, batteries to breach the redoubts of the half-moon. *t*, paſſages over the ditch before the redoubts. *u*, lodgements in the redoubts. *x*, bridge of faſcines. *y*, batteries againſt the defences of the baſtion A. *z*, batteries to breach this baſtion. B, paſſages over its ditch. C, lodgements in the baſtion A. D, lodgements on the border of the ditch before the retrenchment of the baſtion A. E, paſſages over the ditch before this retrenchment.

Fig. 5.

There are places which, without any fore-ditch, have lunettes oppoſite to the falient and re-entering angles of the glacis, which are alſo enveloped by a ſecond covert-way: ſometimes they are vaulted and bomb-proof, as at Luxemburg; and ſometimes they have only a ditch, a parapet, and covert-way. Thoſe which are vaulted and bomb-proof are not eaſily taken, becauſe the ricochet firing and the bombs can do them no miſchief. In that caſe they muſt either be turned, or be taken by mines. A work is ſaid to be turned, when the beſie-

gers

gers get between that work and the place, and so cut off their communication. Sometimes the lunettes have communication under ground, and then there is scarcely any other way of driving out the enemy but by mines. This is tedious, but there is no other remedy. The lunettes of the ditch are always defended by branches of the covert-way, with which they have also a communication like those of the lunettes, A, A, Plate DLXIII. fig. 1. This plate, which represents part of Landau and its attacks in 1713, may serve to give an idea of the manner in which a work is turned. The advanced lunette B, as well as the work C, called a *tenaille*, is turned; that is, the trenches cut off the communication betwixt them and the place.

We shall conclude this subject of the attack of fortified places, with the following principles to be observed by the besieging army.

The approaches ought to be made, without being seen from the town, either directly, obliquely, or in flank.

No more works should be made than are necessary for approaching the place without being seen; that is, the besiegers ought to carry on their approaches the shortest way possible, consistently with being covered against the enemy's fire.

All the parts of the trenches should mutually support each other, and those which are furthest advanced ought not to be distant from those which are to defend them above 120 or 130 fathoms.

The parallels or places of arms the most distant from the town, ought to have a greater extent than those which are nearest, that the besiegers may be able to take the enemy in flank, should they resolve to attack the nearest parallels.

The trench should be opened or begun as near as possible to the place, without exposing the troops too much, in order to accelerate and diminish the operations of the siege.

There is no such thing as giving any exact rule in regard to the distance which ought to be observed on opening the trenches. On level ground, this distance may be 800 or 900 fathoms; but if there should be a hollow way in the vicinity of the place, the besiegers are to take advantage of it, and open the trenches nearer. In general, they are to regulate themselves according to the nature of the ground, more or less favourable to the opening of the trenches. We shall suppose in the present work, that the opening ought to be made within 800 fathoms of the covert-way; the first parallel within 300 fathoms, the second within 150, and the third at the foot of the glacis.

Care must be taken to join the attacks, that they may be able to support each other.

Never to advance a work unless it be well supported; and for this reason, in the interval between the second and third places of arms, the besiegers should make, on both sides of the trenches, smaller places of arms, extending 40 or 50 fathoms in length, parallel to the others, and constructed in the same manner, which will serve to lodge the soldiers who are to protect the works designed to reach the third place of arms. Military Tactics.

The batteries of cannon must be placed in the continuations of the faces of the pieces attacked, to silence their fire, and that the approaches being protected, may advance with greater safety and expedition.

For this reason the besiegers should always embrace the whole front attacked, to have as much space as is requisite to plant the batteries on the produced faces of the works attacked.

The attack must not be commenced with works that lie close to each other, or with re-entrant angles, which would expose the attack to the cross fire of the enemy.

54 General remarks on the defence of fortified towns.

Many circumstances respecting the defence of fortified towns have already been anticipated, or may be collected from what has been said respecting the operations of the besieging army. It is evident that the success or duration of the defence will depend in a great measure on the nature and strength of the works which form the fortification. Much, however, will also depend on the number, resolution, and resources of the garrison, and on the movements of the friendly army by which the besiegers may be opposed. It is estimated by M. Vauban, that the operations for a regular siege of a well fortified town, will take up about 41 days, before the place can be carried by assault. Hence is deduced a computation of the quantity of provisions, ammunition, and stores which ought to be collected for maintaining the siege. The same celebrated engineer calculates that the garrison ought to consist of 600 times as many men as there are bastions in the fortification, allowing 600 men to each bastion. Besides the necessary defence of the works by the cannon on the ramparts, and the musketry of the soldiers, the garrison must make occasional sallies; if weak, to disturb the operations of the besiegers, and if very strong, to engage them in the field. As the siege advances, and the attacking army approaches the glacis, mines should be sprung, and subterraneous passages excavated, to destroy the enemy's works, or cut off a part of their men.

55 Reference to authors on military tactics.

Towards supplying the unavoidable deficiencies in the above sketch of military tactics, we may refer our readers to Clairac's *Field Engineer*, translated by Muller; Le Cointe, *Science des Postes Militaires*, or the English translation; Jeney's work entitled *Le Partisan*, also translated into English; O'Rourke's *Treatise on the Art of War; Essai General de Tactique;* Tielke *on the Art of War*, and his *Field Engineer;* Dundas's *Principles of Military Movements;* Landmann's *Elements of Tactics;* Maizeroy's *Systeme de Tactique;* Archives *Militaires;* Feuquiere's *Memoires;* Bland on *Military Discipline; Military Instructions for Officers detached in the Field;* and the articles BATTALION and BATTLE in Rees's *Cyclopædia.*

PART II. NAVAL TACTICS.

BY naval tactics is understood the art of arranging fleets or squadrons in such an order or disposition as may be most convenient for attacking the enemy, defending themselves, or of retreating with the greatest advantage. Naval tactics are founded on those principles which time and experience have enabled us to deduce

Naval Tactics.

from the improved ſtate of modern naval warfare, which has occaſioned, not only a difference in the mode of conſtructing and working ſhips, but even in the total diſpoſition and regulation of fleets and ſquadrons.

In the preſent part we propoſe to lay down the general principles of naval tactics, and to deſcribe as briefly as is conſiſtent with perſpicuity, the moſt improved ſyſtems which are now adopted in the French and Britiſh navy. As we have elſewhere (ſee NAVIGATION and SEAMANSHIP) detailed the methods of working ſingle ſhips, as they are unconnected with military operations, we ſhall preſume that our readers are already acquainted with theſe ordinary movements.

56 Ordinary diviſion of fleets.

Fleets are generally divided into three ſquadrons, the van, centre, and rear, each under the command of a flag officer. The admiral of the fleet, or chief in command, leads the centre diviſion, while the van is uſually commanded by a vice-admiral, and the rear by a rear-admiral. Each ſquadron is diſtinguiſhed by the poſition of the colours in the ſhips of which it is compoſed. Thus, the ſhips of the centre ſquadron carry their pendants at the main-top-gallant maſt-head; while thoſe of the van diviſion have their pendants at the fore-top gallant maſt-head, and thoſe of the rear at the mizen-top-maſt head. Each ſquadron, as far as poſſible, conſiſts of the ſame number of ſhips, and as nearly as may be of the ſame force. In large fleets, the ſquadrons are ſometimes again divided in a ſimilar manner; the van and rear of the ſquadron being headed by rear-admirals, or ſenior captains, called commodores. In the uſual mode of forming the lines, each commanding admiral arranges his ſhip in the centre of his own ſquadron, and thus the admiral of the fleet is in the centre of the line. When no enemy is in ſight, the ſloops, ſtore-ſhips, fire-ſhips, and other ſmall veſſels, are diſperſed to windward of the fleet, that they may be more eaſily ſupported, and more readily anſwer ſignals. The frigates lie to windward of the van and rear of the convoy, thus keeping a good look-out, and keeping the ſmall veſſels in their proper ſtation. When ſailing in three columns, the centre ſtill keeps in the middle, while the van and rear form the ſtarboard or the larboard column, according to circumſtances. Theſe arrangements are called orders of ſailing, and will be better underſtood from the following definitions.

57 Definitions.

The *ſtarboard line of bearing*, is that line on which the arranged ſhips of a fleet bear from each other, on a cloſe-hauled line, whatever courſe they may be ſteering, ſo that when the ſhips haul their wind, or tack together, they may be on a line cloſe hauled upon the ſtarboard tack. The *larboard line of bearing* is that line on which the ſhips when hauling their wind, or tacking together, may be formed on a line cloſe hauled on the larboard tack. The ſhips of a fleet are ſaid to be *on a line abreaſt*, when their keels are parallel to each other, and their mainmaſts lie in the ſame ſtraight line. Ships are ſaid to lie in a line on the bow or quarter, when they are arranged in a ſtraight line, cutting their keels obliquely in the ſame angle, ſo that reckoning from any intermediate ſhip, the ſhips towards one extremity of the line will be on the bow of that ſhip, while thoſe towards the other extremity will be on her quarter. When ſeveral ſhips in the ſame line ſteer the ſame courſe, while that courſe is different from the line of ſailing, they are ſaid to ſail chequerwiſe. Naval Tactics.

When the ſhips of a fleet arranged in any of the orders of ſailing, and on the ſame line, perform ſucceſſively the ſame manœuvre, as each gets into the wake of the ſhip that leads the van of the line or ſquadron, tacking or veering, bearing away or coming to the wind in the ſame point of the wake of the leading ſhip, they are ſaid to *manœuvre in ſucceſſion*.

58 Illuſtration of the orders of ſailing. Plate DLX

There are uſually reckoned five orders of ſailing, excluſive of the line of battle, the order of retreat, &c. In the firſt order (ſee Plate DLXIV. fig. 1. and 2.) the fleet is arranged on the *ſtarboard* or *larboard* line of bearing, all the ſhips ſteering the ſame courſe. In theſe caſes the fleet, by hauling the wind when in the ſtarboard line, as in fig. 1. will be ready to form the line on the ſtarboard tack; and when ranged on the larboard line of bearing, as in fig. 2. it will, by tacking, be ready to form the line on the larboard tack. N. B. The arrows annexed to the diagrams on the plates, mark the direction of the wind, as in ordinary charts. Fig. 1. 2.

This firſt order of ſailing is now ſeldom employed, except in paſſing through a narrow ſtrait. In the ſecond order of ſailing, the fleet ſteering any proper courſe, is ranged in a line perpendicular to the direction of the wind, as in fig. 3. This ſecond order, beſides being equally defective with the former, is ſubject to the additional diſadvantage of rendering it extremely difficult for the ſhips to tack, without each ſhip falling on board that next a-ſtern. Fig. 3

In the third order of ſailing, the whole fleet is cloſe hauled, and ranged on the two lines of bearing, ſo as to form an angle of 12 points, having the admiral's ſhip (A fig. 4.) in the angular point, and the whole fleet ſteering the ſame courſe. Thus, ſuppoſing, as in the plate, the wind at north, the ſtarboard diviſion of the fleet will bear W. N. W. of the admiral, and the larboard E. N. E. This order in ſmall fleets or ſquadrons, is ſuperior to either of the former; but when the fleet is numerous, the line will be too much extended. Fig. 4

In the fourth order, the fleet is divided into ſix or more columns, and is thus more concentrated. The commanders, ranged on the two lines of bearing, have their ſquadrons aſtern of them on two lines parallel to the direction of the wind; the firſt ſhips of each column being, with reſpect to the commander of the ſquadron, the one on his ſtarboard, and the other on his larboard quarter. The diſtance between the columns ſhould be ſuch that the fleet may readily be reduced to the third order of ſailing, and from that to the order of battle. This order is adapted for fleets or convoys croſſing the ocean, and is repreſented in fig. 5. But as it requires much time to reduce a fleet from this order to that of battle, it is defective when in preſence of an enemy. Fig. 5

In the fifth order, the fleet, cloſe hauled, is arranged in three columns parallel to each other; the van commonly forming the weather, and the rear the lee column. See fig. 6. Fig. 7. repreſents the ſame order, except that each column is here ſubdivided into two, with the ſhip bearing the commander of each ſquadron in the centre of each ſubdiviſion. Fig. 6 and 7.

In forming the order or line of battle, the ſhips of the fleet are drawn up in a line nearly cloſe hauled, ſtanding Order of battle

ſtanding under eaſy ſail, ſo that each ſhip may be at a certain diſtance from the ſhip immediately a-head, as a cable's length, or half that diſtance. The fireſhips and frigates a-head and aſtern, form a line parallel to the former, and to the windward of it, if the enemy be to the leeward; but to the leeward if the enemy be to windward. This order is denoted by fig. 8. where the fleet is ſailing on the ſtarboard tack, with the wind at north.

When a fleet is compelled to retreat before a ſuperior force, it is uſually arranged in an order, the reverſe of the third order of ſailing; the diviſions of the fleet being ranged in the two lines of bearing, ſo as to form an angle of 135° or 12 points, the admiral's ſhip being in the angular point, and the frigates, tranſports, &c. included within the wings to leeward. See fig. 9. where the fleet is ſailing right before the wind. Though any other direction may be taken, the two lines ſtill form the ſame angle.

The order of convoy is that in which the ſhips are all in each others wake, ſteering in the ſame point of the compaſs, and forming a right line. If the fleet is numerous, it may be divided into three columns, which are to be ranged parallel to each other, that of the admiral occupying the centre, and all ſteering the ſame courſe.

Having thus deſcribed the ordinary poſitions of a fleet, we muſt explain the manœuvres by which they are produced, and we ſhall begin with the orders of ſailing.

To form a fleet in the firſt order of ſailing, ſuppoſing the ſhips to be in no particular order, that ſhip which is to lead on the propoſed line of bearing for the order of ſailing, runs to leeward of the greater part of the fleet, and then hauls her wind under an eaſy ſail. Each of the other ſhips then proceeds to take the proper ſtation, by chaſing the ſhip, which is to be a-head of her, and when in the wake of the leading ſhip, adjuſts her quantity of canvas ſo as to preſerve the proper diſtance. The ſhips thus arranged aſtern of each other, are in the line of battle, and from this the firſt order of ſailing is formed, by each ſhip bearing away at the ſame time, and all ſteering the propoſed courſe.

In forming the ſecond order of ſailing, the leading ſhip runs to leeward of ſo many of the fleet as that each ſhip may readily fetch her wake, and then ſteers a courſe eight points from the wind, under an eaſy ſail. The line is formed by each ſhip in the ſame manner as in the firſt order, except that before bearing away, the line is perpendicular to the direction of the wind, or each ſhip has the wind on her beam.

As, in the third order of ſailing, the admiral's ſhip is in the centre; to produce this poſition, the fleet being formed in a line on one of the lines of bearing, and the ſhips ſteering in each others wake, ten points from the wind, the leading or leewardmoſt ſhip firſt hauls her wind. The ſecond ſhip does the ſame as ſoon as ſhe gets into the wake of the former, and this is done by each ſhip till the admirals ſhips haul their wind, when they reach the wake of the leading ſhip. At the ſame time that the admiral's ſhip hauls her wind, the ſternmoſt half of the fleet does the ſame. The ſhips are now in the third order of ſailing, from which the fleet can be formed in the line of battle on either tack.

To form the fourth order of ſailing (ſee N° 58.), the commanding admirals range themſelves on the two lines of bearing, at a proper diſtance from each other, ſteering the propoſed courſe, and the ſhips of the ſeveral columns take each their reſpective places, parallel to each other, and forming lines in the direction of the wind. Naval Tactics. 65 Fourth order.

To form the fifth order, the three leading ſhips of the diviſions take their poſts abreaſt and to leeward of each other, keeping their wind under an eaſy ſail; then the ſhips of each ſquadron make ſail, and take their reſpective ſtations at the proper diſtance aſtern of their leaders, while the commanders of each diviſion, and the correſponding ſhips of each, keep mutually abreaſt of each other. 66 Fifth order.

In forming from the firſt order of ſailing, if the ſhips are running large on the tack that anſwers to the line of bearing on which they ſail, and if the line is to be formed on the ſame tack, all the ſhips haul their wind at once, or as quickly as poſſible after the next to windward; but if they be on the other tack, with reſpect to the line of bearing, they all haul their wind and tack or veer together. If the line of battle is to be formed on the other line of bearing, the ſhip moſt to leewards veers or tacks, and hauls her wind, while the reſt of the fleet veer or tack at the ſame time, and ſteer with the wind four points free, and each ſhip hauls her wind as ſoon as ſhe gets within the wake of the leader. See fig. 10. Plate DLXIV. and fig. 1. Plate DLXV. 67 To form the line of battle. Fig. 10. Plate DLXV. fig. 1.

Suppoſe the fleet running before the wind in the ſecond order of ſailing; to form the line from this poſition, all the ſhips haul up together on the proper tack, preſenting their heads eight points from the wind at the line on which they are arranged; the leading ſhip then hauls her wind, immediately making ſail, or ſhortening ſail, ſo as to cloſe or open the order, and the ſame is done ſucceſſively by all the reſt (ſee fig. 2.). Fig. 2.

In a fleet running large in the third order, the line of battle is formed by the wing which is in the line of bearing corresponding to the tack on which the line is to be formed, and the ſhip at the angle hauling their wind together, while the ſhips of the other wing haul up together eight points from the wind. Each ſhip moving in this direction, till ſhe reach the wake of the other wing, when ſhe hauls cloſe up (ſee fig. 3.). Fig. 3.

In forming the line of battle on the ſame tack from the fifth order of ſailing (as the fourth is not calculated for forming a line of battle), the centre brings to, ſo as only to keep ſteerage way; the weather column bears away two points, and when it gets a-head of the centre, hauls its wind, while the ſhips of the lee column tack together, and crowd ſail to gain the wake of the centre, whey they retack together, and complete the line (ſee fig. 4.); or, the weather column brings to, while the centre and lee tack together, and bear away two points free. When the ſhips of the centre column have gained the wake of the van, they retack together, and bring to; and when thoſe of the lee have gained the rear line, they retack together, and all ſtand on; or laſtly, the lee column brings to, the centre runs under eaſy ſail two points free, to get a-head of the rear ſquadron, while the rear bears away under a preſs of ſail two points free, to get a-head of the centre diviſion. Fig. 4.

2. Suppoſe the weather and centre columns to interchange. To form the line under theſe circumſtances; the centre ſtands on, while the weather column bears away eight

Naval Tactics.

points, and having reached the wake of the centre, which now forms the van, hauls up; the ſhips of the lee column tack together, and run under a preſs of ſail, within two points free, ſo as juſt to gain the rear of the line; when they retack together (ſee fig. 5.), or the lee column brings to, while the centre ſquadron bears away three points under eaſy ſail; and having reached the wake of the van, hauls up, to form the centre diviſion.

Plate DLXV. fig. 5.

3. Suppoſe the centre and lee columns to interchange. The lee column ſtands on cloſe hauled under an eaſy ſail, the weather column bears away two points under a preſs of ſail, till it reach the head of the line, when it hauls up, and the centre bears away eight points, and when in the wake of the lee, now the centre, hauls its wind. (See fig. 6.).

Fig. 6.

4. If the weather and lee columns interchange; the lee column ſtands on under a preſs of ſail cloſe hauled, while the centre, under eaſy ſail, bears away two points, and when it reaches the wake of the now van ſquadron, hauls its wind, and the weather column bears away eight points, hauling up when in the wake of the centre. (See fig. 7.).

Fig. 7.

5. Suppoſe the centre column to form the van, and the weather the rear diviſion. Here the lee column brings to, while the centre bears away two points, forming the line a-head of the former, now the centre, and the weather column veers away ſeven points on the other tack, forming the rear ſquadron. (See fig. 1. Plate DLXVI.).

Plate DLXVI. fig. 1.

6. To form the line ſo that the lee column may form the van, and the centre the rear. The lee column is to ſtand on under a preſs of ſail, while the weather bears away three points under eaſy ſail, and the centre bears away eight points, the ſhips of each column hauling their wind, when in the wake of the now van diviſion. (See fig. 2.).

Fig. 2.

7. If the line of battle is to be formed on the other tack, ſo that the weather ſhall form the van diviſion, as in the firſt caſe, the ſhips of the weather column firſt tack ſucceſſively, while thoſe of the centre and lee ſtand on, the former under eaſy ſail, and the latter ſhortening ſail, the leading ſhips tacking when in the wake of the now van, taking great care that the ſhips of the centre and lee draw not too near to the ſternmoſt ſhips of the van, or to each other. (See fig. 3.).

Fig. 3.

8. To form the line on the other tack, when the centre and weather columns interchange. The weather column brings to, while the centre column ſtands on, till the leading ſhip be fully able to clear the weather column, when the ſhips of the centre tack ſucceſſively as they reach the wake of the van. The lee column ſtands on, tacking ſucceſſively, as the ſhips get into the wake of the van, under moderate ſail. (See fig. 4.).

Fig. 4.

9. In forming the line on the other tack, when the centre and lee interchange. The centre brings to, while the ſhips of the weather tack under ſhortened ſail, and the lee under a preſs of ſail ſtands on, the leading ſhip having gained the wake of the line, tacks, and is followed in ſucceſſion by her diviſion. The centre column fills and ſtands on, when the firſt ſhip of that column, and the laſt of the lee, bear from each other in a direction perpendicular to that of the wind. (See fig. 5.).

Fig. 5.

10. To form on this ſame tack, ſo that the weather and lee may interchange. The weather and centre bring to, while the lee crowds ſail, till it can paſs a-head of the weather column, when the ſhips tack in ſucceſſion. As ſoon as the leading ſhip of the centre, and the laſt of the lee bear from each other in a line perpendicular to the wind, the centre fills, and tacks in ſucceſſion when in the wake of the now van, and the ſhips of the weather column do the ſame when their leading ſhip and the laſt of the centre are under ſimilar circumſtances. (See fig. 6.).

Naval Tactics.

Fig. 6.

11. Suppoſe the centre is to form the van, and the weather the rear, in forming the line on the other tack. The weather brings to, while the other columns make ſail, till they can paſs a-head of the former on the other tack, when they tack ſucceſſively. The weather column, when the others have paſſed it, fills, and tacks to form the rear. (See fig. 7.).

Fig. 7.

12. Suppoſe now the lee column is to form the van. The weather and centre bring to, while the lee crowds ſail, and tacks when it can paſs a-head of the weather column. When the laſt ſhip of the now van has paſſed to windward of the former weather column, the van ſhortens ſail, to give time for the other columns to form, and the weather and centre fill at the ſame time, to gain the wake of the van, when they tack in ſucceſſion. (See fig. 8.).

Fig. 8.

68

To form the orders of ſailing from the line of battle.

We muſt now ſhew how a fleet may be diſpoſed in the principal orders of ſailing from the line of battle; and here, as before, we have ſeveral varieties.

1. To form the firſt order of ſailing from the line of battle on the ſame tack. All the ſhips are to bear away together as many points as the admiral may direct, keeping in the line of bearing for the proper tack. The ſternmoſt firſt bears away, and the others follow in quick ſucceſſion to prevent running foul of each other.

2. If they are to form on the other tack; the leading ſhip bears away four points to leeward, and the reſt follow in ſucceſſion. The ſternmoſt ſhip having bore away, the whole haul up, and will be in bearing for the line on the other tack. (See fig. 9.).

Fig. 9.

3. To form the ſecond order of ſailing from the line of battle, the whole fleet is to bear away together 10 points, ſo that when the headmoſt ſhip, which firſt preſſes ſail, ſhall come abreaſt of the ſecond ſhip, the ſecond ſhip adapts her ſail to keep in this bearing, and ſo in ſucceſſion, each taking care to keep the preceding ſhip in a line with herſelf, perpendicular to the direction of the wind. The whole fleet will now be before the wind. (See fig. 10.).

Fig. 10.

4. To form the third order, the whole fleet is to bear away together ten points, the headmoſt half, including the centre ſhip, carrying a degree of ſail to preſerve their line of bearing, while each of the remaining ſhips is ſucceſſively to ſhorten ſail, ſo as to form the other line of bearing with reſpect to that on which they were before arranged. (See fig. 1. Plate DLXVII.).

Plate DLXVI fig. 1.

5. To change from the line of battle to the fifth order on the ſame tack. Of this evolution there are ſeveral varieties, but we ſhall mention only two; firſt, when the van is to form the weather, and the rear the lee column, and the fleet to keep as much as poſſible to windward.—In this caſe the van and centre tack together, and run cloſe hauled in bow and quarter line, while the rear proceeds in its former courſe under eaſy ſail. When each ſhip of the centre is abreaſt of the correſponding ſhip of the rear, the centre retacks, while

while the van ſtands on, till the centre and rear come up, when it alſo retacks, and all the columns regulate their diſtances. (See fig. 2.). Secondly, when the van is to form the lee, and the rear the weather column.—The van bears away under eaſy ſail, and goes at right angles with the line a-head, while the centre runs two points free, each ſhip ſteering for that ſhip of the van which is to be a-breaſt of her when in column. The diſtance muſt be determined by the leader of the van, who is not to haul up with her diviſion, till ſhe and the ſternmoſt ſhip of the centre column are in a line at right angles with the wind, when both ſtand on under eaſy ſail, while the rear crowds ſail to paſs to windward of both. (See fig. 3.).

Fig. 2.

Fig. 3.

6. To form the fifth order of ſailing from the line of battle on the other tack—of which there are alſo ſeveral varieties; but we ſhall confine ourſelves to two: Firſt, when the van is to form the weather, and the rear the lee column; the van tacks in ſucceſſion, while the leading ſhip of the centre is to tack when the leader of the van paſſes him exactly to windward, in which the is followed by her diviſion, and the rear manœuvres in the ſame manner with reſpect to the centre. (See fig. 4.). Secondly, when the rear is to form the weather and the van the lee column; the van tacks in ſucceſſion, and when about, either ſhortens ſail, or brings to, to allow the other columns time to form. The centre and rear then crowd ſail, and tack in ſucceſſion, the former tacking when its leader has the centre of the lee column in a line at right angles with the wind, or when its centre paſſes a-ſtern of the lee column. When the centre has tacked, it regulates its rate of ſailing by the lee, and both wait for the rear to paſs to windward. The rear tacks when the leader has the firſt ſhip of the lee in a line at right angles with the wind, or when its centre ſhip paſſes a-ſtern of the centre column. (See fig. 5.).

Fig. 4.

Fig. 5.

Fig. 6.

7. Fig. 6. repreſents the order of retreat formed from the line of battle, the whole fleet going four points free. This evolution is ſo ſeldom required in a Britiſh fleet, that we need not dwell on it.

59
To manœuvre in line of battle.

There are various evolutions or manœuvres performed by a fleet when in line of battle, ſome of which we muſt here deſcribe.

Sometimes the fleet has to form the line on the other tack, by tacking in ſucceſſion. To do this, the leading ſhip of the fleet tacks firſt, after making more ſail, or after the ſecond has ſhortened ſail, to increaſe the interval between them. When the firſt ſhip is about, either the ſecond makes more ſail, or the third ſhortens ſail, and as ſoon as the ſecond gets into the wake of the leader, ſhe tacks, putting down the helm juſt as ſhe opens the weather quarter of the firſt ſhip, already on the other tack. In the ſame manner, each of the other ſhips tacks when in the wake of the leader; and the ſhips already about muſt preſerve their proper diſtances, by ſhortening ſail, if neceſſary, till the whole fleet be on the other tack. If a ſhip ſhould miſs ſtays, ſhe muſt immediately fill again on the ſame tack, and make ſail with all poſſible expedition, taking care not to fall to leeward. Thus ſhe will get a-head, and to windward of the following ſhips, which will ſucceſſively perform their evolutions in the wake of the ſhips that are already on the other tack, ſtanding on rather further than if the ſhip a-head had not miſſed ſtays. (See fig. 7.).

Fig. 7.

But ſuppoſe the ſhips are not to tack in ſucceſſion. To form the line on the other tack, the whole fleet veers together; the rear ſhip hauls her wind on the other tack, and ſtands on, while the reſt go two points free on the other tack, and haul up as they ſucceſſively gain the wake of the leading ſhip. (See fig. 8.). Naval Tactics.

Fig. 8.

If the line is to veer in ſucceſſion, the van ſhip veers, and ſtands four points free on the other tack, hauling her wind when clear of the ſternmoſt ſhip, and the reſt follow and haul up in ſucceſſion. (See fig. 9.).

Fig. 9.

Sometimes the fleet has to turn to windward while in line of battle. The beſt way to do this, when there is good ſea-room, is for all the ſhips to tack together, when the fleet will be in line of battle on the one board, and in bow and quarter line on the other. If, however, the fleet be turning to windward in a narrow channel, it is beſt for the ſhips to tack in ſucceſſion, as, were they all to tack together, the van would be ſoon in with the land on one ſide, while the ſtern ſhip, ſoon after the fleet had retacked, would be too near the land on the other ſide.

If the van and centre are to interchange; the van is to bear away a little, and then bring to, while the centre paſſes on to windward, edging a little, to get a-head of the former van on the ſame line; the rear, coming on under an eaſy ſail, edges away likewiſe, to gain the wake of the now centre ſquadron. (See fig. 10.).

Fig. 10.

If the van and rear are to interchange; the van and centre are to bear away a little, and then bring to, ſo that the van may bear away a little more to the leeward than the centre. The rear ſtands on to gain the head of the line; and when a-breaſt of the former van, the centre fills, and both ſtanding on, form a-head of the now rear, by edging down till they are in a line with it. (See fig. 11.).

Fig. 11.

If the centre and rear are to interchange; the van ſtands on under an eaſy ſail, while the centre bears away a little, and brings to, and the rear at the ſame time carries a preſs of ſail to paſs the centre to windward, and get into the wake of the van. The van and centre then edge away to gain the line, with the now rear ſquadron, which then fills. (See fig. 12.).

Fig. 12.

70
To manœuvre in the fifth order of ſailing.

Several evolutions are required while a fleet is in the fifth order of ſailing, and of theſe we ſhall notice ſome of the more important.

When the columns are to tack in ſucceſſion, the ſhips of the lee muſt tack firſt, as they have moſt diſtance to run, and when the leader of the centre comes a-breaſt of the leader to leeward, or at right angles with the cloſe-hauled line on the other tack on which the leader of the lee is now moving, ſhe tacks and is followed ſucceſſively by the ſhips of her diviſion. The weather column manœuvres in the ſame manner, paying the ſame regard to the centre. Here the weather column is ſtill to windward, and ſhould the columns have cloſed too much, or be too far aſunder, the order may be recovered, either by the lee or windward column bearing away, ſo as to make an angle equal to that propoſed between any column, and a line joining the leader of that column, and the ſternmoſt ſhip of the next. (See fig. 13.).

Fig. 13.

When all the columns are to tack together; the ſternmoſt ſhips put in ſtays together; and when in ſtays, their ſeconds a-head put down their helms, and ſo on through the whole fleet. Each column will then be in bow and quarter line. (See fig. 14.).

Fig. 14.

When

Naval Tactics.

When the columns are to veer in ſucceſſion; the leader of the lee column muſt ſteer four points free on the other tack, followed by the ſhips of that diviſion, and when ſhe is clear of the ſternmoſt ſhips of that diviſion, ſhe hauls up. The ſame evolution is performed by the centre and weather ſhips ſucceſſively, ſtanding on till they bring the point at which the lee column began to veer to bear in a right line to leeward of them. They likewiſe ſucceſſively ſpring their luffs when the point at which the lee column hauled its wind, bears right to leeward. (See fig. 15.).

Plate DLXVII. fig. 15.

Suppoſe the fleet, when in the fifth order of ſailing is to turn to windward; let the ſhips be ſo arranged that the leaders and correſponding ſhips may be in the direction of the wind. The van ſhips muſt tack together, which are followed in ſucceſſion, each by the remaining ſhips of the diviſion, when they reach the wake of their leaders, or the ſame point when they tacked; ſo that there will always be three ſhips in ſtays at once, till the whole fleet is on the other tack. The fleet then ſtands on to any propoſed diſtance, and retacks as before. (See fig. 1. Plate DLXVIII.).

Plate DLXVIII. fig. 1.

When the weather and centre columns interchange; the weather and lee lie to, or only keep ſteerage way. The centre column tacks together, and forming a bow and quarter line, goes cloſe hauled to gain the wake of the weather column; it then tacks together, and ſtands on, while the weather column bears away to its new ſtation in the centre, and the lee column fills. (See fig. 2.).

Fig. 2.

When the weather and lee columns are to interchange; the centre column muſt bring to; while the lee ſtands on under a preſs of ſail; and when its ſternmoſt ſhip can paſs to windward of the van of the centre column, that is, when the centre ſhip of the lee is in a perpendicular line to the direction of the wind with the van of the centre column, the lee column then tacks together, and ſtands on cloſe hauled till it comes in a line with the centre column, when it goes large two points to get into the ſituation which the weather column left; and then veers together, hauling the wind for the other tack. At the beginning of the evolution the weather column bears away together under little ſail, and goes large ſix points on the other tack, to get into the wake of the centre column; it then hauls to the former tack, going two points large, till it comes abreaſt of the centre column, when it brings to, and waits for the now weather column. (See fig. 3.).

Fig. 3.

Suppoſe the weather column is to paſs to leeward; the weather column is to ſtand on under eaſy ſail, while the centre and lee tack together, carrying a preſs of ſail till they reach the wake of the weather column, when they retack, and crowd ſail till they come up with it. The weather column, when the others have gained its wake, bears away two points, to gain its ſtation to leeward, when it brings to, till the other columns, now the weather and centre, come up. (See fig. 4.).

Fig. 4.

Suppoſe the lee column is to paſs to windward. The weather and centre columns bring to, while the lee column carries ſail and tacks in ſucceſſion as ſoon as the leading ſhip can weather the headmoſt ſhip of the weather column; and when arrived on the line on which the weather column is formed, it retacks in ſucceſſion, forms on the ſame line, and either brings to or ſtands on under eaſy ſail. If it brings to, the other two columns bear away together two points, to put themſelves a-breaſt of the column now to windward; but if the now weather column ſtood on under an eaſy ſail, they may bear away only one point, to gain their proper ſtations. (See fig. 5.).

Naval Tactics.

Fig. 5.

It is of the greateſt importance that each ſhip of a fleet or ſquadron preſerve her proper ſtation and diſtance with reſpect to the reſt. Theſe may be regulated in two ways, either by obſervation with the quadrant, or by what is called the *naval ſquare*. This ſquare is uſually conſtructed in the following manner.

71 Conſtruction and uſe of the naval ſquare.

On ſome convenient place in the middle of the quarter-deck is deſcribed the ſquare ABCD, fig. 6. having the ſides AD and BC parallel to the keel of the ſhip. Through the centre G, the line EF is drawn parallel to AD or BC, and the diagonals AC and BD are drawn. The angles EGD, EGC are biſected by the ſtraight lines GH, GI, and thus the naval ſquare is completed. Now the angles FGD, FGC are = 4 points each, being each half a right angle, therefore the angles EGD, EGC, the complements of theſe angles, are each = 12 points, and conſequently the angles EGH, EGI are each = 6 points, being each half of the laſt angles. Now, if a ſhip be running cloſe hauled on the ſtarboard tack, in the direction FE, the direction of the wind will be IG, and her cloſe-hauled courſe on the other tack will be GC; but if ſhe be running cloſe hauled on the larboard tack in the ſame direction, her direction when cloſe hauled on the ſtarboard tack will be GD.

Fig. 6.

Now, to apply the naval ſquare to the keeping of ſhips in their reſpective ſtations, ſuppoſe the fleet formed on the fifth order of ſailing, cloſe hauled, the correſponding ſhips of the columns coinciding with the direction of the wind, in order to run to windward with greater facility. The correſponding ſhips in the column muſt be kept in the direction of GH, or GI, according to the direction of the wind and the tack they are on, while all the ſhips of the ſame column muſt be in the direction of EF. (See fig. 7.).

Fig. 7.

Again, ſuppoſe the ſhips arranged in three columns on one of the lines of bearing, and cloſe hauled on the other tack. The ſhips of each column will be in the direction of one of the diagonals, while the correſponding ſhips of the other columns will be in the direction of the other diagonal. (See fig. 8.).

Fig. 8.

72 To reſtore the order of battle, on ſhifts of wind.

Sometimes the line of battle is diſordered on the wind's ſhifting, and requires to be reſtored. Of this there are ſeveral caſes, a few of which we ſhall notice.

1. When the wind comes forward leſs than 6 points. In this caſe the whole fleet except the leader brings to. The leading ſhip, that the ſame diſtances between the ſhips may be preſerved on reſtoring the line, ſteers a courſe as *a b* (fig. 9.), ſo as to be at right angles with the middle point between the former and preſent direction of the wind. His required courſe may be known by adding half the number of points the wind has ſhifted to eight points, and applying this ſum to the former cloſe-hauled courſe. When the leader has arrived at the new cloſe-hauled line with reſpect to the ſecond ſhip a-head, this ſhip immediately fills, and bears away as many points as the leader; and when both theſe have reached the cloſe-hauled line with reſpect to the third ſhip, ſhe alſo fills, and bears away; and thus with the reſt in ſucceſſion; and when they have got into the cloſe-hauled

Fig. 9.

Naval Tactics.

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eloſe-hauled line *b c* with the ſternmoſt ſhip, they all haul their wind together, and the ſternmoſt ſhip fills and ſtands on eloſe hauled.

This may be expeditiouſly performed, if the whole fleet fall off as ſoon as the wind ſhifts, the ſame number of points, and the leader bear away eight points from the middle between the former and preſent directions of the wind, or when the wind ſhifts nearly ſix points, if the leader bear away eight points from the preſent direction of the wind, and hauls her wind as ſoon as the ſternmoſt ſhip bears from her in the eloſe-hauled line, while the ſecond ſhip bears away when ſhe reaches the wake of the leader, and hauls her wind when ſhe has again gained his wake. The third, fourth, &c. ſhips bear away, and alſo haul their wind in ſucceſſion, till the ſternmoſt and the whole line be formed again. (See fig. 10.).

Fig. 10.

2. Suppoſe the wind comes forward leſs than ſix points, and the order of battle is to be re-formed on the other tack. In this caſe all the ſhips are to veer round till their heads come to the requiſite point with reſpect to their former courſe, when the rear ſhip, now become the van, hauls cloſe by the wind, followed ſucceſſively by the other ſhips. Should the wind come a-head more than ſix points, but leſs than twelve, the fleet is to manœuvre as before, but if it ſhift exactly twelve points a-head, the tack muſt be changed.

3. Laſtly, ſuppoſe the wind to ſhift oft—if leſs than two points, the leader hauls her wind, while the fleet ſtands on as before, each ſucceſſively hauling her wind as ſhe gains the wake of her leader. If the tack is to be changed, the whole fleet tack together, and the ſternmoſt ſhip, now the leader, hauls up, while the reſt bear down and haul up in ſucceſſion.

Should the wind change 16 points, all the ſhips immediately brace about for the other tack, by which means the fleet will be going four points large; then the ſhips inſtantly tacking or veering together, the order of battle will be reſtored or formed again on the ſame tack as before the wind changed.

It is inconſiſtent with the nature of our plan to be more minute on the various evolutions of a fleet, when not in action with the enemy. Our nautical readers will find abundant information of this kind in the uſual works on naval tactics, eſpecially the *Elements and Practice of Rigging*, *Seamanſhip*, *Naval Tactics*, &c. of which the lateſt edition is in 4 vols 8vo.; and *The System of Naval Tactics, with coloured figures*, both publiſhed by Steel.

Having deſcribed and illuſtrated the prineipal evolutions which are performed by fleets or ſquadrons under ordinary circumſtances, we are prepared to conſider the nature and conſequences of a naval engagement.

73 um- ces to onſider- n form- a fleet action.

In forming a fleet for battle, it is proper to conſider the ſize and number of the ſhips of which it is to conſiſt, and the diſtance at which they are to be placed with reſpect to each other. In the preſent ſyſtem of naval warfare, it is generally deemed of advantage to have the ſhips that are to form the principal line as large as poſſible; for though large ſhips are not ſo eaſily and expeditiouſly worked as thoſe of a ſmaller ſize, they are moſt ſerviceable during the action, both as carrying a greater weight of metal, and as being leſs expoſed to material injury, either from the enemy's ſhot, or from the weather. In boarding too, a large ſhip muſt have greatly the ſuperiority over a ſmaller, both from her greater height, and from the number of hands which ſhe contains. With reſpect to the number of ſhips, it is of advantage that they be not too numerous, as if the line be too extenſive, the ſignals from the centre are with difficulty obſerved.

In arranging a fleet in line of battle, it is proper to regulate the diſtance ſo that the ſhips ſhall be ſufficiently near to ſupport each other, but not ſo cloſe as that a diſabled ſhip may not readily be got out of the line without diſturbing the reſt of the fleet.

74 Advantages and diſadvantages of the weather gage.

It has long been deemed a point of great conſequence with the commander of a fleet to gain the weather gage, or to get to windward of the enemy, before coming to action. In deciding on the propriety of this, much will depend on the relative ſtrength of each fleet, and on the ſtate of the weather at the time. We ſhall ſtate the advantages and diſadvantages of the weather gage, as they are commonly laid down by writers on naval tactics, though we may obſerve by the way, that if a fleet be much ſuperior to its opponent, it is ſeldom of conſequence whether it engages to windward or to leeward.

A fleet to windward of the enemy is thought to poſſeſs the following advantages. It may approach the leeward fleet at pleaſure, and can of courſe accelerate or delay the beginning of the engagement. If more numerous, it may ſend down a detachment on the rear of the enemy, and thus throw him into confuſion. It may alſo readily ſend down fireſhips on the enemy's fleet, when thrown into confuſion or diſabled. It may board at any time, and is ſcarcely incommoded by the ſmoke of the enemy. The reverſe of theſe circumſtances, of courſe, act againſt a leeward fleet.

The diſadvantages of being to windward of the enemy reſpect chiefly the circumſtances attending a retreat, ſhould this be neceſſary. The windward fleet can ſeldom retire without paſſing through the enemy's line; and if in attempting to retreat, the windward ſhips tack together, thoſe of the leeward fleet may do the ſame, rake the weather ſhips in ſtays, and follow them on the other tack, having now the advantage of the wind. In ſtormy weather, the windward ſhips can ſeldom open their lower deck ports, and the lee guns are not eaſily managed after firing. Again, any diſabled ſhips cannot eaſily quit the line without diſordering the reſt of the fleet, and expoſing either that or themſelves to be raked by the enemy to leeward. A leeward fleet has the advantages of ſerving their lower deck guns in all weathers; of being able to retreat at pleaſure; of drawing off without difficulty their diſabled ſhips; of forming with more readineſs the order of retreat; or of continuing the action as long as convenient; of having it in their power when ſuperior in number, to double the enemy, and of cannonading with great effect the windward ſhips as they bear down for the attack.

As an engagement between two adverſe ſhips is in ſome meaſure an epitome of an engagement between two fleets, we ſhall firſt briefly deſcribe the former, as it takes place under ordinary circumſtances, and ſhall then notice the uſual manner of conducting a general engagement.

A naval engagement may be divided into three ſtages, the *preparation*, the *action*, and the *repair*.

When

Naval Tactics.

75 Deſcription of an engagement between two ſhips.

76 Preparation.

When an enemy's ſhip heaves in ſight, and it is thought adviſable to bring her to an engagement, orders are firſt given to clear for action, which is begun by the boatſwain and his mates piping up the hammocks, in order to clear the ſpace between decks, for the more eaſy management of the guns, as well as to afford the men on the quarter-deck, &c. a better protection againſt the enemy's ſhot, the hammocks being ſtowed in the nettings above the gunwale and bulwarks. After this, the boatſwain's mates go to work to ſecure the yards, which is done by faſtening them with ſtrong chains or ropes in addition to thoſe by which they are ſuſpended. They likewiſe get ready ſuch materials as may be neceſſary for repairing the rigging, if it ſhould be cut away, or otherwiſe damaged by the enemy's ſhot. In the mean time the carpenter and his mates prepare ſhot plugs and mauls, to ſtop any dangerous ſhot holes that may be made in the hull near the ſurface of the water, and provide the neceſſary iron work for refitting the chain-pumps, if their machinery ſhould be injured during the engagement; while the gunner and his mates, and the quarter gunners, examine the guns, to ſee that their charges are dry, and provide every thing that may be required for ſupplying the great guns and ſmall arms with ammunition. The maſter and maſter's mates ſee that the ſails are properly trimmed, according to the ſituation of the ſhip, and increaſe or reduce them as may be found neceſſary; and the lieutenants viſit the different decks, to ſee that all is clear, and to take care that the inferior officers do their duty.

When the hoſtile ſhips have approached within a proper diſtance of each other, the drums beat to arms; the boatſwain and his mates pipe *all hands to quarters!* All the men who are to manage the great guns repair immediately to their reſpective ſtations. The crows, handſpikes, rammers, ſponges, powder-horns, matches, and train tackles, are placed in order by the ſide of the guns: the hatches are immediately cloſed, to prevent ſculkers from getting below; the marines are drawn up on the quarter-deck, &c. the laſhings of the guns are caſt looſe, and the tompions withdrawn. The whole artillery, above and below, is run out at the ports, and levelled to the point-blank range, ready for firing.

77 The action.

When theſe neceſſary preparations are completed, and the officers and crew ready at their reſpective ſtations, and when the two ſhips are ſufficiently near each other, in a proper relative ſituation for the ſhot to take full effect, the action commences with a vigorous cannonade from the great guns, accompanied by the whole efforts of the ſwivels and ſmall arms. The firing is ſeldom performed in vollies, as that would ſhake the ſhip too much, but the guns are loaded and fired one after another, with as much diſpatch and as little confuſion as poſſible, care being taken to fire only when each gun is properly directed to its object. During the firing, the lieutenants traverſe the decks, to ſee that the battle is proſecuted with vivacity, and that the men do their duty, while the midſhipmen ſecond their injunctions, and give the neceſſary aſſiſtance where required, at the guns committed to their charge. The youngeſt of theſe inferior officers are generally employed to carry orders from the captain. The gunners are all this time employed in the magazines, filling cartridges, which are carried along the decks in boxes by the boys of the ſhip. When the action has continued ſo long, or has produced ſuch an effect, that one of the ſhips muſt yield or retreat, if the vanquiſhed ſhip cannot get off, ſhe acknowledges her inferiority by ſtriking, or hauling down her colours, when ſhe is, as ſoon as poſſible, taken poſſeſſion of by the victor, the commander of which ſends a part of his own crew into the captured ſhip, and brings away moſt of her officers and men on board his own ſhip, as priſoners of war.

Naval Tactics.

78 Repair.

The engagement being concluded, they begin to repair; the guns are ſecured by their breechings and tackles, with all convenient expedition. Whatever ſails have been rendered unſerviceable are unbent, and the wounded maſts and yards ſtruck upon deck, to be fiſhed or replaced by others. The ſtanding rigging is knotted, and the running rigging ſpliced where neceſſary. Proper ſails are bent in the room of thoſe which have been diſplaced as uſeleſs. The carpenter and his mates are employed in repairing the breaches made in the ſhip's hull, by ſhot plugs, pieces of plank, and ſheet lead. The gunner and his aſſiſtants are buſied in repleniſhing the allotted number of charged cartridges, to ſupply the place of thoſe which have been expanded, and in refitting whatever furniture of the guns may have been damaged by the action.

79 Engagement between two fleets.

A general engagement between two adverſe fleets of courſe involves a greater variety of circumſtances, and requires greater judgment, and more comprehenſive ſkill in the commanding officer.

When the commander of a fleet has diſcovered an enemy's fleet, his principal object, if he be ſufficiently ſtrong, is to bring it to action as ſoon as poſſible. Every inferior conſideration gives way to this important object, and all neceſſary preparations are immediately made to prepare for ſuch an event. The ſtate of the wind and ſituation of the enemy will in general regulate his conduct with regard to the diſpoſition of his ſhips on that occaſion. To facilitate the execution of the admiral's orders, the whole fleet is diſpoſed in three ſquadrons, and each of theſe claſſed into three diviſions, under the command of different officers. Before the action begins, the adverſe fleets are drawn up in two lines, as formerly deſcribed. As ſoon as the admiral diſplays the ſignal for the line of battle, the ſeveral diviſions ſeparate from the columns in which they were diſpoſed in the uſual order in ſailing, and every ſhip crowds ſail to get into its ſtation in the wake of the next ahead; and a proper diſtance from each other is regularly obſerved from the van to the rear. The admiral, however, occaſionally contracts or extends his line, ſo as to regulate the length of his line by that of his adverſary. This is more particularly neceſſary to prevent his being doubled, by which his van and rear would be thrown into diſorder. When the hoſtile fleets approach each other, the courſes are commonly hauled upon the brails, and the top-gallant ſails and ſtay ſails furled. The movement of each ſhip is regulated chiefly by the main and fore-top ſails and the jib: the mizen-top ſail being reſerved to haſten or retard the courſe of the ſhip; and by filling or backing, hoiſting or lowering it, to determine her velocity. The ſignal for a general engagement is uſually diſplayed when the fleets are ſufficiently near each other, to be within the range of point-blank ſhot, ſo that the guns may be levelled with ſome certainty of execution. After the battle has commenced, it is carried on much in the ſame manner as between two ſhips, except that each

veſſel

Naval Tactics.

veſſel of the fleet, beſides attending to her own movements, has to obſerve the ſignals made by the commanding officer, and repeated by the frigates on the van and rear. The chief object of the admiral is to keep his line as complete as poſſible, by ordering ſhips from thoſe in reſerve to ſupply the place of ſuch as may have been diſabled, and to annoy the enemy as much as poſſible, both by ſtrengthening the feeble parts of his own line, and, if circumſtances admit of it, by ſending down fire-ſhips upon that of the enemy. When the engagement draws near a cloſe, either by the defeat of the enemy, or by the diſabled ſtate of either fleet, ſignals are made from the admiral to take poſſeſſion of ſuch of the enemy's ſhips as have ſtruck, to tow his own diſabled ſhips into a place of ſecurity, and either to chaſe the remainder of the enemy's ſquadron, or, if that be impracticable, to draw off his own ſhips to be refitted. *

Such are the general incidents attending an engagement at ſea, modified of courſe by numerous circumſtances, of which a general deſcription can convey no idea. There are, however, various movements and evolutions connected with a naval engagement, which it will be neceſſary for us to notice.

Where the weather-gage is deemed of ſufficient importance, it is often an object with two fleets to diſpute it with each other. When the enemy is to windward, and it is wiſhed to gain the weather-gage of him, the fleet to leeward ſhould avoid extending itſelf the length of the enemy's line, in order to oblige them to edge down upon theirs, if they intend to attack them; which will be a mean, if they ſtill perſiſt in doing ſo, of loſing the advantage of the wind. It is impoſſible for a fleet to leeward to gain to windward, ſo long as the enemy keep the wind, unleſs a change happens in their favour; therefore all that a fleet to leeward can do muſt be to wait with patience for ſuch a change, of which they will undoubtedly avail themſelves, as well as of any inadvertency the enemy may commit in the mean time. And as long as the fleet to leeward does not extend its line the length of the enemy's, it will be impoſſible for the latter to bring them to action without running the hazard, by bearing down, of loſing the advantage of the wind, which both fleets will be ſo deſirous of preſerving. That an admiral may take advantage of ſuch ſhifts of wind as occaſionally happen, he muſt endeavour to get his ſhips into ſuch ſituations where theſe ſhifts moſt frequently take place. It is well known to experienced naval officers, that particular winds reign moſt on certain coaſts, or off certain headlands. Here, therefore, the admiral ſhould await the approach of the enemy; and though by this plan he may ſometimes be unſucceſsful, he will more frequently gain a material advantage. The diſpoſition of projecting headlands, and the ſetting of tides and currents, often contribute materially towards gaining the wind of the enemy. The fleet to windward ſhould keep that to leeward as much as poſſible abreaſt of it; and thus, unleſs the wind changes conſiderably, they will preſerve the advantage they have gained. They ſhould alſo force them to keep their wind, unleſs they think it prudent not to engage, in which caſe it would be better to keep altogether out of ſight.

When the enemy appears deſirous of avoiding an action, there are various methods of attempting to force him to engage; as firſt, when he has the weather gage. In this caſe the lee fleet, which is deſirous of bringing on an engagement, muſt keep always on the ſame tack with the enemy to windward, taking care to keep their own ſhips ſo exactly abreaſt of the enemy, as to prevent loſing ſight of them; and hence be ready to take advantage of the firſt favourable ſhift of wind to make the attack. An alteration of the courſe may be beſt attempted in the night. The lee fleet muſt have frigates on the look-out, and theſe muſt continually give notice by ſignal of the manœuvres and courſe of the retreating fleet to windward. Thus the weather fleet is always expoſed to purſuit, without being able to get off unſeen; hence muſt ſooner or later be compelled to an engagement, unleſs they can get into ſome friendly port, or ſhould be favoured by a gale of wind ſufficient to diſperſe both fleets, and thus prevent the poſſibility of a general engagement.

Secondly, when the enemy is to leeward.—If the lee fleet keep cloſe to the wind in the order of battle, the fleet to windward is to ſtand on in the ſame manner till it be abreaſt of the enemy, ſhip to ſhip, and at the ſame time to bear away, and ſteer ſo as to bring their reſpective opponents on the ſame point of the compaſs with themſelves. Thus the adverſe fleets will be ſufficiently near each other to begin the action, by each ſhip's preſenting her bow to the ſhip abreaſt of her in the order of ſailing, which may be eaſily changed for the order of battle, by all the ſhips hauling together cloſe to the wind, in the moment which precedes the action. If the fleet to leeward appear inclined to engage, it may bring to, to prevent loſing time, and after this they will fill as ſoon as the action commences, becauſe it is of advantage to a lee line to be advancing a-head. As the lee fleet fills and ſtands in cloſe by the wind, the weather line ſhould keep a-breaſt, before it bears away, to come within the requiſite diſtance, that the van ſhip of the weather fleet may always keep to windward of the leading ſhip of the lee line, and be guarded againſt any ſhift of wind a-head.

If the lee fleet bear away four points to move their order of battle on the other tack, and avoid the action, filing off in ſucceſſion in the wake of the van ſhip, the weather line, by bearing away all together eight points, cannot fail, as both fleets are ſuppoſed to ſail equally, to paſs through the middle of their line, and force them to fight with diſadvantage, if their extent be double the diſtance between the two fleets. If the extent of the fleet be leſs than the above limitation, then the weather fleet will divide the lee fleet more unequally; and if the diſtance between the fleets be conſiderable, the weather fleet will be able to break through the line. If the lee fleet bear away four points all together, being of equal extent with the fleet to windward, and their diſtance from each other equal to that of the length of one of the lines; ſhould the weather fleet bear away at the ſame time eight points, they will approach very near the ſternmoſt of the retreating fleet; but they will not have it in their power to cut off any part of that fleet, even with an equality of ſailing; ſo that the only advantage gained by this manœuvre will be an ability of attacking the rear, and bringing it to action.

If the van ſhip and the reſt of the weather fleet had a ſufficient velocity to keep the centre ſhip of the lee line on the ſame point of bearing; in that caſe, the leading ſhip may break through the enemy's line about the

Naval Tactics.

middle ſhip of the centre diviſion; for, ſuppoſing the fleets in the order of battle, on the ſtarboard tack, ſteering eaſt, with the wind at ſouth ſouth-eaſt, being at two leagues diſtance from each other, both the lines being four leagues in extent; then the lee line bearing away all together four points, will run north-eaſt; while the fleet to windward, bearing away all together eight points, will ſteer north; the van ſhip of which will keep the centre diviſion of the lee line in the point of bearing north-weſt. As ſhe is ſuppoſed to be able to continue in this poſition, it follows, that the van of the weather line muſt cloſe the centre of the flying line to leeward, after having run four leagues. The time and diſtance neceſſary to cut off a retreating fleet may always be known according to the laſt ſuppoſition. If the lee fleet ſhould get on the other tack, and run large, ſtill in the order of battle, they will be ſooner forced to action by the weather fleet, who have only to bear away eight or nine points on the ſame tack, or run right before the wind.

81 To avoid coming to action.

As in forcing a fleet to action, there are two principal caſes in which a fleet may avoid an action, where circumſtances are not ſufficiently favourable; firſt, when the enemy is to windward, and ſecondly, when he is to leeward. In the former caſe the lee fleet ſhould form the order of retreat, if the enemy are in view, and run on the ſame tack as their leading ſhip; but if he is ſtill out of ſight, and they have received intelligence of his approach, by their frigates on the look-out, they may bear away large, without confining themſelves to keep the wind directly off, unleſs when in the order of retreat. In the ſecond caſe, it ſeldom happens that the weather fleet can be forced to an engagement, becauſe it can always ſtand on that tack which increaſes its diſtance from the enemy; that is, by ſtanding on one tack while the enemy is on the other. The windward fleet muſt of courſe not keep too near the enemy, and take all poſſible means of avoiding being abreaſt of him.

82 To double an enemy.

It is often of advantage to double the enemy; that is, to bring a part of the fleet round upon his van or rear, ſo as to place him between two fires. This manœuvre alſo reſolves itſelf into two principal caſes: firſt, when the enemy is to windward; ſecondly, when he is to leeward. In the firſt caſe, the lee fleet that attempts to double the enemy, ſhould extend itſelf abreaſt of him, ſo that its van or rear may extend beyond his line, in order to overreach him, by tacking in ſucceſſion, ſo that the extended part of the line may get up to windward. If this manœuvre be properly executed, it will be impoſſible for the ſhips of the weather line long to maintain their ſtations, for no veſſel cloſely attacked by two others of equal force can long reſiſt.

It is of ſome conſequence to determine whether the attempt to double ſhould be made on the van or the rear of the enemy, as on the propriety of adopting the one or the other of theſe meaſures, may in a great meaſure depend the iſſue of the battle. In the preſent caſe, it is moſt eaſy to double the van of the enemy, becauſe if they are engaged by the ſhips abreaſt of them, thoſe which are advanced ahead will be able, by making all ſail, to get in the perpendicular to the direction of the wind with the van of the enemy, and tack in ſucceſſion to gain the wind of them on the other board, thus keeping them to leeward; and when they are come ſufficiently to windward, they are again to go about, in order to keep the two headmoſt ſhips of the enemy's line continually under their fire. If there be two or three ſhips to tack in ſucceſſion and gain the wind of the enemy, they may edge down on the van of the water line at pleaſure, keeping themſelves a little to windward of it; and as that van is already engaged by the other ſhips abreaſt on the other ſide, ſhe muſt neceſſarily be ſoon diſabled. If they bear away, they muſt drop upon the line with which they are engaged to leeward, while the ſhips to windward ſtill continue to cannonade them. If they attempt going about, in order to attack more cloſely the ſhips to windward, they will be raked, while in ſtays, by their opponents to leeward and to windward, who enfilading them with whole broadſides, which they cannot return, muſt complete their diſorder. If they make ſail, in order to fruſtrate the deſign of the ſhips inclined to double, thoſe with which they are engaged abreaſt to leeward have only to perform the ſame manœuvre, and keep them under their fire; while the others, after having haraſſed them as much as poſſible, will do their beſt to perform the ſame manœuvre on the ſucceeding ſhips.

Naval Tactics.

If any of the ſhips in the van of the weather line are diſabled in the maſts or yards, they will drop aſtern, and run foul of the next ſucceeding ſhip, and theſe again on the next aſtern. Thus, the enemy's order of battle will be broken, while on the other hand the lee line is preſerved; and thoſe ſhips which have gained the wind of the enemy will, without engaging more ſhips than they can manage, contribute to increaſe the confuſion.

When the enemy is to leeward, and the weather fleet attempts to double, the ſhips of the weather line muſt extend their van beyond that of the enemy, and then veer in order to bring the headmoſt ſhips of the lee line between two fires. It muſt not, however, be concealed, that it is much more dangerous to the ſhips engaged in this ſervice to attempt doubling a fleet to leeward, than one to windward, as if diſabled, or ſeparated too far from their own fleet, they cannot ſo eaſily extricate themſelves, and rejoin the fleet.

83 To avoi being doubled

When one fleet attempts to double another, this latter will of courſe do all in their power to avoid the impending danger; and this they will the more readily do, according to their number, or their ſituation. If the fleet thus threatened be to windward, one of the methods propoſed to avoid being doubled, is to extend the line towards the point threatened, ſo as to leave a greater ſpace between the ſhips; but in doing this, there is a riſk of having the line broken by the ſuperior enemy. Another method ſuggeſted is, for the flag ſhips of the windward fleet to oppoſe themſelves to thoſe of the lee line, which is ſuppoſed to render ſeveral of the enemy's ſhips in the intervals of little uſe; but one great inconvenience of this manœuvre is, that it leaves the van and rear moſt expoſed to the enemy's fire, and that the rear diviſion in particular is in great danger of being doubled. To remedy theſe defects, the largeſt ſhips ſhould be placed in the van and rear of each diviſion, and the fleet muſt regulate its ſailing in ſuch a manner that its rear ſhall never be aſtern of the rear of the enemy.

When the enemy is to leeward, the weather fleet is to keep aſtern of the enemy, ſo that the van of the weather fleet, may be oppoſed to, and attack the enemy's centre. Hence the enemy's van will become uſeleſs for

Naval Tactics.

some time; and should it attempt to tack and double on the weather fleet, much time will be lost in performing that evolution; and it also runs the risk of being separated by the calm which often happens in the course of an engagement, occasioned by the discharge of the guns. A considerable interval might also be left between the centre and van, if necessary precautions be taken to prevent the van from being cut off.

84 Chasing.

There are several circumstances of importance to be considered in the subject of chasing, i. e. when one ship or fleet pursues another, called the *chase*, either to bring her or them to action, or to oblige them to surrender.

85 In the case of single ships.

When a single ship chases another, it is to be presumed in general, that one of them is the better sailer, though this is not always the case, and still by proper manœuvring the chasing ship, or *chaser*, may gain on the chase. In the following observations, however, we shall suppose the chaser to sail faster than the chase. The manœuvres of the chaser will depend on her being to windward or leeward of the chase.

When the chase is to windward, it is evident that as soon as she perceives a strange ship which she takes for an enemy, she will haul her wind, in order to prolong the chase, as otherwise her retreat would soon be cut off. The chaser then stands on also nearly close hauled, till she has the chase on her beam; she then tacks, and stands on close hauled till the chase is again on her beam, and then retacks. In this manner she continues tacking every time she brings the chase perpendicular to her course on either board; and by thus manœuvring, it is certain that the chaser will, by the superiority only of her sailing, join the other in the shortest time. For since the chaser tacks always as soon as the chase is perpendicular to her course, she is then at the shortest distance possible on that board; and since the chaser is supposed to be the fastest sailer, these shortest distances will decrease every time the chaser tacks. It is therefore of advantage to the chase to keep constantly on the same course, without losing her time in going about, as tacking cannot be so favourable to her as to her adversary, whose sailing is superior. If the captain of the chaser should so little understand his profession as to stand on a long way, and tack in the wake of the chase, the best thing she can do is to heave in stays, and pass to windward of him on the other tack, except she should find herself likely gaining advantage by going large; for if the chaser persists in tacking in the wake of the other ship, the pursuit will be very much prolonged.

When the chase is to leeward, the chaser is to steer that course by which she thinks she will gain most on the chase. If, after having run a short time, the chase is found to draw more aft, the chaser should then bear away a little more; but if the chase draw a-head, the chaser should haul up a little, and thus the course may be so regulated that the chase may always bear on the same point, and then the chaser will get up with the chase in the shortest time possible; for if any other course were steered, the chaser would be either too far a-head or too far astern, and hence the pursuit would be prolonged. The chase should run on that course which will carry her directly from the chaser, and should consider which is her best trim with respect to the wind, that she may move with the greatest possible rapidity from the chaser; for some ships have more advantage in going large, others with the wind right aft, and others when close hauled.

Another method has been proposed for chasing a ship to leeward, that is, by constantly steering directly for the chase: in this case, the tract described by the chaser is called the line or *curve of pursuit*. To illustrate this, let A (fig. 11. Plate DLXVIII.) represent the chaser, and B the chase directly to leeward of her, and running with less velocity than the pursuer, in the direction BC, perpendicular to that of the wind. Now, to construct this curve, let B*b* be the distance run by the chase in any short interval of time; join A*b* and make A 1 equal the distance run by the chaser in the same time. Again, make *bc*, *cd*, *de*, *ef*, &c. each equal to B*b*; join 1*c*, and make 1, 2 = A 1; join 2*d*, and make 2, 3 equal to A 1; proceed in like manner till the two distances carried forward meet as at C, and a curve described through the points A, 1, 2, 3, &c. will represent nearly the curve of pursuit; and the less the interval A 1 is taken, the more accurately will the curve be formed. In this particular case, the length of the distance BC may be found as follows, provided the distance AB and the proportional velocities of the two ships be known.

86 Curve of pursuit. Plate DLXVIII. fig. 11.

Let the velocity of the chase be denoted by a fraction, that of the chaser being unity. Multiply the given distance AB by this fraction, and divide the product by the complement of the square of the same fraction, and the quotient will be the distance run by the chase B. Suppose AB, the distance of the chase directly to leeward of the chaser, be taken at 12 miles, and suppose the velocity of the chase three-fourths of that of the chaser; what will be the distance run by the chase before she is overtaken? Now $\frac{12\times\frac{3}{4}}{1-\frac{3}{4}^2}=\frac{9}{\frac{7}{16}}=9\times\frac{16}{7}=20\frac{4}{7}$ miles; and since the velocity of the chaser to that of the chase is as 4 to 3, hence the distance run by the chaser will be $=20\frac{2}{7}\times\frac{3}{4}=27\frac{3}{7}$ miles. As the chaser alters her course at every point, and probably sails better with the wind in one direction with respect to her course than when the wind is in another direction, her velocity will be different at different points of the course. Thus, suppose her to sail faster when the wind is on the quarter, her velocity will constantly increase to a certain point, and will then diminish. Hence in real practice the curve of pursuit will not be exactly what is laid down in the above problem, and of course the measure of BC will differ a little from what we have there laid down. See *RESISTANCE of Fluids* and SEAMANSHIP.

87 In the case of fleets.

If the whole fleet is to give chase, the admiral will make the proper signal, and then each ship will instantly make all the sail possible. If the retreating fleet is not much inferior to the other, a few of the fastest sailing vessels only are to be detached from the superior fleet, in order to pick up any stragglers, or those ships which may have fallen astern; and the remaining part of the fleet will keep in the same line or order of sailing as the retreating fleet, so that they may, if possible, force them to action. But if the retreating fleet is much inferior, the admiral of the superior fleet will make the

Naval Tactics.

ſignal for a general chaſe, and then each ſhip will immediately crowd all the ſail poſſible after the retreating fleet; or, if the chaſe be ſtill leſs numerous, the admiral will detach one of the ſquadrons of his fleet, by hoiſting the proper ſignal for that purpoſe, and he will follow with the remainder of the fleet. The ſquadron that chaſes, ſhould be very careful not to engage too far in the chaſe, for fear of being overpowered; but at the ſame time to endeavour to ſatisfy themſelves with regard to the object of their chaſe. They muſt pay great attention to the admiral's ſignals at all times; and in order to prevent ſeparation, they ſhould collect themſelves before night, eſpecially if there be any appearance of foggy weather coming on, and endeavour to join the fleet again. The ſhips are diligently to obſerve when the admiral makes the ſignal to give over chaſe; that each regarding the admiral's ſhip as a fixed point, is to work back into her ſtation, to form the order of line again as quickly as the nature of the chaſe and the diſtance will permit.

When a fleet is obliged to run from an enemy who is in ſight, it is uſual to draw up the ſhips in that form or order, called the *order of retreat;* and the admiral, when hard purſued, without any probability of eſcaping, ought, if practicable, to run his ſhips aſhore, rather than ſuffer them to be taken afloat, and thereby give additional ſtrength to the enemy. In ſhort, nothing ſhould be neglected that may contribute to the preſervation of his fleet, or prevent any part of it from falling into the hands of the conqueror.

We have now gone through the principal evolutions of fleets and ſquadrons, nearly as they are deſcribed in the *Elements of rigging, ſeamanſhip, and naval tactics*, and other approved publications on ſimilar ſubjects. We have indeed omitted the method of forcing an enemy's line, and of avoiding being forced, becauſe the former will be readily underſtood from what we have to add on the improved method of tactics of M. Grenier, and Mr Clerk of Eldin.

88 Defects of the uſual line of battle.

Various defects have been obſerved in the tactics uſually employed at ſea, eſpecially in a line of battle, and in the mode of bringing an enemy to action. The uſual order of battle firſt introduced by the duke of York, afterwards James II. of England, is defective from its length. Its great extent makes it difficult for the admiral to judge what orders are proper to be iſſued, to the ſhips ſtationed at the extremities, while his ſignals, however diſtinctly made, are liable to be miſtaken by the commanders of theſe ſhips. Beſides, the extremities of a long line, eſpecially if it be to leeward, are neceſſarily defenceleſs, as the enemy may throw himſelf with a ſuperior force on the van or rear, and cut either of theſe off before it can be properly ſupported by the other ſquadrons. Viſcount de Grenier, who was, we believe, one of the firſt to notice theſe defects, propoſed to remedy them by introducing a new order of battle.

89 Principles of de Grenier's method of tactics.

Plate DLXVIII. fig. 12.

The leading principles of De Grenier's tactics are founded on the following conſiderations. It is evident that each ſhip of a fleet muſt at all times occupy the centre of a certain horizon. This horizon De Grenier divides into two unequal parts, calling the greater the *direct and graduated ſpace*, and the leſs the *indirect, croſſed, and ungraduated ſpace*. The reaſon of theſe appellations is, that on the greater ſegment of the horizontal circle there are 20 different points, which may be marked by degrees from one of the cloſe-hauled lines to the other, and to which a ſhip may ſail from the centre by ſo many direct courſes without tacking; whereas from the other 12 points, including that from which the wind blows, ſhe cannot arrive but by ſteering croſs courſes, which muſt neceſſarily delay her progreſs. Suppoſe now a fleet to leeward, ſo diſpoſed that only a part of it can fight with another equally numerous, and ranged to windward in a ſingle line, and let the lee fleet be ranged on three ſides of a lozenge *a b*, *c d*, *e f*, (fig. 12.) The ſquadron *a b*, which is moſt to windward, being drawn up in line of battle, cannot be fought but by an equal number AB, CD, EF. All the reſt of that fleet therefore muſt remain inactive, unleſs the ſhips which are not engaged ſhould try to paſs to leeward of the fleet *a b*, *c d*, *e f*. But ſhould the ſhips of the weather fleet, which are placed between B and F, bear away as they appear in the figure between C *i* and F *i*, the ſhips between A and B, which are fighting to windward, cannot bear away with them. Suppoſe now that the ſhips between C *i* and F *i* have paſſed to leeward, the ſquadrons *c d*, *e f*, which are ranged according to De Grenier's ſyſtem, and have not yet been engaged, ſhould come to windward and join with their friends *a b* againſt that ſquadron of the enemy AB which is ſtill to windward and engaged; it is almoſt impoſſible but that the ſquadron AB muſt be deſtroyed by ſo great a ſuperiority, before it could receive aſſiſtance from the ſhips to leeward between C *i* and F *i*.

Naval Tactics.

90 His ord of ſailin

De Grenier propoſes only three orders of ſailing, one when a fleet is to paſs a ſtrait; a ſecond when it ſteers in open ſea, on the look-out for an enemy, or with a view to avoid him; and a third when on an extenſive cruiſe diſpoſed ſo that it cannot be eaſily ſurpriſed or broken. Of theſe three orders, only the ſecond and third differ from the uſual orders of ſailing. The former of theſe is repreſented by fig. 1. Plate DLXIX. where the columns *a b*, *c d*, *e f*, are diſpoſed on three ſides of a regular lozenge, on the two cloſe-hauled lines. The ſhips of the two diviſions *c d*, *e f*, ſometimes to windward (as in fig. 2.) and ſometimes to leeward (as in fig. 1.) of the third diviſion *a b*, are to be formed on two parallels of one of the cloſe-hauled lines in the wakes of their reſpective headmoſt ſhips; while the third diviſion *a b* is to be ranged ahead or aſtern of the others on the other cloſe-hauled line, ſteering chequerwiſe the ſame courſe as the other diviſions.

Plat DLX fig. 1. 2.

When *a b* is to windward of *c d* and *e f* (fig. 1.), De Grenier calls that the *windward primitive order of ſailing*, and when to leeward (fig. 2.), the fleet is ſaid to be in the *leeward primitive order of ſailing*. Theſe are the two principal poſitions in almoſt every caſe, and with very little variety, may become the order of battle, of chaſing, &c.

His third order is illuſtrated by fig. 3. where the diviſions *a b* and *e f*, are ſuppoſed at the diſtance of about ſix leagues from each other; *c d* and *c f* reſting on the extremities of the baſe of a triangle STV, while the centre ſhip of the diviſion *a b* reſts on its ſummit T; none of the diviſions could be cut off by an enemy, however formidable, ſeen from its centre ſhip at the diſtance of ſix leagues. For if, on the proper ſignal, the diviſion *a b* ſhould ſteer from T toward X, on the courſe

Fig. 3

oppoſite

Naval Tactics.

oppoſite to the cloſe-hauled line it ſteered before, and the two diviſions *c d* and *e f* ſteer from V and S towards X likewiſe, it is plain that each of theſe diviſions would have only three leagues to run to join the other two, while the enemy which was firſt perceived at the diſtance of ſix leagues, muſt run nine before he can come up with the neareſt of theſe ſquadrons.

91 Order of battle. Plate DLXIX. fig. 4. and 5.

To form De Grenier's order of battle repreſented in fig. 4. and 5. it will be ſufficient for the ſhips of the three diviſions ranged in the windward primitive order of ſailing (ſee N° 90.) to heave in ſtays all together, and get on the other tack on the oppoſite line of bearing (fig. 4.); or for the ſhips in the leeward primitive order at once to haul the wind on the ſame tack as they ſteer; and they will find themſelves in order of battle, fig. 5. When the two columns *c d* and *e f*, are to leeward of the third diviſion *a b*, ranged in order of battle, this is called the *natural order of battle*, and when *c d* and *e f* are to windward of *a b*, this is the *inverted order of battle*. The former of theſe is calculated for a fleet combating to leeward, and the latter for a fleet which muſt fight to windward.

6. To explain the advantages of theſe diſpoſitions, let us ſuppoſe the line AB, CD, EF, fig. 6. to repreſent an enemy's fleet to windward in the uſual order of battle, on the cloſe-hauled line, and on the ſtarboard tack, and let *a b* be one of the diviſions of a fleet diſpoſed according to the now natural order, on the ſtarboard tack, while the line *c d*, *e f*, repreſent the other two diviſions ſtanding on chequerwiſe on the ſame tack, but formed on the oppoſite cloſe-hauled line. When the enemy comes to attack this latter fleet on a ſuppoſition that it is inferior to their own, their diviſions AB and EF, in order to attack the ſhips *a* or *b*, muſt bear away. Now, to prevent the attack, each of the diviſions *c d*. *e f*, muſt make the following evolutions according to their reſpective ſituations, and the manœuvres of the enemy. 1. The ſhips of the diviſion *a b* are to ſlacken as much as poſſible their headway, and form a very cloſe line, till the enemy makes a movement to attack the headmoſt or ſternmoſt ſhip of that diviſion. 2. The ſhips of the diviſion *c d* are to make ſail till they come under the ſecond or third ſhip of the rear of the line of battle *a b*, when they will take the ſame ſail as the ſhips of that diviſion, to preſerve that poſition until the hoſtile ſhips make their evolution to attack the rear ſhips of that diviſion. In this ſituation the ſhips of the diviſion *c d* will be able to obſerve the manœuvres of the enemy, in order to change tack, and form themſelves in order of battle on the oppoſite board as ſoon as the hoſtile ſhips ſhall have run over a certain ſpace; becauſe the ſhips of the diviſion *c d*, ſteering afterwards cloſe hauled in the wake of the ſternmoſt ſhip of the diviſion *a b*. will be able to cover the rear ſhips of that diviſion, and get the weather-gage of the hoſtile diviſions which are bearing away; rake their ſhips; run along ſide of them; double their rear-guard, and put it between two fires. if thoſe hoſtile ſhips are following in the wake of each other; divide it, if they bear away chequerwiſe; or gain to windward, and put between two fires the enemy's diviſion CD, while engaged with the diviſion *a b*. 3. The diviſion *e f* may abandon their poſt, and run chequerwiſe under a preſs of ſail as ſoon as the enemy falls a-head of *a b*; that if the enemy's diviſion AB attempts to fall on *e f*, or on the van of *a b*, they may, by going about, ſteer in order of battle cloſe hauled on the oppoſite line, and cover the ſhip *a*, double the hoſtile diviſion CD a-head, or divide AB which is running chequerwiſe on the oppoſite tack.

Fig. 7. marks another method of manœuvring by the diviſions *c d*, *e f*, when the enemy's ſhips are arranged in a ſingle line not well formed. Fig. 7.

92 De Grenier's method of arranging the admiral's ſhip, frigates and tranſports. Figs. 8. and 9.

Figs. 8. and 9. illuſtrate De Grenier's method of placing the admiral's ſhip, and the frigates and tranſports attached to a fleet. A, fig. 8. is the admiral placed a-head of the fleet, at a ſhort diſtance from the headmoſt of the ſecond diviſion, and in the ſame direction of the wind as the headmoſt ſhip of the firſt diviſion; *f f* are two frigates obſerving the ſame rule and poſition with reſpect to the van ſhip of the third, and rear of the firſt diviſion. When the fleet is in order of battle, as in fig. 9. the admiral's ſhip A is in the centre of the lozenge, and two of the frigates, *f f*, on the fourth ſide of the lozenge. The tranſports and ſtore-ſhips, when the fleet is in order of ſailing or convoy, occupy the ſpace circumſcribed by the lozenge, but in order of battle they are diſpoſed in a line oppoſite to that of the enemy.

We cannot enter on a more minute or ſatisfactory account of this ſyſtem; for a full expoſition of which we muſt refer to the original work entitled *L'Art de Guerre en Mer, ou Tactique Navale*, &c. par M. le Viſcompte de Grenier, or the extracts from it contained in the *Elements and Practice of Rigging and Seamanſhip*.

93 Mr Clerk's tactics.

We muſt now turn our attention to the improvements in tactics ſuggeſted by our countryman Mr Clerk;—improvements which have received the approbation of ſeveral diſtinguiſhed officers of the Britiſh navy, and to hints derived from which we are in a great meaſure indebted for ſome of the moſt ſignal victories which have heaped additional honour on the naval power of Britain.

94 Mr Clerk's objections to the uſual method of attack.

Before entering on an explanation of Mr Clerk's tactics, we muſt briefly ſtate his objections to the uſual method of bringing ſhips to action, by the weather ſhip or fleet ſteering directly down upon the enemy. By doing this, the enemy to leeward often has an opportunity of completely diſabling the ſhips making the attack, as the former can uſe all their guns on one ſide, while the latter can only uſe their bow chaſes. Suppoſe B, fig. 10. Plate DLXIX. to repreſent a ſhip of 80 guns to windward, in ſight of an enemy's ſhip of equal force F, to leeward. Now, if B bears down directly upon F, the latter, by lying to, as in fig. 11. will preſent a broadſide of 40 guns, all bearing for a conſiderable time on B, while the latter coming down headwiſe, can only bring the two light guns of her forecaſtle to bear on F, not to mention that F, by lying broadſide to, will have her maſts and rigging little expoſed to the enemy's ſhot, while B ſtanding head on, is expoſed to be raked by every ſhot from F, and in particular her rigging is in the utmoſt danger. Plate DLXIX. figs. 10. and 11.

95 His new method. Figs. 12. and 13.

Inſtead of this objectionable mode of attack, Mr Clerk propoſes that B having the wind, ſhould run down aſtern as in the dotted line at fig. 12. till ſhe gets into the courſe of F, near her wake, or in ſuch a poſition as will bring her parallel to F's courſe, and within a proper diſtance, when ſhe can run up cloſe along ſide of F, and engage on equal terms; or, that ſhe ſhould ſhoot a-head, then veer, and run down on the weather bow of F, as in fig. 13. till ſhe can force the chaſe to bear

Naval Tactics.

bear away to leeward, keeping close by her, on equal terms, taking care in both cases not to put it in the power of F to bring her broadside to bear on her without retaliation.

96 Effects of firing at the hull or rigging. Plate DLXIX. fig. 14.

Fig. 14. is employed by Mr Clerk to illustrate the different procedure of a French and British man of war in firing, the former at the rigging, and the latter at the hull of the enemy, with their effects. Let F represent a large ship desirous of avoiding a close engagement, but lying to, to receive with advantage an enemy's ship B, of equal force. Suppose that F, by firing at the rigging of B, may have carried away some of the principal stays, several of the windward shrouds, a fore-topmast, or other rigging of less consequence, without having wounded a single man; and suppose a second ship consort to F, receiving an enemy's ship like B, but firing only at her hull, so as to kill 30 or 40 men, without damaging her rigging. Now, when F and her consort wish to avoid a close engagement, it is evident that that ship B, which has lost part of her rigging, is much more disabled from coming to close action than her consort whose rigging is entire, though she may have lost a great number of her men.

97 One ship of a line of battle cannot be exposed to the fire of many hostile ships at once. Fig. 15.

By the scheme at fig. 15. it is intended to illustrate the impossibility of one ship being exposed to the fire of many ships at one time. Let I, H, F, H, I, represent five ships in line of battle a-head, about a cable's length, or 240 yards asunder, and suppose the length of each ship to be 40 yards, so that the whole space between the head of one ship and the head of that next adjacent equals 280 yards. Let the perpendicular line FK, extending from the beam of F fix cables lengths or 1440 yards, be divided into six equal parts. It is evident that any ship stationed at E in the line FK, 720 yards distant, cannot long be exposed to the fire of more than the centre ship F of this squadron. For if we suppose that H and K a-head and a-stern of F, can bring their broadsides to bear on E; by putting themselves in positions for that purpose, they will not only disorder their own line, but one will leave her head and the other her stern exposed to a raking fire from the opposite ships BB in the enemy's line. If B can suffer little from the two ships H, H, at the distance of 720 yards, it is evident that she will suffer still less from these ships as she approaches nearer the enemy's line. Again, if instead of a cable's length asunder, we suppose the ships I, F, I, two cables length asunder, to bear on the ship B. It is evident from the figure that in this case B will not be more exposed to the fire of I and I at the distance of 1440 yards than she was to that of H and H at half that distance; and so in similar cases.

98 Principles on which the bringing of ships to action is founded. Fig. 17.

In explaining the principles on which we are to judge of the advantages or defects of different modes of bringing ships to action, Mr Clerk supposes a fleet of 10, 20, or more ships of 80 guns each, drawn up in line of battle to leeward, as at F, fig. 16. and lying to with an intention to avoid an action; while another fleet, as B, of equal number and force, also drawn up in line of battle, three or four miles to windward, wishes to make an attack, and come to close quarters on equal terms. The fleets being thus disposed, should the fleet at B attempt running down to attack the fleet at F, each ship standing head on to the opposite ship in the leeward line, it is to be expected, from what we have already stated, that the attacking ships will be disabled, at least in their rigging, before they can come to close action; but suppose that the commander of the weather fleet, though his ships have been disabled in their rigging during their course *a a a* to leeward, fig. 17. has made them bring to at a great distance, but sufficiently near to injure F. This latter fleet, which has been endeavouring to avoid an action, will now bear away with little injury to a new station, as G, and there remain out of the reach of B's shot, and this fleet must repair its rigging before it can make another attack. Naval Tactics. Fig. 17.

Again, suppose that the fleet B, instead of standing head on, were to run down in an angular course, as at fig. 18. It is plain that if any ship in this angular line should be crippled, her defect in sailing will occasion a confusion of several of the other ships in that line. It may be said that the stoppage of one ship a-head will not necessarily produce a stoppage of every ship a-stern of her, because they may run to leeward of the disabled ship; but we must observe that by this time the ships a-head in the van A may be engaged, and consequently not having much head way, are nearly stationary, so that each ship a-stern, in attempting to bear down as at D, D, must be confined to a certain course, and must run the risk of being raked in coming down before the wind, and consequently of being disabled before coming up with the enemy. Fig. 18.

Thirdly, the van of the fleet B having attained their station at A, a-breast of the van of F, fig. 19. and having begun the action, the van ships of F, with a view to retreat, may throw in a broadside on the van of B, and then bear away in succession, as at H, followed by the rest of the fleet F, which, after exchanging broadsides with the van of B, may draw up in a new line two or three miles to leeward at I I, fig. 20. Fig. 19.

Suppose again, for further illustration, that B, fig. 1. Plate DLXX. represents a fleet putting before the wind, each ship intending, when brought to at a determined distance at A, to take up her particular antagonists in the line of the enemy F to leeward; and let F be supposed at rest, without any motion a-head. It is easy to conceive that while the alternate ships of F's line, under cover of the smoke, withdraw from battle to GGG, the intermediate ships left behind them in the line will be sufficient to amuse even the whole of B's fleet, till the ships G shall form a new line HH as a support from the leeward. In such case B, after being disabled, and not having foreseen the manœuvre, will neither be able to prevent the intermediate ships with which he is engaged from bearing away to join their friends, nor, were he able, would it be advisable to follow them, for the same manœuvre with equal success can again and again be repeated. Plate DLXX. fig. 1.

To explain the relative motion of these two fleets, let F, fig. 2. represent a fleet of 12 ships in line of battle, a cable's length asunder, and suppose the length of each ship from the end of the jib-boom to the stern to be $36\frac{2}{3}$ fathoms. The whole fleet will occupy a space of two English miles; and if it be supposed to sail in the direction FG, at the rate of four knots an hour, it will in an hour have moved to G, four miles from its former position. Fig. 2.

Now, let there be an opposite fleet B, also 12 ships, situated four miles to windward, and let the point A be a quarter of a mile right to windward of the point G. Then, if B by bearing away in the direction BA, gain the

Naval tactics.

the point A at the same time that the leeward fleet F has arrived at G, B will have moved nearly at the rate of $5\frac{1}{2}$ miles an hour, and the angle contained between the direction of its line of bearing and its present course will be nearly four points.

Secondly, in fig. 3. if F, by carrying more sail, move at the rate of six miles an hour, from F to G, then B, with a more slanting course, will have more difficulty in keeping the line a-breast while coming down to the attack, owing to the additional obstruction which will attend each succeeding ship in such a slanting course. Again, if the leeward fleet shall lie up one point higher, as FG, fig. 4. the rears of the two fleets will be removed to a much greater distance, and the van A must be sooner up with the enemy's van, and of course so much farther from support, while F bringing up his ships in succession, may disable the van of A, and afterwards bear away at pleasure with little injury, as at H. Now B being supposed disabled, and having his rear D distracted, will be unable to prevent F from escaping.

From these considerations it appears that a fleet to windward, by extending its line of battle with a view to stop and attack the whole line of an enemy's fleet to leeward, must labour under considerable disadvantages, and will scarcely succeed in the attempt.

99 New mode of attack of the windward.

On these principles Mr Clerk explains the reason why, before the commencement of the present contest between Britain and France, the French fleets so repeatedly escaped from the British, without any serious defeat or loss, viz. by avoiding a general engagement, and disabling the British van as it bore down to attack them. He therefore recommends a different mode of attack from the windward, which we shall proceed to illustrate by proper diagrams.

Fig. 5. Let F (fig. 5.) represent a fleet in line of battle, under easy sail, willing to avoid an action, but ready to receive an attack in the usual way, from another fleet B, three or four miles to windward, arranged in three columns. How shall B make the attack on F, so as, without aiming at the improbable advantage of taking or destroying the greater part of this fleet, they may secure three or four of the sternmost ships? Mr Clerk advises, that a sufficient strength be detached to secure these ships, while the admiral keeps aloof with the rest of his fleet, disposed as in the figure, ready to make the necessary observations and give the requisite support to the detached ships. If F continues to avoid an action by standing on in line, the detachment, coming into the position BA, will secure the three ships at I; and if the headmost ships of F were to tack, and be followed by the rest in succession as at fig. 6. not only the Fig. 6. the three ships at I will be left at the mercy of the ships detached from B, but two more, as G, will be exposed to an attack from another squadron of B at C. If all Fig. 7. the ships of F tack together, as in fig. 7. the delay, and probably the confusion, consequent on this manœuvre, will still more endanger the sternmost ships, or will bring on a general and close action. Again, if F attempts to haul off, beginning with his sternmost ship G, Fig. 8. and and then runs to leeward, as at fig. 8. he will expose his 9. ships to a raking fire from B, and still endanger his sternmost ships by getting too far to leeward for their support; or if the headmost ships at H, fig. 9. veer first, to be followed by the rest astern, the danger would be still greater. Thus it appears that in every assignable case, a fleet to leeward, avoiding an attack from an equal or superior windward, as here advised, by preserving the line, will risk the loss of three or more of their sternmost ships.

Naval Tactics.

Now, let us suppose that F, while standing on a line on the larboard tack, when threatened with an attack on his rear from B, veers and passes on opposite tacks to leeward (see fig. 10.). The consequence of this will be, that his headmost ships will be forced to leeward by B, and compelled to engage under disadvantageous circumstances, and the disadvantage to F will be much the same, whether he again veers and resumes his former position, as at G, fig. 11. or stands on before the wind, as at P, fig. 12. Fig. 10, 11, 12.

We have hitherto supposed that the wind has been fixed in one point; but let us suppose it to shift, and let us inquire what will be the effect of such a circumstance on the two lines F and B. While the fleets are in the former position, F in line, and B in four divisions, B, B, B, A, steering E, with the wind at N, fig. 13. let the wind shift to the west. The only consequence of this will be, that F will be thrown still farther to leeward, to its greater disadvantage. But let the wind shift to E, so as to be a-head, as in figs. 14. and 15. Still if the admiral of B manages properly, and carefully watches the motions of F, this change will produce no advantage to the latter. For B has nothing to do but veer as the wind comes round, so as to bring his ships to windward of the three sternmost ships of F, and to leeward of the rest of his line, so as to cut off the three sternmost ships. Fig. 13. Figs. 14. and 15.

If the wind should be supposed to veer from point to point all round the compass, so that the fleet F, maintaining the weather-gage of B, shall make a circuit round B to leeward; still if B act cautiously, F will lose the three threatened ships.

Lastly, suppose the wind should instantly shift to a point opposite to what it was at the commencement of the attack, as from N. to S. Before it can be ascertained whether such a change will be to the advantage or disadvantage of F, the relative situations of the two fleets must be considered. Suppose that the van and centre be separated at some distance from his rear, and that in consequence this fleet shall have taken such a position as is shown at fig. 16. Though in this case he will have got to windward, his three ships can never be regained or preserved from the attack of B. The most favourable situation for F would be when the fleets were in the position denoted by fig. 13. as then he could not only support his three ships with advantage, but even threaten, and cut off a part of B's detachment. In attempting this, however, he incurs the risk of coming to a close engagement, which we have supposed him to be sedulously avoiding. Fig. 16. Fig. 16.

100 From the leeward.

Besides this method of attack from the windward by detachments from the main fleet, Mr Clerk shows how a successful attack may be made by a fleet *to leeward*, by its breaking the enemy's line, and this either near the rear, near the centre, or not far from the van, of which cases the two former will be most likely to prove successful. The enemy's line can only be cut when the two hostile fleets veer on opposite tacks. The most simple method of effecting this is for the van ship of the attacking squadron, instead of ranging parallel to that of the enemy, and to leeward of him, to pass through the

Naval Tactics.

the firſt interval that offers, followed by the reſt of the line, which is thus led acroſs that of the enemy. In conſequence of this manœuvre, the van of the leeward fleet will be to windward of the enemy's rear, and thus the attacking ſquadron will have its line entire, while that of its adverſary is divided. Again, the ſhips of the rear diviſion, having their progreſs obſtructed, will probably crowd on each other, get into confuſion, and be driven to leeward. We cannot detail the different caſes mentioned by Mr Clerk; but for theſe and many other valuable ſuggeſtions on the ſubject of naval tactics, we muſt refer to his uſeful and ingenious Eſſay *.

* See *Clerk's Eſſay on Naval Tactics*, ſecond Edition.

The above is a very faint and meagre outline of Mr Clerk's tactics, but it is all which our limits enable us to give. It will afford general readers ſome idea of the nature of the propoſed improvements, and profeſſional men will naturally conſult the original *eſſay*.

On theſe or ſimilar principles is founded the method of *breaking through the enemy's line*, and thus cutting off a part of his fleet, ſo ſucceſsfully adopted by the Britiſh admirals in the great naval actions that have diſtinguiſhed the late and preſent wars with France. We cannot better illuſtrate the principles above laid down, than by giving a ſhort detail of the laſt of theſe memorable engagements, the BATTLE OF TRAFALGAR. With this we ſhall conclude our ſketch of *naval tactics*, and our practical obſervations on the art of WAR.

101 Battle of Trafalgar, October 21ſt, 1805.

After having been long blocked up in the harbour of Cadiz, the combined French and Spaniſh fleet effected their eſcape, while the Britiſh fleet, under the command of Lord Nelſon, was at a conſiderable diſtance. On the 19th of October 1805, the ſhips which had been left to watch the motions of the enemy, communicated to the commander in chief the agreeable intelligence, that the combined fleet had put to ſea, and was ſailing with light winds in a weſterly direction. Lord Nelſon concluding that their deſtination muſt be the Mediterranean, immediately made all ſail with his ſhips for the entrace of the ſtraits. Here he was informed by Captain Blackwood, that the enemy had not yet paſſed the ſtraits.

On the 21ſt of October, at daylight, Cape Trafalgar bearing eaſt by ſouth about ſeven leagues diſtant, the combined fleet was diſcovered about ſix or ſeven miles to the eaſtward. The wind was about weſt, and very light As Lord Nelſon had long expected to fall in with the enemy's fleet, he had concerted with his officers the beſt and moſt expeditious meaſures for bringing them to a ſpeedy and deciſive action. As ſoon, therefore, as they hove in ſight, he immediately made the ſignal for the Britiſh fleet to bear up in two columns, as they formed in order of ſailing. The combined fleet was drawn up in line of battle, with their heads to the northward, and had formed the line with great cloſeneſs and correctneſs. It conſiſted of 33 ſhips of the line, 18 French, and 15 Spaniſh, under Admiral Villeneuve, as commander in chief, who occupied the centre in the Bucentaure, while the Spaniſh admiral, Gravina, led the rear in the Prince of Aſturias. The Britiſh fleet conſiſted of 27 ſhips, including three ſixty-fours. Lord Nelſon headed the van in the Victory, having under him the Temeraire, Neptune, Conqueror, Leviathan, Ajax, Orion, Agamemnon, Minotaur, Spartiate, Britannia, Africa, with the Euryalus, Sirius, Phœbe, and Naiad frigates, Pickle ſchooner, and Entreprenante cutter; while the rear, conſiſting of the Royal Sovereign, Mars, Belleiſle, Tonnant, Bellerophon, Coloſſus, Achille, Polyphemus, Revenge, Swiftſure, Defence, Thunderer, Defiance, Prince, and Dreadnought, was led by Vice-admiral Collingwood in the Royal Sovereign.

Naval Tactics.

As the mode of attack adopted by the Britiſh was unuſual, the combined fleet was obliged to draw up their line in a new manner. It formed a creſcent, with its convexity to leeward, ſo that in leading down to their centre, the rear diviſion of the Britiſh had both their van and rear abaft the beam. Before the action commenced, every alternate ſhip was about a cable's length to windward of her ſecond ahead and aſtern, thus forming a kind of double line, and appearing, when on their beam, to leave a ſmall interval between them without crowding their ſhips. The French and Spaniards were not formed in ſeparate diviſions, but intermixed without any apparent regard to order of national ſquadrons. As the Britiſh commander had previouſly communicated to his flag-officers and captains his preconeerted mode of attack, few ſignals were neceſſary, and none were made on approaching the enemy, except to direct cloſe order as the lines bore down.

The action commenced at noon, by the leading ſhips of both columns breaking through the enemy's line, the Victory about the tenth ſhip from the van, and the Royal Sovereign about the twelfth from the rear; the ſucceeding ſhips breaking through in every part aſtern of their leaders, and engaging the enemy at the very muzzles of their guns. By this manœuvre the van of the enemy was unengaged, and thus the inferiority of the Britiſh, in point of number, was of leſs conſequence, while the ſuperior ſkill and bravery of Britiſh ſeamen ſoon acquired a decided advantage. The conflict was ſevere, as the enemy's ſhips were fought with a gallantry highly honourable to their commanders. The Britiſh attack, however, was irreſiſtible. About three P. M. many of the enemy's ſhips had ſtruck their colours, and their line had given way. Ten ſhips of the line, and the frigates, under Admiral Gravina, made their eſcape, and ſtood to leeward towards Cadiz. The five headmoſt ſhips of their van tacked, and, ſtanding to the ſouthward, to windward of the Britiſh line, were brought to action, and the ſternmoſt of them taken. Nineteen ſhips of the line, with three flag-officers, including the commander in chief, remained in the hands of the Britiſh. Never was there a victory more glorious or more deciſive; never was the pre-eminence of the Britiſh flag more triumphantly conſpicuous.

The events ſubſequent to this memorable battle, and the loſſes ſuſtained on either ſide, having little connection with the ſubject of the preſent article, need not be here detailed. They are freſh in the memory of our readers, and Britain ſtill laments the loſs of her immortal Nelſon *.

* See *Nelſon.*

VENTILATOR.

PLATE DXLIV.

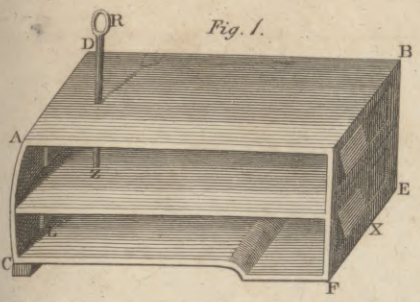
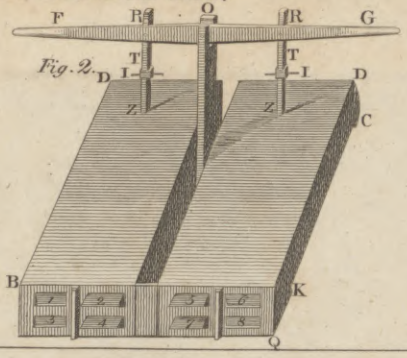


Fig. 1.



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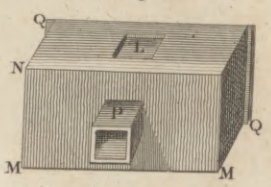


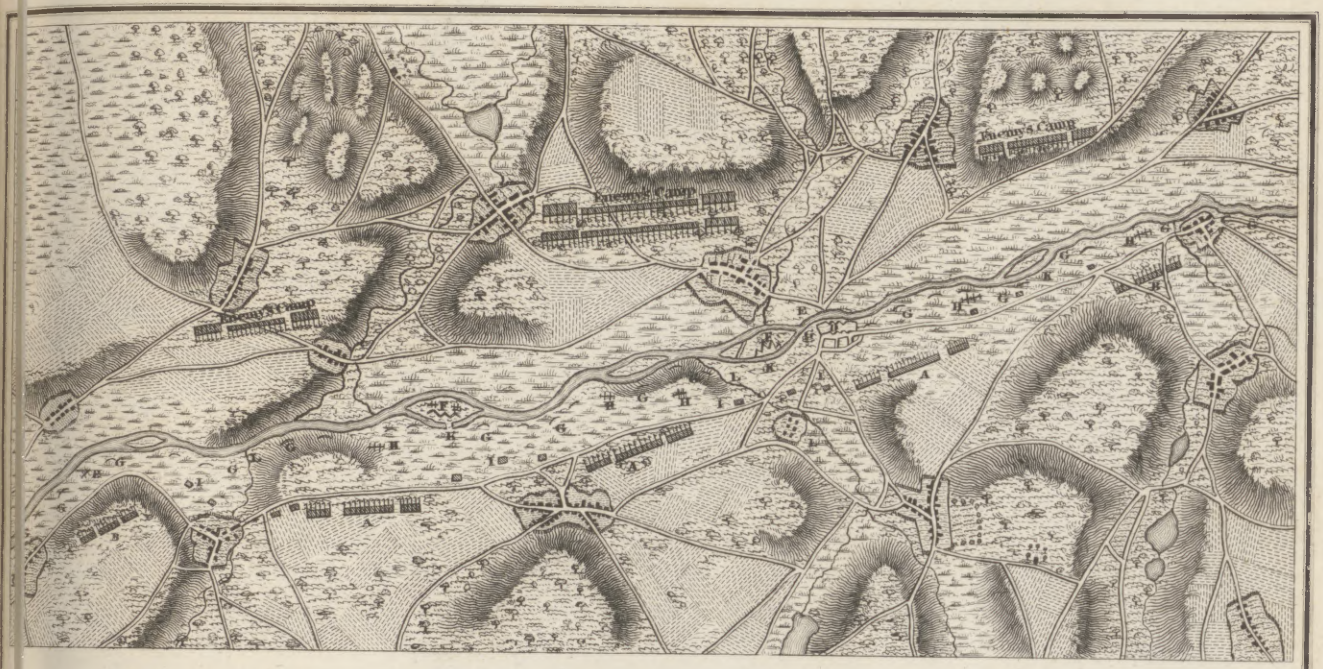
Fig. 3.

WAR.

W. Archibald sculp.

PLAN OF THE POSITION OF AN ARMY FOR THE DEFENCE OF A RIVER.

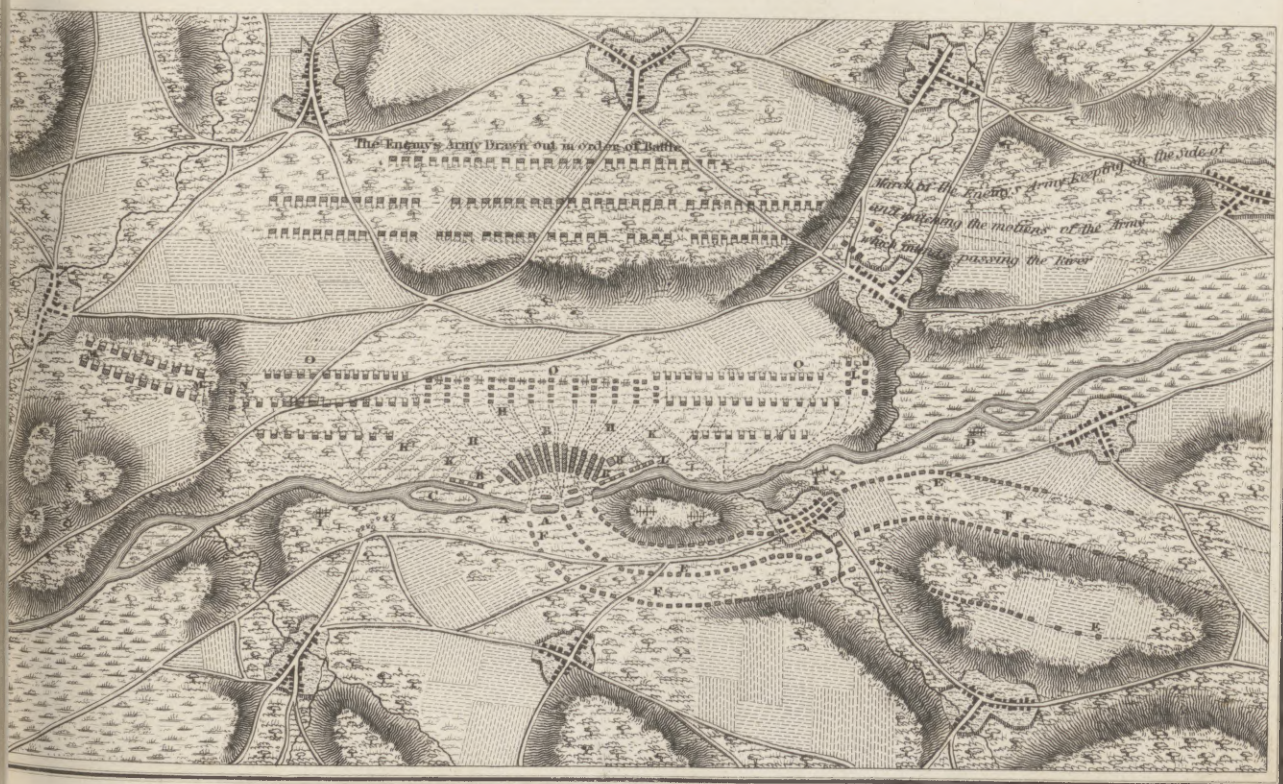
I.



Scale of 1 League
100 400 1200 2400 T.

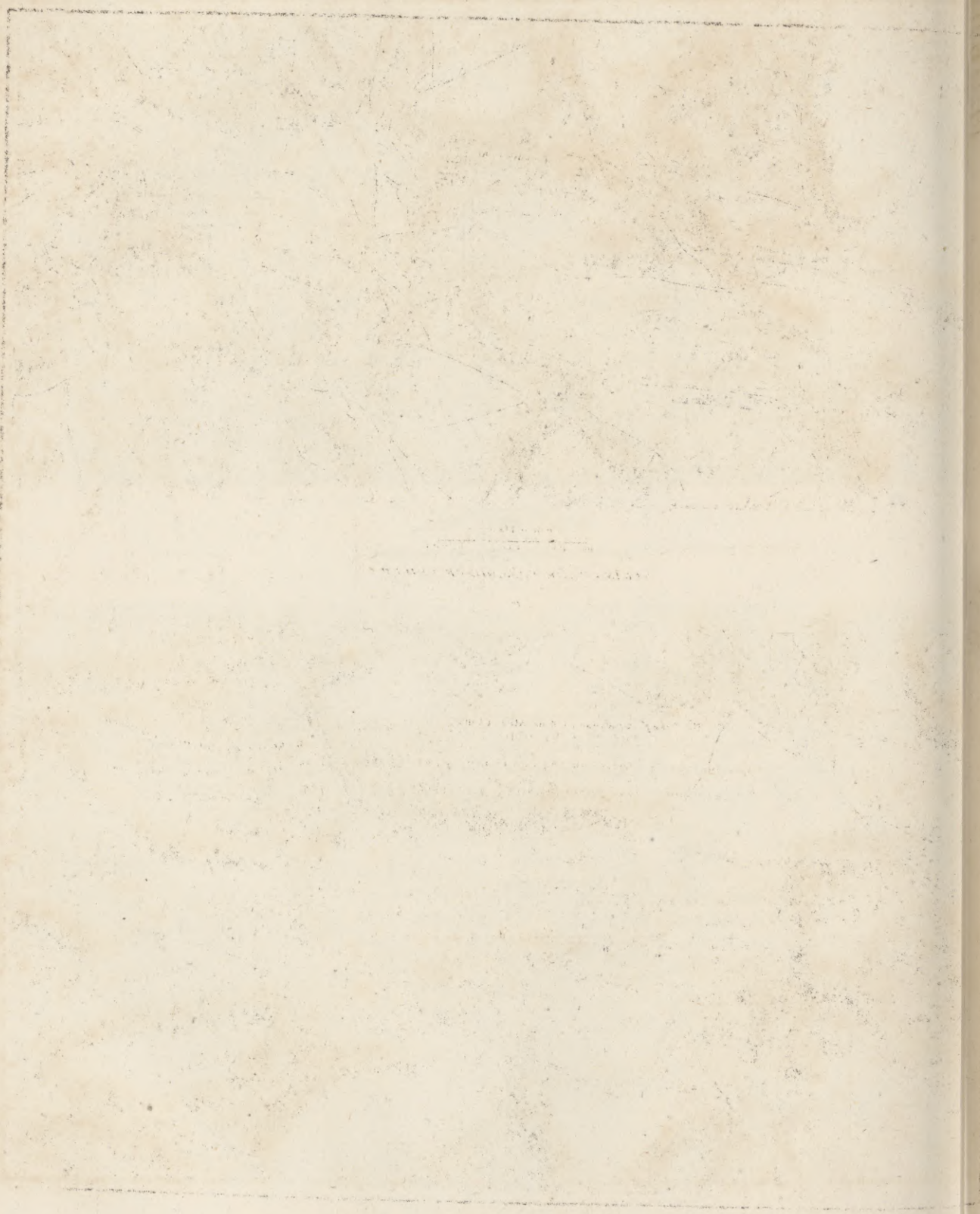
PLAN OF THE PASSAGE OF A RIVER

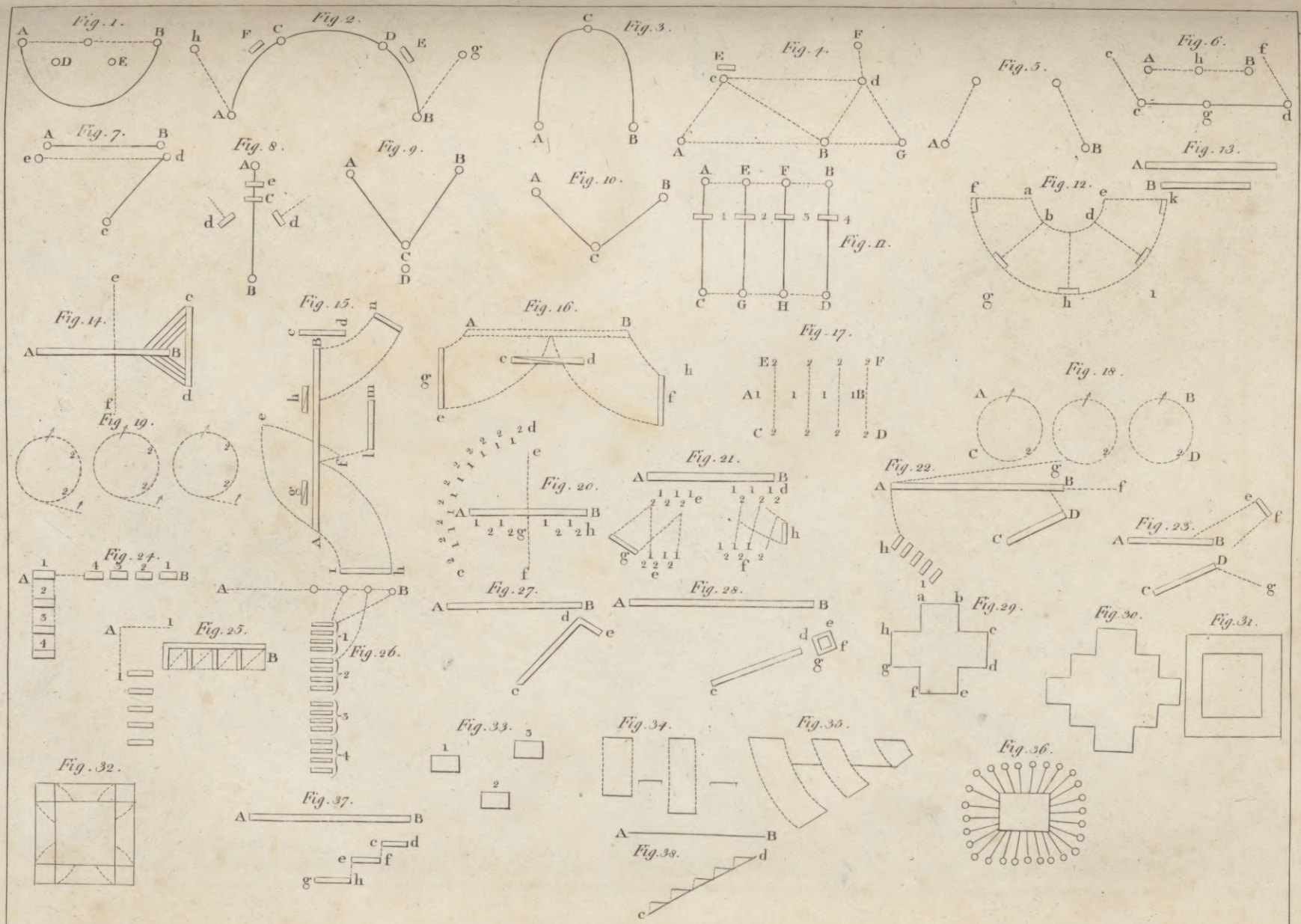
II.



Engraved by W. & D. Lizars, Edin.r

Scale of ½ a League
50 300 600 1200T





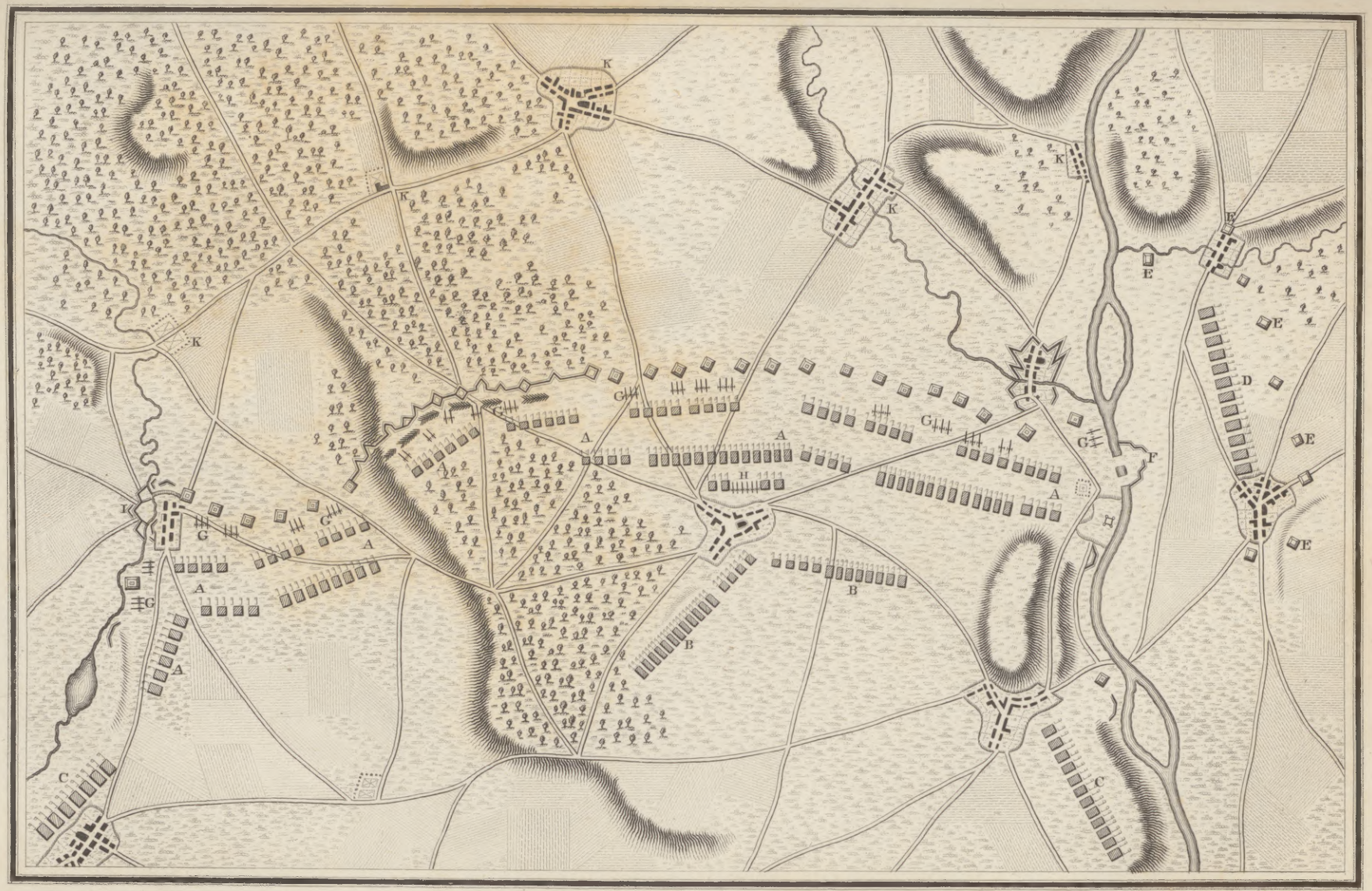
E. Mitchell sculp.t

PLAN OF THE POSITION OF AN ARMY IN ITS CAMP.

PLATE DXLVII.

Engraved by W. & D. Lizars Edin.

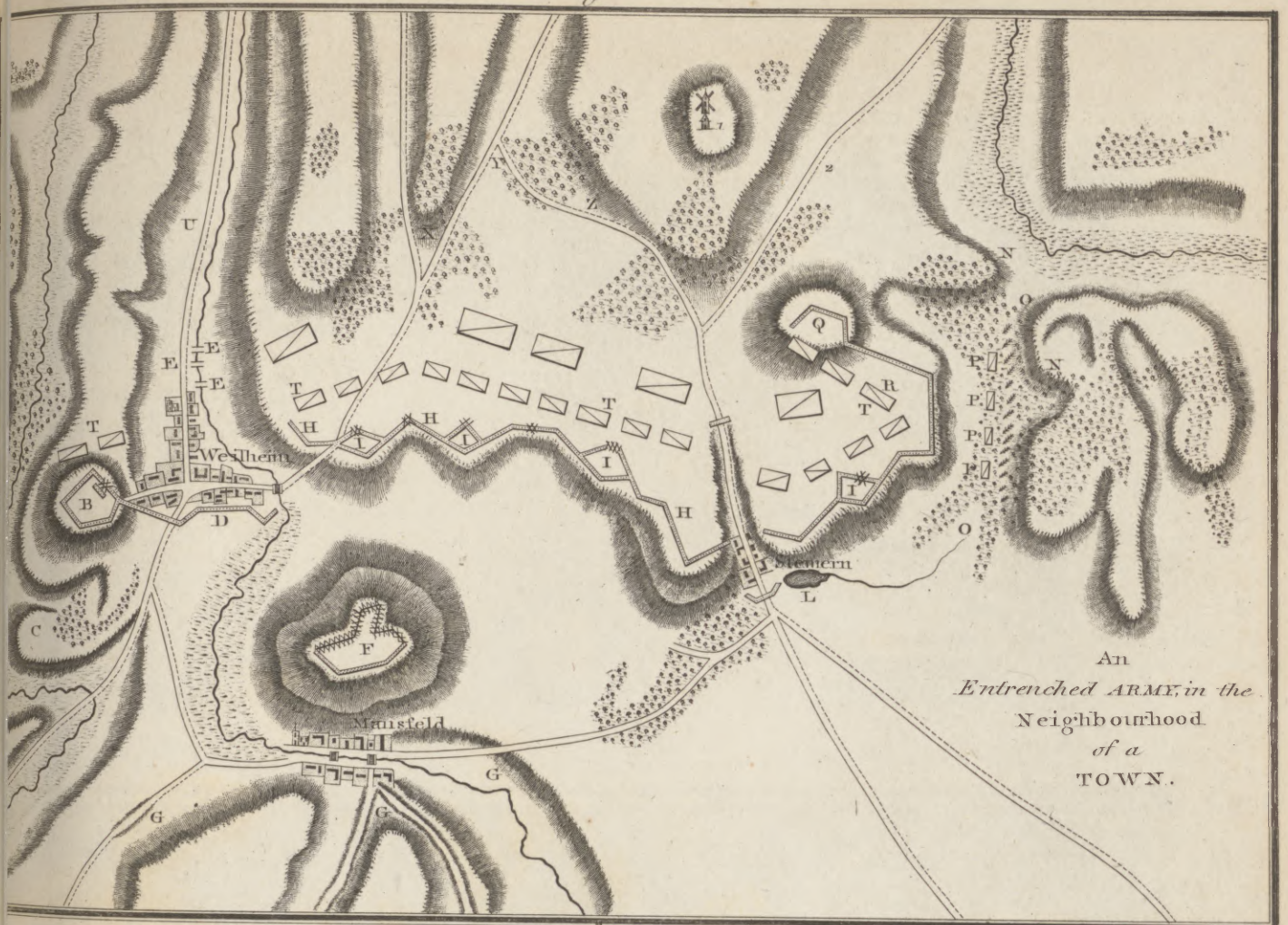
PLAN OF AN INTRENCHED CAMP.



W. Archibald Sculp.

Scale of $\frac{3}{4}$ a League.

50 200 400 600 1200 T.


Weilhem
Mansfeld
Mengern
An
Entrenched ARMY, in the
Neighbourhood
of a
TOWN.

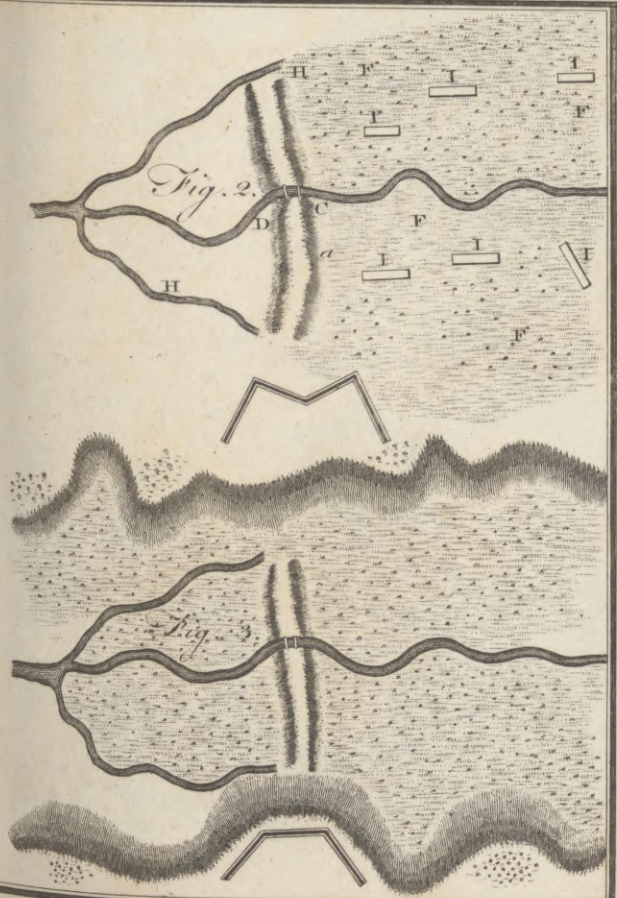


Fig. 2.
Fig. 3.

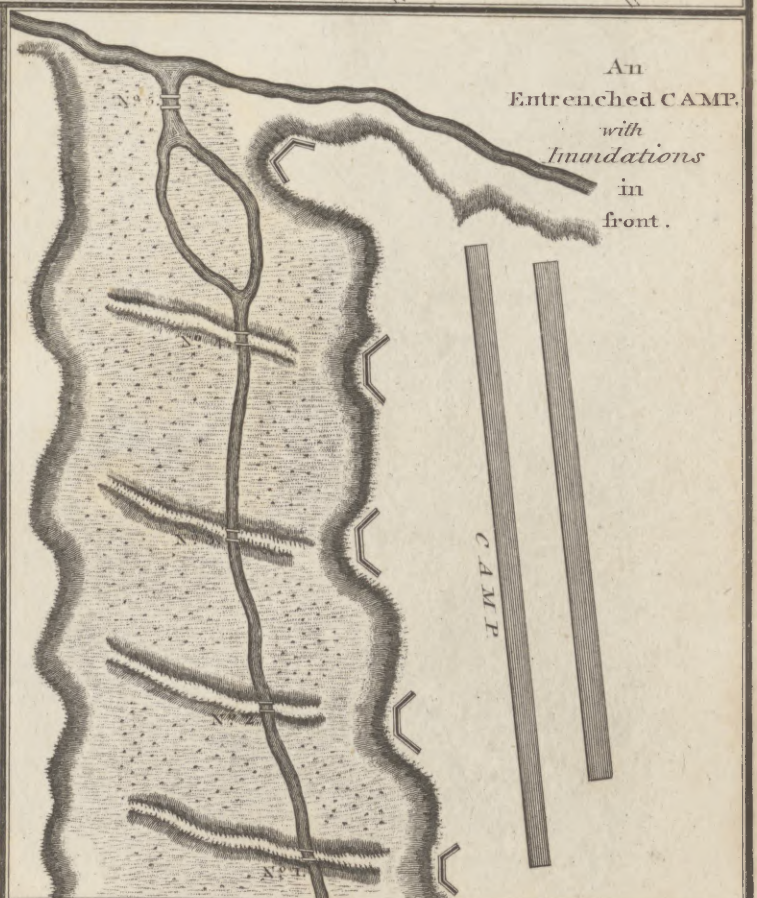
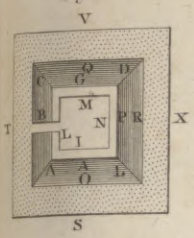

CAMP
An
Entrenched CAMP.
with
Inundations
in
front.

Fig. 1.



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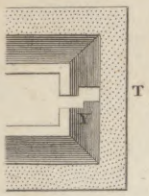
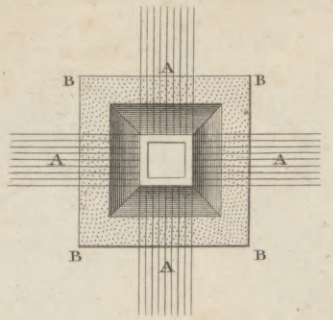


Fig. 4.



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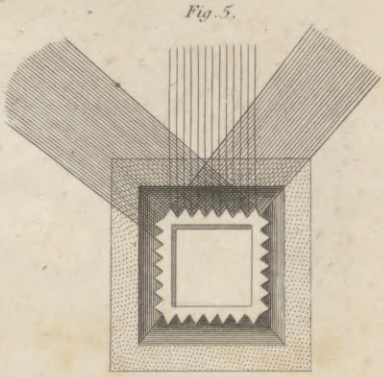
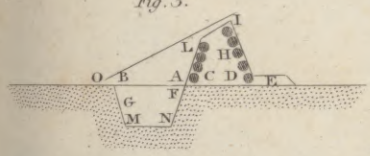


Fig. 3.



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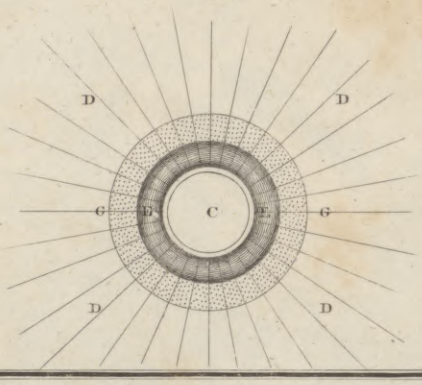

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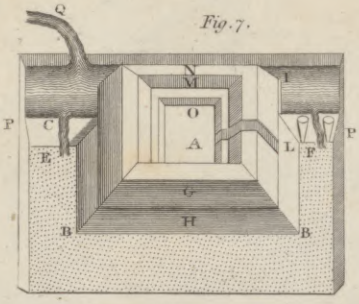
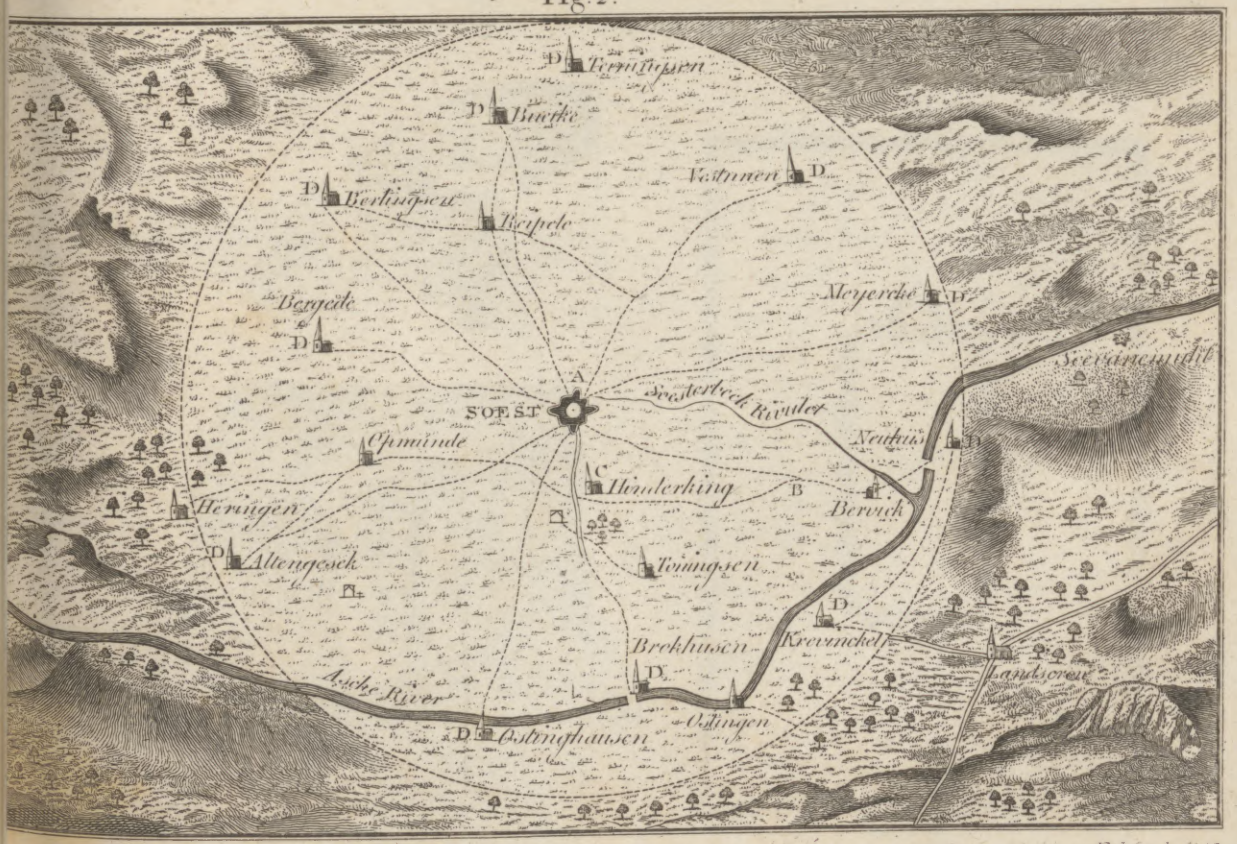


Fig. 8.

Engd. by W. & D. Lizars Edin.r

Fig. 1.

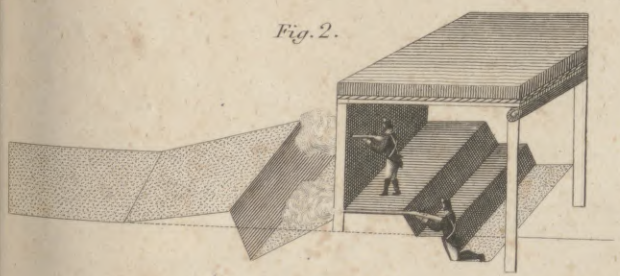
Fig. 2.



E. Mitchell Sculp.

Fig. 1.

Fig. 2.



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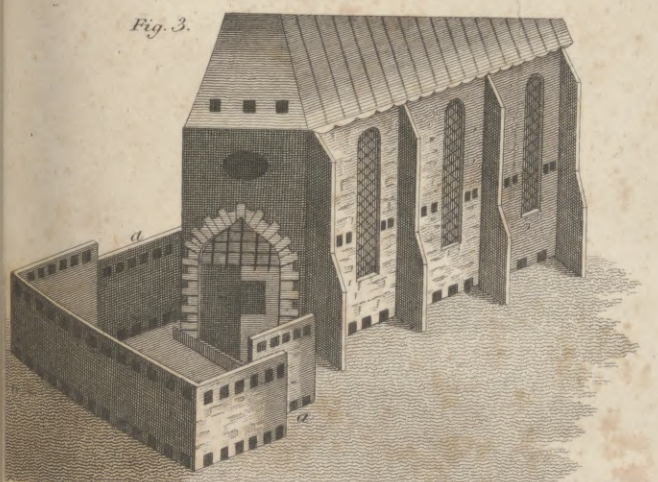

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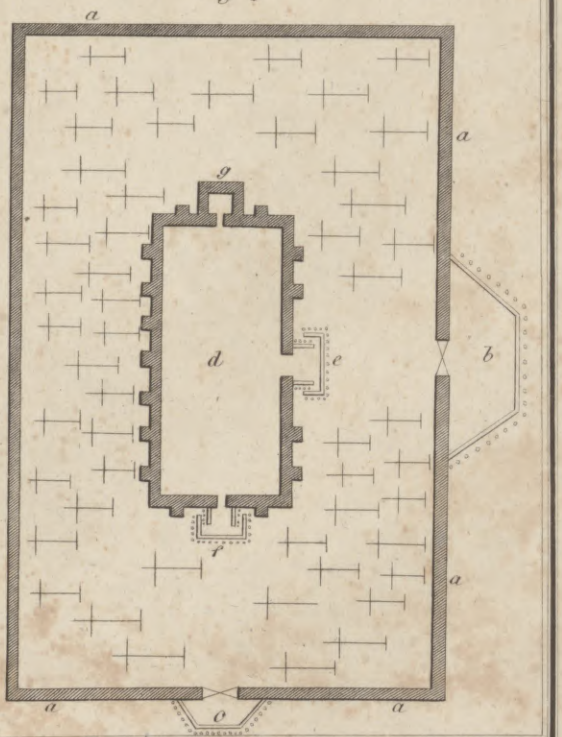

W. Archibald Sculp.

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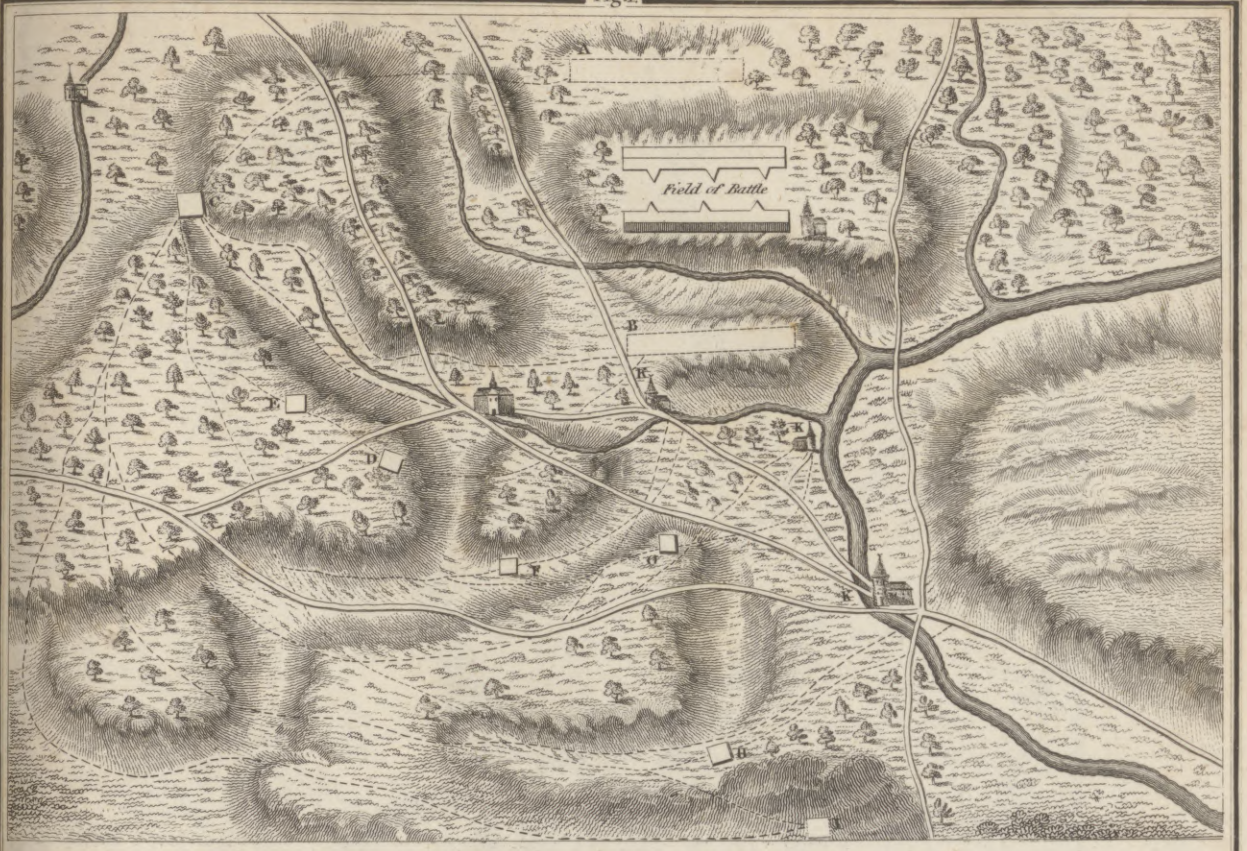
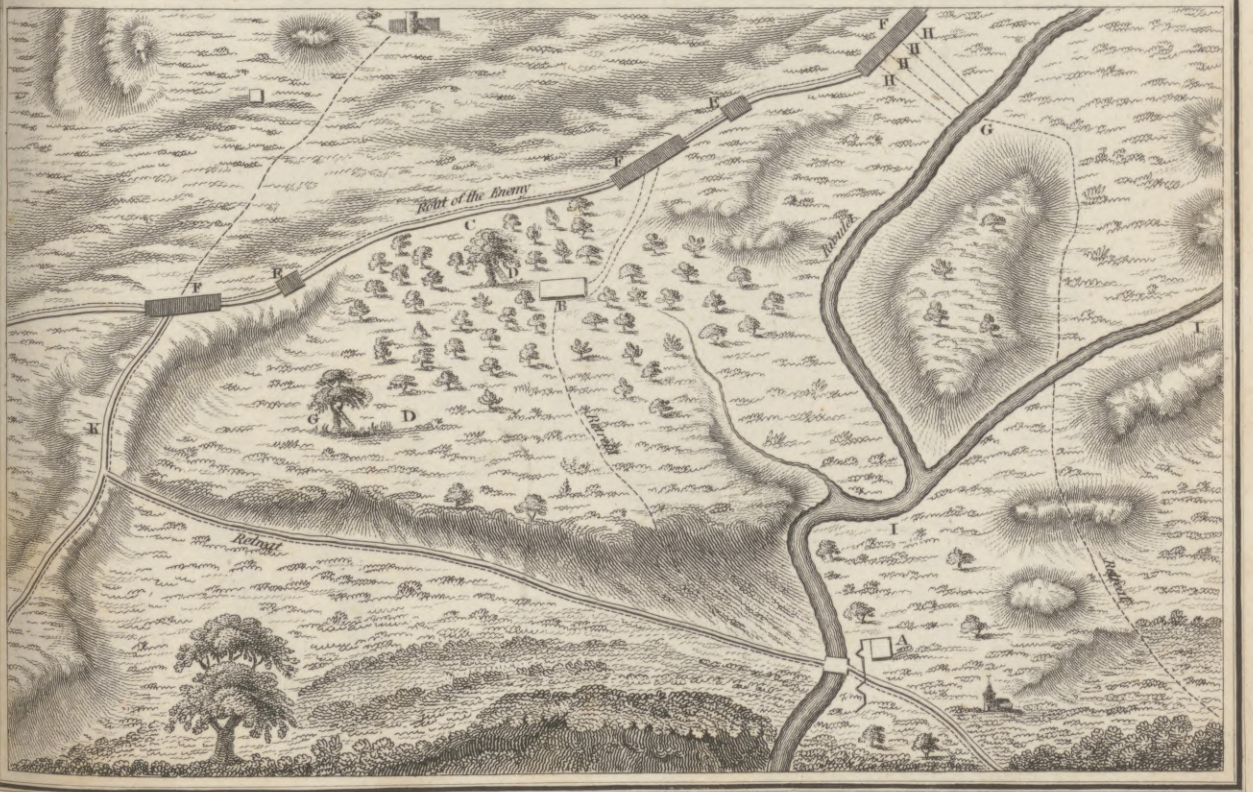


Fig. 2



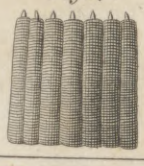
Engraved by W. & D. Lizars Edinburgh.

W. Train Sculpt.

Fig.1.

Fig.2.

Fig.4.



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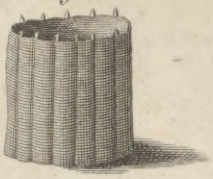
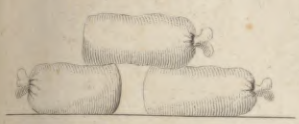


Fig.6.

Fig.5.

Fig.7.



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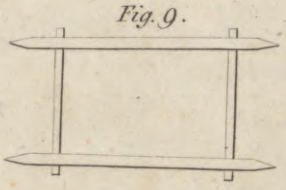

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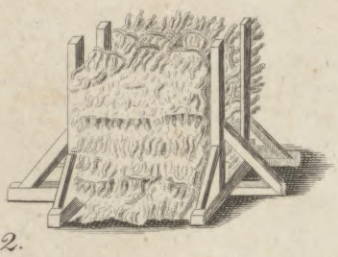

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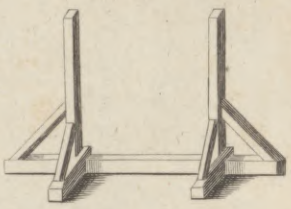

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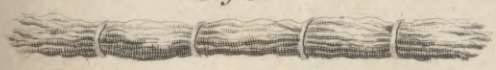

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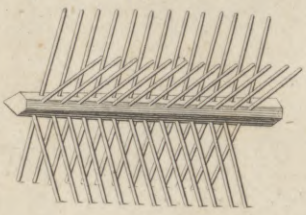

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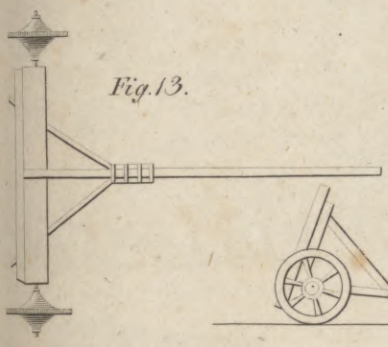

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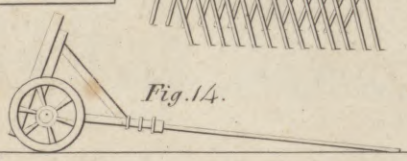

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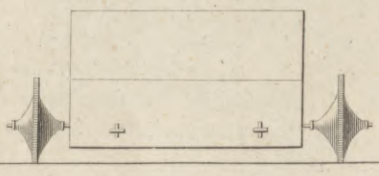
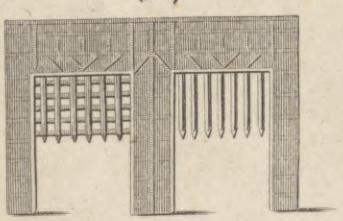


Fig.16.

Fig.17.



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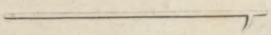


Fig.19.

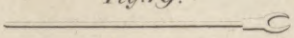
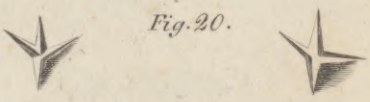
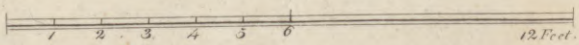
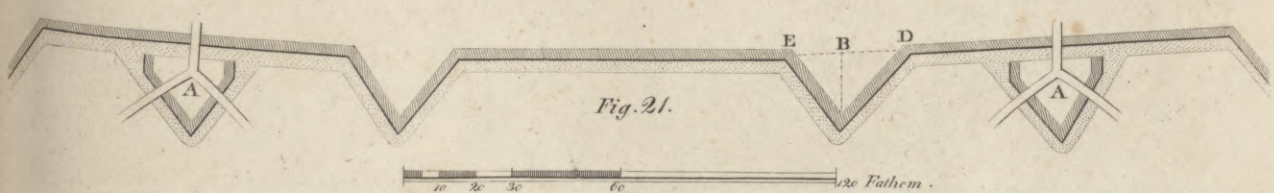


Fig.20.







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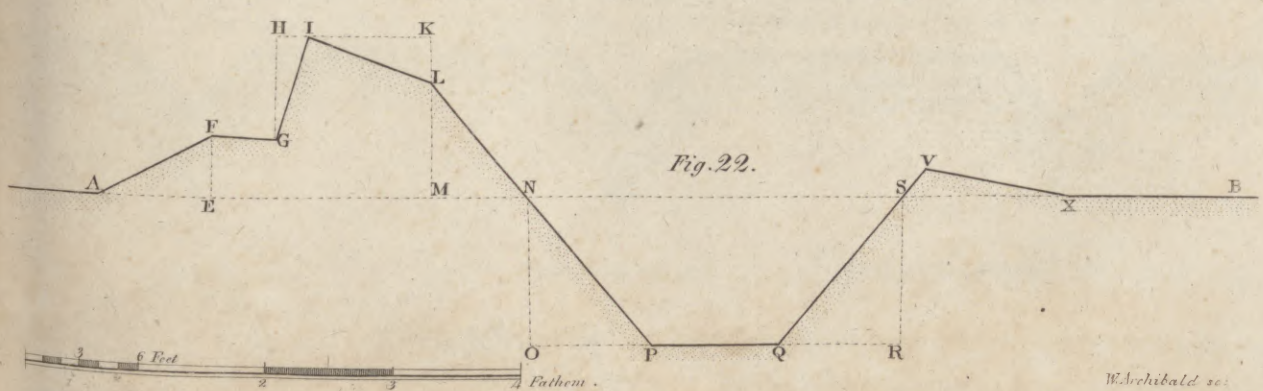
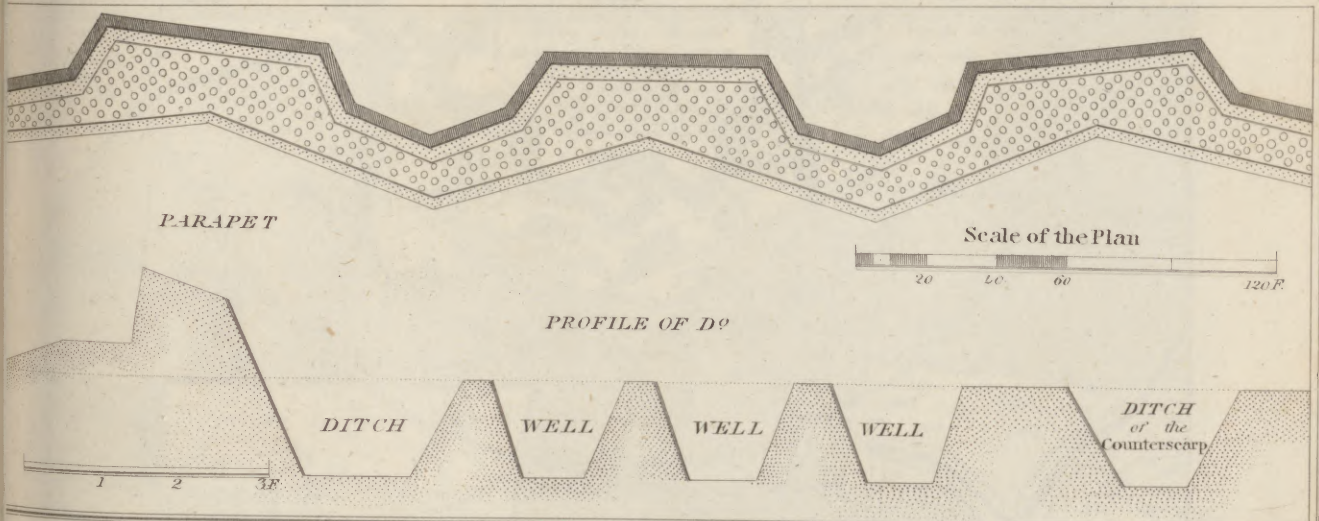


Fig.22.

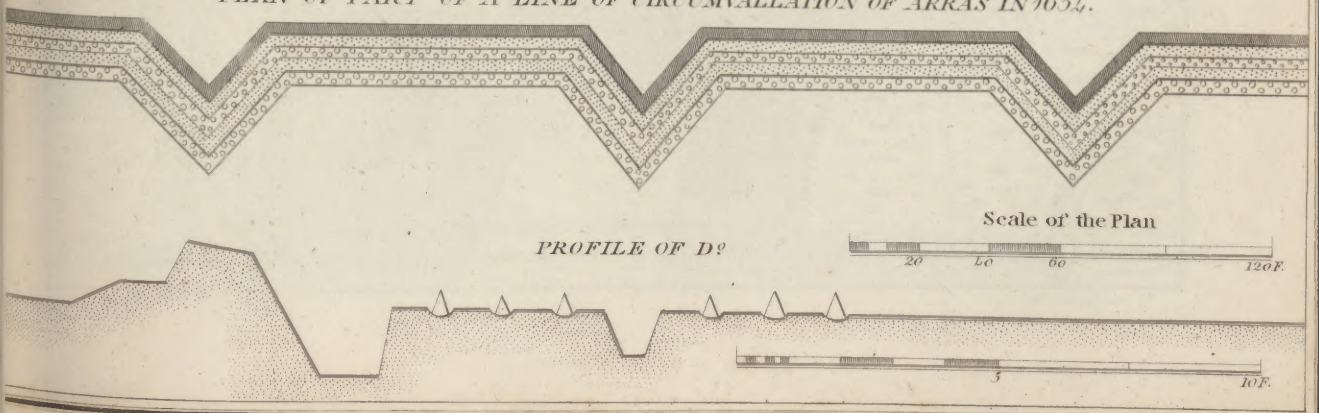
W. Archibald sc.

PLAN OF THE CIRCUMVALLATION AND ATTACKS OF PHILIPSBURG in 1734.

PLAN OF PART OF THE CIRCUMVALLATION OF PHILIPSBURG IN 1734.



PLAN OF PART OF A LINE OF CIRCUMVALLATION OF ARRAS IN 1654.



Engraved by W.& D. Lizars Edinburgh.

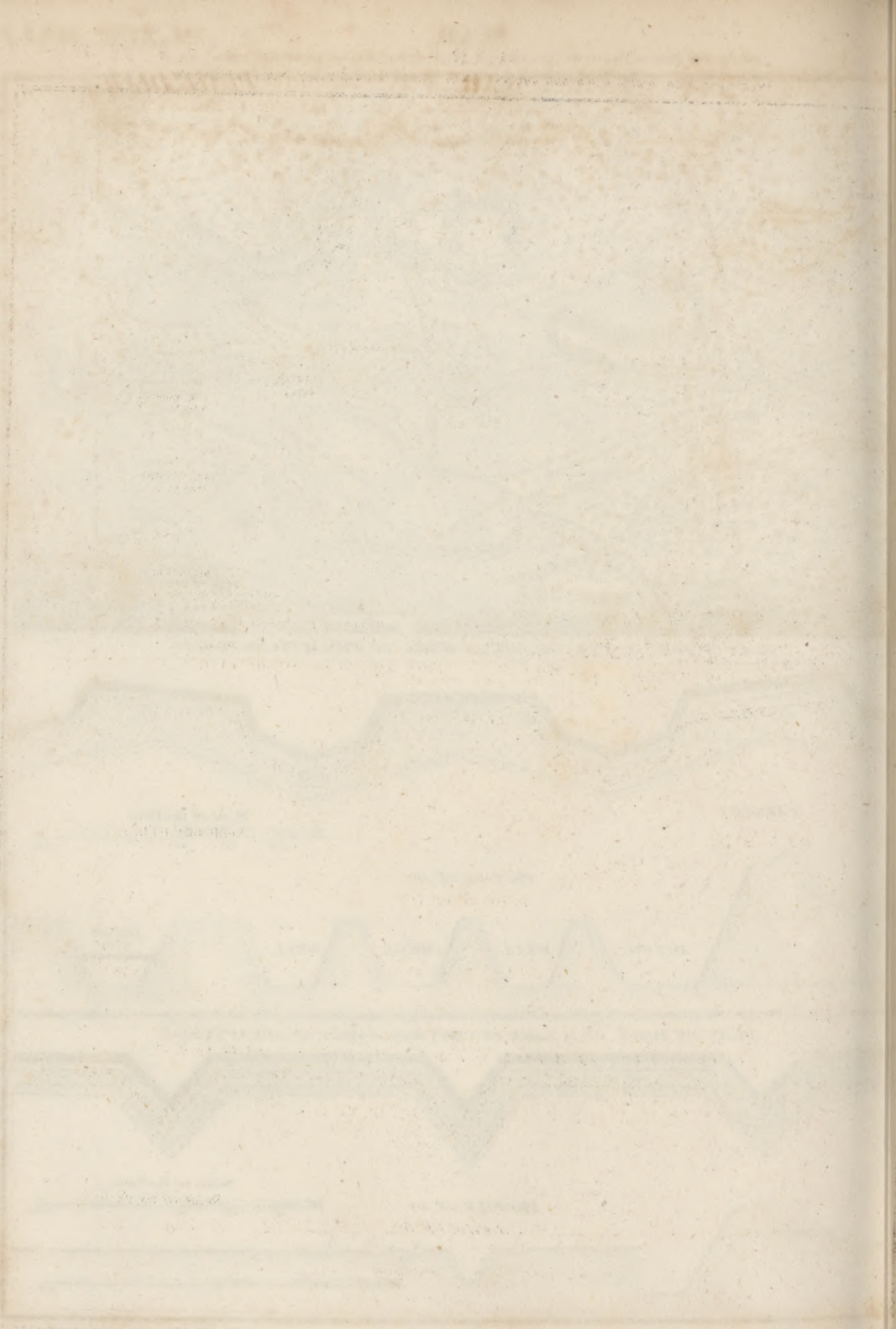
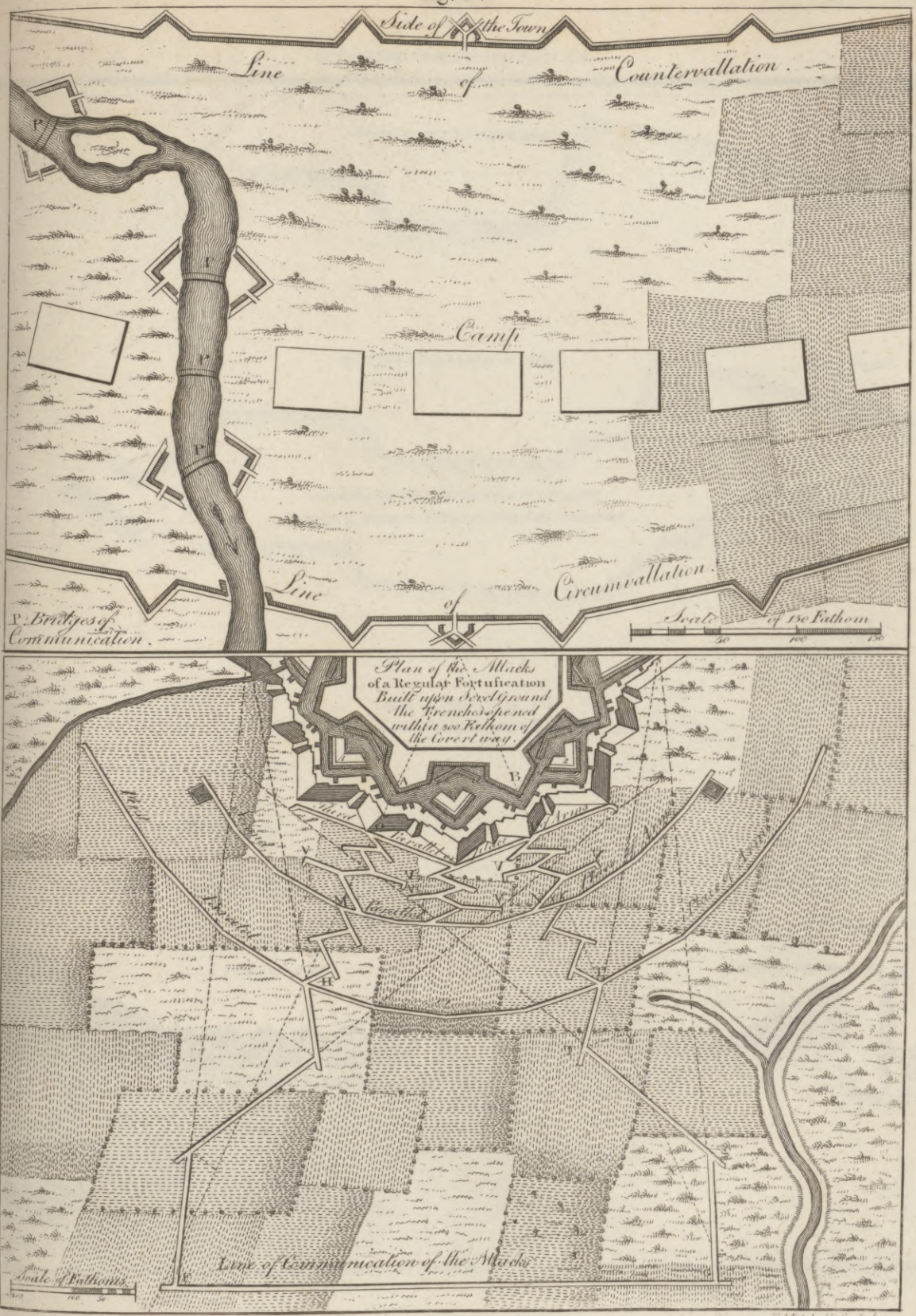
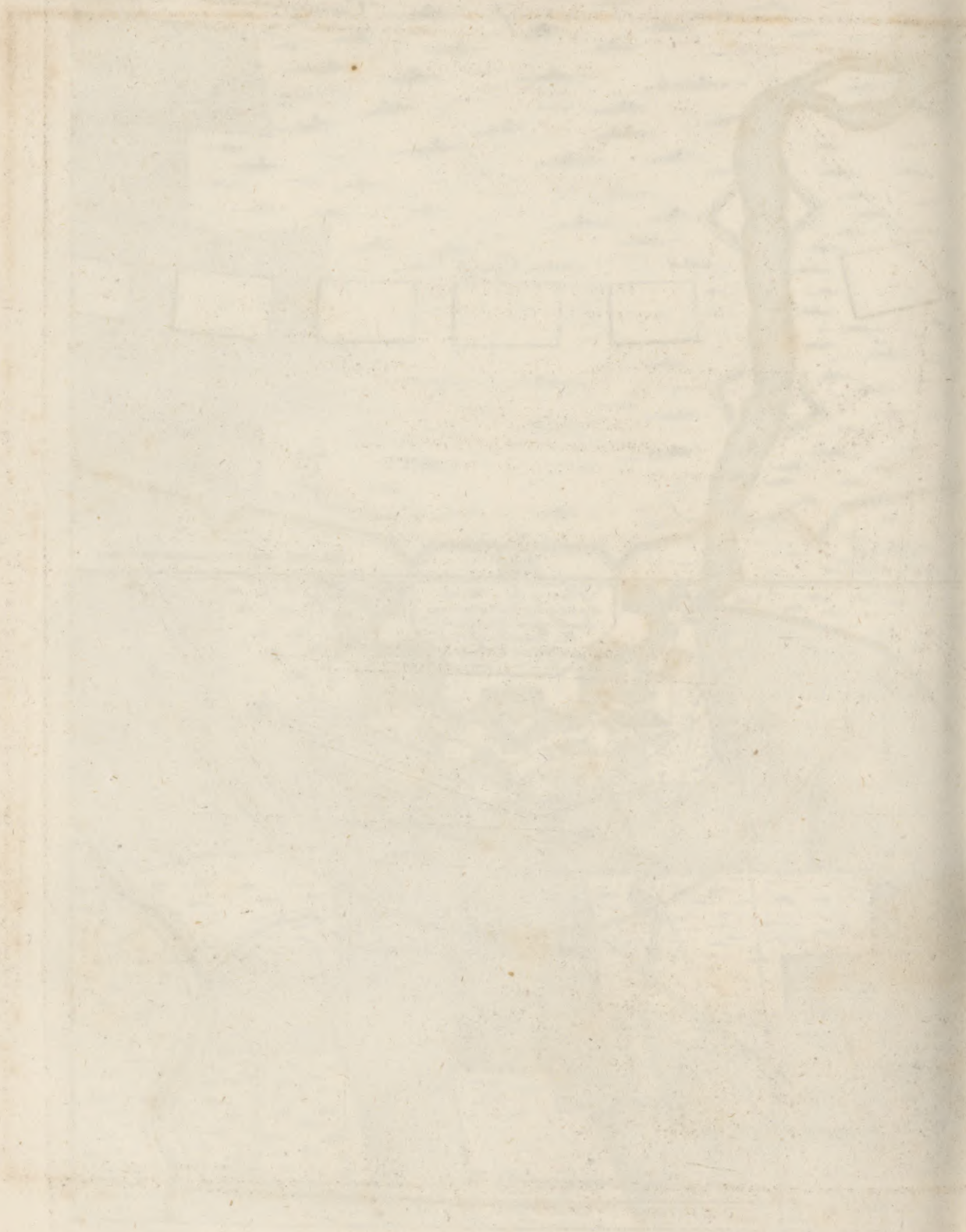


Fig. 1.


Side of the Town
Line of Countervallation.
Camp
Line of Circumvallation.
Bridges of Communication.
Scale of 150 Fathom
50 100 150
Plan of the Attacks of a Regular Fortification Built upon Level Ground the Frenches opened within 300 Fathom of the Covert way.
A
B
Line of Communication of the Attacks
Scale of Fathoms
E. Mitchell Sculp.



ATTACK OF FORTIFIED PLACES.

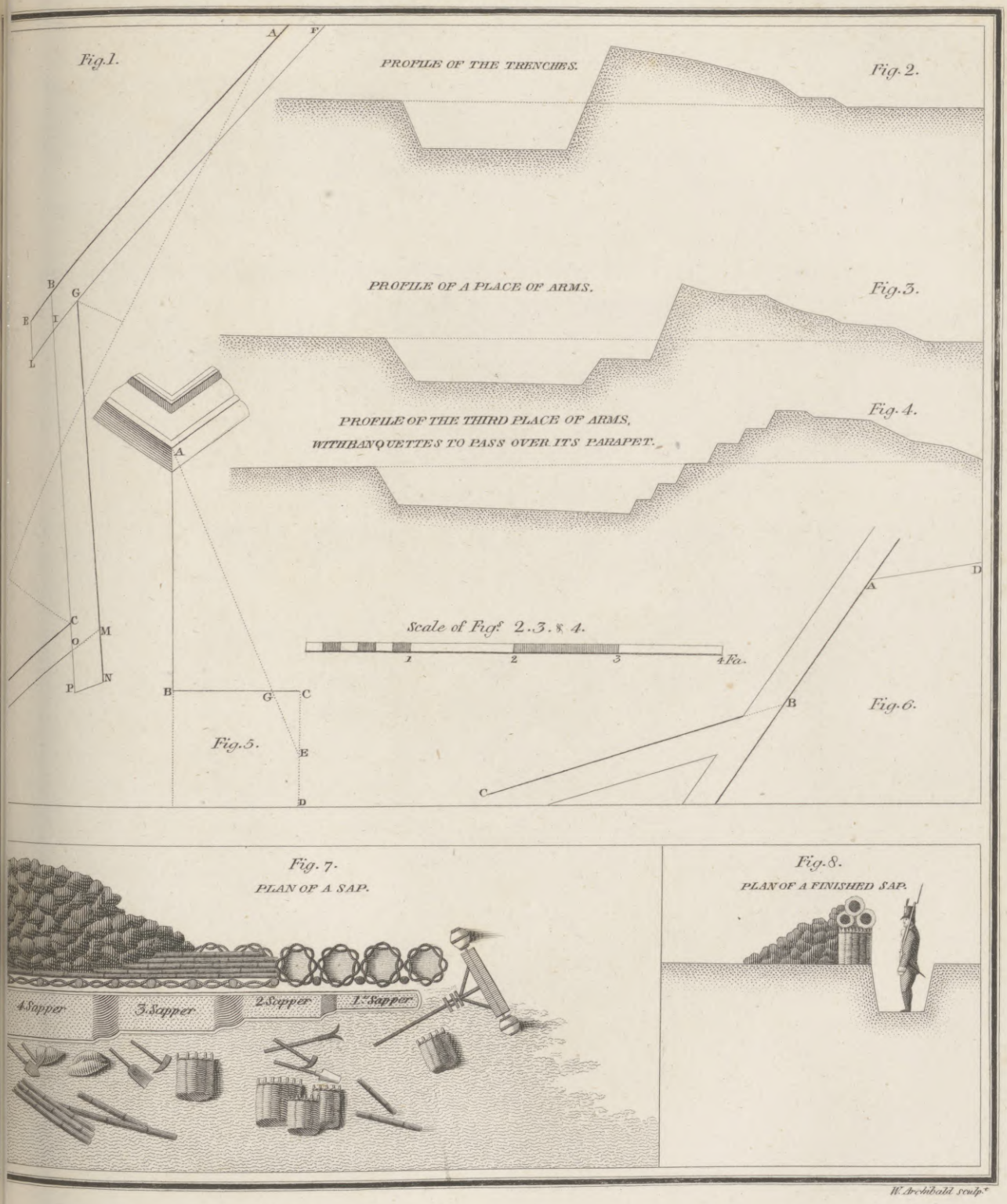


Fig. 7.
PLAN OF A SAP.

Fig.8.
PLAN OF A FINISHED SAP.

W. Archibald sculp.r

Fig. 1.
Back of a Sap.

Fig. 2.
Profile representing the excavation of 4 Sappers.

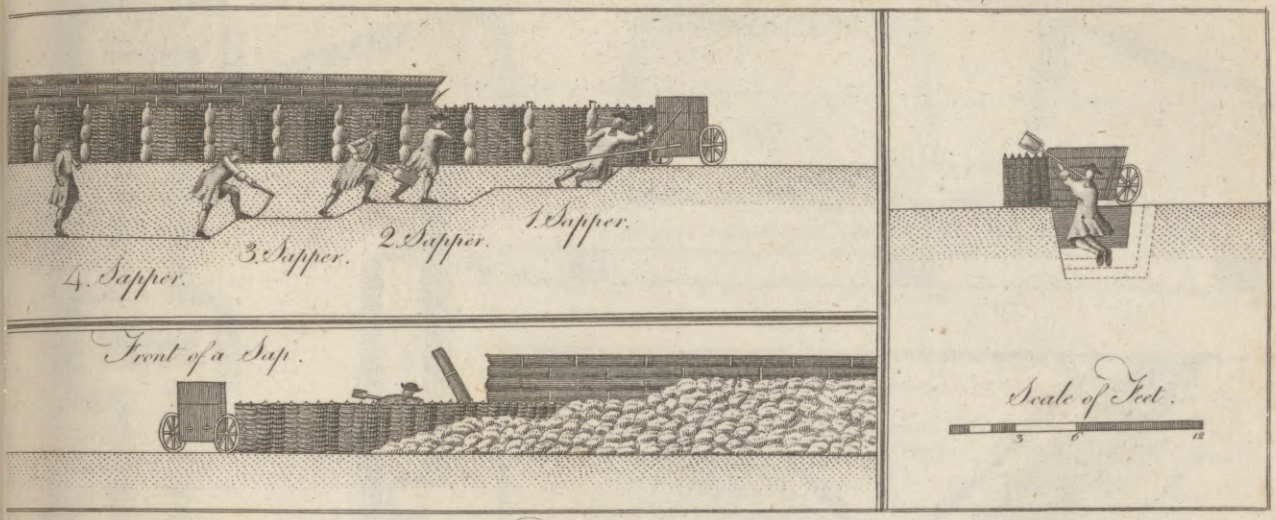
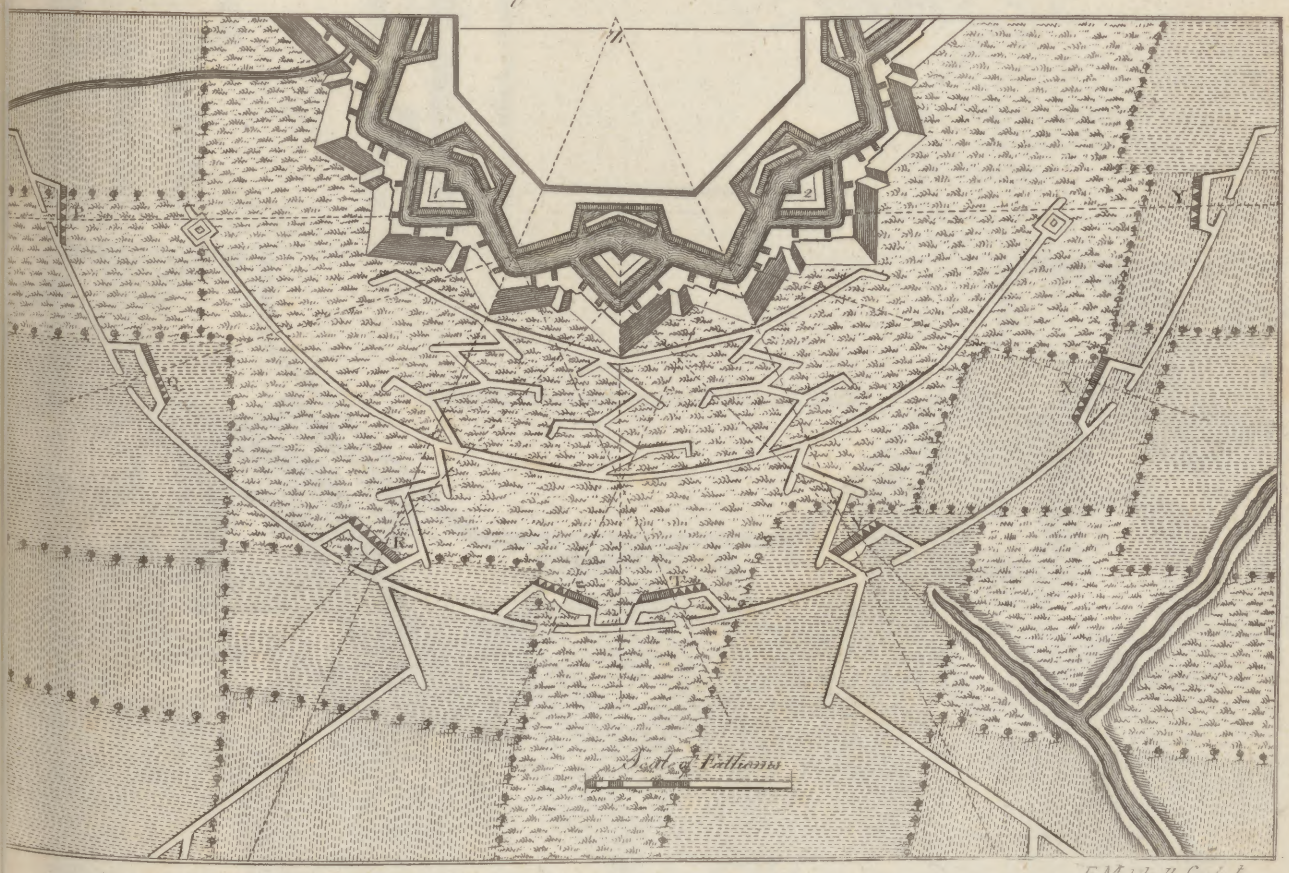
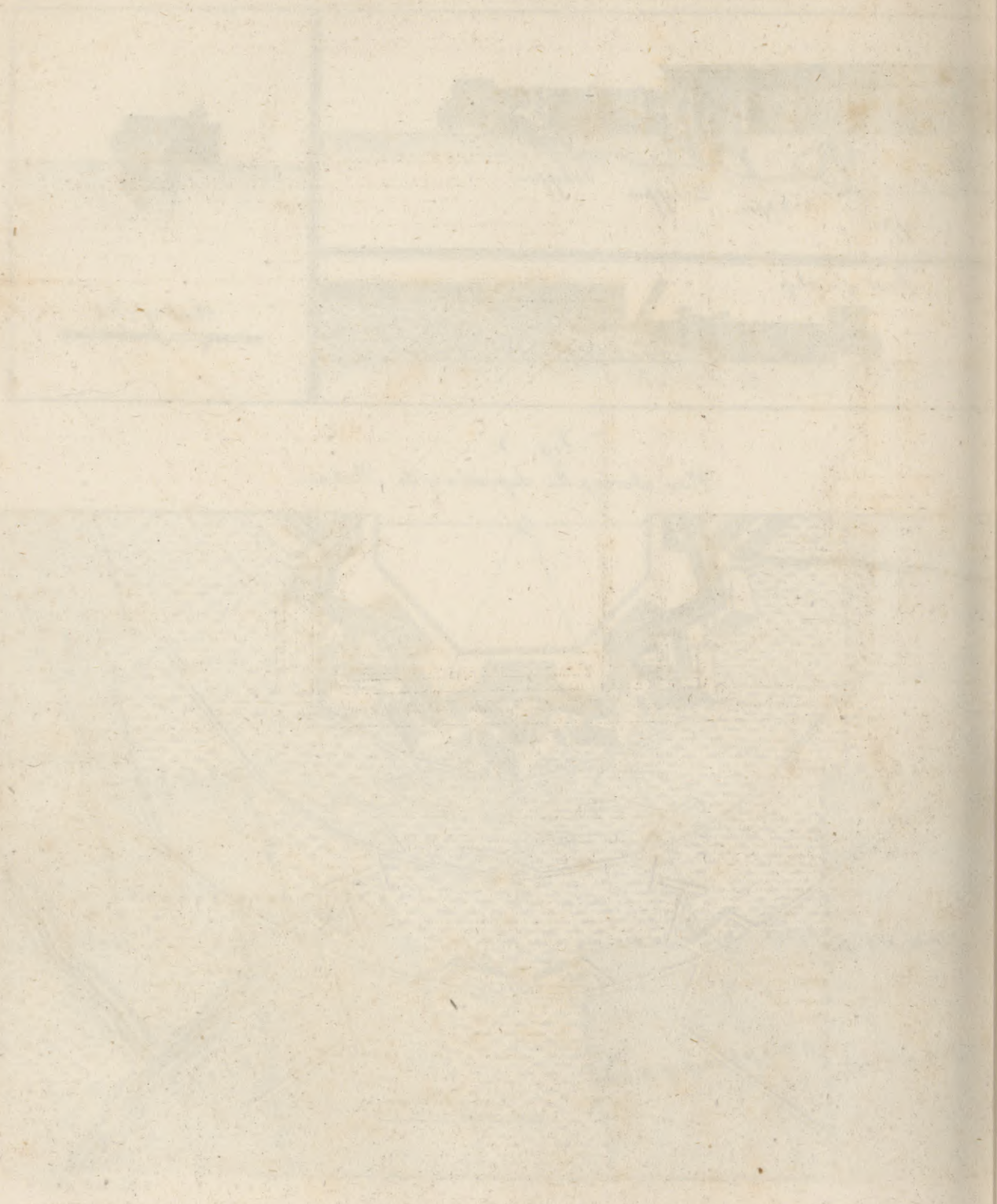
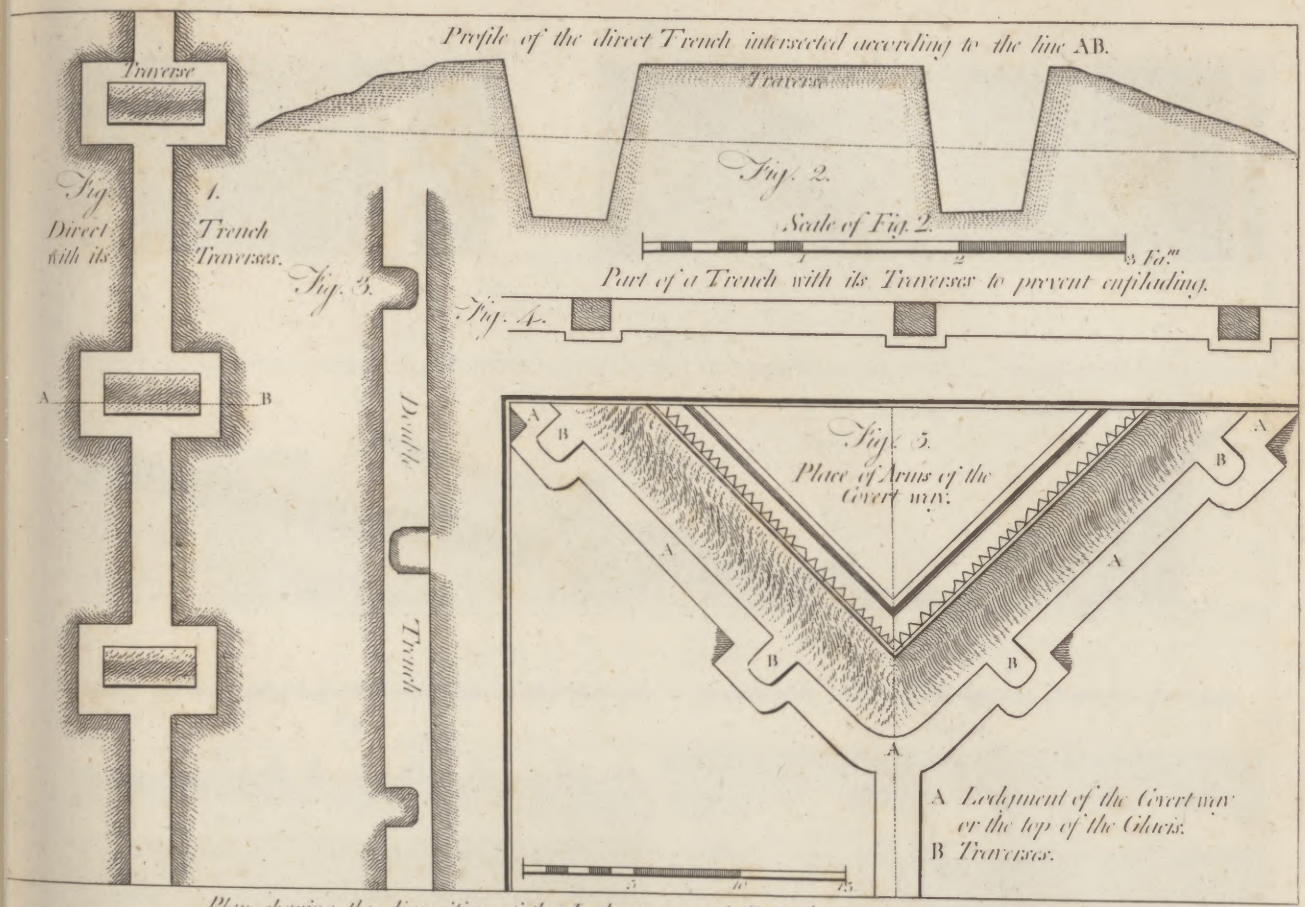


Fig. 3.
Plan shewing the disposition of the Batteries.

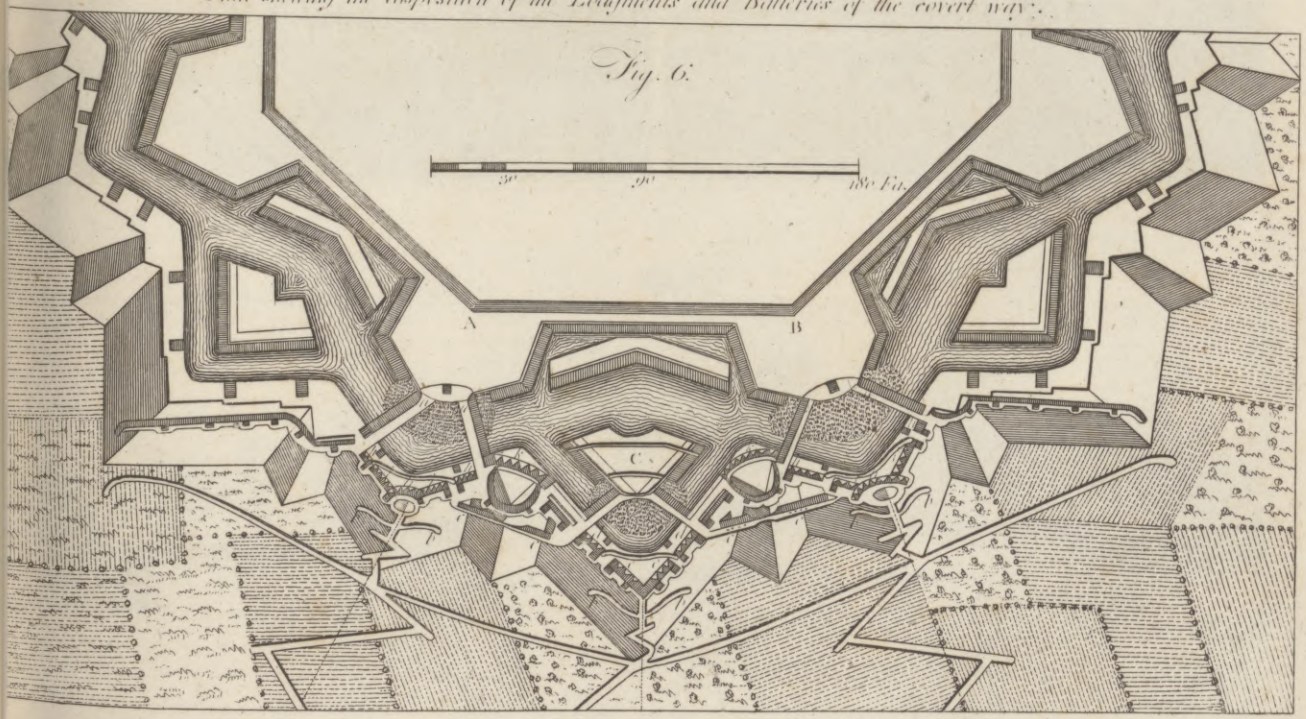


E. Mitchell Sculp.





Plan shewing the disposition of the Lodgments and Batteries of the covert way.



E.Mitchell Sculp.t

ATTACK of FORTIFIED PLACES.

Fig. 1.

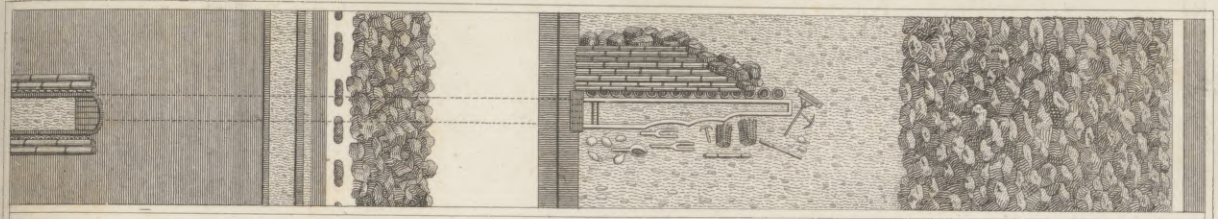
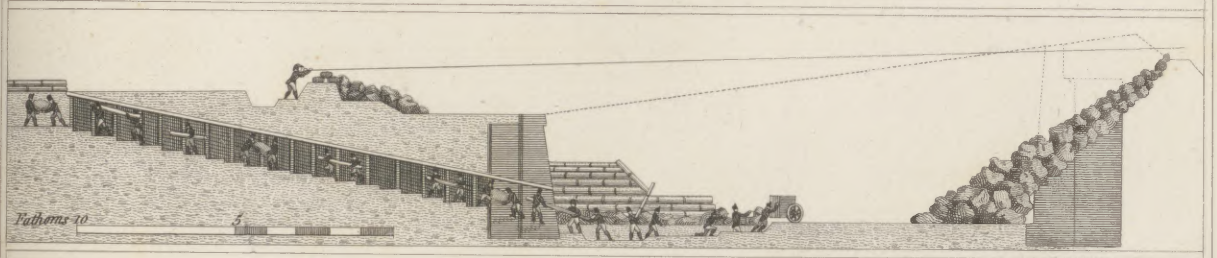
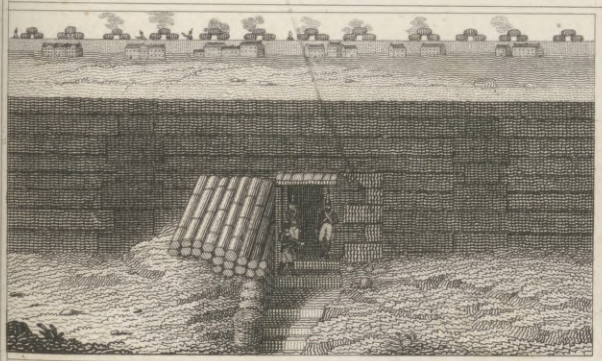


Fig. 2.

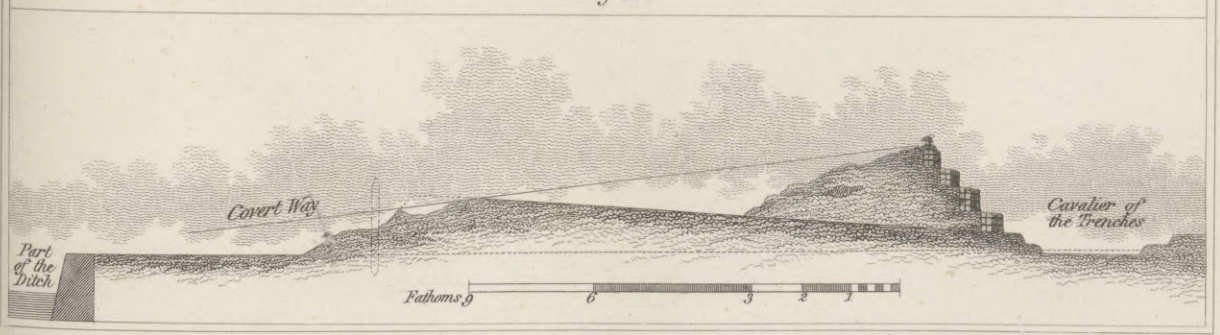


Entrance into the descent of a dry Ditch viewed from the top of the Breech.
Fig. 4.



Opening of the descent into the dry Ditch viewed from the Country.
Fig. 3.

Fig. 5.



W. Archibald Sculpt.

WAR.

Attack of Fortified Places.

PLATE DLXII.

Fig.1.

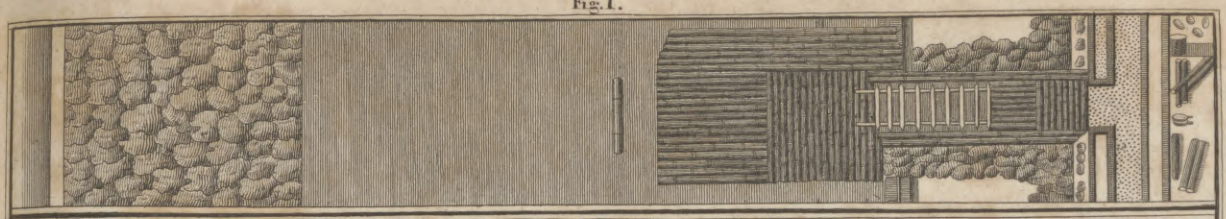


Fig.2.

Opening of the descent into a wet ditch viewed from the Glacis.

Entrance into the descent of the wet ditch viewed from the Breach.

Fig.3.

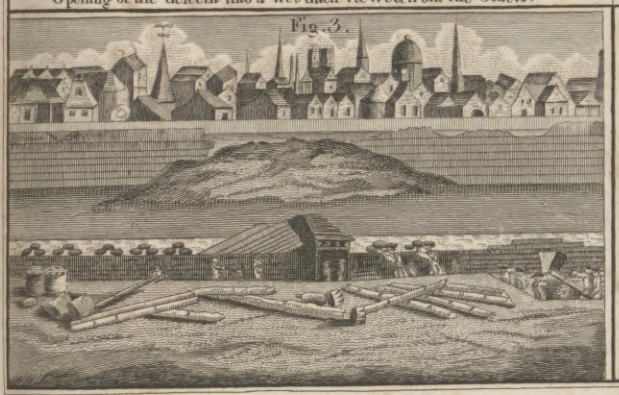


Fig.4.

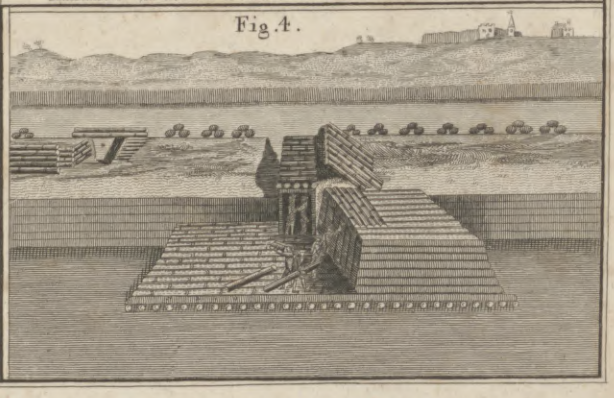
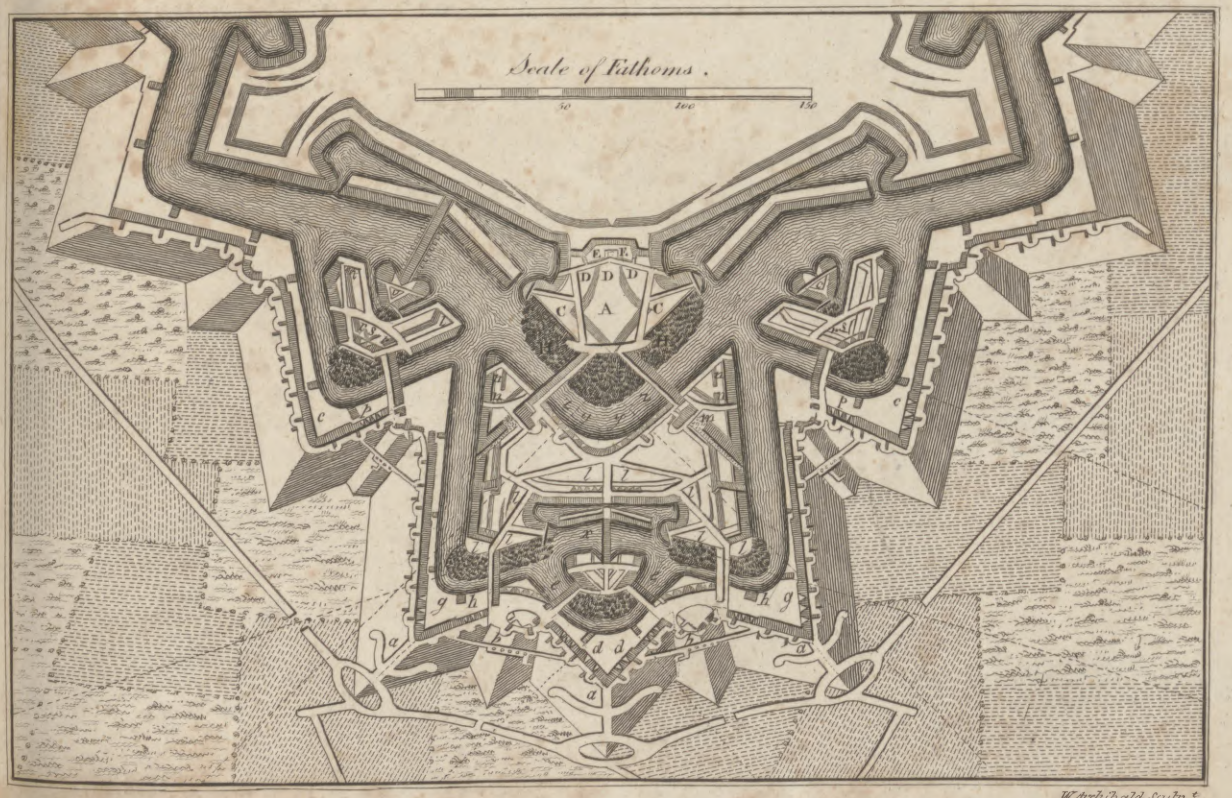


Fig.5.



W. Archibald Sculp.ᵗ

ATTACK OF FORTIFIED PLACES

Fig. 2.

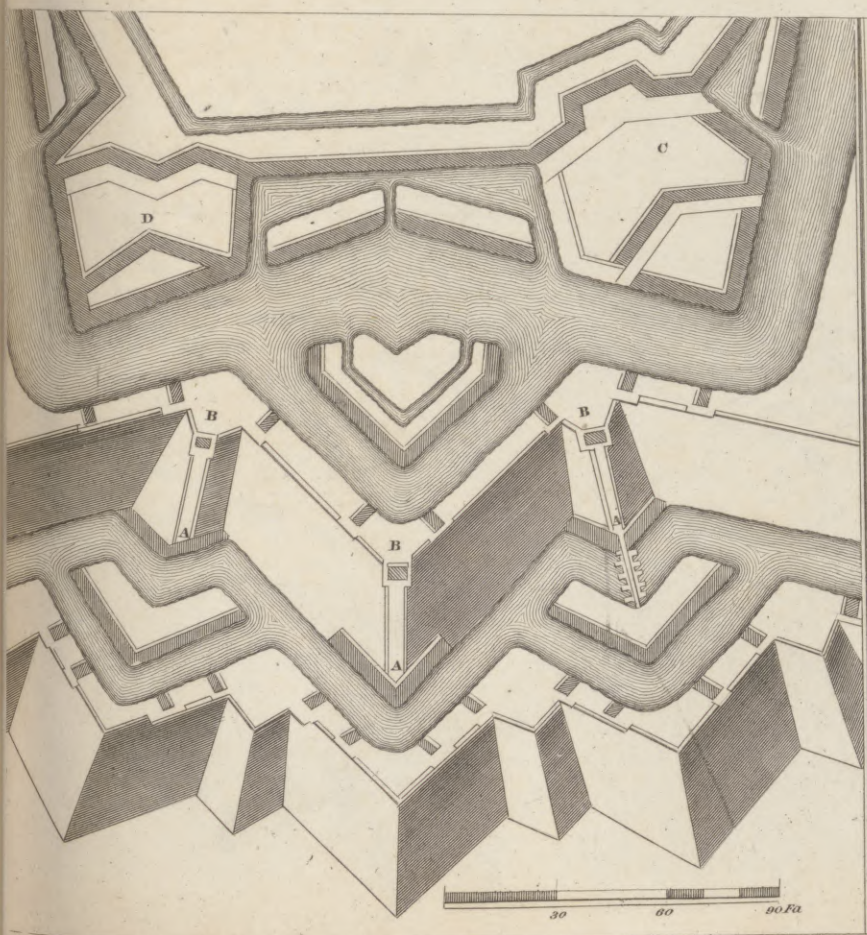
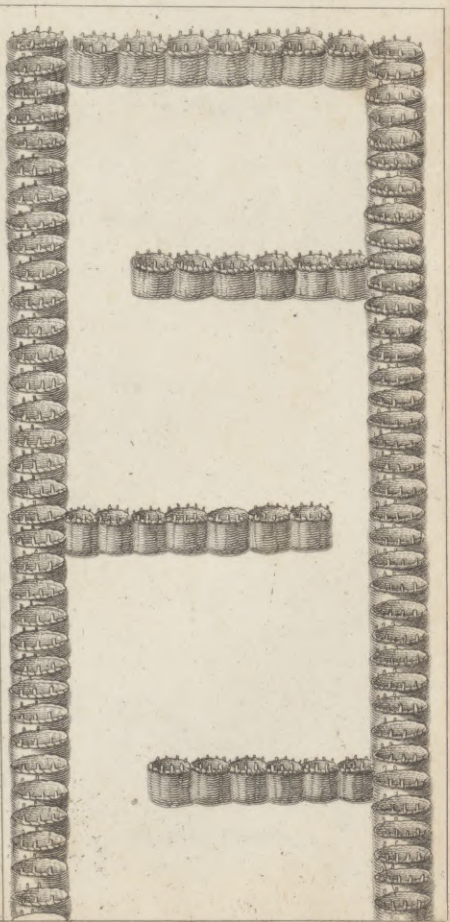


Fig. 3.



Engraved by W & D. Lizars Edin.r

Fig. 1.

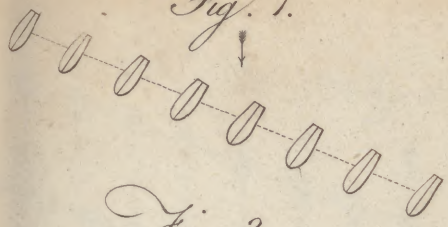


Fig. 2.

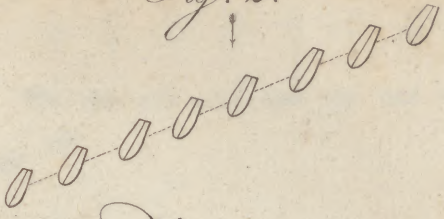


Fig. 3.

Fig. 4.

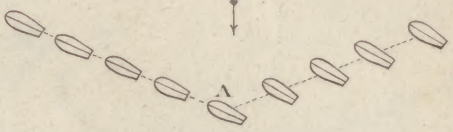


Fig. 5.

Fig. 6.

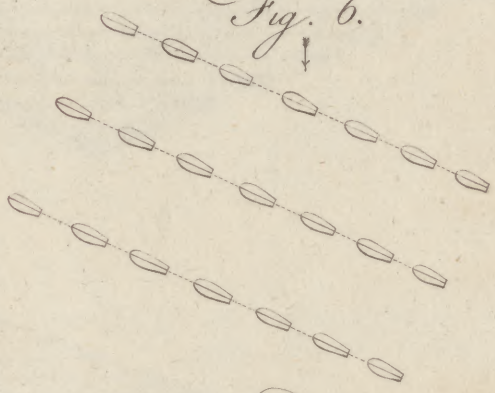


Fig. 10.

Fig. 7.

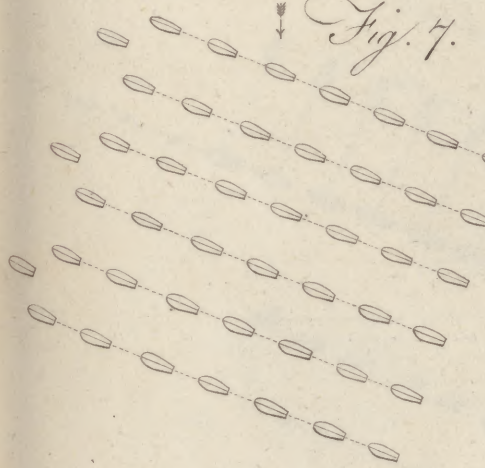


Fig. 8.

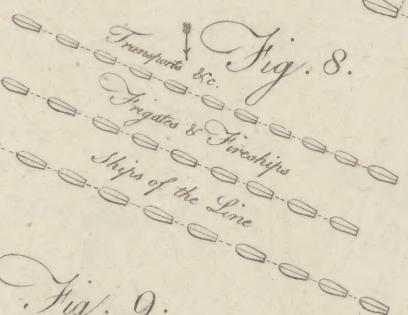
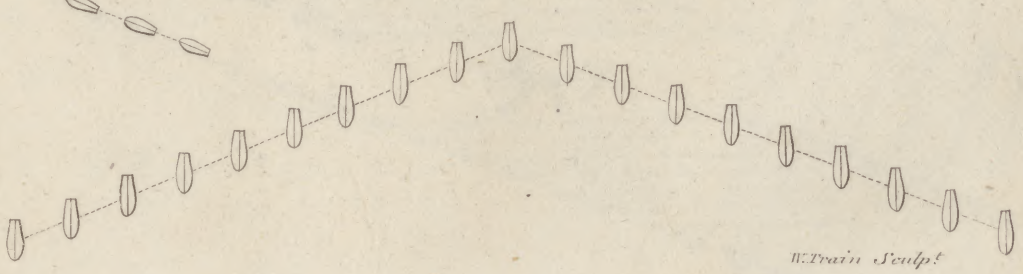


Fig. 9.



W. Train Sculp.t

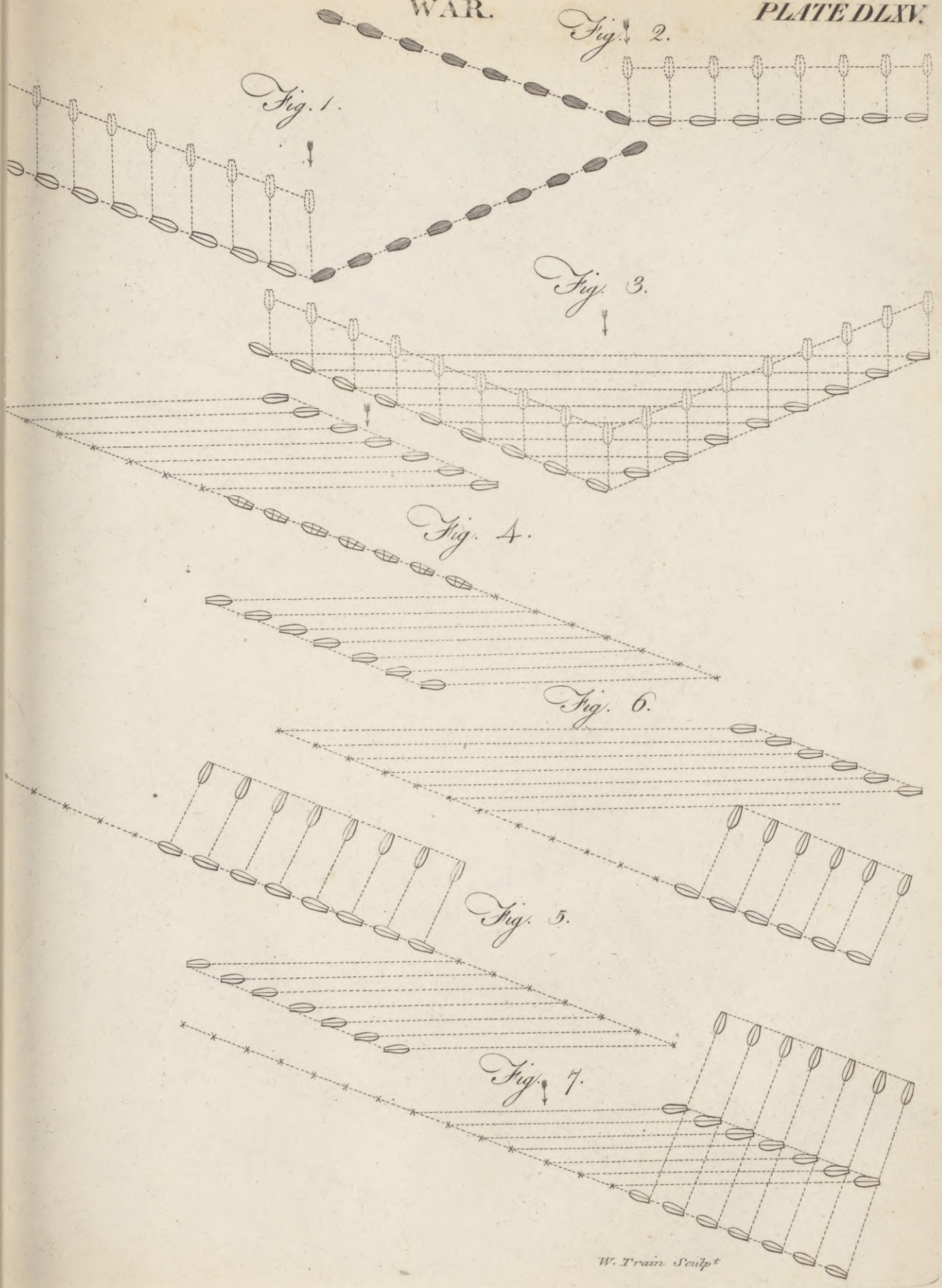


Fig. 2.
Fig. 1.
Fig. 3.
Fig. 4.
Fig. 6.
Fig. 5.
Fig. 7.
W. Train Sculpt

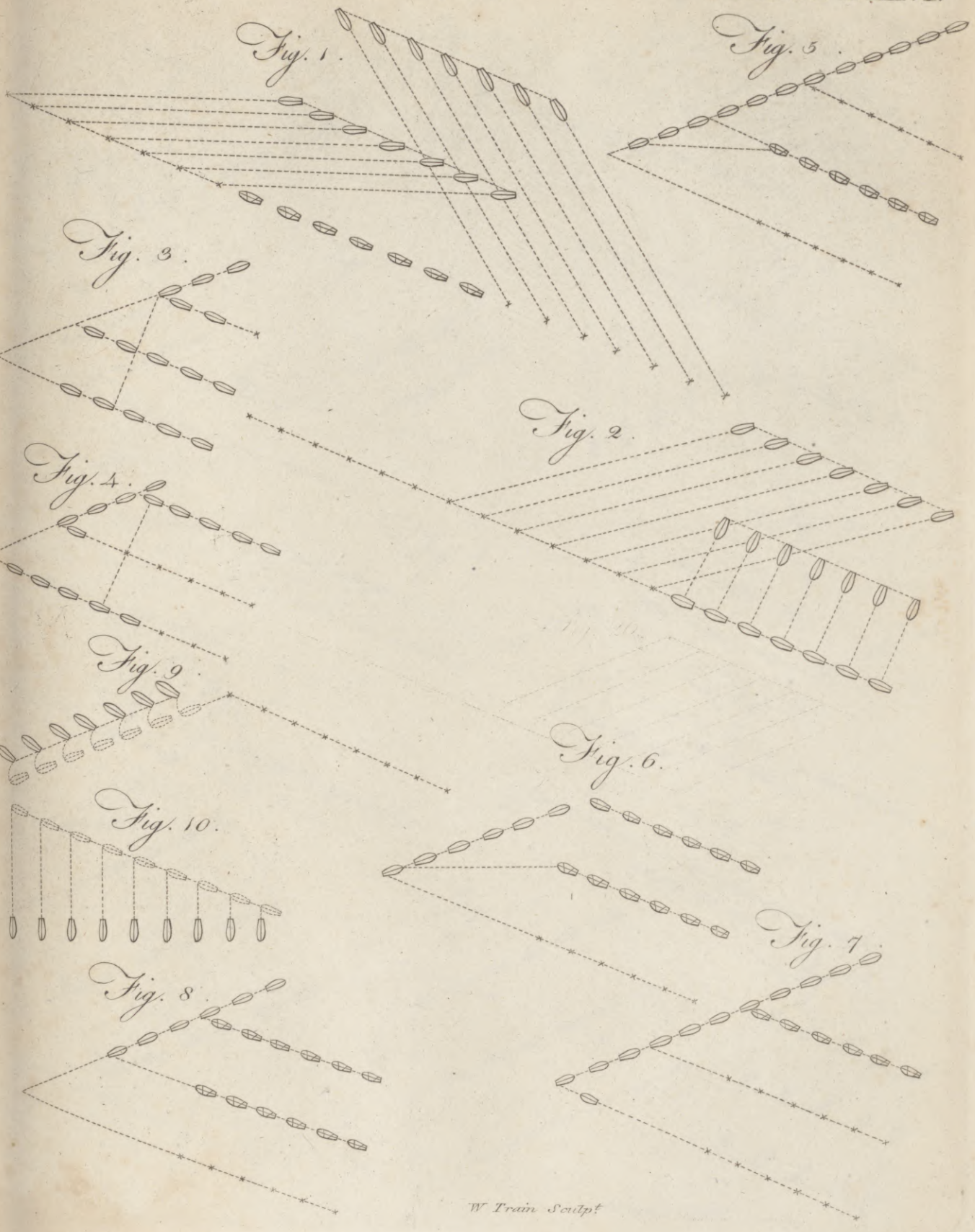
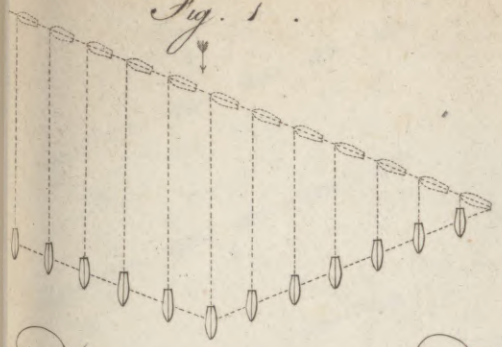


Fig. 1.
Fig. 5.
Fig. 3.
Fig. 2.
Fig. 4.
Fig. 9.
Fig. 6.
Fig. 10.
Fig. 7.
Fig. 8.
W Train Sculpt.

Fig. 1.



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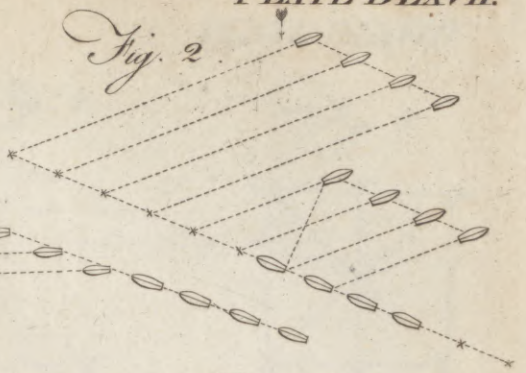

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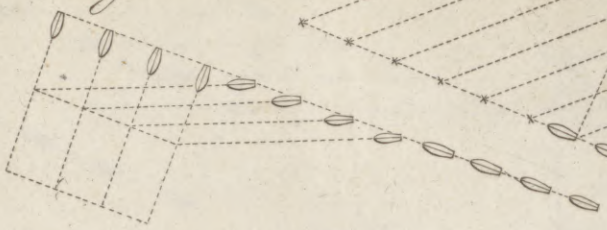

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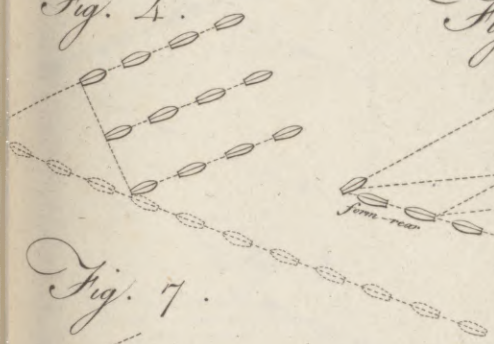

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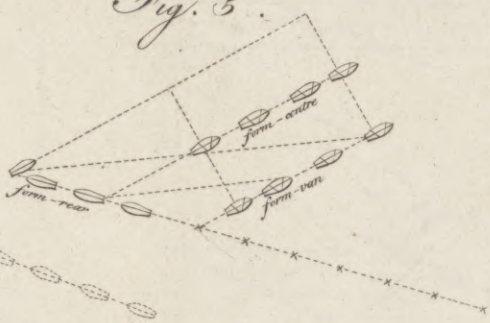

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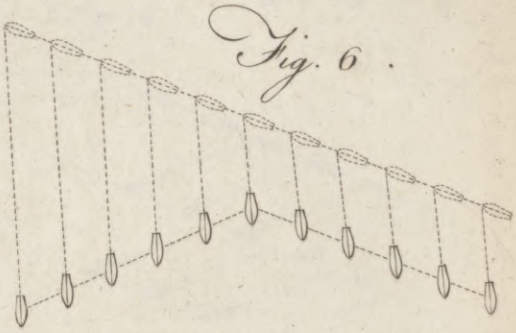

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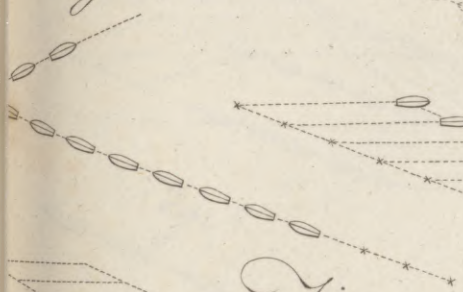

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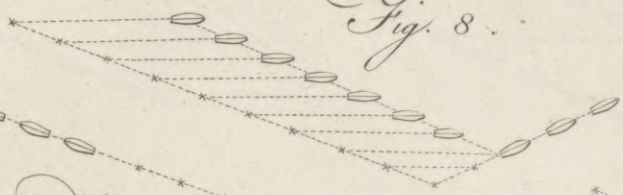


Fig. 9.

Fig. 10.

Fig. 11.

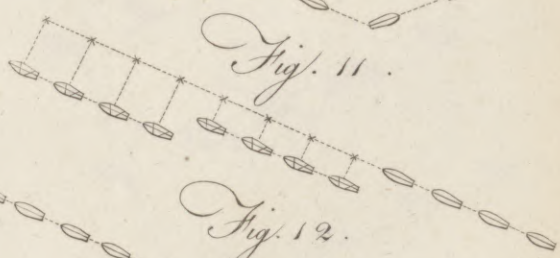


Fig. 12.

Fig. 13.

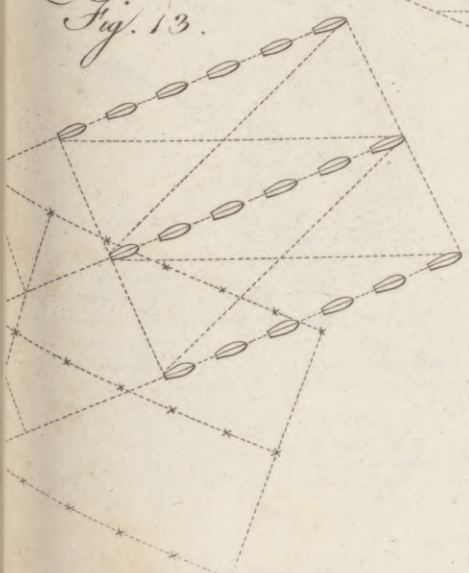
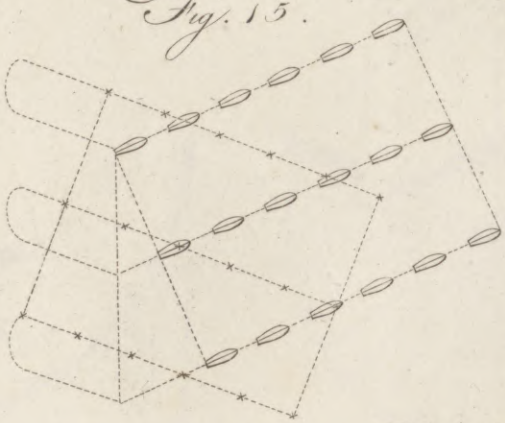


Fig. 15.



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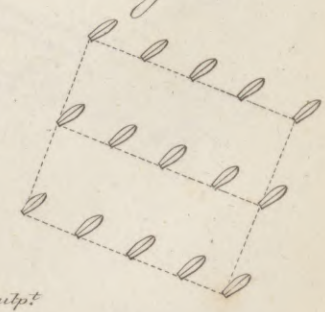
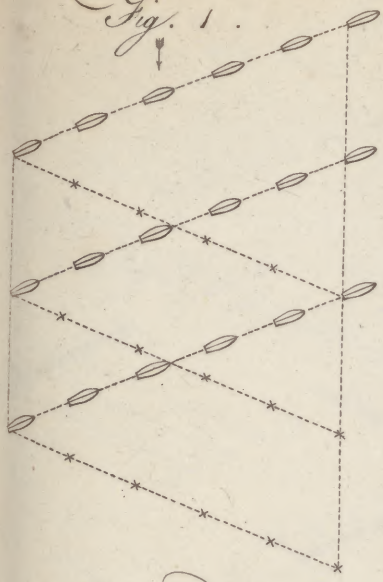


W. Train Sculpt.

Fig. 1.



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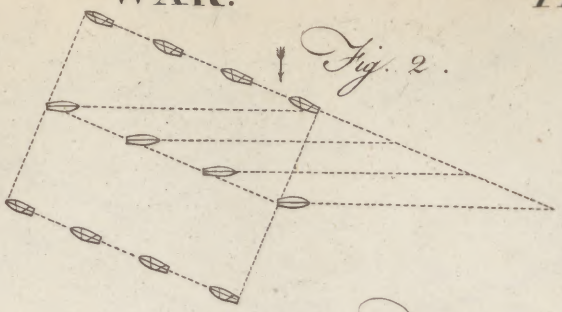

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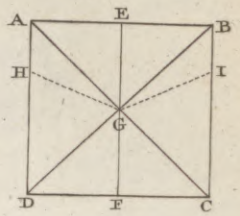


Fig. 4.

Fig. 5.

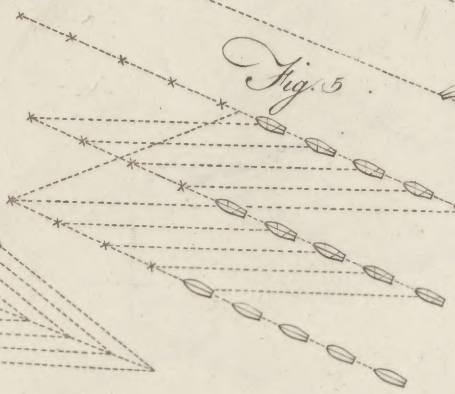


Fig. 3.

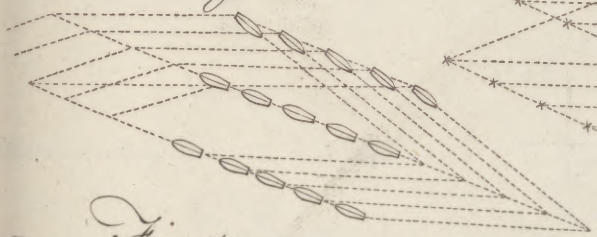


Fig. 8.

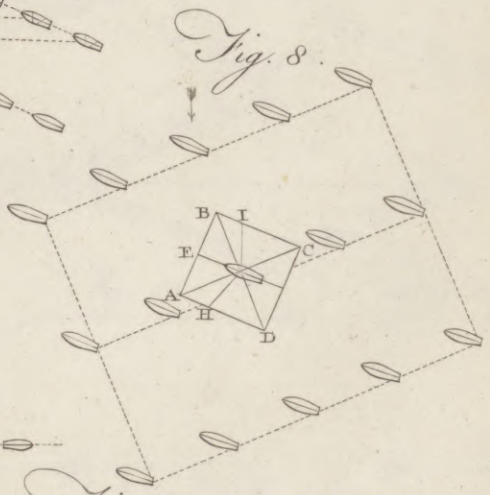
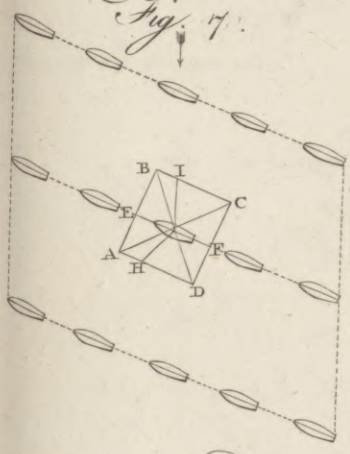


Fig. 7.



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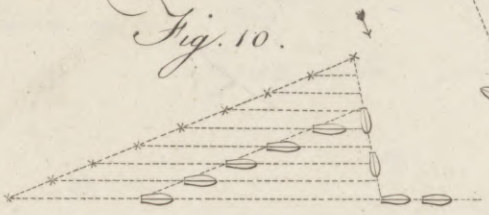

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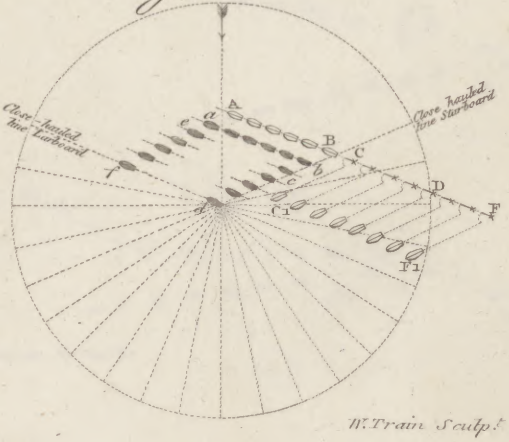

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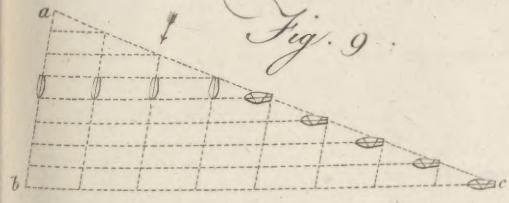

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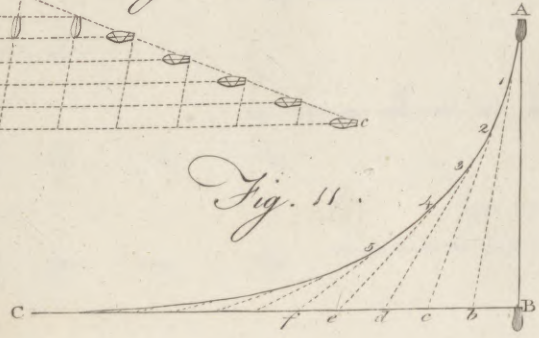
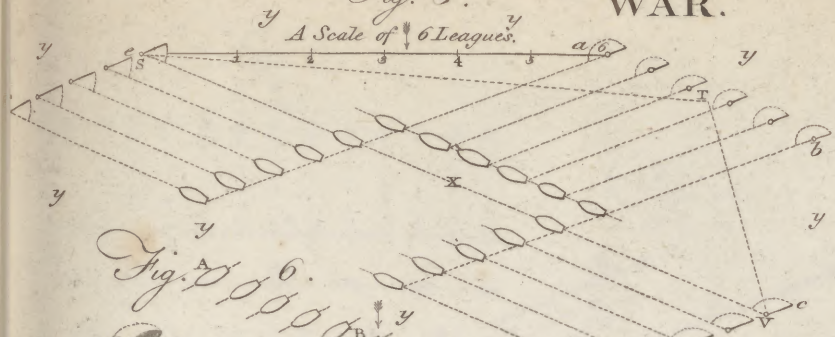


W. Train Sculp.t

WAR.

Fig. 3.



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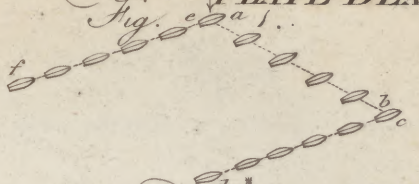

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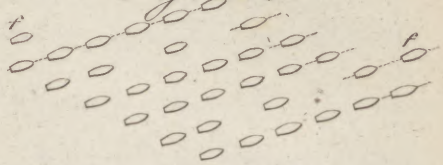

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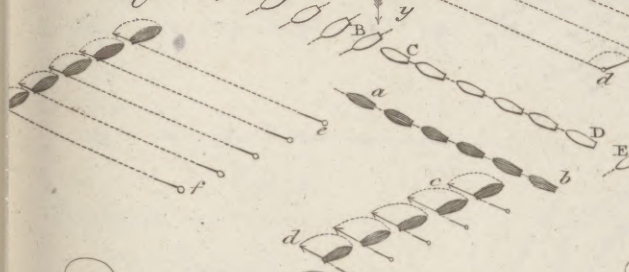

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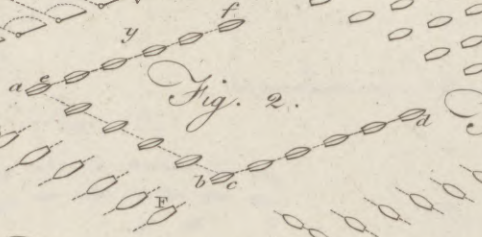

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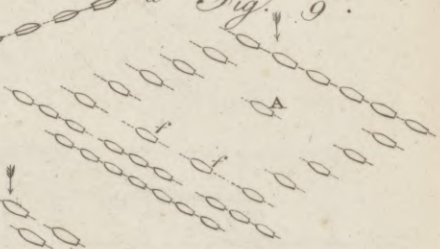

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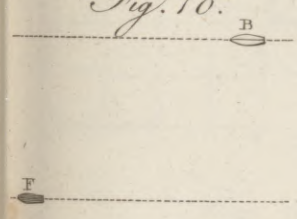

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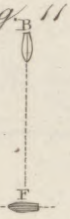

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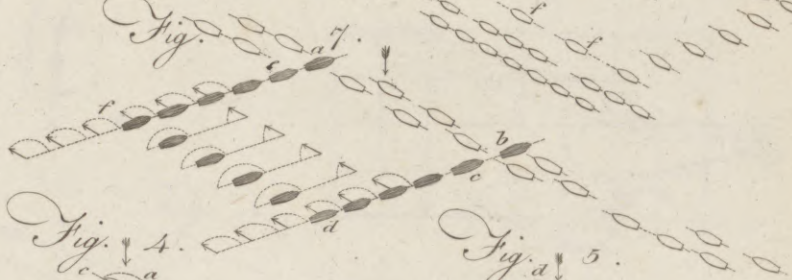

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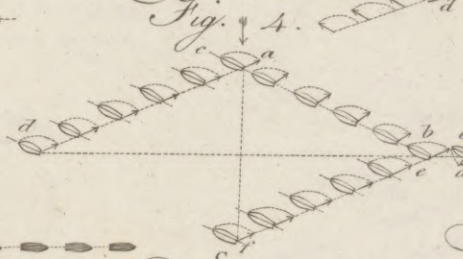
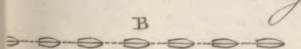


Fig. 5.

Fig. 16.



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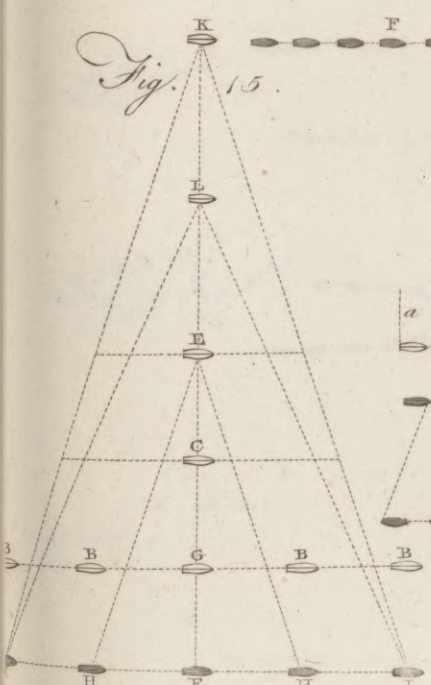

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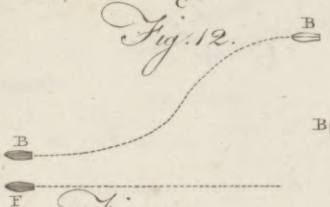

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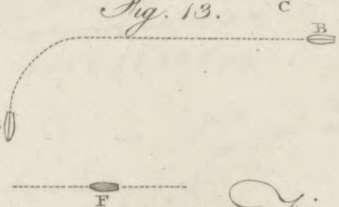

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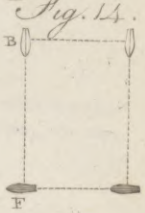

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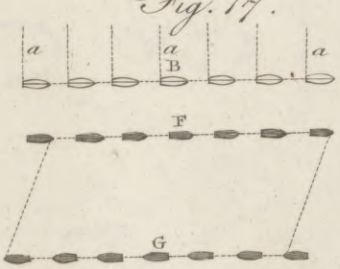

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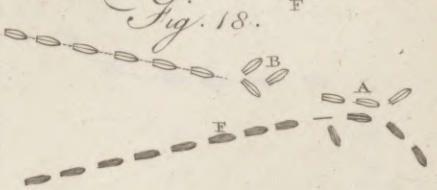

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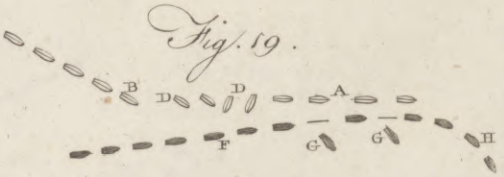

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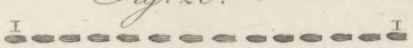
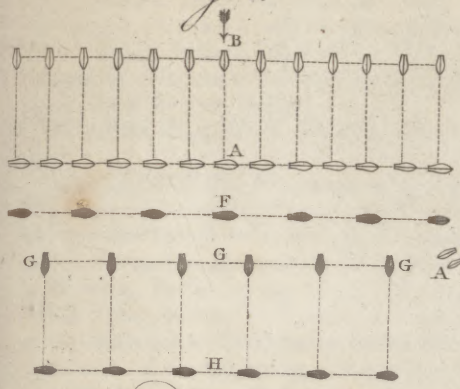


W. Train Sculpt.

Fig. 1.



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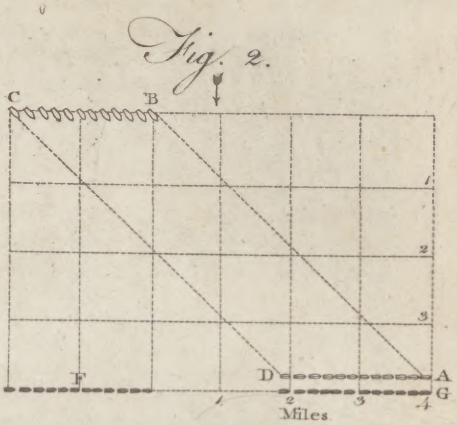

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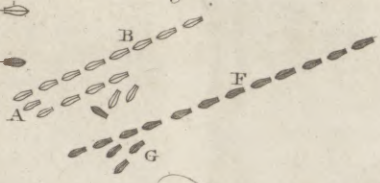
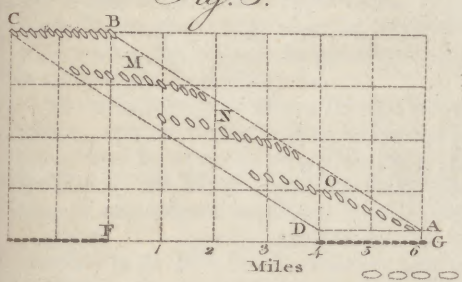


Fig. 12.

Fig. 3.



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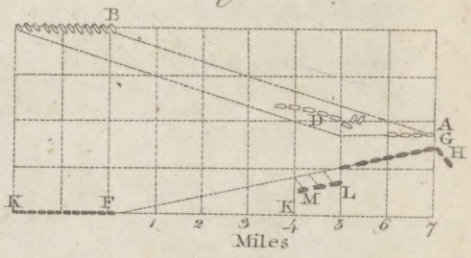

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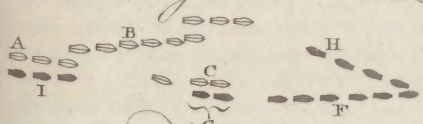

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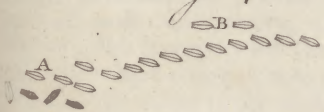

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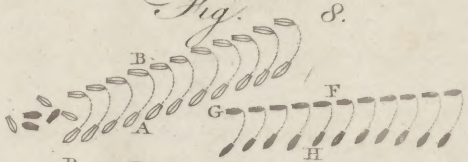

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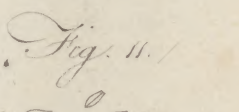

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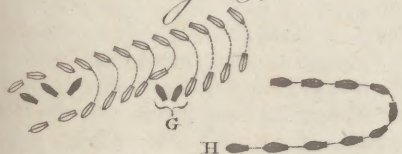
Fig. 9.



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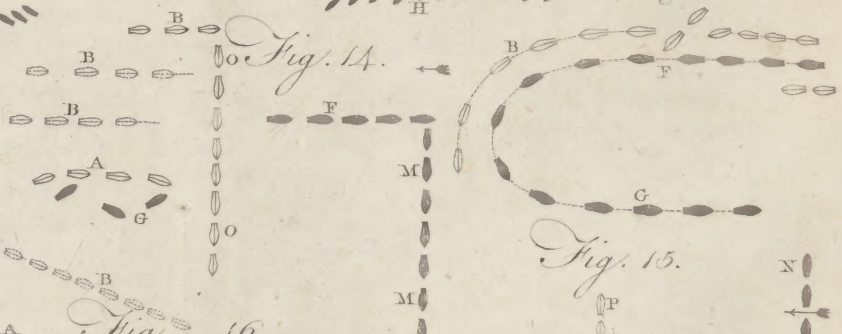

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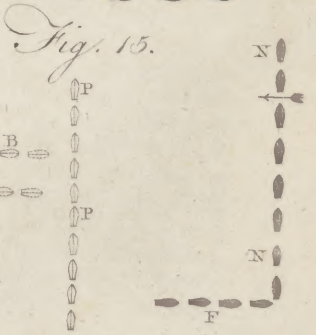

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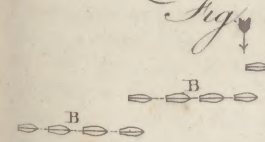

Fig. 16.

W. Train Sculpt.

War || Warburton.

Man-of-War Bird. See PELICANUS, ORNITHOLOGY *Index.*

War-Cry was formerly cuſtomary in the armies of moſt nations, when juſt upon the point of engaging. Sometimes they were only tumultuous ſhouts, or horrid yells, uttered with an intent to ſtrike terror into their adverſaries; ſuch as is now uſed by the Indians in America, called the *war-whoop.*

WARBLES, a diſeaſe of horſes. See FARRIERY *Index.*

WARBURTON, WILLIAM, a learned Engliſh biſhop, was deſcended from an ancient family in Cheſhire, and was the ſecond ſon of George Warburton, an attorney at Newark in the county of Nottingham, was born at Newark, December 24. 1698. He was firſt put to ſchool there under a Mr Twells, but had the chief part of his education at Okeham in Rutlandſhire, where he continued till the beginning of the year 1714, and ſoon after he was put out clerk to an eminent attorney of Great Markham in Nottinghamſhire, where he continued till the year 1719, when he returned to his family at Newark; but whether he practiſed there or elſewhere as an attorney, is not known.

He had always expreſſed a ſtrong inclination to take orders; and the love of letters, which tended to retard, rather than forward, his progreſs in the profeſſion choſen for him by his friends, growing every day ſtronger in him, it was deemed expedient to give way to that inclination. He therefore devoted himſelf to the ſtudies neceſſary to fit him for the church, and at length in 1723 he was ordained deacon, and prieſt in 1727.

In 1728 he was preſented by Sir Robert Sutton to the rectory of Brand-Broughton, in the dioceſe of Lincoln, where he ſpent the greater part of his life, and compoſed all the great works which will carry his fame down to poſterity. In the ſame year he was put upon the king's liſt of Maſters of Arts, erected on his majeſty's viſit to the univerſity of Cambridge. He had already publiſhed ſome juvenile performances, which diſplayed genius and reading, and attracted conſiderable notice; but it was not till the year 1736 that he may be ſaid to have emerged from the obſcurity of a private life into the notice of the world.—The firſt publication which rendered him afterwards famous now appeared, under the title of "The Alliance between Church and State; or, the Neceſſity and Equity of an Eſtabliſhed Religion and a Teſt Law; demonſtrated from the Eſſence and End of Civil Society, upon the fundamental Principles of the Law of Nature and Nations." In this treatiſe, ſays Biſhop Horſley *, the author "hath ſhown the general good policy of an eſtabliſhment, and the neceſſity of a TEST for its ſecurity, upon principles which republicans themſelves cannot eaſily deny. His work is one of the fineſt ſpecimens that are to be found perhaps in any language, of ſcientific reaſoning applied to a political ſubject."

eview of Caſe of Prote- t Diſ- ters, d. 1787. FACE.

At the cloſe of the Alliance was announced the ſcheme of the Divine Legation of Moſes, in which he had then made conſiderable progreſs. The firſt volume of this work was publiſhed in January 1737-8, under the title of "The Divine Legation of Moſes demonſtrated on the Principles of a religious Deiſt, from the Omiſſion of the Doctrine of a future State of Rewards and Puniſhments in the Jewiſh Diſpenſation, in ſix books, by William Warburton, M. A. author of the Alliance between Church and State;" and met with a reception which neither the ſubject, nor the manner in which it was treated, ſeemed to authoriſe. It was, as the author afterwards obſerved, fallen upon in ſo outrageous and brutal a manner as had been ſcarce pardonable, had it been "The Divine Legation of Mahomet."—It produced ſeveral anſwers, and ſo much abuſe from the authors of "The Weekly Miſcellany," that in leſs than two months he was conſtrained to defend himſelf, in "A Vindication of the Author of the Divine Legation of Moſes, from the Aſperſions of the Country Clergyman's Letter in the Weekly Miſcellany of February 24. 1737-8, 8vo." Warburton.

Mr Warburton's extraordinary merit had now attracted the notice of the heir apparent to the crown, in whoſe immediate ſervice we find him in June 1738, when he publiſhed "Faith working by Charity to Chriſtian Edification, a Sermon, preached at the laſt epiſcopal Viſitation for Confirmation in the Dioceſe of Lincoln; with a Preface, ſhowing the Reaſon of its Publication; and a Poſtſcript, occaſioned by ſome Letters lately publiſhed in the Weekly Miſcellany; by William Warburton, M. A. Chaplain to his Royal Highneſs the Prince of Wales."

The "Eſſay on Man" had now been publiſhed ſome years; and it is univerſally ſuppoſed, that the author had, in the compoſition of it, adopted the philoſophy of Lord Bolingbroke, whom, on this occaſion, he had followed as his guide, without underſtanding the tendency of his principles. In 1738, M. de Crouſaz wrote ſome remarks on it, accuſing the author of Spinoziſm and Naturaliſm; which falling into Mr Warburton's hands, he publiſhed a defence of the firſt epiſtle, and ſoon after of the remaining three, in ſeven letters; of which ſix were printed in 1739, and the ſeventh in June 1740, under the title of "A Vindication of Mr Pope's Eſſay on Man, by the author of the Divine Legation." The opinion which Mr Pope conceived of theſe defences, as well as of their author, will be beſt ſeen in his letters. In conſequence, a firm friendſhip was eſtabliſhed between them, which continued with undiminiſhed fervour until the death of Mr Pope; who, during the remainder of his life, paid a deference and reſpect to his friend's judgment and abilities, which will be conſidered by many as almoſt bordering on ſervility.

Towards the end of the year 1739, Mr Warburton publiſhed a new and improved edition of the firſt volume of the Divine Legation; and in 1741, appeared the ſecond part, which completed the argument, though not the entire plan of that work. "A work, ſays Biſhop Hurd *, in all views of the moſt tranſcendant merit, whether we conſider the invention or the execution. A plain ſimple argument, yet perfectly new, proving the divinity of the Moſaic law, and laying a ſure foundation for the ſupport of Chriſtianity, is there drawn out to a great length by a chain of reaſoning ſo elegantly connected, that the reader is carried along it with eaſe and pleaſure; while the matter preſented to him is ſo ſtriking for its own importance, ſo embelliſhed by a lively fancy, and illuſtrated from all quarters by exquiſite learning and the moſt ingenious diſquiſition, that in the whole compaſs of modern or ancient theology, there is nothing equal or ſimilar to this extraordinary performance."

* *Life of Warburton prefixed to his Works.*

This is the panegyric of a man reflecting with tenderneſs

Warburton. derneſs on the memory of his friend and benefactor; but it approaches much nearer to the truth than the cenſures of thoſe cabaliſtic critics, who, faſtening upon ſome weak part of the Divine Legation, or perhaps never having looked into it, have ridiculouſly contended that the author was far from being eminent as a ſcholar, and that his work is inimical to the cauſe of Chriſtianity! Putting partiality aſide, there is in the Divine Legation of Moſes abundant evidence of the malignant folly of this charge, as no man can read and underſtand that work without being convinced that its author was a Chriſtian, not only ſincere but zealous; that he was, what Johnſon calls him *, "a man of vigorous faculties, of a mind fervent and vehement, ſupplied, by unlimited and inceſſant inquiry, with a wonderful extent and variety of knowledge, which had neither depreſſed his imagination nor clouded his perſpicuity; and that to every work, and this work in particular, he brought a memory full fraught, with a fancy fertile of original combinations, exerting at once the powers of the ſcholar, the reaſoner, and the wit." But we think it muſt be acknowledged, that his learning was too multifarious to be always exact, and his inquiries too eagerly puſhed to be always cautious. We have no heſitation, however, to ſay, that to the divine this great work, with all its imperfections, is, in our opinion, one of the moſt valuable that is to be found in any language.

* *Life of Pope.*

In the ſummer 1741, Mr Pope and Mr Warburton, in a country ramble, took Oxford in their way. The univerſity was naturally pleaſed at the arrival of two ſuch ſtrangers, and ſeemed deſirous of enrolling their names among their graduates. The degree of D. D. was intended for the divine, and that of LL. D. for the poet: but intrigue and envy defeated this ſcheme; and the univerſity loſt the honour of decorating at the ſame time the two greateſt geniuſes of the age, by the fault of one or two of its members. Pope retired with ſome indignation to Twickenham, where he conſoled himſelf and his friend with this ſarcaſtic reflection—"We ſhall take our degree together in fame, whatever we do at the univerſity."

The friendſhip of this eminent poet was of ſervice to Mr Warburton in more reſpects than that of increaſing his fame. He introduced and warmly recommended him to moſt of his friends, and among others to Mr Murray, afterwards earl of Mansfield, and Ralph Allen, Eſq. of Prior-park. In conſequence of this introduction, we find Mr Warburton at Bath 1742; where he printed a ſermon which had been preached at the Abbey-church on the 24th of October, for the benefit of Mr Allen's favourite Charity, the General Hoſpital or Infirmary. In this year alſo he printed a Diſſertation on the origin of books of chivalry, at the end of Jarvis's Preface to a tranſlation of Don Quixote, which Mr Pope tells him, he had not got over two paragraphs of, before he cried out, *Aut Eraſmus, aut Diabolus.*

In 1742, Mr Warburton publiſhed "A Critical and Philoſophical Commentary on Mr Pope's Eſſay on Man, in which is contained a Vindication of the ſaid Eſſay from the Miſrepreſentation of M. de Reſnal, the French Tranſlator, and of M. de Crouſaz, Profeſſor of Philoſophy and Mathematics in the Academy of Lauſanne, the Commentator." It was at this period, when Mr Warburton had the entire confidence of Mr Pope, that he adviſed him to complete the Dunciad, by changing the hero, and adding to it a fourth book. This was accordingly executed in 1742, and publiſhed early in 1743, with notes by our author; who, in conſequence of it, received his ſhare of the abuſe which Mr Cibber liberally beſtowed on both Mr Pope and his annotator. In the latter end of the ſame year he publiſhed complete editions of "The Eſſay on Man," and "The Eſſay on Criticiſm;" and from the ſpecimen which he there exhibited of his abilities, it may be preſumed Mr Pope determined to commit the publication of thoſe works which he ſhould leave to Mr Warburton's care. At Mr Pope's deſire, he, about this time, reviſed and corrected the "Eſſay on Homer," as it now ſtands in the laſt edition of that tranſlation. Warburton

The publication of "The Dunciad" was the laſt ſervice which our author rendered Mr Pope in his lifetime. After a lingering and tedious illneſs, the event of which had been long foreſeen, this great poet died on the 30th of May 1744; and by his will, dated the 12th of the preceding December, bequeathed to Mr Warburton one half of his library, and the property of all ſuch of his works already printed as he had not otherwiſe diſpoſed of or alienated, and all the profits which ſhould ariſe from any edition to be printed after his death: but at the ſame time directed that they ſhould be publiſhed without any future alterations.

"In 1744, Mr Warburton turned his attention to the ſeveral attacks which had been made on the "Divine Legation," and defended himſelf in a manner which, if it did not prove him to be poſſeſſed of much humility or diffidence, at leaſt demonſtrated, that he knew how to wield the weapons of controverſy with the hand of a maſter. His firſt defence now appeared, under the title of "Remarks on ſeveral occaſional Reflections, in Anſwer to the Reverend Dr Middleton, Dr Pococke, the Maſter of the Charter-houſe, Dr Richard Grey, and others; ſerving to explain and juſtify divers Paſſages in the Divine Legation, objected to by thoſe learned Writers. To which is added, A general Review of the Argument of the Divine Legation, as far as it is yet advanced; wherein is conſidered the Relation the ſeveral Parts bear to each other and the whole. Together with an Appendix, in Anſwer to a late Pamphlet intitled, An Examination of Mr W——'s ſecond Propoſition." This was followed next year by "Remarks on ſeveral occaſional Reflections, in Anſwer to the Reverend Doctors Stebbing and Sykes; ſerving to explain and juſtify the Two Diſſertations in the Divine Legation, concerning the command to Abraham to offer up his Son, and the Nature of the Jewiſh Theocracy, objected to by theſe learned Writers. Part II. and laſt." Both theſe anſwers are couched in thoſe high terms of confident ſuperiority, which marked almoſt every performance that fell from his pen during the remainder of his life.

On the 5th of September 1745, the friendſhip between him and Mr Allen was more cloſely cemented by his marriage with Miſs Tucker, who ſurvived, and is now, if alive, Mrs Stafford Smith of Prior-park. At that important criſis our author preached and publiſhed three ſeaſonable ſermons: 1. "A faithful Portrait of Popery, by which it is ſeen to be the Reverſe of Chriſtianity, as it is the Deſtruction of Morality, Piety, and Civil Liberty. Preached at St James's, Weſtminſter, October

Warburton. October 1745." 2. "A Sermon occaſioned by the preſent unnatural Rebellion, &c. Preached in Mr Allen's Chapel at Prior-park, near Bath, November 1745." 3. "The Nature of National Offences truly ſtated.—Preached on the General Faſt-day, Dec. 18. 1745-6." On account of the laſt of theſe ſermons, he was again involved in a controverſy with his former antagoniſt Dr Stebbing, which occaſioned "An Apologetical Dedication to the Reverend Dr Henry Stebbing, in Anſwer to his Cenſure and Miſrepreſentations of the Sermon preached on the General Faſt, &c.

Notwithſtanding his great connections, his acknowledged abilities, and his eſtabliſhed reputation, a reputation founded on the durable baſis of learning, and upheld by the decent and attentive performance of every duty incident to his ſtation; yet we do not find that he received any addition to the preferments given him in 1728 by Sir Robert Sutton (except the chaplainſhip to the prince of Wales), until April 1746, when he was unanimouſly called by the Society of Lincoln's Inn to be their preacher. In November he publiſhed "A Sermon preached on the Thankſgiving appointed to be obſerved the 9th of October, for the Suppreſſion of the late unnatural Rebellion." In 1747 appeared his edition of Shakeſpeare and his Preface to Clariſſa; and in the ſame year he publiſhed, 1. "A Letter from an Author to a Member of Parliament concerning Literary Property." 2. "Preface to Mrs Cockburn's Remarks upon the Principles and Reaſonings of Dr Rutherford's Eſſay on the Nature and Obligations of Virtue, &c." 3. "Preface to a Critical Inquiry into the Opinions and Practice of the ancient Philoſophers, concerning the Nature of a Future State, and their Method of teaching by double Doctrine," (by Mr Towne) 1747, ſecond edition. In 1748, a third edition of "The Alliance between Church and State, corrected and enlarged."

"In 1749, a very extraordinary attack was made on the moral character of Mr Pope, from a quarter where it could be leaſt expected. An inſignificant pamphlet, under the name of *A Patriot King*, was that year publiſhed by Lord Bolingbroke, or by his direction, with a preface to it, reflecting highly on Mr Pope's honour. The provocation was ſimply this: The manuſcript of that trivial declamation had been intruſted to the care of Mr Pope, with the charge (as it was pretended) that only a *certain* number of copies ſhould be printed. Mr Pope, in his exceſſive admiration of his *guide, philoſopher*, and friend, took that opportunity, for fear ſo invaluable a treaſure of patriot eloquence ſhould be loſt to the public, to exceed his commiſſion, and to run off more copies, which were found, after his death, in the printer's warehouſe. This charge, however frivolous, was aggravated beyond meaſure; and, notwithſtanding the proofs which Lord Bolingbroke, had received of Pope's devotion to him, envenomed with the utmoſt malignity. Mr Warburton thought it became him to vindicate his deceaſed friend; and he did it ſo effectually, as not only to ſilence his accuſer, but to cover him with confuſion *."

Hurd's life of Warburton.

About this time the publication of Dr Middleton's Inquiry concerning the miraculous Powers of the Chriſtian church, gave riſe to a controverſy, which was managed with great warmth and aſperity on both ſides, and not much to the credit of either party. On this occaſion Mr Warburton publiſhed an excellent performance, written with a degree of candour and temper, which, it is to be lamented, he did not always exerciſe. The title of it was "Julian; or a Diſcourſe concerning the Earthquake and fiery Eruption which defeated that Emperor's attempt to rebuild the Temple at Jeruſalem, 1750." A ſecond edition of this diſcourſe, "with Additions," appeared in 1751, in which year he gave the public his edition of Mr Pope's Works, with Notes, in nine volumes 8vo; and in the ſame year printed "An Anſwer to a Letter to Dr Middleton, inſerted in a Pamphlet intitled, The Argument of the Divine Legation fairly ſtated," &c.; and "An Account of the Prophecies of Ariſe Evans, the Welſh Prophet in the laſt Century," annexed to the firſt volume of Dr Jortin's Remarks on Eccleſiaſtical Hiſtory, which afterwards ſubjected him to much trouble. Warburton.

In 1752, Mr Warburton publiſhed the firſt volume of a courſe of ſermons, preached at Lincoln's Inn, intitled, "The Principles of Natural and Revealed Religion, occaſionally opened and explained;" and this was two years afterwards followed by a ſecond. After the public had been ſome time promiſed, it may, from the alarm which was taken, be almoſt ſaid threatened with, the appearance of Lord Bolingbroke's Works, they were about this time printed. The known abilities and infidelity of this nobleman had created apprehenſions in the minds of many people, of the pernicious effects of his doctrines; and nothing but the appearance of his whole force could have convinced his friends, how little there was to be dreaded from arguments againſt religion ſo weakly ſupported. Many anſwers were ſoon publiſhed, but none with more acuteneſs, ſolidity, and ſprightlineſs, than "A View of Lord Bolingbroke's Philoſophy, in two Letters to a Friend, 1754;" the third and fourth letters were publiſhed in 1755, with another edition of the two former; and in the ſame year a ſmaller edition of the whole; which, though it came into the world without a name, was univerſally aſcribed to Mr Warburton, and afterwards publicly owned by him. To ſome copies of this is prefixed an excellent complimentary epiſtle from the preſident Monteſquieu, dated May 26. 1754.

At this advanced period of his life, that preferment which his abilities might have claimed, and which had hitherto been withheld, ſeemed to be approaching towards him. In September 1754, he was appointed one of his majeſty's chaplains in ordinary; and in the next year was preſented to a prebend in the cathedral of Durham. About this time the degree of Doctor of Divinity was conferred on him by Dr Herring, then archbiſhop of Canterbury. A new impreſſion of The Divine Legation being now called for, he printed a fourth edition of the firſt part of it, corrected and enlarged, divided into two volumes, with a dedication to the earl of Hardwicke. The ſame year appeared "A Sermon preached before his Grace Charles Duke of Marlborough, Preſident, and the Governors of the Hoſpital for the Smallpox and for Inoculation, at the Pariſh-church of St Andrew, Holborn, April the 24th, 1755." And in 1756, Natural and Civil Events the Inſtruments of God's Moral Government; a Sermon, preached on the laſt public Faſt-day, at Lincoln's Inn Chapel."

In 1757, Dr Warburton meeting with Mr Hume's

Warburton. tract, entitled, The Natural Hiſtory of Religion, filled the margin of the book, as well as ſome interleaved ſlips of paper, with many ſevere and ſhrewd remarks on the infidelity and naturaliſm of the author. Theſe he put into the hands of his friend Dr Hurd, who, making a few alterations of the ſtyle, added a ſhort introduction and concluſion, and publiſhed them in a pamphlet, entitled, "Remarks on Mr David Hume's Natural Hiſtory of Religion, by a Gentleman of Cambridge, in a Letter to the Reverend Dr Warburton." This lively attack upon Mr Hume gave him ſo much offence, that he thought proper to vent his ſpleen on the ſuppoſed author, in the poſthumous diſcourſe which he called his *Life;* and thus to do greater honour to Dr Hurd than to any other of his numerous antagoniſts.

Towards the end of the year 1757, Dr Warburton was promoted to the deanery of Briſtol; and in the beginning of the year 1760, he was, through Mr Allen's intereſt with Mr Pitt, afterwards earl of Chatham, advanced to the biſhopric of Glouceſter. That great miniſter is known to have declared, "that nothing of a private nature, ſince he had been in office, had given him ſo much pleaſure as bringing our author on the bench." There was, however, another miniſter, who dreaded his promotion, and thought he ſaw a ſecond Atterbury in the new biſhop of Glouceſter; but Warburton, ſays Biſhop Hurd, had neither talents nor inclination for parliamentary intrigue or parliamentary eloquence: he had other inſtruments of fame in his hands, and was infinitely above the vanity of being caught

* *Dryden.* "With the fine notion of a buſy man *."

He was conſecrated on the 20th of January 1760, and on the 30th of the ſame month preached before the houſe of lords. In the next year he printed "A Rational Account of the Nature and End of the Sacrament of the Lord's Supper." In 1762, he publiſhed "The Doctrine of Grace; or the Office and Operations of the Holy Spirit vindicated from the Inſults of Infidelity and the Abuſes of Fanaticiſm," 2 vols 12mo; and in the ſucceeding year drew upon himſelf much illiberal abuſe from ſome writers of the popular party, on occaſion of his complaint in the houſe of lords, on the 15th of November 1763, againſt Mr Wilkes, for putting his name to certain notes on the infamous "Eſſay on Woman."

In 1765 he publiſhed a new edition of the ſecond part of the Divine Legation, in three volumes; and as it had now received his laſt hand, he preſented it to his great friend Lord Mansfield, in a dedication which deſerves to be read by every perſon who eſteems the well-being of ſociety as a concern of any importance. It was the appendix to this edition which produced the well-known controverſy between him and Dr Lowth, which we have noticed elſewhere (ſee LOWTH), as doing no great honour, by the mode in which it was conducted, to either party. In the next year he gave a new and much improved edition of the Alliance between the Church and State. This was followed, in 1767, by a third volume of ſermons, to which is added, his firſt Triennial Charge to the Clergy of the Dioceſe of Glouceſter; which may be ſafely pronounced one of the moſt valuable diſcourſes of the kind that is to be found in our own or any other language. With this publication he cloſed his literary courſe; except that he made an effort towards publiſhing, and actually printed, the ninth and laſt book of the Divine Legation. This book, with one or two occaſional ſermons, and ſome valuable directions for the ſtudy of *theology*, have been given to the world in the ſplendid edition of his works in ſeven volumes 4to, by his friend and biographer the preſent biſhop of Worceſter. That prelate confeſſes, that the ninth book of the Divine Legation diſplays little of that vigour of mind and fertility of invention which appear ſo conſpicuous in the former volumes; but he adds, perhaps truly, that under all the diſadvantages with which it appears, it is the nobleſt effort which has hitherto been made to give a *rationale* of Chriſtianity. Warburton, Ward.

While the biſhop of Glouceſter was thus exerting his laſt ſtrength in the cauſe of religion, he projected a method by which he hoped to render it effectual ſervice after his death. He transferred 500l. to Lord Mansfield, Sir Eardley Wilmot, and Mr Charles Yorke, upon truſt, to found a lecture, in the form of a courſe of ſermons, to prove the truth of revealed religion in general, and of the Chriſtian in particular, from the completion of the prophecies in the Old and New Teſtament, which relate to the Chriſtian church, eſpecially to the apoſtaſy of Papal Rome. To this foundation we owe the admirable Introductory Lectures of Hurd, and the well-adapted Continuation of Halifax and Bagot.

It is a melancholy reflection, that a life ſpent in the conſtant purſuit of knowledge, frequently terminates in the loſs of thoſe powers, the cultivation and improvement of which are attended to with too ſtrict and unabated a degree of ardour. This was the caſe with Dr Warburton; and it ſeems probable that this decline of intellectual vigour was aggravated by the loſs of his only ſon, a promiſing young man, who died of a conſumption but a ſhort time before the biſhop, who himſelf reſigned to fate in the year 1779, and in the 81ſt of his age. A neat marble monument was erected to his memory in the cathedral of Glouceſter.

WARD, DR SETH, an Engliſh prelate, chiefly diſtinguiſhed for his knowledge in mathematics and aſtronomy, was born at Buntingford in Hertfordſhire, about the year 1617. He was admitted of Sidney college, Cambridge, where he applied with great vigour to his ſtudies, particularly to the mathematics, and was choſen fellow of his college. He was much involved in the conſequences of the civil war, but ſoon after the Reſtoration obtained the biſhopric of Exeter; in 1667, he was tranſlated to Saliſbury; and in 1671 was made chancellor of the order of the Garter; he was the firſt Proteſtant biſhop that enjoyed that honour, and he procured it to be annexed to the ſee of Saliſbury. Biſhop Ward was one of thoſe unhappy perſons who have the misfortune to ſurvive their ſenſes, which happened in conſequence of a fever ill cured; he lived to the Revolution, without knowing any thing of the matter, and died in 1690. He was the author of ſeveral Latin works in mathematics and aſtronomy, which were thought excellent in their day; but their uſe has been ſuperſeded by later diſcoveries and the Newtonian philoſophy.

WARD, is variouſly uſed in our old books: a ward in London is a diſtrict or diviſion of the city, committed to the ſpecial charge of one of the aldermen; and in London there are 26 wards, according to the number of the mayor and aldermen, of which every one has his

Ward ‖ Wardrobe.

his ward for his proper guard and jurisdiction. A forest is divided into wards; and a prison is called a *ward*. Lastly, the heir of the king's tenant, that held *in capite*, was termed a *ward* during his nonage; but this wardship is taken away by the statute 12 Car. II. c. 24.

WARD-Holding, in *Scots Law*. See LAW, N° clxv. 1. and clxvi. 3.

WARD-Hook, or *Wadd-hook*, in *Gunnery*, a rod or staff, with an iron end turned serpentwise, or like a screw, to draw the wadding out of a gun when it is to be unloaded.

WARDEN, or GUARDIAN, one who has the charge or keeping of any person, or thing, by office. Such is the warden of the Fleet, the keeper of the Fleet prison; who has the charge of the prisoners there, especially such as are committed from the court of chancery for contempt.

WARDHUYS, a port of Norwegian Lapland, 120 miles south-east of the North Cape. E. Long. 31. 12. N. Lat. 70. 23.

WARDMOTE, in London, is a court so called, which is kept in every ward of the city; answering to the *curiata comitia* of Rome.

WARDROBE, a closet or little room adjoining to a bedchamber, serving to dispose and keep a person's apparel in; or for a servant to lodge in, to be at hand to wait, &c.

WARDROBE, in a prince's court, is an apartment wherein his robes, wearing apparel, and other necessaries, are preserved under the care and direction of proper officers.

In Britain, the *Master or Keeper of the Great Wardrobe* was an officer of great antiquity and dignity. High privileges and immunities were conferred on him by King Henry VI. which were confirmed by his successors; and King James I. not only enlarged them, but ordained that this office should be a corporation or body politic for ever.

It was the duty of this office to provide robes for the coronations, marriages, and funerals of the royal family; to furnish the court with hangings, cloths of state, carpets, beds, and other necessaries; to furnish houses for ambassadors at their first arrival; cloths of state, and other furniture, for the lord lieutenant of Ireland, and all his majesty's ambassadors abroad; to provide all robes for foreign knights of the garter, robes for the knights of the garter at home; robes and all other furniture for the officers of the garter; coats for kings, heralds, and pursuivants at arms; robes for the lords of the treasury, and chancellor of the exchequer, &c.; livery for the lord chamberlain, grooms of his majesty's privy chamber, officer of his majesty's robes; for the two chief justices, for all the barons of the exchequer, and several officers of these courts; all liveries for his majesty's servants, as yeomen of the guard, and wardens of the Tower, trumpeters, kettle-drummers, and fifes; the messengers, and all belonging to the stables, as coachmen, footmen, littermen, postilions, and grooms, &c. all the king's coaches, chariots, harnesses, saddles, bits, bridles, &c. the king's watermen, game-keepers, &c. also furniture for the royal yachts, and all rich embroidered tilts, and other furniture for the barges.

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Besides the master or keeper of the wardrobe, who had a salary of 2000l. there was his deputy, who had 150l. and a comptroller and a patent clerk, each of whom has a salary of 300l. Besides many other inferior officers and servants, who were all sworn servants to the king.

Wardrobe, Wardship.

There was likewise a removing wardrobe, who had its own set of officers, and standing wardrobe-keepers at St James's, Windsor Castle, Hampton Court, Kensington, and Somerset House; but the whole of the wardrobe establishment was abolished by act of parliament in 1782, and the duty of it in future to be done by the lord chamberlain.

WARDSHIP, in chivalry, one of the incidents of tenure by knight-service. See *FEODAL System*, *KNIGHT Service*, and TENURE.

Upon the death of a tenant, if the heir was under the age of 21, being a male, or 14, being a female, the lord was intitled to the wardship of the heir, and was called the *guardian in chivalry*. This wardship consisted in having the custody of the body and lands of such heir, without any account of the profits, till the age of 21 in males, and 16 in females. For the law supposed the heir-male unable to perform knight-service till 21; but as for the female, she was supposed capable at 14 to marry, and then her husband might perform the service. The lord therefore had no wardship, if at the death of the ancestor the heir-male was of the full age of 21, or the heir-female of 14: yet if she was then under 14, and the lord once had her in ward, he might keep her so till 16, by virtue of the statute of Westminster, 1. 3 Edw. I. c. 22. the two additional years being given by the legislature for no other reason but merely to benefit the lord.

This wardship, so far as it related to land, though it was not nor could be part of the law of feuds, so long as they were arbitrary, temporary, or for life only; yet when they became hereditary, and did consequently often descend upon infants, who by reason of their age could neither perform nor stipulate for the services of the feud, does not seem upon feudal principles to have been unreasonable. For the wardship of the land, or custody of the feud, was retained by the lord, that he might out of the profits thereof provide a fit person to supply the infant's services till he should be of age to perform them himself. And if we consider a feud in its original import, as a stipend, fee, or reward for actual service, it could not be thought hard that the lord should withhold the stipend so long as the service was suspended. Though undoubtedly to our English ancestors, where such stipendary donation was a mere supposition or figment, it carried abundance of hardship; and accordingly it was relieved by the charter of Henry I. which took this custody from the lord, and ordained that the custody, both of the land and the children, should belong to the widow or next of kin. But this noble immunity did not continue many years.

The wardship of the body was a consequence of the wardship of the land; for he who enjoyed the infant's estate was the propereſt person to educate and maintain him in his infancy: and also, in a political view, the lord was most concerned to give his tenant a suitable education, in order to qualify him the better to perform those services which in his maturity he was bound to render.

When the male heir arrived at the age of 21, or the heir female at that of 16, they might sue out their livery or *ouster-le-main*; that is, the delivery of their lands

out

Wardſhip || Warn.

out of their guardian's hands. For this they were obliged to pay a fine, namely, half-a-year's profits of the land; though this ſeems expreſsly contrary to *magna charta*. However, in conſideration of their lands having been ſo long in ward, they were excuſed all reliefs, and the king's tenants alſo all primer ſeiſins. In order to aſcertain the profits that aroſe to the crown by theſe fruits of tenure, and to grant the heir his livery, the itinerant juſtices, or juſtices in eyre, had it formerly in charge to make inquiſition concerning them by a jury of the county, commonly called an *inquiſitio poſt mortem;* which was inſtituted to inquire (at the death of any man of fortune) the value of his eſtate, the tenure by which it was holden, and who, and of what age, his heir was; thereby to aſcertain the relief and value of the primer ſeiſin, or the wardſhip and livery accruing to the king thereupon. A manner of proceeding that came in proceſs of time to be greatly abuſed, and at length an intolerable grievance; it being one of the principal accuſations againſt Empſon and Dudley, the wicked engines of Henry VII. that by colour of falſe inquiſitions they compelled many perſons to ſue out livery from the crown, who by no means were tenants thereunto. And afterwards a court of wards and liveries was erected, for conducting the ſame inquiries in a more ſolemn and legal manner.

When the heir thus came of full age, provided he held a knight's fee, he was to receive the order of knighthood, and was compelled to take it upon him, or elſe pay a fine to the king. For in thoſe heroical times no perſon was qualified for deeds of arms and chivalry who had not received this order, which was conferred with much preparation and ſolemnity. We may plainly diſcover the footſteps of a ſimilar cuſtom in what Tacitus relates of the Germans, who, in order to qualify their young men to bear arms, preſented them in a full aſſembly with a ſhield and lance; which ceremony is ſuppoſed to have been the original of the feodal knighthood. This prerogative, of compelling the vaſſals to be knighted, or to pay a fine, was expreſsly recogniſed in parliament by the ſtatute *de militibus*, 1 Edw. II.; was exerted as an expedient for raiſing money by many of our beſt princes, particularly by Edw. VI. and Queen Elizabeth; but this was the occaſion of heavy murmurs when exerted by Charles I.; among whoſe many misfortunes it was, that neither himſelf nor his people ſeemed able to diſtinguiſh between the arbitrary ſtretch and the legal exertion of prerogative. However, among the other conceſſions made by that unhappy prince before the fatal recourſe to arms, he agreed to diveſt himſelf of this undoubted flower of the crown; and it was accordingly aboliſhed by ſtatute 16. Car. I. c. 20.

WARE, a town of Hertfordſhire, with a market on Tueſdays, and a fair on the laſt Tueſday in April, and Tueſday before St Matthew's day (Sept. 21.) for horſes and other cattle. It is a large, well frequented, and well inhabited thoroughfare town, ſeated on the river Lea, 21 miles north of London. It carries on a great trade in malt and corn, which they are continually ſending in large quantities to London. E. Long. 0. 3. N. Lat. 51. 50.

WARN, in *Law*, is to ſummon a perſon to appear in a court of juſtice.

WARNING *of* TENANTS, in *Scots Law*. See LAW, N° clxvii. 16.

Warning || Warrant

WARP, in the manufactures, a name for the threads, whether of ſilk, wool, linen, hemp, &c. that are extended lengthwiſe on the weaver's loom; and acroſs which the workman, by means of his ſhuttle, paſſes the threads of the woof, to form a cloth, ribband, fuſtian, or the like.

WARP, a ſmall rope employed occaſionally to remove a ſhip from one place to another, in a port, road, or river. And hence,

To WARP, is to change the ſituation of a ſhip, by pulling her from one part of a harbour, &c. to ſome other, by means of warps, which are attached to buoys; to anchors ſunk in the bottom; or to certain ſtations upon the ſhore, as poſts, rings, trees, &c. The ſhip is accordingly drawn forwards to thoſe ſtations, either by pulling on the warps by hand, or by the application of ſome purchaſe, as a tackle, windlaſs, or capſtern, upon her deck.

When this operation is performed by the ſhip's leſſer anchors, theſe machines, together with their warps, are carried out in the boats alternately towards the place where the ſhip is endeavouring to arrive: ſo that when ſhe is drawn up cloſe to one anchor, the other is carried out to a competent diſtance before her, and being ſunk, ſerves to fix the other warp, by which ſhe is farther advanced.

Warping is generally uſed when the ſails are unbent, or when they cannot be ſucceſsfully employed, which may either ariſe from the unfavourable ſtate of the wind, the oppoſition of the tide, or the narrow limits of the channel.

WARRANDICE, in *Scots Law*. See LAW, N° clxiv. 11.

WARRANT, is a power and charge to a conſtable or other officer to apprehend a perſon accuſed of any crime. It may be iſſued in extraordinary caſes by the privy council, or ſecretaries of ſtate; but moſt commonly it is iſſued by juſtices of the peace. This they may do in any caſes where they have a juriſdiction over the offence, in order to compel the perſon accuſed to appear before them; for it would be abſurd to give them power to examine an offender, unleſs they had alſo power to compel him to attend and ſubmit to ſuch examination. And this extends to all treaſons, felonies, and breaches of the peace; and alſo to all ſuch offences as they have power to puniſh by ſtatute. Before the granting of the warrant, it is fitting to examine upon oath the party requiring it, as well as to aſcertain that there is a felony or other crime actually committed, without which no warrant ſhould be granted; as alſo to prove the cauſe and probability of ſuſpecting the party againſt whom the warrant is prayed. *Blackſt. Comment.* vol. iv. p. 290.

This warrant ought to be under the hand and ſeal of the juſtice; ſhould ſet forth the time and place of making, and the cauſe for which it is made; and ſhould be directed to the conſtable or other peace officer, or it may be to any private perſon by name. A general warrant to apprehend all perſons ſuſpected, without naming or particularly deſcribing any perſon in ſpecial, is illegal and void for its uncertainty; for it is the duty of the magiſtrate, and ought not to be left to the officer, to judge of the ground of ſuſpicion. Alſo a warrant to apprehend

Warrant || Warren.

prehend all perſons guilty of ſuch a crime, is no legal warrant; for the point upon which its authority reſts, is a fact to be decided on a ſubſequent trial; namely, whether the perſon apprehended thereupon be guilty or not guilty. When a warrant is received by the officer, he is bound to execute it, ſo far as the juriſdiction of the magiſtrate and himſelf extends. A warrant from any of the juſtices of the court of king's bench extends over all the kingdom, and is teſted or dated *England:* but a warrant of a juſtice of the peace in one county, muſt be backed, that is, ſigned, by a juſtice of another county, before it can be executed there. And a warrant for apprehending an Engliſh or a Scotch offender, may be indorſed in the oppoſite kingdom, and the offender carried back to that part of the united kingdom in which the offence was committed.

WARRANTY, WARRANTIA, in *Law*, a promiſe, or covenant by deed, made by the bargainer for himſelf and his heirs, to warrant and ſecure the bargainee and his heirs, againſt all men, for enjoying the thing agreed on or granted between them.

WARREN, SIR PETER, an admiral, diſtinguiſhed by his virtue, learning, and undaunted courage, was deſcended from an ancient family in Ireland, and received a ſuitable education to qualify him for a command in the royal navy, in which he ſerved for ſeveral years with great reputation; but the tranſaction which placed his great abilities in their full light, was the taking of Louiſbourg in the year 1745, when he was appointed commodore of the Britiſh ſquadron ſent on that ſervice. He joined the fleet of tranſports from Boſton in Canſo bay on the 25th of April, having under his command the Superb of 60, and the Launceſton and Eltham of 40 guns; he was afterwards joined by ſeveral other men of war ſent from England, and took poſſeſſion of Louiſbourg on the 17th of June. The French, exaſperated at this loſs, were conſtantly on the watch to retake it; and in 1747 fitted out a large fleet for that purpoſe, and at the ſame time another ſquadron to proſecute their ſucceſs in the Eaſt Indies. Theſe ſquadrons ſailed at the ſame time; but the views of the French were rendered abortive by the gallant admiral Anſon and Sir Peter Warren, who had been created rear-admiral, who with a large fleet of ſhips fell in with the French, defeated the whole fleet, and took the greateſt part of the men of war. This was the laſt ſervice Sir Peter rendered to his country as a commander in the Britiſh fleet; for a peace being concluded in the ſucceeding year, the fleet was laid up in the ſeveral harbours.

He was now choſen one of the repreſentatives in parliament for Weſtminſter; and in the midſt of his popularity he paid a viſit to Ireland, his native country, where he died of an inflammatory fever in 1752, ſincerely lamented by all ranks of people; and an elegant monument of white marble was erected to his memory in Weſtminſter abbey.

WARREN, is a franchiſe or place privileged by preſcription or grant from the king, for the keeping of beaſts and fowls of the warren; which are hares and coneys, partridges, pheaſants, and ſome add quails, woodcocks, and water-fowl, &c. Theſe being *feræ naturæ*, every one had a natural right to kill as he could: but upon the introduction of the foreſt laws at the Norman conqueſt, theſe animals being looked upon as royal game, and the ſole property of our ſavage monarchs, this franchiſe of free-warren was invented to protect them, by giving the grantee a ſole and excluſive power of killing ſuch game, ſo far as his warren extended, on condition of his preventing other perſons. A man therefore that has the franchiſe of warren, is in reality no more than a royal game-keeper: but no man, not even a lord of a manor, could by common law juſtify ſporting on another's ſoil, or even on his own, unleſs he had the liberty of free-warren. This franchiſe is almoſt fallen into diſregard ſince the new ſtatutes for preſerving the game; the name being now chiefly preſerved in grounds that are ſet apart for breeding hares and rabbits. There are many inſtances of keen ſportſmen in ancient times, who have ſold their eſtates, and reſerved the free-warren, or right of killing game, to themſelves: by which means it comes to paſs that a man and his heirs have ſometimes free-warren over another's ground.

Warren || Warwick.

A warren may lie open; and there is no neceſſity of incloſing it as there is of a park. If any perſon offend in a free-warren, he is puniſhable by the common law, and by ſtatute 21 Edw. III. And if any one enter wrongfully into any warren, and chaſe, take, or kill, any coneys without the conſent of the owner, he ſhall forfeit treble damage, and ſuffer three months impriſonment, &c. by 22 and 23 Car. II. c. 25. When coneys are on the ſoil of the party, he hath a property in them by reaſon of the poſſeſſion, and action lies for killing them; but if they run out of the warren and eat up a neighbour's corn, the owner of the land may kill them, and no action will lie.

WARSAW, a large city of Poland, the capital of that country, and of the province of Maſovia. It is built partly in a plain, and partly on a gentle aſcent riſing from the banks of the Viſtula, which is about as broad as the Thames at Weſtminſter, but very ſhallow in ſummer. This city and its ſuburbs occupy a vaſt extent of ground, and are ſuppoſed to contain 70,000 inhabitants, among whom is a great number of foreigners. The whole has a melancholy appearance, exhibiting the ſtrong contraſt of wealth and poverty, luxury and diſtreſs, which pervades every part of this unhappy country. The ſtreets are ſpacious, but ill paved; the churches and public buildings are large and magnificent; the palaces of the nobility are numerous and ſplendid; but the greateſt part of the houſes, particularly in the ſuburbs, are mean and ill conſtructed wooden hovels.—Warſaw is 160 miles ſouth-eaſt by ſouth of Dantzie, 130 north-north-eaſt of Cracow, and 300 north-eaſt by north of Vienna. E. Long. 21. 6. N. Lat. 50. 14.

WART. See SURGERY *Index*.

WARWICK, the capital of Warwickſhire in England, and from which this county derives its name. It is very ancient, and ſuppoſed by Camden to be the place called by the Romans *Præſidium*, where the Dalmatian horſe were poſted. It ſtands on a rock of freeſtone, of which all the public edifices in the town are built. At the Norman invaſion it was a conſiderable place; and had many burgeſſes, of whom 12 were obliged by their tenure to accompany the king in his wars. It is ſupplied with water brought in pipes from ſprings half a mile from the town, beſides what it derives from the wells within it made in the rock: and it is eaſily kept clean, by being ſituated upon a declivity. Four ſtreets, from the four cardinal points of the compaſs, meet in the centre of the town. The principal public buildings are

St

Warwick, Warwickſhire.

St Mary's, a very ſtately edifice, an hoſpital, a townhouſe of freeſtone, three charity ſchools, and a noble bridge over the Avon. It has had ſeveral charters; but is governed at preſent by a mayor, 12 brethren, 24 burgeſſes, &c. It contains 5775 inhabitants; and gives title of earl to the family of the Grevilles. W. Long. 1. 36. N. Lat. 52. 20.

WARWICKSHIRE, a county of England, 47 miles in length, by 30 in breadth. It is bounded at its northern extremity by a point of Derbyſhire; on the north-weſt by Staffordſhire; on the north-eaſt by Leiceſterſhire; on the eaſt by Northamptonſhire; on the ſouth-weſt by Glouceſterſhire, and on the ſouth-eaſt by Oxfordſhire. It is ſituated partly in the dioceſe of Lichfield and Coventry, and partly in that of Worceſter; it contains four hundreds, and one liberty, one city, 12 market towns, 158 pariſhes; ſends ſix members to parliament, and the population is computed at 208,190. The air is mild, pleaſant, and healthy. The river Avon divides the north part of it, or the Woodlands, from the ſouth, called the Feldon; and the ſoil of both is rich and fertile. Its productions are corn, malt, wood, wool, cheeſe, coal, iron, and limeſtone. The chief rivers of this county are the Avon, Tame, and Arrow. Warwick is the capital; but Birmingham is far ſuperior to it in reſpect of trade and manufactures, and even to any other town in England.

Birmingham, in this county, of which the account given in the order of the alphabet is very deficient, is one of the moſt remarkable towns in England, or perhaps in Europe, for the extent, variety, elegance, and utility of its manufactures. This town was little diſtinguiſhed previous to the reign of Charles II. but ſince that period it continued to increaſe in extent and importance. In the year 1700, the number of ſtreets in Birmingham was only 30; they are now nearly 250. In the year 1779 there were only three houſes on a particular ſpot, which in 1791 contained 833.

Birmingham owes its proſperity and population to its manufactures, which are in a great meaſure the conſequence of its vicinity to coal, aided by the ſpirited and induſtrious exertions of a few individuals. It has been ſtated, and no doubt with great truth, that its proſperity is in no ſmall degree indebted to its exemption from the reſtrictions of borough and corporate laws. To give ſome notion of the progreſs and extent of the manufactures of this place, it may be mentioned that the late Mr Taylor, who introduced gilt buttons, japanned, gilt, and painted ſnuff-boxes, with various articles of manufacture in enamel, died in 1775, at the age of 64, having amaſſed a fortune of 200,000l. In painting ſnuff-boxes at ſo low a rate as one farthing each, one man could gain 3l. 10s. per week. The weekly produce of Mr Taylor's manufacture of buttons amounted to 800l. beſide many other valuable and curious productions.

The manufactory of Meſſrs Boulton and Watt, which for its extent, variety, and importance, ſtands unrivalled in Europe, has been already noticed under the word SOHO. The new coinage of copper, which is ſo often deſervedly admired, and the re-ſtamped dollars, are the productions of the Soho manufactory. The firſt coining mill was erected at Soho in 1783. It is now ſo much improved, that eight machines driven by the ſteam-engine, are going on at the ſame time. Each of thoſe machines ſtrikes from 70 to 84 pieces of the ſize of a guinea per minute, and hence the whole eight machines work off in one hour between 30,000 and 40,000 coins. The different proceſſes of the machinery are, 1. Rolling the maſſes of copper into ſheets. 2. Rolling them through cylindrical ſteel rollers. 3. Clipping the pieces of copper for the dye. 4. Shaking the coin in bags. 5. Striking both ſides of the coin, and then milling it; after which it is diſplaced, and another is introduced, to be ſubjected to the ſame operation. But the moſt extraordinary contrivance of this ingenious machinery is, that a preciſe account of every coin which paſſes through it is regularly kept, ſo that it is impoſſible to practiſe fraud. Warwickſhire || Waſhington.

Beſide the branches of induſtry already mentioned, there are manufactories of guns, bayonets, and ſwords, of ſporting guns, of whips, of japan ware, of numerous works in braſs and ſteel, both for ornament and uſe, and at one time of leather to a conſiderable extent.

Birmingham contains a muſeum of natural and artificial curioſities, a handſome theatre, rebuilt ſince 1791, ſeveral churches belonging to the eſtabliſhment, various diſſenting meeting houſes, and a number of charitable eſtabliſhments. In the neighbourhood of Birmingham there are three extenſive breweries; and by means of canals this place has the advantage of eaſy communication with almoſt every part of the kingdom.

WASH, among diſtillers, the fermentable liquor uſed by malt diſtillers. See BREWERY.

WASHING, in *Painting*, is when a deſign, drawn with a pen or crayon, has ſome one colour laid over it with a pencil, as Indian ink, biſtre, or the like, to make it appear the more natural, by adding the ſhadow of prominences, apertures, &c. and by imitating the particular matters whereof the thing is ſuppoſed to conſiſt.

Thus a pale red is employed to imitate brick and tile; a pale Indian blue, to imitate water and ſlate; green, for trees and meadows; ſaffron or French berries, for gold or braſs; and ſeveral colours for marbles.

WASHING of Ores, the ſeparation of the ores of metals, by means of water, from earths and ſtones, which would otherwiſe render it difficult of fuſion. See ORES, *Reduction of*.

WASHINGTON, a city of North America, and now the metropolis of the United States. It is ſeated at the junction of the rivers Potomac and the Eaſtern Branch, extending about four miles up each, including a tract of territory ſcarcely to be exceeded, in point of convenience, ſalubrity, and beauty, by any in the world. This territory, which is called *Columbia*, lies partly in the ſtate of Virginia, and partly in that of Maryland, and was ceded by thoſe two ſtates to the United States of America, and by them eſtabliſhed to be the ſeat of government after the year 1800. It is divided into ſquares or grand diviſions, by ſtreets running due north and ſouth, and eaſt and weſt, which form the ground-work of the plan. However, from the Capitol, the preſident's houſe, and ſome of the important areas in the city, run diagonal ſtreets, from one material object to another, which not only produce a variety of charming proſpects, but remove the inſipid ſameneſs which renders ſome other great cities unpleaſing. The great leading ſtreets are all 160 feet wide, including a pavement of 10 feet, and a gravel walk of 30 feet planted with trees on each ſide, which will leave 80 feet of paved ſtreet for carriages. The reſt of the ſtreets are in general

Waſhington. general 110 feet wide, with a few only 90 feet, except North, South, and Eaſt Capitol Streets, which are 160 feet. The diagonal ſtreets are named after the reſpective ſtates compoſing the Union, while thoſe running north and ſouth are, from the Capitol eaſtward, named *Eaſt Firſt Street*, *Eaſt Second Street*, &c. and thoſe weſt of it are in the ſame manner called *Weſt Firſt Street*, *Weſt Second Street*, &c. Thoſe running eaſt and weſt are from the Capitol northward named *North A Street*, *North B Street*, &c. and thoſe ſouth of it are called *South A Street*, *South B Street*, &c. The ſquares or diviſions of the city amount to 1150. The rectangular ſquares generally contain from three to ſix acres, and are divided into lots of from 40 to 80 feet in front, and their depth from about 110 to 300 feet, according to the ſize of the ſquare. The irregular diviſions produced by the diagonal ſtreets are ſome of them ſmall, but generally in valuable ſituations. Their acute points are all to be cut off at 40 feet, ſo that no houſe in the city will have an acute corner. All the houſes muſt be of brick or ſtone. The area for the Capitol (or houſe for the legiſlative bodies) is ſituated upon the moſt beautiful eminence in the city, about a mile from the Eaſtern Branch, and not much more from the Potomac, commanding a full view of every part of the city, as well as a conſiderable extent of the country around. The preſident's houſe will ſtand upon a riſing ground, not far from the banks of the Potomac, poſſeſſing a delightful water proſpect, with a commanding view of the Capitol, and ſome other material parts of the city.

The city being ſituated upon the great poſt road, exactly equidiſtant from the northern and ſouthern extremities of the Union, and nearly ſo from the Atlantic ocean to the river Ohio, upon the beſt navigation, and in the midſt of the richeſt commercial territory in America, commanding the moſt extenſive internal reſources, is by far the moſt eligible ſituation for the reſidence of congreſs; and it is now preſſing forward, by the public-ſpirited enterpriſe, not only of the people of the United States, but alſo of foreigners.

WASHINGTON, *George*, the celebrated commander of the American army, and the firſt preſident of the United States, after their ſeparation from the mother-country, was born in the year 1732, in the pariſh of Waſhington in Virginia. He was deſcended from an ancient family in Cheſhire, of which a branch was eſtabliſhed in Virginia about the middle of the 17th century. Little is known concerning his education, or the early years of his life. Before he was 20 years of age, he was appointed a major in the colonial militia, and had then an opportunity of diſplaying thoſe military and political talents which have ſince rendered his name ſo famous throughout the world. In the diſputes which aroſe between the French and Engliſh officers, about ſettling the limits of Canada and Louiſiana, Major Waſhington was employed by the governor of Virginia as a negociator, and he ſucceeded in preventing a threatened invaſion of the Engliſh frontiers by the French and their Indian allies; but, in the following year, when hoſtilities ſeemed inevitable, he was appointed lieutenant-colonel, and ſoon after to the command of a regiment raiſed by the colony for its own defence. In 1755, Colonel Waſhington ſerved as a volunteer in the unfortunate expedition of General Braddock, and in that expedition, which was attended with great difficulty, he exhibited ſo much calmneſs and intrepidity, that the utmoſt confidence was repoſed in his talents, and perfect obedience paid to his commands by the whole army. After having been employed in a different and more ſucceſsful expedition to the river Ohio, the ſtate of his health required him, about the year 1758, to reſign his military ſituation; and in the ſixteen following years, during which period he married Mrs Cuſtis, a Virginian lady, of amiable character and reſpectable connections, it would appear that he reſided chiefly at his beautiful ſeat of Mount Vernon, and was occupied in the cultivation of his eſtate. Waſhington.

When the diſaffection of the Americans to the Britiſh government had become pretty general, and had at laſt ſpread to the colony of Virginia, Colonel Waſhington was appointed a delegate from that ſtate to the congreſs which met at Philadelphia on the 26th October 1774, and ſoon after he was appointed to the command of the American army, which had aſſembled in the provinces of New England. The conduct of Waſhington during the whole of the war, as well as during the period that he preſided in the government of the United States, has been ſo fully detailed in another part of this work, that it would be unneceſſary repetition, even to give a general outline of it in this place. See AMERICA.

Waſhington reſigned the preſidency in 1796, after having publiſhed a farewell addreſs to his countrymen. This addreſs was remarkably diſtinguiſhed for the ſimplicity and ingenuouſneſs, moderation and ſobriety, the good ſenſe, prudence and honeſty, as well as ſincere affection for his country and for mankind, which the author of it had always exhibited; it ſeemed to be a perfect picture of his whole life. From the time of his reſignation till the month of July 1798, he lived in retirement at his ſeat of Mount Vernon. At this period, when the unprincipled actors in the French revolution were carrying on their wicked machinations in every part of the world to which their influence extended, the United States reſolved to arm by land and ſea in their own defence. General Waſhington was called from his retirement, and the command of the army was beſtowed upon him. This he accepted, becauſe he conſidered, as he himſelf expreſſed it, "every thing we hold dear and ſacred was ſeriouſly threatened, although he had flattered himſelf that he had quitted for ever the boundleſs field of public action, inceſſant trouble, and high reſponſibility, in which he had long acted ſo conſpicuous a part." In this ſituation he continued during the remaining ſhort period of his life. On Thurſday the 12th of December 1799, he was ſeized with an inflammation in the throat, and was carried off on Saturday the 14th of the ſame month, in the 68th year of his age. In his dying moments he diſplayed the ſame calmneſs, ſimplicity, and regularity, which had uniformly marked his conduct through life. He ſaw the approaches of death without fear; and he met them without parade. Even the perfectly well ordered ſtate of the minuteſt particulars of his private buſineſs bears the ſtamp of that conſtant authority of prudence and practical reaſon over his actions which was always the moſt prominent feature of his character.

WASHINGTON is the name of many counties, towns, and villages in the American ſtates; a circumſtance which affords a ſtriking proof in what degree of eſteem

Washington || Watch.

and veneration the name from which they are derived was held by the inhabitants of the new world.

WASP. See VESPA, ENTOMOLOGY *Index*.

WATCH, in the art of war, a number of men poſted at any paſſage, or a company of the guards who go on the patrole.

WATCH, in the navy, the ſpace of time wherein one diviſion of a ſhip's crew remains upon deck, to perform the neceſſary ſervices, whilſt the reſt are relieved from duty, either when the veſſel is under ſail or at anchor.

The length of the ſea-watch is not equal in the ſhipping of different nations. It is always kept four hours by our Britiſh ſeamen, if we except the dog-watch, between four and eight in the evening, that contains two reliefs, each of which are only two hours on deck. The intent of this is to change the period of the night-watch every 24 hours; ſo that the party watching from eight till 12 in one night, ſhall watch from midnight till four in the morning on the ſucceeding one. In France the duration of the watch is extremely different, being in ſome places ſix hours, and in others ſeven or eight; and in Turkey and Barbary it is uſually five or ſix hours.

A ſhip's company is uſually claſſed into two parties; one of which is called the *ſtarboard* and the other the *larboard* watch. It is, however, occaſionally ſeparated into three diviſions, as in a road or in particular voyages.

In a ſhip of war the watch is generally commanded by a lieutenant, and in merchant ſhips by one of the mates; ſo that if there are four mates in the latter, there are two in each watch; the firſt and third being in the larboard, and the ſecond and fourth in the ſtarboard watch: but in the navy, the officers who command the watch uſually divide themſelves into three parties, in order to lighten their duty.

WATCH, is alſo uſed for a ſmall portable movement, or machine, for the meaſuring of time; having its motion regulated by a ſpiral ſpring.

Watches, ſtrictly taken, are all ſuch movements as ſhow the parts of time; as clocks are ſuch as publiſh it, by ſtriking on a bell, &c. But commonly the name *watch* is appropriated to ſuch as are carried in the pocket; and *clock* to the large movements, whether they ſtrike the hour or not. See CLOCK.

The invention of ſpring or pocket watches belongs to the preſent age. It is true, we find mention made of a watch preſented to Charles V. in the hiſtory of that prince: but this, in all probability, was no more than a kind of clock to be ſet on a table, ſome reſemblance whereof we have ſtill remaining in the ancient pieces made before the year 1670. There was alſo a ſtory of a watch having been diſcovered in Scotland belonging to King Robert Bruce; but this we believe has turned out altogether apocryphal. The glory of this very uſeful invention lies between Dr Hooke and M. Huygens; but to which of them it properly belongs, has been greatly diſputed; the Engliſh aſcribing it to the former, and the French, Dutch, &c. to the latter. Mr Derham in his Artificial Clockmaker, ſays roundly, that Dr Hooke was the inventor; and adds, that he contrived various ways of regulation. One way was with a loadſtone: Another with a tender ſtraight ſpring, one end whereof played backwards and forwards with the balance; ſo that the balance was to the ſpring as the bob to a pendulum, and the ſpring as the rod thereof: A third method was with two balances, of which there were divers ſorts; ſome having a ſpiral ſpring to the balance for a regulator, and others without. But the way that prevailed, and which continues in mode, was with one balance, and one ſpring running round the upper part of the verge thereof: Though this has a diſadvantage, which thoſe with two ſprings, &c. were free from; in that a ſudden jerk, or confuſed ſhake, will alter its vibrations, and put it in an unuſual hurry. Watch

The time of theſe inventions was about the year 1658; as appears, among other evidences, from an inſcription on one of the double balance watches preſented to King Charles II. viz. Rob. Hooke *inven.* 1658. T. Tompion *fecit*, 1675. The invention preſently got into reputation, both at home and abroad; and two of them were ſent for by the dauphin of France. Soon after this, M. Huygens's watch with a ſpiral ſpring got abroad, and made a great noiſe in England, as if the longitude could be found by it. It is certain, however, that his invention was later than the year 1673, when his book *de Horol. Oſcillat.* was publiſhed; wherein he has not one word of this, though he has of ſeveral other contrivances in the ſame way.

One of theſe the lord Brouncker ſent for out of France, where M. Huygens had got a patent for them. This watch agreed with Dr Hooke's in the application of the ſpring to the balance; only M. Huygens's had a longer ſpiral ſpring, and the pulſes and beats were much ſlower. The balance, inſtead of turning quite round, as Dr Hooke's, turns ſeveral rounds every vibration.

Mr Derham ſuggeſts, that he has reaſon to doubt M. Huygens's fancy firſt was ſet to work by ſome intelligence he might have of Dr Hooke's invention from Mr Oldenburgh, or ſome other of his correſpondents in England; and this, notwithſtanding Mr Oldenburgh's attempt to vindicate himſelf in the Philoſophical Tranſactions, appears to be the truth. Huygens invented divers other kinds of watches, ſome of them without any ſtring or chain at all; which he called, particularly, *pendulum watches*.

Striking WATCHES are ſuch as, beſides the proper watch-part for meaſuring of time, have a clock-part for ſtriking the hours, &c.

Repeating WATCHES, are ſuch as by pulling a ſtring, &c. repeat the hour, quarter, or minute, at any time of the day or night.—This repetition was the invention of Mr Barlow, and firſt put in practice by him in larger movements or clocks about the year 1676. The contrivance immediately ſet the other artiſts to work, who ſoon contrived divers ways of effecting the ſame. But its application to pocket-watches was not known before King James II.'s reign; when the ingenious inventor above mentioned, having directed Mr Thompſon to make a repeating watch, was ſoliciting a patent for the ſame. The talk of a patent engaged Mr Quare to reſume the thoughts of a like contrivance, which he had had in view ſome years before: he now effected it; and being preſſed to endeavour to prevent Mr Barlow's patent, a watch of each kind was produced before the king and council; upon trial of which, the preference was given to Mr Quare's. The difference between them was, that Barlow's was made to repeat by puſhing in two pieces on each ſide the watch-box; one of which repeated the hour, and the other the quarter: whereas Quare's was made to repeat by a pin that ſtruck out near the pendant, which being thruſt in (as

Watch. now it is done by thrufting in the pendant itſelf), repeated both the hour and quarter with the ſame thruſt.

Of the Mechaniſm of a WATCH, properly ſo called. Watches, as well as clocks, are compoſed of wheels and pinions, and a regulator to direct the quickneſs or ſlowneſs of the wheels, and of a ſpring which communicates motion to the whole machine. But the regulator and ſpring of a watch are vaſtly inferior to the weight and pendulum of a clock, neither of which can be employed in watches. In place of a pendulum, therefore, we are obliged to uſe a balance (fig. 1.) to regulate the motion of a watch; and a ſpring (fig. 2.) which ſerves in place of a weight, to give motion to the wheels and balance.

Plate LXXI. 1. 2.

The wheels of a watch, like thoſe of a clock, are placed in a frame formed of two plates and four pillars. Fig. 3. repreſents the inſide of a watch, after the plate (fig. 4.) is taken off. A is the barrel which contains the ſpring (fig. 2.); the chain is rolled about the barrel, with one end of it fixed to the barrel A (fig. 5.), and the other to the fuſee B.

3. 4. 5.

When a watch is wound up, the chain which was upon the barrel winds about the fuſee, and by this means the ſpring is ſtretched; for the interior end of the ſpring is fixed by a hook to the immoveable axis, about which the barrel revolves; the exterior end of the ſpring is fixed to the inſide of the barrel, which turns upon an axis. It is therefore eaſy to perceive how the ſpring extends itſelf, and how its elaſticity forces the barrel to turn round, and conſequently obliges the chain which is upon the fuſee to unfold and turn the fuſee; the motion of the fuſee is communicated to the wheel C (fig. 5.); then, by means of the teeth, to the pinion *c*, which carries the wheel D; then to the piſton *d*, which carries the wheel E: then to the pinion *e*, which carries the wheel F; then to the point *f*, upon which is the balance-wheel G, whoſe pivot runs in the pieces A called the *potance*, and B called a *follower*, which are fixed on the plate fig. 4. This plate, of which only a part is repreſented, is applied to that of fig. 3. in ſuch a manner that the pivots of the wheels enter into holes made in the plate fig. 3. Thus the impreſſed force of the ſpring is communicated to the wheels: and the pinion *f* being then connected to the wheel F, obliges it to turn (fig. 5.). This wheel acts upon the palettes of the verge, 1, 2, (fig. 1.), the axis of which carries the balance HH, (fig. 1.). The pivot I, in the end of the verge, enters into the hole *c* in the potance A (fig. 4.) In this figure the palettes are repreſented; but the balance is on the other ſide of the plates, as may be ſeen in fig. 6. The pivot 3 of the balance enters into a hole of the cock BC (fig. 7.), a perſpective view of which is repreſented in fig. 8. Thus the balance turns between the cock and the potance *c* (fig. 4.), as in a kind of cage. The action of the balance-wheel upon the palettes 1, 2, (fig. 1.), is the ſame with what we have deſcribed with regard to the ſame wheel in the clock; *i. e.* in a watch, the balance-wheel obliges the balance to vibrate backwards and forwards like a pendulum. At each vibration of the balance a palette allows a tooth of the balance-wheel to eſcape; ſo that the quickneſs of the motion of the wheels is entirely determined by the quickneſs of the vibrations of the balance; and theſe vibrations of the balance and motion of the wheels are produced by the action of the ſpring.

6. 7. 8.

But the quickneſs or ſlowneſs of the vibrations of the balance depend not ſolely upon the action of the great ſpring, but chiefly upon the action of the ſpring *a*, *b*, *c*, called *the ſpiral ſpring* (fig. 9.), ſituated under the balance H, and repreſented in perſpective (fig. 6.). The exterior end of the ſpiral is fixed to the pin *a*, (fig. 9.). This pin is applied near the plate in *a*, (fig. 6.); the interior end of the ſpiral is fixed by a peg to the centre of the balance. Hence if the balance is turned upon itſelf, the plates remaining immoveable, the ſpring will extend itſelf, and make the balance perform one revolution. Now, after the ſpiral is thus extended, if the balance be left to itſelf, the elaſticity of the ſpiral will bring back the balance, and in this manner the alternate vibrations of the balance are produced. Watch. Fig. 9.

In fig. 5. all the wheels above deſcribed are repreſented in ſuch a manner, that you may eaſily perceive at firſt ſight how the motion is communicated from the barrel to the balance.

In fig. 10. are repreſented the wheels under the dial-plate by which the hands are moved. The pinion *a* is adjuſted to the force of the prolonged pivot of the wheel D (fig. 5.), and is called a *cannon pinion*. This wheel revolves in an hour. The end of the axis of the pinion *a*, upon which the minute-hand is fixed, is ſquare; the pinion (fig. 10.) is indented into the wheel *b*, which is carried by the pinion *a*. Fig. 11. is a wheel fixed upon a barrel, into the cavity of which the pinion *a* enters, and upon which it turns freely. This wheel revolves in 12 hours, and carries along with it the hour-hand. For a full account of the principles upon which watches and all time-keepers are conſtructed, we muſt refer our readers to a ſhort treatiſe, entitled *Thoughts on the Means of improving Watches*, by Thomas Mudge. Fig. 10. Fig. 11.

WATCH-Glaſſes, in a ſhip, are glaſſes employed to meaſure the period of the watch, or to divide it into any number of equal parts, as hours, half-hours, &c. ſo that the ſeveral ſtations therein may be regularly kept and relieved, as at the helm, pump, look-out, &c.

WATCH-Work. There is one part of the movements of clocks and watches of which we have yet given no particular account. This is the method of applying the maintaining power of the wheels to the regulator of the motions, ſo as not to injure its power of regulation. This part of the conſtruction is called SCAPEMENT, and falls to be deſcribed under the preſent article, to which we have referred from SCAPEMENT.

I
Objects of ſcapements.

The motions of a clock or watch are regulated by a pendulum or balance, without which check the wheels impelled by the weight in the clock, or ſpring in the watch, would run round with a rapidly accelerating motion, till this ſhould be rendered uniform by friction, and the reſiſtance of the air. If, however, a pendulum or balance be put in the way of this motion, in ſuch a manner that only one tooth of a wheel can paſs, the revolution of the wheels will depend on the vibration of the pendulum or balance.

We cannot here enter on an hiſtorical account of the improvements that have been made on the regulating powers of clocks and watches, nor can we detail the principles on which their action depends. It will be ſufficient here to notice the moſt ſimple conſtruction of ſcapements, and then to deſcribe two or three of the moſt improved conſtructions that have been applied to time-keepers.

We know that the motion of a pendulum or balance

Watch. is alternate, while the preſſure of the wheels is conſtantly exerted in the ſame direction. Hence it is evident that ſome means muſt be employed to accommodate theſe different motions to each other. Now, when a tooth of the wheel has given the pendulum or balance a motion in one direction, it muſt quit it, that the pendulum or balance may receive an impulſion in the oppoſite direction. This *eſcape* of the tooth has given riſe to the term *ſcapement*.

2 Beſt ordinary ſcapement for clocks. Fig. 12.

The ordinary ſcapement is extremely ſimple, and may be thus illuſtrated. Let *x y* fig. 12. Plate DLXXI. repreſent a horizontal axis, to which the pendulum *p* is attached by a ſlender rod. This axis has two leaves *c* and *d*, one near each end, and not in the ſame plane, but ſo that when the pendulum hangs perpendicularly at reſt, *c* ſpreads a few degrees to the right, and *d* as much to the left. Theſe are called the pallets. Let *a f b* repreſent a wheel, turning on a perpendicular axis *e o* in the order *a f e b*. The teeth of this wheel are in the form of thoſe of a ſaw, leaning forward in the direction of the rim's motion. This wheel is uſually called the crown-wheel, or in watches the balance-wheel. See CLOCK and WATCH. It generally contains an odd number of teeth. In the figure the pendulum is repreſented at the extremity of its excurſion towards the right, the tooth *a* having juſt eſcaped from the pallet *c*, and *b* having juſt dropt on *d*. Now it is evident that while the pendulum is moving to the left, in the arch *p g*, the tooth *b* ſtill preſſes on the pallet *d*, and thus accelerates the pendulum, both in its deſcent along *p h*, and its aſcent up *h g*, and that when *d*, by turning round the axis *x y*, raiſes its point above the plane of the wheel, the tooth *b* eſcapes from it, and *i* drops on *c*, now nearly perpendicular. Thus *c* is preſſed to the right, and the motion of the pendulum along *g p* is accelerated. Again, while the pendulum hangs perpendicularly in the line *x h*, the tooth *b*, by preſſing on *d*, will force the pendulum to the left, in proportion to its lightneſs, and if it be not too heavy, will force it ſo far from the perpendicular, that *b* will eſcape, and *i* will catch on *c*, and force the pendulum back to *p*, when the ſame motion will be repeated. This effect will be more remarkable, if the rod of the pendulum be continued through *x y*, and have a ball *q* on the other end, to balance *p*. When *b* eſcapes from *d*, the balls are moving with a certain velocity and momentum, and in this condition the balance is checked when *i* catches on *c*. It is not, however, inſtantly ſtopped, but continues to move a little to the left, and *i* is forced a little backward by the pallet *c*. It cannot make its eſcape over the top of the tooth *i*, as all the momentum of the balance was generated by the force of *b*, and *i* is of equal power. Beſides, when *i* catches on *c*, and the motion of *c* to the left continues, the lower point of *c* is applied to the face of *i*, which now acts on the balance by a long lever, ſoon ſtops its motion in that direction, and continuing to preſs on *c*, urges the balance in the oppoſite direction. It is eaſy to ſee that the motion of the wheel here muſt be hobbling and unequal, which has given to this ſcapement the name of the *recoiling* ſcapement.

3 Vibrations of pendulums are iſochronous.

In conſidering the utility of the following improved ſcapement for clocks, we muſt keep in mind the following propoſition, which, after the above illuſtration, ſcarcely requires any direct proof. It is, that the natural vibrations of a pendulum are *iſochronous*, or are performed in equal times. The great object of the ſcapement is to preſerve this iſochronous motion of the pendulum. Watch

4 Cumming ſcapement for clock

As the defect of the recoiling ſcapement was long apparent, ſeveral ingenious artiſts attempted to ſubſtitute in its place a ſcapement that ſhould produce a more regular and uniform motion. Of theſe, the ſcapement contrived by Mr Cumming appears to be one of the moſt ingenious in its conſtruction, and moſt perfect in its operation. The following conſtruction is ſimilar to that of Mr Cumming, but rendered rather leſs complex for the purpoſe of ſhortening the deſcription.

Let ABC, fig. 13. repreſent a portion of the ſwing wheel, of which O is the centre, and A one of the teeth; Z is the centre of the crutch, pallets, and pendulum. The crutch is repreſented of the form of the letter A, having in the circular croſs piece a ſlit *i k*, alſo circular, Z being the centre. The arm ZF forms the firſt detent, and the tooth A is repreſented as locked on it at F. D is the firſt pallet on the end of the arm Z *d* moveable round the ſame centre with the detents, but independent of them. The arm *d e* to which the pallet D is attached, lies wholly behind the arm ZF of the detent, being fixed to a round piece of braſs *e f g*, having pivots turning concentric with the axis of the pendulum. To the ſame piece of braſs is fixed the horizontal arm *e* H, carrying to its extremity the ball H, of ſuch ſize, that the action of the tooth A on the pallet D is juſt able to raiſe it up to the poſition here drawn. ZP *p* repreſents the fork, or pendulum rod, behind both detent and pallet. A pin *p* projects forward, coming through the ſlit *i k*, without touching either margin of it. Attached to the fork is the arm *m n*, of ſuch length that, when the pendulum rod is perpendicular, the angular diſtance of *n q* from the rod *e q* H is juſt equal to the angular diſtance of the left ſide of the pin *p* from the left end *i* of the ſlit *i k*. Fig. 13.

Now, the natural poſition of the pallet D is at ∂, repreſented by the dotted lines, reſting on the back of the detent F. It is naturally brought into this poſition by its own weight, and ſtill more by the weight of the ball H. The pallet D, being ſet on the foreſide of the arm at Z, comes into the ſame plane with the detent F and the ſwing-wheel, though here repreſented in a different poſition. The tooth C of the wheel is ſuppoſed to have eſcaped from the ſecond pallet, on which the tooth A immediately ſeizes the pallet D, ſituated at ∂, forces it out, and then reſts on the detent F, the pallet D leaning on the tip of the tooth. After the eſcape of C, the pendulum, moving down the arch of ſemivibration, is repreſented as having attained the vertical poſition. Proceeding ſtill to the left, the pin *p* reaches the extremity *i* of the ſlit *i k*; and, at the ſame inſtant, the arm *n* touches the rod *e* H in *q*. The pendulum proceeding a hairsbreadth further, withdraws the detent F from the tooth, which now even puſhes off the detent, by acting on the inclining face of it. The wheel being now unlocked, the tooth following C on the other ſide acts on its pallet, puſhes it off, and reſts on its detent, which has been rapidly brought into a proper poſition by the action of A on the inclining face of F. By a ſimilar action of C on its detent at the moment of eſcape, F was brought into a poſition proper for the wheels being locked by the tooth A. As the pendulum ſtill goes on, the ball H, and pallet connected with it, are carried by the arm *m n*, and before the pin *p* again reaches the

end

Watch. end of the ſlit, which had been ſuddenly withdrawn by the action of A on F, the pendulum comes to reſt. It now returns towards the right, loaded with the ball H on the left, and thus the motion loſt during the laſt vibration is reſtored. When the pin *p*, by its motion to the right, reaches the end *k* of *i k*, the wheel on the right ſide is unlocked, and at the ſame inſtant the weight H being raiſed from the pendulum by the action of a tooth like B on the pallet D, ceaſes to act.

In this ſcapement, both pallets and detents are detached from the pendulum, except in the moment of unlocking the wheel, ſo that, except during this ſhort interval, the pendulum may be ſaid to be free during its whole vibration, and of courſe its motion muſt be more equable and undiſturbed.

5 apements watches. The conſtructing of a proper ſcapement for watches requires peculiar delicacy, owing to the ſmall ſize of the machine, from which the error of $\frac{1}{100}$ of an inch has as much effect as the error of a whole inch in a common clock. From the neceſſary lightneſs of the balance, too, it is extremely difficult to accumulate a ſufficient quantity of regulating power. This can be done only by giving the balance a great velocity, which is effected by concentrating as much as poſſible of its weight in the rim, and making its vibrations very wide. The balance rim of a tolerable watch ſhould paſs through at leaſt ten inches in every ſecond.

6 ibrations a balance e iſochro- ous. In conſidering the moſt proper ſcapements for watches, we may aſſume the following principle, viz. that the oſcillations of a balance urged by its ſpring, and undiſturbed by extraneous forces, are iſochronous.

7 eſt ordi- ary ſcape- ent for atches. g. 14. In ordinary pocket watches, the common recoiling ſcapement of clocks is ſtill employed, and anſwers the common purpoſes of a watch tolerably well, ſo that, if properly executed, a good ordinary watch will keep time within a minute in the day. Theſe watches, however, are ſubject to great variation in their rate of going, from any change in the power of the wheels.

The following is conſidered as the beſt conſtruction of the common watch ſcapement, and is repreſented by fig. 14. as it appears when looking ſtraight down on the end of the balance arbor. C marks the centre of the balance and verge; CA repreſents the upper pallet, or that next the balance, and CB the lower pallet; F and D are two teeth of the crown wheel, moving from left to right; E, G, are two teeth in the lower part, moving from right to left. The tooth D appears as having juſt eſcaped from the point of CA, and the tooth E as having juſt come in contact with CB. In practice, the ſcapement ſhould not be quite ſo cloſe, as by a ſmall inequality of the teeth, D might be kept from eſcaping at all. The following are thought the beſt proportions: The diſtance between the front of the teeth (that is, of G, F, E, D), and the axis C of the balance, is $\frac{1}{5}$ of FA, the diſtance between the points of the teeth. The length CA, CB of the pallets is $\frac{3}{5}$ of the ſame degrees, and the front DH or FK of the teeth makes an angle of 25° with the axis of the crown wheel. The ſloping ſide of the tooth muſt be of an epicycloidal form, ſuited to the relative motion of the tooth and pallet.

It appears from theſe proportions, that by the action of the tooth D, the pallet A can *throw out* till it reach *a*, 120° from CL, the line of the crown-wheel axis. To this if we add BCA=95°, we ſhall have LC *a*=120°. Again, B will throw out as far on the other ſide. Now, if from 240°, the ſum of the extent of vibration of both pallets, we take 95° the angle of the pallets, the remainder 145° will expreſs the greateſt vibration which the balance can make, without ſtriking the front of the teeth. From ſeveral cauſes, however, this meaſure is too great, and 120° is reckoned a ſufficient vibration in the beſt ordinary ſcapement. Watch.

8 Graham's horizontal ſcapement. Fig. 15. and 16. Of the improvements on the ſcapements of watches, one of the moſt important is that by Mr George Graham, which we ſhall proceed to deſcribe. DE, fig. 15. repreſents part of the rim of the balance wheel; A and C, two of its teeth with their faces *b e* formed into planes, inclined to the circumference of the wheel in an angle of about 15°, ſo that the length *b e* of the face may be nearly quadruple of its height *e m*. Let a circular arch ABC be deſcribed round the centre of the wheel, and through the middle of the faces of the teeth. The axis of the balance will paſs through ſome point B of this arch, and the mean circumference of the teeth may be ſaid to paſs through the centre of the verge. On this axis is fixed a portion of a thin hollow cylinder *b c d*, made of hard tempered ſteel, or of ſome hard and tough ſtone, ſuch as ruby or ſapphire. By this conſtruction the portion of the cylinder occupies 210° of the circumference. The edge *b*, to which the tooth approaches from without, is rounded off on both angles. The other edge *d* is formed into a plane, inclined to the radius about 30°. Now, ſuppoſe the wheel preſſed forward in the direction AC, the point *b* of the tooth, touching the rounded edge, will puſh it outwards, turning round the balance in the direction *b c d*. The heel *e* of the tooth will eſcape from this edge when it is in the poſition *h*, and *e* is in the poſition *f*. The point *b* of the tooth will now be at *d*, but the edge of the cylinder will be at *i*. The tooth therefore reſts in the inſide of the cylinder, while the balance continues its vibration a little way, in conſequence of the impulſe it has received from the action of the inclined plane. When this vibration is ended, by the oppoſition of the balance ſpring, the balance will return, and the tooth now in the poſition B, rubbing on the inſide of the cylinder, the balance comes back into its natural poſition *b c d*, with an accelerated motion by the action of its ſpring, and would of itſelf vibrate as far as the other ſide. It is, however, aſſiſted again by the tooth, which preſſes on the edge *d*, puſhes it aſide till it attain the poſition *k*, when the tooth entirely eſcapes from the cylinder. At this inſtant the other edge of the cylinder, having attained the poſition *l*, is in the way of the next tooth, which is now in the poſition A, while the balance continues its vibration, the tooth reſting and rubbing on the outſide of the cylinder. When this vibration is finiſhed, the balance, by the action of the ſpring, reſumes its firſt motion, and as ſoon as the balance gets into its natural poſition, the tooth begins to act on the edge *b*, puſhes it aſide, eſcapes from it, and drops as before in the inſide of the cylinder. In this conſtruction the arch of action or ſcapement is 30° = twice the angle which the face of a tooth makes with the circumference.

It is neceſſary to explain how the cylinder is connected with the verge, ſo as to make ſuch a great revolution round the tooth of the wheel. The triangular tooth *e b m* is placed on the top of a little pillar fixed into the end of the piece of braſs *m* D formed in the rim of the wheel. Thus the plane of the wedge tooth is parallel

Watch. rallel to the plane of the wheel, but at a ſmall diſtance above it. The verge is repreſented at fig. 16. and conſiſts of a long hollow cylinder of caſt ſteel, having a great portion of the metal cut out. If ſpread out flat, this cylinder would aſſume the form of fig. 17.; and if we conceive this flat piece rolled up till the edges GH and G′H′ unite, we ſhall have the exact form. The part acted on by the point of the tooth is denoted by the dotted line *b d*, and the part D, I, F, E ſerves to connect the two ends.

This ſcapement of Mr Graham is called a *horizontal* ſcapement, becauſe the balance is parallel to the other wheels.

9 Lepaute's improvement. Fig. 18. and 19.

Another ſcapement of a ſuperior conſtruction was contrived by M. Lepaute of Paris, and is of ſuch a ſingular form as to render it extremely difficult to illuſtrate it by a figure. The repreſentations at fig. 18. and 19. will, however, give general readers ſome idea of its mode of action, and a ſkilful artiſt will eaſily ſee how the ſeveral parts may be adapted to each other. ABC fig. 18. repreſents part of the rim of the balance wheel, having the pins 1, 2, 3, 4, 5, &c. projecting from its faces; the pins 1, 3, 5, being on the ſide next the eye, and the pins 2 and 4 on the oppoſite ſide. D is the centre of the balance and verge, and the ſmall circle round D repreſents its thickneſs. But the verge in this place is crooked, that the rim of the wheel may not be intercepted by it. To it is attached a piece of hard tempered ſteel *a b c d*, of which the part *a b c* is a concave arch of a circle, having D for its centre. It wants about 30° of a ſemicircle. The reſt *c d* is alſo an arch of a circle having the ſame radius with the balance, wheel. In the natural poſition of the balance, a line drawn from D, through the middle of the face *c d* is a tangent to the circumference of the wheel. But if the balance be turned round till the point *d* of the horn come to *d′*, and the point *c* come to 2 in the circumference in which the pins are placed, the pin preſſing on the beginning of the horn or pallet, puſhes it aſide, ſlides along it, and eſcapes at *d*, having generated a certain velocity in the balance. Let another pallet ſimilar to that now deſcribed be placed on the other ſide of the wheel, but in a contrary poſition, with the acting face of the pallet turned away from the centre of the wheel. Let it be ſo placed at E, that the moment the pin 1 on the upper ſide of the wheel eſcapes from the pallet *c d*, the pin 4 on the lower ſide of the wheel falls on the end of the circular arch *e f g* of the other pallet. Now, if the pallets be connected by equal pulleys G and F on the axis of each, and a thread round both ſo that they ſhall turn one way; the balance on the axis D having received an impulſe from the pin 1, will continue its motion from A towards *i*, and will carry the other pallet with a ſimilar motion round the centre E from *h* to *k*. The pin 4 will therefore reſt in the concave arch *g f e* as the pallet turns round. When the force of the balance is ſpent, the pallet *c d* returns towards its firſt poſition. The pallet *g h* turns with it, and when the point of the firſt has arrived at *d*, the beginning *g* of the other arrives at the pin 4; and, proceeding farther, this pin eſcapes from the concave arch *e f g*, and ſlides along the pallet *g h*, puſhing it aſide, and of courſe urging the pallet round the centre E, and the balance on the axis D round at the ſame time, and in the ſame direction. The pin 4 eſcapes from the pallet *g h*, when *h* arrives at 3; but while the pin 4 is ſliding along the yielding pallet *g h*, the pin 3 is moving in the circumference B D A; and the inſtant that the pin 4 eſcapes from *h* at 3, the pin 3 arrives at 2, where the beginning *c* of the concave arch *c b* is ready to receive it. It therefore reſts on this arch, while the balance continues its motion, and this may continue till the point *b* of the arch comes to 2. The balance now ſtops, its force being ſpent, and then returns; and the pin 3 eſcapes from the circle at *c*, ſlides along the yielding pallet *c d*, and when it eſcapes at 1, another pin on the lower ſide of the wheel arrives at 4, and finds the arch *g f e* ready to receive it. And thus the vibration of the balance will be continued. Watch.

From the above deſcription we may deduce the proper dimenſions of the parts of the pallet. Thus, the length of the pallet *c d* or *g h*, muſt be equal to the interval between two ſucceeding pins, and the diſtance of the centres DE, muſt be double of that interval. The radius D*e* or E*g*, may be as ſmall as we chooſe. The concave arches *c b a* and *g f e*, muſt be continued ſo far as to allow a pin to reſt on them during the whole excurſion of the balance. The angle of ſcapement, in which the balance remains under the influence of the wheels, is obtained by drawing the lines D*c* and D*d*, and we ſhall find that this angle *c* D *d* is here about 30°, though it may be made either greater or leſs than this.

Fig. 19. explains how the two pallets may be combined on one verge. KL is the verge with a pivot at each end. It is bent like a crank MNO, to admit the balance wheel between its branches. BC repreſents this wheel, ſeen edgewiſe, with its pin alternately on different ſides. The pallets are alſo repreſented by *b c d* and *h g f*, fixed to the inſide of the branches of the crank, fronting each other. The poſition of their acting faces may be ſeen in the preceding figure, on the verge D, where the pallet *g h* is repreſented by the dotted line 2 *i′*, as ſituated behind the pallet *c d*. The remote pallet 2 *i* is ſo placed, that when the point *d* of the near pallet is quitted by a pin 1 on the upper ſide of the wheel, the angle formed by the face and the arch of reſt of the other pallet is juſt ready to receive the next pin 2, which lies on the lower ſide of the rim. It is plain that the action here will be the ſame as if the pallets were on ſeparate axes. The pin 1 eſcapes from *d*, and the pin 2 is received on the arch of reſt, and locks the wheel, while the balance continues in motion. When the balance returns, 2 gets off the arch of reſt, puſhes aſide the pallet 2 *i*, eſcapes from it when *i* gets to 1, and then the point *c* is ready to receive the pin 3, &c. The vibrations may be increaſed by giving a ſufficient impulſe through the angle of ſcapement, but they cannot exceed a certain quantity, otherwiſe N, the top of the crank, would ſtrike the rim of the wheel. The vibrations may be eaſily increaſed to 180°, by placing the pins at the very edge of the wheel; and by placing them at the points of long teeth, ſo that the crank may get in between them, the vibrations may be carried to a much greater extent. Fig. 19.

The conſtruction juſt deſcribed is exceedingly ingenious; and if the machinery be well executed, this ſcapement will excel the horizontal ſcapement of Graham, both as it has but two acting faces to form, and as it admits of making the circle of reſt extremely ſmall, without leſſening the acting face of the pallet. The conſtruction is, however, very delicate and difficult, and muſt require a very nice workman.

An

WATCH WORK. PLATE DLXXI.

Fig. 1.

Fig. 2.

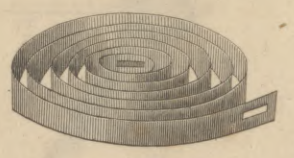


Fig. 3.

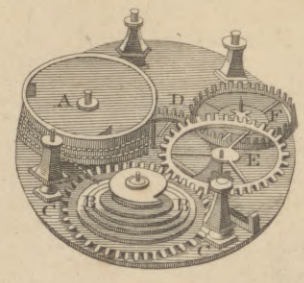


Fig. 4.

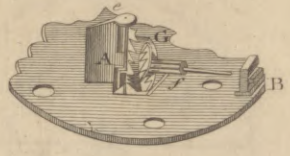


Fig. 5.

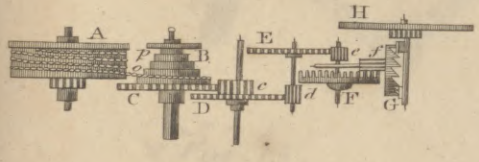


Fig. 6.

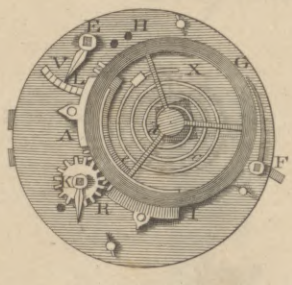


Fig. 7.

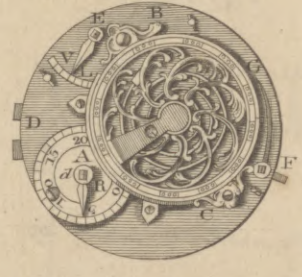


Fig. 8.

Fig. 9.

Fig. 12.

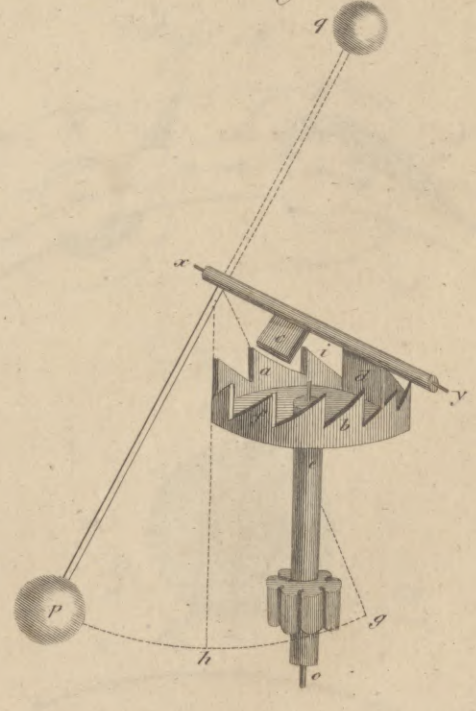


Fig. 10.

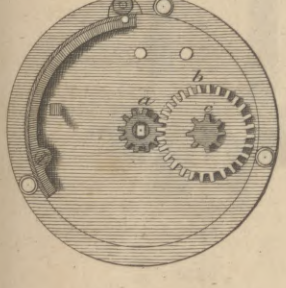


Fig. 11.

W. Train Sculpt.

Fig. 13.

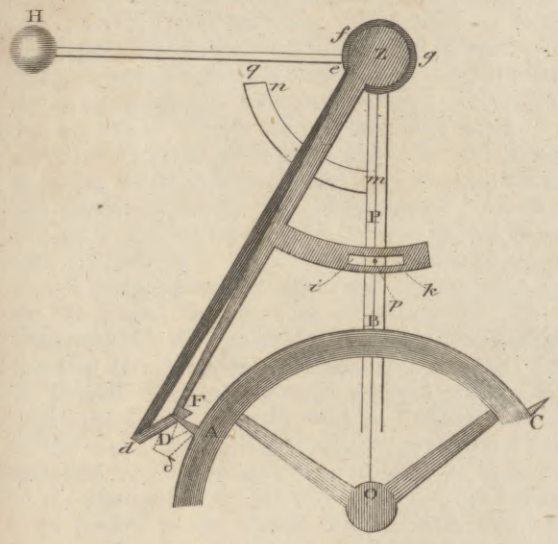


Fig. 14.

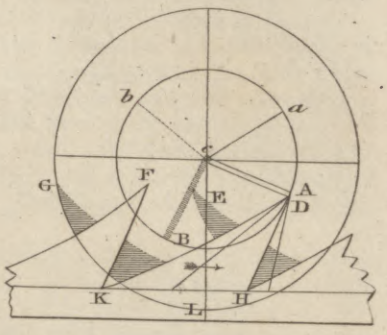


Fig. 15.

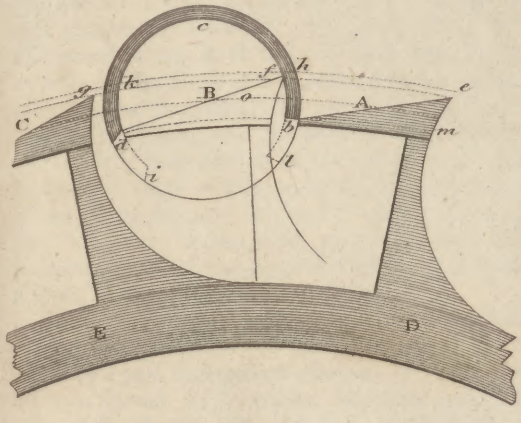


Fig. 16.

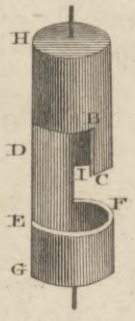


Fig. 17.

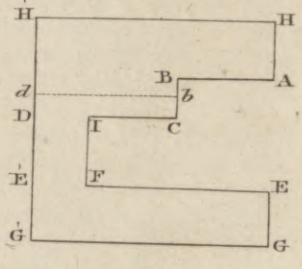


Fig. 18.

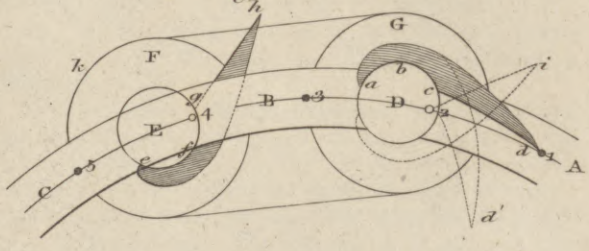


Fig. 19.

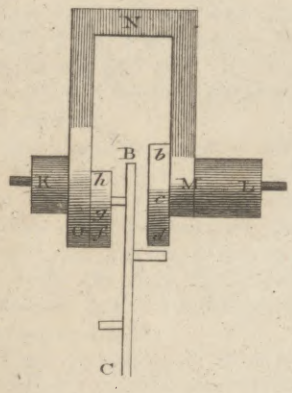
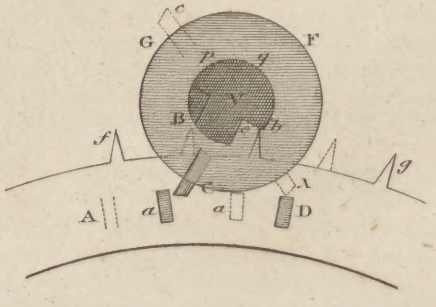


Fig. 20.



W. Perrin Sculpt.

Watch || Water.

An excellent ſcapement of much more eaſy conſtruction, is that commonly called *Duplaie's ſcapement*, and with this we ſhall conclude our account of watch-work. Fig. 20. repreſents the eſſential parts ſomewhat magnified. AD a portion of the balance-wheel, having teeth *f*, *h*, *g*, at the circumference. Theſe teeth are for producing the *reſt* of the wheel, while the balance is making excurſions beyond the ſcapement. This is effected by an agate cylinder *s p g*, on the verge. This cylinder has a notch *o*. When the cylinder turns round in the direction *o p g*, the notch eaſily paſſes the tooth B which is reſting on the cylinder ſurface; but when it returns in the direction *q p o*, the tooth B gets into the notch, and follows it, preſſing on one ſide of it till the notch comes into the poſition *o*. The tooth being then in the poſition *h*, eſcapes from the notch, and another tooth drops on the convex ſurface of the cylinder at B. The balance-wheel is alſo furniſhed with a ſet of flat-ſided pins, ſtanding upright on its rim repreſented by *a* D. There is likewiſe fixed on the verge a larger cylinder GFC above the ſmaller one *o p q*, with its lower ſurface clear of the wheel, and having a pallet C, of ſapphire, firmly indented into it, and projecting ſo far as to keep clear of the pins on the wheel. The poſition of this cylinder, with reſpect to the ſmaller one below it, is ſuch that the tooth *b* being eſcaped from the notch, the pallet C has juſt paſt the pin *a*, which was at A while B reſted on the ſmall cylinder; but it moved from A to *a*, while B moved to *b*. The wheel being now at liberty, the pin *a* exerts its preſſure on the pallet C in the moſt direct manner, and gives it a ſtrong impulſion, following and accelerating it till another tooth ſtops on the little cylinder. The angle of ſcapement depends partly on the projection of the pallet, and partly on the diameter of the ſmall cylinder, and the advance of the tooth B into the notch. Independent of the action on the ſmall cylinder, the angle of ſcapement would be the whole arch of the larger cylinder between C and *x*. But *a* ſtops before it be clear of the pallet, and the arch of impulſion is ſhortened by all the ſpace deſcribed by the pin while a tooth moves from B to *b*. It ſtops at *d*.

10 Duplaie's ſcapement. Fig. 20.

For an account of other ſcapements we muſt refer our readers to the *Memoirs of the Academy of Sciences at Paris* for 1748, Cumming's *Elements of Clock and Watch-work*, a French work entitled *Machines approuvées par l'Academie des Sciences*, and Young's *Lectures on Natural Philoſophy*, vol. i. p. 193, and Plate 16, vol. ii. p. 193.

WATCHING, in *Medicine*, is when the patient cannot ſleep. In fevers it is a dangerous ſymptom, and if long continued ends in a delirium.

WATER, a well known fluid, diffuſed through the atmoſphere, and over the ſurface of the globe, and abounding in a certain proportion in animals, vegetables, and minerals.

The uſes of water are ſo univerſally known, that it would be ſuperfluous to enumerate them in this article. It is eſſential to animal and vegetable life; it makes eaſy the intercourſe between the moſt diſtant regions of the world; and it is one of the moſt uſeful powers in the mechanic arts. It is often found combined with various ſubſtances, and is then frequently beneficial in curing or alleviating diſeaſes.

Thoſe properties of water which fit it for anſwering mechanical purpoſes are explained in other articles of this work (ſee HYDRODYNAMICS, PNEUMATICS, N° 3. RESISTANCE, and RIVERS); and for the diſcovery of the compoſition of water, ſee CHEMISTRY *Index*. Water.

Mineral WATERS. For the method of analyſing them, ſee alſo CHEMISTRY *Index*.

Under the title of *MINERAL Waters*, we have given an analyſis of the moſt remarkable waters in Europe.

Holy WATER, which is made uſe of in the church of Rome, as alſo by the Greeks, and by the other Chriſtians of the Eaſt of all denominations, is water with a mixture of ſalt, bleſſed by a prieſt according to a ſet form of benediction. It is uſed in the bleſſing of perſons, things, and places; and is likewiſe conſidered as a ceremony to excite pious thoughts in the minds of the faithful.

The prieſts, in bleſſing it, firſt, in the name of God, commands the devils not to hurt the perſons who ſhall be ſprinkled with it, nor to abuſe the things, nor diſquiet the places, which ſhall likewiſe be ſo ſprinkled. He then prays that health, ſafety, and the favour of heaven, may be enjoyed by ſuch perſons, and by thoſe who ſhall uſe ſuch things, or dwell in ſuch places. Veſtments, veſſels, and other ſuch things that are ſet apart for divine ſervice, are ſprinkled with it. It is ſometimes ſprinkled on cattle, with an intention to free or preſerve them from diabolical enchantments; and in ſome ritual books there are prayers to be ſaid on ſuch occaſions, by which the ſafety of ſuch animals, as being a temporal bleſſing to the poſſeſſors, is begged of God, whoſe providential care is extended to all his creatures. The hope which Catholics entertain of obtaining ſuch good effects from the devout uſe of holy water, is grounded on the promiſe made to believers by Chriſt (St Mark xvi. 17.), and on the general efficacy of the prayers of the church; the petition of which prayers God is often pleaſed to grant; though ſometimes, in his Providence, he ſees it not expedient to do ſo. That ſuch effects have been produced by holy water in a remarkable manner, has been aſſerted by many authors of no ſmall weight; as, namely, by St Epiphanius, Haer. 30th; St Hierom, in the Life of St Hilarion; Theodoret *Hiſt. Eccl.* lib. v. cap. 21.; Palladius, *Hiſt. Lauſ.*; Bede, lib. v. cap. 4.

As a ceremony (ſays the Catholic), water brings to our remembrance our baptiſm; in which, by water, we were cleanſed from original ſin. It alſo puts us in mind of that purity of conſcience which we ought to endeavour always to have, but eſpecially when we are going to worſhip our God. The ſalt, which is put into the water to preſerve it from corrupting, is alſo a figure of divine grace, which preſerves our ſouls from the corruption of ſin; and is likewiſe an emblem of that wiſdom and diſcretion which ought to ſeaſon every action that a Chriſtian does, and every word that he ſays. It is wont to be bleſſed and ſprinkled in churches on Sundays, in the beginning of the ſolemn office. It is kept in veſſels at the doors of the ſame churches, that it may be taken by the faithful as they enter in. It is alſo often kept in private houſes and chambers.

Putrid WATER, is that which has acquired an offenſive ſmell and taſte by the putreſcence of animal or vegetable ſubſtances contained in it. It is in the higheſt degree pernicious to the human frame, and capable of bringing on mortal diſeaſes even by its ſmell. It is not always from the apparent muddineſs of waters that we

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Water. can judge of their diſpoſition to putrefy; ſome which are ſeemingly very pure, being more apt to become putrid than others which appear much more mixed with heterogeneous matters. Under the article ANIMALCULE, N° 33, is mentioned a ſpecies of inſects which have the property of making water ſtink to an incredible degree, though their bulk in proportion to the fluid which ſurrounds them is leſs than that of one to a million. Other ſubſtances no doubt there are which have the ſame property; and hence almoſt all water which is confined from the air is apt to become offenſive, even though kept in glaſs or ſtoneware veſſels. Indeed it is a common obſervation, that water keeps much longer ſweet in glaſs veſſels, or in thoſe of earthen or ſtoneware, than in thoſe of wood, where it is exceedingly apt to putrefy. Hence, as ſhips can only be ſupplied with water kept in wooden caſks, ſailors are extremely liable to thoſe diſeaſes which ariſe from putrid water; and the diſcovery of a method by which water could eaſily be prevented from becoming putrid at ſea would be exceedingly valuable. This may indeed be done by quicklime; for when water is impregnated with it, all putreſcent matters are either totally deſtroyed, or altered in ſuch a manner as never to be capable of undergoing the putrefactive fermentation again. But a continued uſe of lime-water could not fail of being pernicious, and it is therefore neceſſary to throw down the lime; after which the water will have all the purity neceſſary for preſerving it free from putrefaction. This can only be done by means of fixed air; and mere expoſure in broad ſhallow veſſels to the atmoſphere would do it without any thing elſe, only taking care to break the cruſt which formed upon it. Two methods, however, have been thought of for doing this with more expedition. The one, invented by Dr Alſton, is, by throwing into the water impregnated with lime a quantity of magneſia. The lime attracts fixed air more powerfully than magneſia; in conſequence of which the latter parts with it to the lime: and thus becoming inſoluble, falls along with the cauſtic magneſia to the bottom, and thus leaves the water perfectly pure. Another method is that of Mr Henry, who propoſes to throw down the lime by means of an effervеſcing mixture of oil of vitriol and chalk put down to the bottom of the water caſk. His apparatus for this purpoſe is as ſimple as it can well be made, though it is hardly probable that ſailors will give themſelves the trouble of uſing it; and Dr Alſton's ſcheme would ſeem better calculated for them, were it not for the expence of the magneſia; which indeed is the only objection made to it by Mr Henry. Putrid water may be reſtored and made potable by a proceſs of the ſame kind.

Of late it has been diſcovered that charcoal poſſeſſes many unexpected properties, and, among others, that of preſerving water from corruption, and of purifying it after it has been corrupted. Mr Lowitz, whoſe experiments on charcoal have been publiſhed in Crell's Chemical Journal, has turned his attention to this ſubject in a memoir read to the Economical Society at Peterſburgh. He found that the effect of charcoal was rendered much more ſpeedy by uſing along with it ſome ſulphuric acid. One ounce and a half of charcoal in powder, and 24 drops of concentrated ſulphuric acid (oil of vitriol), are ſufficient to purify three pints and a half of corrupted water, and do not communicate to it any ſenſible acidity. This ſmall quantity of acid renders it unneceſſary to uſe more than a third part of the charcoal powder which would otherwiſe be wanted; and the leſs of that powder is employed, the leſs is the quantity of water loſt by the operation, which, in ſea-voyages, is an object worthy of conſideration. In proportion to the quantity of acid made uſe of, the quantity of charcoal may be diminiſhed or augmented. All acids produce nearly the ſame effects: neutral ſalts alſo, particularly nitre and ſea-ſalt, may be uſed, but ſulphuric acid is preferable to any of theſe; water which is purified by means of this acid and charcoal will keep a longer time than that which is purified by charcoal alone. When we mean to purify any given quantity of corrupted water, we ſhould begin by adding to it as much powder of charcoal as is neceſſary to deprive it entirely of its bad ſmell. To aſcertain whether that quantity of powdered charcoal was ſufficient to effect the clarification of the ſaid water, a ſmall quantity of it may be paſſed through a linen bag, two or three inches long; if the water, thus filtrated, ſtill has a turbid appearance, a freſh quantity of powdered charcoal muſt be added, till it is become perfectly clear: the whole of the water may then be paſſed through a filtering bag, the ſize of which ſhould be proportioned to the quantity of water. If ſulphuric acid, or any other, can be procured, a ſmall quantity of it ſhould be added to the water, before the charcoal powder. Water.

The cleaning of the caſks in which water is to be kept in ſea-voyages ſhould never be neglected: they ſhould be well waſhed with hot water and ſand, or with any other ſubſtance capable of removing the mucilaginous particles, and afterwards a quantity of charcoal duſt ſhould be employed, which will entirely deprive them of the muſty or putrid ſmell they may have contracted.—The charcoal uſed for purifying water ſhould be well burnt, and afterwards beat into a fine powder.

Sea-WATER. See *SEA-Water.*

WATER-Carts, carriages conſtructed for the purpoſe of watering the roads for ſeveral miles round London; a precaution abſolutely neceſſary near the metropolis, where, from ſuch a vaſt daily influx of carriages and horſes, the duſt would otherwiſe become quite inſufferable in hot dry weather. Pumps are placed at proper diſtances to ſupply theſe carts.

WATER-Ordeal. See ORDEAL.

WATER, among jewellers, is properly the colour or luſtre of diamonds and pearls. The term, though leſs properly, is ſometimes uſed for the hue or colour of other ſtones.

WATER-Bellows. See *Machines for blowing Air into FURNACES.*

WATER-Colours, in *Painting*, are ſuch colours as are only diluted and mixed up with gum-water, in contradiſtinction to oil-colours. See *COLOUR-Making.*

WATER-Gang, a channel cut to drain a place by carrying off a ſtream of water.

WATER-Hen. See PARRA, ORNITHOLOGY *Index.*

WATER-Lines of a Ship, certain horizontal lines ſuppoſed to be drawn about the outſide of a ſhip's bottom, cloſe to the ſurface of the water in which ſhe floats. They are accordingly higher or lower upon the bottom, in proportion to the depth of the column of water required to float her.

WATER-Logged, the ſtate of a ſhip when, by receiving a great quantity of water into the hold, by leaking, &c. ſhe

Water-logged || Water-ſpout.

ſhe has become heavy and inactive upon the ſea, ſo as to yield without reſiſtance to the efforts of every wave ruſhing over her decks. As, in this dangerous ſituation, the centre of gravity is no longer fixed, but fluctuating from place to place, the ſtability of the ſhip is utterly loſt: ſhe is therefore almoſt totally deprived of the uſe of her ſails, which would operate to overſet her, or preſs the head under water. Hence there is no reſource for the crew, except to free her by the pumps, or to abandon her by the boats as ſoon as poſſible.

WATER-Sail, a ſmall ſail ſpread occaſionally under the lower ſtudding-ſail, or driver boom, in a fair wind and ſmooth ſea.

WATER-Ouzel. See TURDUS, ORNITHOLOGY *Index*.

WATER-Spout, an extraordinary meteor, conſiſting of a large maſs of water collected into a ſort of column, and moved with rapidity along the ſurface of the ſea.

The beſt account of the water-ſpout which we have met with is in the Phil. Tranſ. Abridged, vol. iii. as obſerved by Mr Joſeph Harris, May 21. 1732, about ſunſet, lat. 32° 30′ N.; long. 9° E. from Cape Florida.

"When firſt we ſaw the ſpout (ſays he), it was whole and entire, and much of the ſhape and proportion of a ſpeaking trumpet; the ſmall end being downwards, and reaching to the ſea, and the big end terminated in a black thick cloud. The ſpout itſelf was very black, and the more ſo the higher up. It ſeemed to be exactly perpendicular to the horizon, and its ſides perfectly ſmooth, without the leaſt ruggedneſs. Where it fell the ſpray of the ſea roſe to a conſiderable height, which made ſomewhat the appearance of a great ſmoke. From the firſt time we ſaw it, it continued whole about a minute, and till it was quite diſſipated about three minutes. It began to waſte from below, and ſo gradually up, while the upper part remained entire, without any viſible alteration, till at laſt it ended in the black cloud above; upon which there ſeemed to fall a very heavy rain in that neighbourhood.—There was but little wind, and the ſky elſewhere was pretty ſerene."

Water-ſpouts have by ſome been ſuppoſed to be merely electrical in their origin; particularly by Signior Beccaria, who ſupported his opinion by ſome experiments. But if we attend to the ſucceſſive phenomena neceſſary to conſtitute a complete water-ſpout through their various ſtages, we ſhall be convinced, that recourſe muſt be had to ſome other principle in order to obtain a complete ſolution.

Dr Franklin, in his Phyſical and Meteorological Obſervations, ſuppoſes a water-ſpout and a whirlwind to proceed from the ſame cauſe; their only difference being, that the latter paſſes over the land, and the former over the water. This opinion is corroborated by M. de la Pryme, in the Philoſophical Tranſactions, where he deſcribes two ſpouts obſerved at different times in Yorkſhire, whoſe appearances in the air were exactly like thoſe of the ſpouts at ſea, and their effects the ſame as thoſe of real whirlwinds.

A fluid moving from all points horizontally towards a centre, muſt at that centre either mount or deſcend. If a hole be opened in the middle of the bottom of a tub filled with water, the water will flow from all ſides to the centre, and there deſcend in a whirl: but air flowing on or near the ſurface of land or water, from all ſides towards a centre, muſt at that centre aſcend; becauſe the land or water will hinder its deſcent.

The doctor, in proceeding to explain his conceptions, begs to be allowed two or three poſitions, as a foundation for his hypotheſis. 1. That the lower region of air is often more heated, and ſo more rarefied, than the upper, and by conſequence ſpecifically lighter. The coldneſs of the upper region is manifeſted by the hail, which falls from it in warm weather. 2. That heated air may be very moiſt, and yet the moiſture ſo equally diffuſed and rarefied as not to be viſible till colder air mixes with it; at which time it condenſes and becomes viſible. Thus our breath, although invifible in ſummer, becomes viſible in winter. Water-ſpout.

Theſe circumſtances being granted, he preſuppoſes a tract of land or ſea, of about 60 miles in extent, unſheltered by clouds and unrefreſhed by the wind, during a ſummer's day, or perhaps for ſeveral days without intermiſſion, till it becomes violently heated, together with the lower region of the air in contact with it; ſo that the latter becomes ſpecifically lighter than the ſuperincumbent higher region of the atmoſphere, wherein the clouds are uſually floated: he ſuppoſes alſo that the air ſurrounding this tract has not been ſo much heated during thoſe days, and therefore remains heavier. The conſequence of this, he conceives, ſhould be, that the heated lighter air ſhould aſcend, and the heavier deſcend; and as this riſing cannot operate throughout the whole tract at once, becauſe that would leave too extenſive a vacuum, the riſing will begin preciſely in that column which happens to be lighteſt or moſt rarefied; and the warm air will flow horizontally from all parts of this column, where the ſeveral currents meeting, and joining to riſe, a whirl is naturally formed, in the ſame manner as a whirl is formed in a tub of water, by the deſcending fluid receding from all ſides of the tub towards the hole in the centre.

And as the ſeveral currents arrive at this central riſing column with a conſiderable degree of horizontal motion, they cannot ſuddenly change it to a vertical motion: therefore as they gradually, in approaching the whirl, decline from right to curve or circular lines, ſo, having joined the whirl, they aſcend by a ſpiral motion; in the ſame manner as the water deſcends ſpirally through the hole in the tub before mentioned.

Laſtly, as the lower air neareſt the ſurface is more rarefied by the heat of the ſun, it is more impreſſed by the current of the ſurrounding cold and heavy air which is to aſſume its place, and conſequently its motion towards the whirl is ſwifteſt, and ſo the force of the lower part of the whirl ſtrongeſt, and the centrifugal force of its particles greateſt. Hence the vacuum which incloſes the axis of the whirl ſhould be greateſt near the earth or ſea, and diminiſh gradually as it approaches the region of the clouds, till it ends in a point.

This circle is of various diameters, ſometimes very large.

If the vacuum paſſes over water, the water may riſe in a body or column therein to the height of about 32 feet. The whirl of air may be as inviſible as the air itſelf, though reaching in reality from the water to the region of cool air, in which our low ſummer thunder-clouds commonly float; but it will ſoon become viſible at its extremities. The agitation of the water under the whirling of the circle, and the ſwelling and riſing of the water in the commencement of the vacuum, render it viſible below. It is perceived above by the

Water-spout, Water-works.

warm air being brought up to the cooler region, where its moiſture begins to be condenſed by the cold into thick vapour, and is then firſt diſcovered at the higheſt part, which being now cooled condenſes what riſes behind it, and this latter acts in the ſame manner on the ſucceeding body; where, by the contact of the vapours, the cold operates faſter in a right line downwards, than the vapours themſelves can climb in a ſpiral line upwards: they climb however; and as by continual addition they grow denſer, and by conſequence increaſe their centrifugal force, and being riſen above the concentrating currents that compoſe the whirl, they fly off, and form a cloud.

It ſeems eaſy to conceive, how, by this ſucceſſive condenſation from above, the ſpout appears to drop or deſcend from the cloud, although the materials of which it is compoſed are all the while aſcending. The condenſation of the moiſture contained in ſo great a quantity of warm air as may be ſuppoſed to riſe in a ſhort time in this prodigiouſly rapid whirl, is perhaps ſufficient to form a great extent of cloud; and the friction of the whirling air on the ſides of the column may detach great quantities of its water, diſperſe them into drops, and carry them up in the ſpiral whirl mixed with the air. The heavier drops may indeed fly off, and fall into a ſhower about the ſpout; but much of it will be broken into vapour, and yet remain viſible.

As the whirl weakens, the tube may apparently ſeparate in the middle; the column of water ſubſiding, the ſuperior condenſed part drawing up to the cloud. The tube or whirl of air may nevertheleſs remain entire, the middle only becoming inviſible, as not containing any viſible matter.

Dr Lindſay, however, in ſeveral letters publiſhed in the Gentleman's Magazine, has controverted this theory of Dr Franklin, and endeavoured to prove that water-ſpouts and whirlwinds are diſtinct phenomena; and that the water which forms the water-ſpout, does not aſcend from the ſea, as Dr Franklin ſuppoſes, but deſcends from the atmoſphere. Our limits do not permit us to inſert his arguments here, but they may be ſeen in the Gentleman's Magazine, volume li. p. 559, 615; vol. liii. p. 1025; and vol. lv. p. 594. We cannot avoid obſerving, however, that he treats Dr Franklin with a degree of aſperity to which he is by no means entitled, and that his arguments, even if concluſive, prove nothing more than that ſome water-ſpouts certainly deſcend; which Dr Franklin hardly ever ventured to deny. There are ſome very valuable diſſertations on this ſubject by Profeſſor Wilcke of Upſal.

WATER-Works. Under this name may be comprehended almoſt every hydraulic ſtructure or contrivance; ſuch as, canals, conduits, locks, mills, water engines, &c. But they may be conveniently arranged under two general heads, 1ſt, Works which have for their object the conducting, raiſing, or otherwiſe managing, of water; and, 2dly, Works which derive their efficacy from the impulſe or other action of water. The *firſt* claſs comprehends the methods of ſimply conducting water in aqueducts or in pipes for the ſupply of domeſtic conſumption or the working of machinery: It comprehends alſo the methods of procuring the ſupplies neceſſary for theſe purpoſes, by means of pumps, water, or fire engines. It alſo comprehends the ſubſequent management of the water thus conducted, whether in order to make the proper diſtribution of it according to the demand, or to employ it for the purpoſe of navigation, by lockage, or other contrivances. —And in the proſecution of theſe things many ſubordinate problems will occur, in which practice will derive great advantages from a ſcientific acquaintance with the ſubject. The *ſecond* claſs of water-works is of much greater variety, comprehending almoſt every kind of hydraulic machine; and would of itſelf fill volumes. Many of theſe have already occurred in various articles of this Dictionary. In deſcribing or treating them, we have tacitly referred the diſcuſſion of their general principles, in which they all reſemble each other, to ſome article where they could be taken in a connected body, ſuſceptible of general ſcientific diſcuſſion, independent of the circumſtances which of neceſſity introduced the particular modifications required by the uſes to which the ſtructures were to be applied. That part of the preſent article, therefore, which embraces theſe common principles, will chiefly relate to the theory of water mills, or rather of water wheels; becauſe, when the neceſſary motion is given to the axis of the water wheel, this may be ſet to the performance of any taſk whatever.

Water-works.

CLASS I.

1. *Of the conducting of water.*

THIS is undoubtedly a buſineſs of great importance, and makes a principal part of the practice of the civil engineer: It is alſo a buſineſs ſo imperfectly underſtood, that we believe that very few engineers can venture to ſay, with tolerable preciſion, what will be the quantity of water which his work will convey, or what plan and dimenſions of conduit will convey the quantity which may be propoſed. For proof of this we ſhall only refer our readers to the facts mentioned in the article RIVERS, N° 27, &c.

In that article we have given a ſort of hiſtory of the progreſs of our knowledge in hydraulics, a branch of mechanical philoſophy which ſeems to have been entirely unknown to the ancients. Even Archimedes, the author of almoſt all that we know in hydroſtatics, ſeems to have been entirely ignorant of any principles by which he could determine the motion of water. The mechanical ſcience of the ancients ſeems to have reached no farther than the doctrine of equilibrium among bodies at reſt. Guglielmini firſt ventured to conſider the motion of water in open canals and in rivers. Its motion in pipes had been partially conſidered in detached ſcraps by others, but not ſo as to make a body of doctrine. Sir Iſaac Newton firſt endeavoured to render hydraulics ſuſceptible of mathematical demonſtration: But his fundamental propoſition has not yet been freed from very ſerious objections; nor have the attempts of his ſucceſſors, ſuch as the Bernoullis, Euler, D'Alembert, and others, been much more ſucceſsful: ſo that hydraulics may ſtill be conſidered as very imperfect, and the general concluſions which we are accuſtomed to receive as fundamental propoſitions are not much better than matters of obſervation, little ſupported by principle, and therefore requiring the moſt ſcrupu-

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Water-works.

lous caution in the application of them to any hitherto untried caſe. When experiments are multiplied ſo as to include as great a variety of caſes as poſſible; and when theſe are cleared of extraneous circumſtances, and properly arranged, we muſt receive the concluſions drawn from them as the general laws of hydraulics. The experiments of the abbé Boſſut, narrated in his *Hydrodynamique*, are of the greateſt value, having been made in the caſes of moſt general frequency, and being made with great care. The greateſt ſervice, however, has been done by the chevalier Buat, who ſaw the folly of attempting to deduce an accurate theory from any principles that we have as yet learned, and the neceſſity of adhering to ſuch a theory as could be deduced from experiment alone, independent of any more general principles. Such a theory muſt be a juſt one, if the experiments are really general, unaffected by the particular circumſtances of the caſe, and if the claſſes of experiment are ſufficiently comprehenſive to include all the caſes which occur in the moſt important practical queſtions. Some principle was neceſſary, however, for connecting theſe experiments. The ſufficiency of this principle was not eaſily aſcertained. M. Buat's way of eſtabliſhing this was judicious. If the principle is ill-founded, the reſults of its combination in caſes of actual experiments muſt be irregular; but if experiments, ſeemingly very unlike, and in a vaſt variety of diſſimilar caſes, give a train of reſults which is extremely regular and conſiſtent, we may preſume that the principle, which in this manner harmonizes and reconciles things ſo unlike, is founded in the nature of things; and if this principle be ſuch as is agreeable to our cleareſt notions of the internal mechaniſm of the motions of fluids, our preſumption approaches to conviction.

Proceeding in this way, the chevalier Buat has collected a prodigious number of facts, comprehending almoſt every caſe of the motion of fluids. He firſt claſſed them according to their reſemblance in ſome one particular, and obſerved the differences which accompanied their differences in other circumſtances; and by conſidering what could produce theſe differences, he obtained general rules, deduced from fact, by which theſe differences could be made to fall into a regular ſeries. He then arranged all the experiments under ſome other circumſtances of reſemblance, and purſued the ſame method; and by following this out, he has produced a general propoſition, which applies to the whole of this numerous liſt of experiments with a preciſion far exceeding our utmoſt hopes. This propoſition is contained in N° 59. of the article RIVERS, and is there offered as one of the moſt valuable reſults of modern ſcience. Water-works.

We muſt, however, obſerve, that of this liſt of experiments there is a very large claſs, which is not direct, but requires a good deal of reflection to enable us to draw a confident concluſion; and this is in caſes which are very frequent and important, viz. where the declivity is exceedingly ſmall, as in open canals and rivers. The experiments were of the following forms: Two large ciſterns were made to communicate with each other by means of a pipe. The ſurfaces of the water in theſe ciſterns were made to differ only by a ſmall fraction of an inch: and it is ſuppoſed that the motion in the communicating pipe will be the ſame as in a very long pipe, or an open canal, having this very minute declivity. We have no difficulty in admitting the concluſion; but we have ſeen it conteſted, and it is by no means intuitive. We had entertained hopes that this important caſe would have been determined by direct experiments, which the writer of this article was commiſſioned to make by the Board for Encouraging Improvements and Manufactures in Scotland: But the infirm ſtate of his health was always an effectual bar to the accompliſhment of this deſirable object. This, however, need not occaſion any heſitation in the adoption of M. Buat's general propoſition, becauſe the experiments which we are now criticiſing fall in preciſely with the general train of the reſt, and ſhow no *general* deviation which would indicate a fallacy in principle.

We apprehend it to be quite unneceſſary to add much to what has been already delivered on the motion of waters in an open canal. Their *general progreſſive* motion, and conſequently the quantity delivered by an aqueduct of any ſlope and dimenſion, are ſufficiently determined; and all that is wanted is the tables which we promiſed in N° 65. of the article RIVERS, by which any perſon who underſtands common arithmetic may, in five minutes time or leſs, compute the quantity of water which will be delivered by the aqueduct, canal, conduit, or pipe; for the theorem in N° 59. of this article applies to them all without diſtinction. We therefore take this opportunity of inſerting theſe tables, which have been computed on purpoſe for this work with great labour.

TABLE I. *Logarithms of the Values of the Numerator of the Fraction* $\frac{307\,(\sqrt{d}-0,1)}{\sqrt{s}-L\sqrt{s}+1,6}$ *for every Value of the Hydraulic mean Depth* d: *Alſo the Value of* $0,3\,(\sqrt{d}-0,1)$.

d.	Log. of $307\,(\sqrt{d}-0,1)$	$0,3\times(\sqrt{d}-0,1)$	*d.*	Log. of $307\,(\sqrt{d}-0,1)$	$0,3\times(\sqrt{d}-0,1)$	*d.*	Log. of $307\,(\sqrt{d}-0,1)$	$0,3\times(\sqrt{d}-0,1)$	*d.*	Log. of $307\,(\sqrt{d}-0,1)$	$0,3\times(\sqrt{d}-0,1)$
0,1	1.82208	0,06	4,9	2.81216	0,63	9,7	2.96634	0,9	54	3.34738	2,17
0,2	2.02786	0,1	5,0	2.81674	0,63	9,8	2.96865	0,91	55	3.35143	2,19
0,3	2.13753	0,13	5,1	2.82125	0,65	9,9	2.97093	0,91	56	3.35539	2,21
0,4	2.21343	0,16	5,2	2.82567	0,65	10	2.97319	0,92	57	3.35928	2,23
0,5	2.27040	0,18	5,3	2.83000	0,66	11	2.99454	0,97	58	3.36312	2,25
0,6	2.31618	0,2	5,4	2.83222	0,67	12	3.01401	1,01	59	3.36687	2,27
0,7	2.35441	0,22	5,5	2.83840	0,67	13	3.03189	1,05	60	3.37057	2,3
0,8	2.38719	0,24	5,6	2.84248	0,68	14	3.04843	1,09	61	3.37421	2,31
0,9	2.41588	0,25	5,7	2.84648	0,68	15	3.06383	1,13	62	3.37778	2.33
1,0	2.44138	0,27	5,8	2.85043	0,69	16	3.07820	1,17	63	3.38130	2,35
1,1	2.46431	0,28	5,9	2.85431	0,69	17	3.09170	1,21	64	3.38477	2,37
1,2	2.48518	0,3	6,0	2.85812	0,7	18	3.10441	1,24	65	3.38817	2,39
1,3	2.50426	0,31	6,1	2.86185	0,7	19	3.11644	1,28	66	3.39158	2,41
1,4	2.52185	0,32	6,2	2.86554	0,71	20	3.12783	1,31	67	3.39483	2,42
1,5	2.53818	0,34	6,3	2.86916	0,72	21	3.13867	1,34	68	3.39809	2,44
1,6	2.55345	0,35	6,4	2.87271	0,73	22	3.14899	1,38	69	3.40130	2,46
1,7	2.56769	0,36	6,5	2.87622	0,73	23	3.15885	1,41	70	3.40446	2,48
1,8	2.58112	0,37	6,6	2.87966	0,74	24	3.16828	1,44	71	3.40758	2,49
1,9	2.59381	0,38	6,7	2.88306	0,75	25	3.17734	1,47	72	3.41065	2,51
2,0	2.60580	0,39	6,8	2.88641	0,75	26	3.18601	1,5	73	3.41369	2,53
2,1	2.61713	0,4	6,9	2.88971	0,76	27	3.19438	1,53	74	3.41667	2,55
2,2	2.62803	0,41	7,0	2.89296	0,76	28	3.20243	1,56	75	3.41962	2,57
2,3	2.63839	0,42	7,1	2.89614	0,77	29	3.21020	1,58	76	3.42253	2,58
2,4	2.64827	0,44	7,2	2.89930	0,77	30	3.21770	1,61	77	3.42540	2,60
2,5	2.65772	0,45	7,3	2.90241	0,78	31	3.22495	1,64	78	3.42823	2,62
2,6	2.66681	0,45	7,4	2.90549	0,78	32	3.23196	1,67	79	3.43103	2,63
2,7	2.67556	0,46	7,5	2.90851	0,79	33	3.23877	1,69	80	3.43380	2,65
2,8	2.68395	0,47	7,6	2.91150	0,79	34	3.24537	1,72	81	3.43653	2,67
2,9	2.69207	0,48	7,7	2.91445	0,8	35	3.25176	1,74	82	3.43923	2,69
3,0	2.69989	0,49	7,8	2.91734	0,8	36	3.25799	1,77	83	3.44189	2,7
3,1	2.70743	0,5	7,9	2.92022	0,81	37	3.26404	1,79	84	3.44452	2,72
3,2	2.71472	0,51	8,0	2.92305	0,82	38	3.26993	1,82	85	3.44712	2,74
3,3	2.72181	0,52	8,1	2.92584	0,82	39	3.27566	1,84	86	3.44968	2,75
3,4	2.72866	0,53	8,2	2.92860	0,83	40	3.28125	1,87	87	3.45222	2,77
3,5	2.73531	0,53	8,3	2.93133	0,83	41	3.28669	1,89	88	3.45473	2,78
3,6	2.74178	0,54	8,4	2.93403	0,84	42	3.29201	1,91	89	3.45721	2,79
3,7	2.74805	0,55	8,5	2.93670	0,84	43	3.29720	1,93	90	3.45965	2,81
3,8	2.75417	0,56	8,6	2.93933	0,85	44	3.30227	1,95	91	3.46208	2,83
3,9	2.76009	0,56	8,7	2.94192	0,85	45	3.30722	1,98	92	3.46448	2,85
4,0	2.76589	0,57	8,8	2.94449	0,86	46	3.31207	2,00	93	3.46685	2,86
4,1	2.77153	0,58	8,9	2.94703	0,86	47	3.31681	2,03	94	3.46920	2,88
4,2	2.77704	0,59	9,0	2.94954	0,87	48	3.32145	2,05	95	3.47152	2,89
4,3	2.78240	0,59	9,1	2.95202	0,87	49	3.32599	2,07	96	3.47381	2,91
4,4	2.78765	0,6	9,2	2.95447	0,88	50	3.33043	2,09	97	3.47608	2,93
4,5	2.79277	0,6	9,3	2.95690	0,88	51	3.33480	2,11	98	3.47833	2,94
4,6	2.79779	0,61	9,4	2.95930	0,89	52	3.33908	2,13	99	3.48056	2,95
4,7	2.80269	0,62	9,5	2.96167	0,89	53	3.34327	2,15	100	3.48277	2,97
4,8	2.80747	0,63	9,6	2.96402	0,9						

TABLE II. *Logarithms of the Values of the Denominator of the Fraction* $\frac{307(\sqrt{d}-0,1)}{\sqrt{s}-L\sqrt{s}+1,6}$ *for every of Value of the Slopes.*

s.	Log. of $\sqrt{s}-L\sqrt{s}+1,6$	s.	Log. of $\sqrt{s}-L\sqrt{s}+1,6$	s.	Log. of $\sqrt{s}-L\sqrt{s}+1,6$	s.	Log. of $\sqrt{s}-L\sqrt{s}+1,6$	s.	Log. of $\sqrt{s}-L\sqrt{s}+1,6$	s.	Log. of $\sqrt{s}-L\sqrt{s}+1,6$
1,0	9.71784	7,3	0.20651	45	0.67997	170	1.01983	800	1.39690	5200	1.83142
1,1	9.74210	7,4	0.20997	46	0.68574	180	1.03410	810	1.39985	5300	1.83575
1,2	9.76388	7,5	0.21336	47	0.69135	190	1.04751	820	1.40277	5400	1.84002
1,3	9.78376	7,6	0.21674	48	0.69688	200	1.06026	830	1.40564	5500	1.84421
1,4	9.80202	7,7	0.22109	49	0.70226	210	1.07237	840	1.40678	5600	1.84833
1,5	9.81882	7,8	0.22335	50	0.70749	220	1.08390	850	1.41128	5700	1.85237
1,6	9.83461	7,9	0.22663	51	0.71265	230	1.09489	860	1.41408	5800	1.85634
1,7	9.84930	8,0	0.22982	52	0.71767	240	1.10542	870	1.41683	5900	1.86022
1,8	9.86314	8,1	0.23297	53	0.72263	250	1.11553	880	1.41953	6000	1.86404
1,9	9.87622	8,2	0.23611	54	0.72746	260	1.12523	890	1.42220	6100	1.86778
2,0	9.88857	8,3	0.23923	55	0.73223	270	1.13453	900	1.42487	6200	1.87146
2,1	9.90031	8,4	0.24229	56	0.73695	280	1.14345	910	1.42746	6300	1.87507
2,2	9.91153	8,5	0.24532	57	0.74155	290	1.15204	920	1.43005	6400	1.87863
2,3	9.92267	8,6	0.24832	58	0.74601	300	1.16035	930	1.43263	6500	1.88213
2,4	9.93247	8,7	0.25128	59	0.75043	310	1.16838	940	1.43515	6600	1.88558
2,5	9.94231	8,8	0.25422	60	0.75481	320	1.17612	950	1.43464	6700	1.88898
2,6	9.95173	8,9	0.25709	61	0.75906	330	1.18363	960	1.44011	6800	1.89233
2,7	9.96085	9,0	0.25996	62	0.76328	340	1.19092	970	1.44254	6900	1.89564
2,8	9.96942	9,1	0.26281	63	0.76745	350	1.19803	980	1.44498	7000	1.89891
2,9	9.97818	9,2	0.26560	64	0.77151	360	1.20490	990	1.44737	7100	1.90214
3,0	9.98632	9,3	0.26839	65	0.78276	370	1.21158	1000	1.44976	7200	1.90532
3,1	9.99427	9,4	0.27116	66	0.77945	380	1.21806			7300	1.90845
3,2	0.00200	9,5	0.27387	67	0.78333	390	1.22435	1100	1.47223	7400	1.91154
3,3	0.00945	9,6	0.27656	68	0.78718	400	1.23048	1200	1.49269	7500	1.91458
3,4	0.01669	9,7	0.27921	69	0.79092	410	1.23647	1300	1.51148	7600	1.91757
3,5	0.02373	9,8	0.28186	70	0.76463	420	1.24232	1400	1.52885	7700	1.92052
3,6	0.03064	9,9	0.28450	71	0.79824	430	1.24805	1500	1.54497	7800	1.92344
3,7	0.03733	10,	0.28709	72	0.80182	440	1.25360	1600	1.56014	7900	1.92632
3,8	0.04383	----		73	0.80536	450	1.25903	1700	1.57416	8000	1.92916
3,9	0.05015	11	0.31170	74	0.80882	460	1.26433	1800	1.58747	8100	1.93197
4,0	0.05638	12	0.33425	75	0.81231	470	1.26951	1900	1.60004	8200	1.93475
4,1	0.06245	13	0.35488	76	0.81571	480	1.27461	2000	1.61195	8300	1.93749
4,2	0.06839	14	0.37420	77	0.81908	490	1.27957	2100	1.62325	8400	1.94020
4,3	0.07412	15	0.39235	78	0.82236	500	1.28445	2200	1.63403	8500	1.94287
4,4	0.07898	16	0.40926	79	0.82562	510	1.28923	2300	1.64432	8600	1.94551
4,5	0.08533	17	0.42521	80	0.82885	520	1.29391	2400	1.65414	8700	1.94811
4,6	0.09081	18	0.44028	81	0.83206	530	1.29851	2500	1.66358	8800	1.95069
4,7	0.09615	19	0.45439	82	0.83525	540	1.30300	2600	1.67261	8900	1.95324
4,8	0.10131	20	0.46776	83	0.83835	550	1.30740	2700	1.68133	9000	1.95576
4,9	0.10644	21	0.48044	84	0.84142	560	1.31172	2800	1.68971	9100	1.95826
5,0	0.11147	22	0.49262	85	0.84442	570	1.31597	2900	1.69780	9200	1.96073
5,1	0.11635	23	0.50433	86	0.84739	580	1.32015	3000	1.70558	9300	1.96317
5,2	0.12108	24	0.51548	87	0.85034	590	1.32426	3100	1.71313	9400	1.96559
5,3	0.12595	25	0.52621	88	0.85327	600	1.32830	3200	1.72042	9500	1.96797
5,4	0.13061	26	0.53656	89	0.85618	610	1.33226	3300	1.72750	9600	1.97033
5,5	0.13519	27	0.54654	90	0.85908	620	1.33614	3400	1.73435	9700	1.97267
5,6	0.13970	28	0.55606	91	0.86189	630	1.33997	3500	1.74099	9800	1.97497
5,7	0.14410	29	0.56526	92	0.86463	640	1.34373	3600	1.74746	9900	1.97726
5,8	0.14844	30	0.57415	93	0.86741	650	1.34743	3700	1.75373	10000	1.97952
5,9	0.15274	31	0.58263	94	0.87017	660	1.35108	3800	1.75984	11000	2.00099
6,0	0.15697	32	0.59095	95	0.87286	670	1.35468	3900	1.76578	12000	2.02056
6,1	0.16113	33	0.59901	96	0.87552	680	1.35823	4000	1.77159	13000	2.03855
6,2	0.16522	34	0.60692	97	0.87818	690	1.36170	4100	1.77725	14000	2.05518
6,3	0.16927	35	0.61448	98	0.88076	700	1.36513	4200	1.78277	15000	2.07065
6,4	0.17322	36	0.62180	99	0.88338	710	1.36851	4300	1.78814	16000	2.08512
6,5	0.17713	37	0.62900	100	0.88593	720	1.37185	4400	1.79339	17000	2.09869
6,6	0.18099	38	0.63599	----		730	1.37513	4500	1.77851	18000	2.11148
6,7	0.18477	39	0.64276	110	0.91014	740	1.37839	4600	1.80352	19000	2.12357
6,8	0.18854	40	0.64933	120	0.93212	750	1.38157	4700	1.80875	20000	2.13503
6,9	0.19229	41	0.65571	130	0.95236	760	1.38371	4800	1.81321	21000	2.14594
7,0	0.19584	42	0.66200	140	0.97109	770	1.38782	4900	1.81790	22000	2.15633
7,1	0.19886	43	0.66811	150	0.98843	780	1.39089	5000	1.82249	23000	2.16624
7,2	0.20298	44	0.67413	160	1.00466	790	1.39391	5100	1.82699	24000	2.17573

Water-works.

TABLE I. consists of three columns.—*Column* 1. entitled d, contains the hydraulic mean depths of any conduit in inches. This is set down for every 10th of an inch in the first 10 inches, that the answers may be more accurately obtained for pipes, the mean depth of which seldom exceeds three or four inches. The column is continued to 100 inches, which is fully equal to the hydraulic mean depth of any canal.

Column 2. contains the logarithms of the values of $\sqrt{d}-0.1$, multiplied by 307; that is, the logarithm of the numerator of the fraction $\frac{307(\sqrt{d}-0.1)}{\sqrt{s}-L\sqrt{s}+1.6}$ in N° 65. of the article RIVERS.

Column 3. contains the product of the values of $\sqrt{d}-0.1$ multiplied by 0.3.

TABLE II. consists of two columns.—*Column* 1. entitled s, contains the denominator of the fraction expressing the slope or declivity of any pipe or canal; that is, the quotient of its length divided by the elevation of one extremity above the other. Thus, if a canal of one mile in length be three feet higher at one end than the other, then s is $\frac{5280}{3}$, $=1760$.

Column 2. contains the logarithms of the denominators of the above-mentioned fraction, or of the different values of the quantity $\sqrt{s}-L\sqrt{s}+1.6$.

These quantities were computed true to the third decimal place. Notwithstanding this, the last figure in about a dozen of the first logarithms of each table is not absolutely certain to the nearest unit. But this cannot produce an error of 1 in 100,000.

Examples of the Use of these Tables.

Example 1. Water is brought into the city of Edinburgh in several mains. One of these is a pipe of five inches diameter. The length of the pipe is 14.637 feet; and the reservoir at Comiston is 44 feet higher than the reservoir into which it delivers the water on the Castle Hill. *Query*, The number of Scotch pints which this pipe should deliver in a minute?

1. We have $d=\frac{5}{4}$, $=1.25$ inches. The logarithm corresponding to this d, being nearly the mean between the logarithms corresponding to 1.2 and 1.3 is 2.49472.

2. We have $s=\frac{14637}{44}$, or 332.7. The logarithm corresponding to this in Table II. is had by taking proportional parts for the difference between the logarithms for $s=330$ and $s=340$, and is 1.18533.

3. From 2.49472
Take 1.18533

Remains 1.30939, the logarithm of 20.385 inches.

4. In column 3. of Table I. opposite to $d=1.2$ and $d=1.3$ are 0.3 and 0.31, of which the mean is 0.305 inches, the correction for viscidity.

5. Therefore the velocity in inches per second is $20.385-0.305$, or 20.08.

6. To obtain the Scotch pints per minute (each containing 103.4 cubic inches), multiply the velocity by 60, and this product by 5^2, and this by 0.7854 (the area of a circle whose diameter is 1), and divide by 103.4. Or, by logarithms,

Water-works.

Add the log. of 20.08	1.30276
log. of 60″	1.77815
log. of 5^2 or 25	1.39794
log. of 0.7854	9.89509
	4.37394
Subtract the log. of 103.4	2.01451
Remains the log. of 228.8 pints	2.35943

Example 2. The canal mentioned in the article RIVERS, N° 63. was 18 feet broad at the surface, and 7 feet at the bottom. It was 4 feet deep, and had a declivity of 4 inches in a mile. *Query*, The mean velocity?

1. The slant side of the canal, corresponding to 4 feet deep and $5\frac{1}{2}$ projection, is 6.8 feet; therefore the border touched by the water is $6.8+7+6.8$, $=20.6$. The area is $4\times\frac{18+7}{2}$, $=50$ square feet. Therefore $d=\frac{50}{20.6}$, $=2.427$ feet, or 29.124 inches. The logarithm corresponding to this in Table I. is 3.21113, and the correction for viscidity from the third column of the same Table is 1.58.

2. The slope is one-third of a foot in a mile, or one foot in three miles. Therefore s is 15.840. The logarithm corresponding to this is 2.08280.

3. From 3.21113
Subtract 2.08280

Remains 1.12833=log. of 13.438 inches.
Subtract for viscidity 1.58

Velocity per second - 11.858

This velocity is considerably smaller than what was observed by Mr Watt. And indeed we observe, that in the very small declivities of rivers and canals, the formula is a little different. We have made several comparisons with a formula which is essentially the same with Buat's, and comes nearer in these cases. Instead of taking the hyperbolic logarithm of $\sqrt{s}+1.6$, multiply its common logarithm by $2\frac{1}{4}$, or multiply it by 9, and divide the product by 4; and this process is vastly easier than taking the hyperbolic logarithm.

We have not, however, presumed to calculate tables on the authority of our own observations, thinking too respectfully of this gentleman's labours and observations. But this subject will, ere long, be fully established on a series of observations on canals of various dimensions and declivities, made by several eminent engineers during the execution of them. Fortunately Mr Buat's formula is chiefly founded on observations on small canals; and is therefore most accurate in such works where it is most necessary, viz. in mill courses, and other derivations for working machinery.

We now proceed to take notice of a few circumstances which deserve attention, in the construction of canals, in addition to those delivered in the article RIVERS.

When a canal or aqueduct is brought off from a bason

or

Water-works.

or larger ſtream, it ought always to be widened at the entry, if it is intended for drawing off a continued ſtream of water: For ſuch a canal has a ſlope, without which it can have no current. Suppoſe it filled to a dead level to the farther end: Take away the bar, and the water immediately begins to flow off at that end. But it is ſome time before any motion is perceived at the head of the canal, during all which time the motion of the water is augmenting in every part of the canal; conſequently the ſlope is increaſing in every part, this being the ſole cauſe of its ſtream. When the water at the entry *begins* to move, the ſlope is ſcarcely ſenſible there; but it ſenſibly ſteepens every moment with the increaſe of velocity, which at laſt attains its maximum relative to the ſlope and dimenſions of the whole canal; and this regulates the depth of water in every point down the ſtream. When all has attained a ſtate of permanency, the ſlope at the entry *remains* much greater than in any other part of the canal; for this ſlope muſt be ſuch as will produce a velocity ſufficient for ſupplying its TRAIN.

And it muſt be remembered, that the velocity which muſt be produced greatly exceeds the mean velocity correſponding to the train of the canal. Suppoſe that this is 25 inches. There muſt be a velocity of 30 inches at the ſurface, as appears by the Table in the article RIVERS, N° 80. This muſt be produced by a real fall at the entry.

In every other part the ſlope is ſufficient, if it merely ſerves to give the water (already in motion) force enough for overcoming the friction and other reſiſtances. But at the entry the water is ſtagnant, if in a baſon, or it is moving paſt laterally, if the aqueduct is derived from a river; and, having no velocity whatever in the direction of the canal, it muſt derive it from its ſlope. The water therefore which has acquired a permanent form in ſuch an aqueduct, muſt neceſſarily take that form which exactly performs the offices requiſite in its different portions. The ſurface remains horizontal in the baſon, as to KC (fig. 1.), till it comes near the entry of the canal AB, and there it acquires the form of an undulated curve CDE; and then the ſurface acquires an uniform ſlope EF, in the lower part of the canal, where the water is in train.

Plate LXXIII. fig. 1.

If this is a drain, the diſcharge is much leſs than might be produced by the ſame bed if this ſudden ſlope could be avoided. If it is to be navigated, having only a very gentle ſlope in its whole length, this ſudden ſlope is a very great imperfection, both by diminiſhing the depth of water, which might otherwiſe be obtained along the canal, and by rendering the paſſage of boats into the baſon very difficult, and the coming out very hazardous.

All this may be avoided, and the velocity at the entry may be kept equal to that which forms the train of the canal, by the ſimple proceſs of enlarging the entry. Suppoſe that the water could accelerate along the ſlopes of the canal, as a heavy body would do on a finely poliſhed plane. If we now make the width of the entry in its different parts inverſely proportional to the fictitious velocities in thoſe parts, it is plain that the ſlope of the ſurface will be made parallel to that of the canal which is in train. This will require a form ſomewhat like a bell or ſpeaking trumpet, as may eaſily be ſhown by a mathematical diſcuſſion. It would, however, be ſo much evaſated at the baſon as to occupy much room, and it would be very expenſive to make ſuch an excavation. But we may, at a very moderate expence of money and room, make the increaſe of velocity at the entry almoſt inſenſible. This ſhould always be done, and it is not all expence: for if it be not done, the water will undermine the banks on each ſide, becauſe it is moving very ſwiftly, and will make an excavation for itſelf, leaving all the mud in the canal below. We may obſerve this enlargement at the entry of all natural derivations from a baſon or lake. It is a very inſtructive experiment, to fill up this enlargement, continuing the parallel ſides of the drain quite to the ſide of the lake. We ſhall immediately obſerve the water grow ſhallower in the drain, and its performance will diminiſh. Suppoſing the ditch carried on with parallel ſides quite to the ſide of the baſon, if we build two walls or dykes from the extremities of thoſe ſides, bending outwards with a proper curvature (and this will often be leſs coſtly than widening the drain), the diſcharge will be greatly increaſed. We have ſeen inſtances where it was nearly doubled.

Water-works.

The enlargement at the mouths of rivers is generally owing to the ſame cauſe. The tide of flood up the river produces a ſuperficial ſlope oppoſite to that of the river, and this widens the mouth. This is moſt remarkable when the tides are high, and the river has little ſlope.

After this great fall at the entry of the canal, in which all the filaments are much accelerated, and the inferior ones moſt of all, things take a contrary turn. The water, by rubbing on the bottom and the ſides, is retarded; and therefore the ſection muſt, from being ſhallow, become a little deeper, and the ſurface will be convex for ſome diſtance till all comes into train. When this is eſtabliſhed, the filaments neareſt the bottom and ſide are moving ſloweſt, and the ſurface (in the middle eſpecially) retains the greateſt velocity, gliding over the reſt. The velocity in the canal, and the depth of the ſection, adjuſt themſelves in ſuch a manner that the difference between the ſurface of the baſon and the ſurface of the uniform ſection of the canal correſponds exactly to the velocity. Thus, if this be obſerved to be two feet in a ſecond, the difference of height will be $\frac{3}{16}$ths of an inch.

All the practical queſtions that are of conſiderable importance reſpecting the motion of water in aqueducts, may be eaſily, though not elegantly, ſolved by means of the tables.

But it is to be remembered, that theſe tables relate only to uniform motion, that is, to water that is in train, and where the velocity ſuffers no change by lengthening the conduit, provided the ſlope remain the ſame. It is much more difficult to determine what will be the velocity, &c. in a canal of which nothing is given but the form, and ſlope, and depth of the entry, without ſaying how deep the water runs in it. And it is here that the common doctrines of hydraulics are moſt in fault, and unable to teach us how deep the water will run in a canal, though the depth of the baſon at the entry be perfectly known. Between the part of the canal which is in train and the baſon, there is an interval where the water is in a ſtate of acceleration, and is afterwards retarded.

The determination of the motions in this interval is exceedingly

Water-works.

exceedingly difficult, even in a rectangular canal. It was one great aim of M. Buat's experiments to aſcertain this by meaſuring accurately the depth of the water. But he found that when the ſlope was but a very few inches in the whole length of his canal, it was not in train for want of greater length; and when the ſlope was ſtill leſs, the ſmall fractions of an inch, by which he was to judge of the variations of depth, could not be meaſured with ſufficient accuracy. It would be a moſt deſirable point to determine the length of a canal, whoſe ſlope and other dimenſions are given, which will bring it into train; and what is the ratio which will then obtain between the depth at the entry and the depth which will be maintained. Till this be done, the engineer cannot aſcertain by a direct proceſs what quantity of water will be drawn off from a reſervoir by a given canal. But as yet this is out of our reach. Experiments, however, are in view which will promote the inveſtigation.

But this and ſimilar queſtions are of ſuch importance, that we cannot be ſaid to have improved hydraulics, unleſs we can give a tolerably preciſe anſwer. This we can do by a ſort of retrograde proceſs, proceeding on the principles of uniform motion eſtabliſhed by the Chevalier Buat. We may ſuppoſe a train maintained in the canal, and then examine whether this train *can* be produced by any fall that is poſſible at the entry. If it can, we may be certain that it is ſo produced, and our problem is ſolved.

We ſhall now point out the methods of anſwering ſome chief queſtions of this kind.

Queſt. 1. Given the ſlope s and the breadth w of a canal, and the height H of the ſurface of the water in the baſon above the bottom of the entry; to find the depth h and velocity V of the ſtream, and the quantity of water Q which is diſcharged?

The chief difficulty is to find the depth of the ſtream where it is in train. For this end, we may ſimplify the hydraulic theorem of uniform motion in N° 59. of the article RIVER; making $V=\frac{\sqrt{Ngd}}{\sqrt{S}}$, where g is the velocity (in inches) acquired in a ſecond by falling, d is the hydraulic mean depth, and $\sqrt{S}$ ſtands for $\sqrt{S}-L\sqrt{S}+1.6$. N is a number to be fixed by experiment (ſee RIVER, N° 53.) depending on the contraction or obſtruction ſuſtained at the entry of the canal, and it may in moſt common caſes be taken $=244$; ſo that $\sqrt{Ng}$ may be ſomewhat leſs than 307. To find it, we may begin by taking for our depth of ſtream a quantity h, ſomewhat ſmaller than H the height of the ſurface of the baſon above the bottom of the canal. With this depth, and the known width w of the canal, we can find the hydraulic depth d (ſee RIVERS, N°48.). Then with $\sqrt{d}$ and the ſlope find V by the Table: make this $V=\frac{\sqrt{Ngd}}{\sqrt{S}}$. This gives $\sqrt{Ng}=\frac{V\sqrt{S}}{\sqrt{d}}$. This value of Ng is ſufficiently exact; for a ſmall error of depth hardly affects the hydraulic mean depth.

After this preparation, the expreſſion of the mean velocity in the canal will be $\frac{\sqrt{Ng}\sqrt{\frac{wh}{w+2h}}}{\sqrt{S}}$. The height which will produce this velocity is $\frac{Ng}{2GS}\left(\frac{wh}{w+2h}\right)$.

Water-works.

Now this is the ſlope at the entry of the canal which produces the velocity that is afterwards maintained againſt the obſtructions by the ſlope of the canal. It is therefore $=H-h$. Hence we deduce

$$h=\frac{-\left(w\left(\frac{Ng}{2GS}+1\right)-2H\right)}{4}+\frac{\sqrt{8Hw+\left(w\left(\frac{Ng}{2GS}+1\right)-2H\right)^2}}{4}.$$

If there be no contraction at the entry, $g=G$ and $\frac{g}{2G}=\frac{1}{2}$.

Having thus obtained the depth h of the ſtream, we obtain the quantity of water by combining this with the width w and the velocity V.

But as this was but an approximation, it is neceſſary to examine whether the velocity V be poſſible. This is very eaſy. It muſt be produced by the fall $H-h$. We ſhall have no occaſion for any correction of our firſt aſſumption, if h has not been extravagantly erroneous, becauſe a ſmall miſtake in h produces almoſt the ſame variation in d. The teſt of accuracy, however, is, that h, together with the height which will produce the velocity V, muſt make up the whole height H. Aſſuming h too ſmall, leaves $H-h$ too great, and will give a ſmall velocity V, which requires a ſmall value of $H-h$. The error of $H-h$ therefore is always greater than the error we have committed in our firſt aſſumption. Therefore when this error of $H-h$ is but a trifle, ſuch as one-fourth of an inch, we may reſt ſatisfied with our anſwer.

Perhaps the eaſieſt proceſs may be the following: Suppoſe the whole ſtream in train to have the depth H. The velocity V obtained for this depth and ſlope by the Table requires a certain productive height u. Make $\sqrt{H+u}:H=H:h$, and h will be exceedingly near the truth. The reaſon is obvious.

Queſt. 2. Given the diſcharge (or quantity to be furniſhed in a ſecond) Q, the height H of the baſon above the bottom of the canal, and the ſlope: to find the dimenſions of the canal?

Let x and y be the depth and mean width. It is plain that the equation $\frac{Q}{xy}=\sqrt{2G}\sqrt{H-x}$ will give a value of y in terms of x. Compare with this the value of y obtained from the equation $\frac{Q}{xy}=\frac{\sqrt{Ng}}{\sqrt{S}}\sqrt{\frac{xy}{y+2x}}$. This will give an equation containing only x and known quantities. But it will be very complicated, and we muſt have recourſe to an approximation. This will be beſt underſtood in the form of an example.

Suppoſe the depth at the entry to be 18 inches, and the ſlope $\frac{1}{1000}$. Let 1200 cubic feet of water per minute be the quantity of water to be drawn off, for working machinery or any other purpoſe; and let the canal be

Water-works.

be supposed of the best form, recommended in N° 69. of the article RIVER, where the base of the sloping side is four-thirds of the height.

The slightest consideration will show us that if $\frac{V^2}{744}$ be taken for the height producing the velocity, it cannot exceed 3 inches, nor be less than 1. Suppose it $=2$, and therefore the depth of the stream in the canal to be 16 inches; find the mean width of the canal by the equation $w=\frac{Q}{h(\sqrt{d}-0.1\left(\frac{307}{\sqrt{S}}-0.3\right)}$, in which Q is 20 cubic feet (the 60th part of 1200), $\sqrt{S}$ is $=28.153$, $=\sqrt{1000}-L\sqrt{1000}+1.6$, and $h=16$. This gives $w=5.52$ feet. The section $n=7.36$ feet, and $V=32.6$ inches. This requires a fall of 1.52 inches instead of 2 inches. Take this from 18, and there remains 16.48, which we shall find not to differ one-tenth of an inch from the exact depth which the water will acquire and maintain. We may therefore be satisfied with assuming 5.36 feet as the mean width, and 3.53 feet for the width at the bottom.

This approximation proceeds on this consideration, that when the width diminishes by a small quantity, and in the same proportion that the depth increases, the hydraulic mean depth remains the same, and therefore the velocity also remains, and the quantity discharged changes in the exact proportion of the section. Any minute error which may result from this supposition, may be corrected by increasing the fall producing the velocity, in the proportion of the first hydraulic mean depth to the mean depth corresponding to the new dimensions found for the canal. It will now become 1.53, and V will be 32.72, and the depth will be 16.47. The quantity discharged being divided by V, will give the section $=7.335$ feet, from which, and the new depth, we obtain 5.344 for the width.

This and the foregoing are the most common questions proposed to an engineer. We asserted with some confidence that few of the profession are able to answer them with tolerable precision. We cannot offend the professional gentlemen by this, when we inform them that the Academy of Sciences at Paris were occupied during several months with an examination of a plan proposed by M. Parcieux, for bringing the waters of the Yvette into Paris; and after the most mature consideration, gave in a report of the quantity of water which M. De Parcieux's aqueduct would yield, and that their report has been found erroneous in the proportion of at least 2 to 5: For the waters have been brought in, and exceed the report in this proportion. Indeed long after the giving in the report, M. Perronet, the most celebrated engineer in France, affirmed that the dimensions proposed were much greater than were necessary, and said that an aqueduct of $5\frac{1}{2}$ feet wide, and $3\frac{1}{2}$ deep with a slope of 15 inches in a thousand fathoms, would have a velocity of 12 or 13 inches per second, which would bring in all the water furnished by the proposed sources. The great diminution of expence occasioned by the alteration encouraged the community to undertake the work. It was accordingly begun, and a part executed. The water was found to run with a velocity of near 19 inches when it was $3\frac{1}{2}$ feet deep. M. Perronet founded his computation on his own experience alone, acknowledging that he had no theory to instruct him. The work was carried no farther, it being found that the city could be supplied at a much smaller expence by steam-engines erected by Boulton and Watt. But the facts which occurred in the partial execution of the aqueduct are very valuable. If M. Perronet's aqueduct be examined by our general formula, s will be found $=\frac{1}{4800}$, and $d=18.72$, from which we deduce the velocity $=18\frac{1}{3}$, agreeing with the observation with astonishing precision.

Water-works.

The experiments at Turin by Michaelotti on canals were very numerous, but complicated with many circumstances which would render the discussion too long for this place. When cleared of these circumstances, which we have done with scrupulous care, they are also abundantly conformable to our theory of the uniform motion of running waters. But to return to our subject:

Should it be required to bring off at once from the bason a mill-course, having a determined velocity for driving an undershot wheel, the problem becomes easier, because the velocity and slope combined determine the hydraulic mean depth at once; and the depth of the stream will be had by means of the height which must be taken for the whole depth at the entry, in order to produce the required velocity.

In like manner, having given the quantity to be discharged, and the velocity and the depth at the entry, we can find the other dimensions of the channel; and the mean depth being found, we can determine the slope.

When the slope of a canal is very small, so that the depth of the uniform stream differs but a little from that at the entry, the quantity discharged is but small. But a great velocity, requiring a great fall at the entry, produces a great diminution of depth, and therefore it may not compensate for this diminution, and the quantity discharged may be smaller. Improbable as this may appear, it is not demonstrably false; and hence we may see the propriety of the following

Question 3. Given the depth H at the entry of a rectangular canal, and also its width w; required the slope, depth, and velocity which will produce the greatest possible discharge?

Let x be the unknown depth of the stream. $H-x$ is the productive fall, and the velocity is $\sqrt{2G}\sqrt{H-x}$. This multiplied by wx will give the quantity discharged. Therefore $wx\sqrt{2G}\sqrt{H-x}$ must be made a maximum. The common process for this will give the equation, $2H=3x$, or $x=\frac{2}{3}H$. The mean velocity will be $\sqrt{2G}$, $\sqrt{\frac{1}{3}H}$; the section will be $\frac{2}{3}wH$, and the discharge $=\frac{2}{3}\sqrt{2G}wH\sqrt{\frac{1}{3}H}$, and $d=\frac{\frac{2}{3}wH}{w+\frac{4}{3}H}$. With these data the slope is easily had by the formula for uniform motion.

If the canal is of the trapezoidal form, the investigation is more troublesome, and requires the resolution of a cubic equation.

It may appear strange that increasing the slope of a canal beyond the quantity determined by this problem can diminish the quantity of water conveyed. But one of these two things must happen; either the motion will not acquire uniformity in such a canal for want of length,

Water-works.

length, or the discharge must diminish. Supposing, however, that it could augment, we can judge how far this can go. Let us take the extreme case by making the canal vertical. In this case it becomes a simple weir or wasteboard. Now the discharge of a waste-board is $\frac{2}{3}\sqrt{2G}\,w(h^{\frac{3}{2}}-(\frac{1}{2}h)^{\frac{3}{2}}$. The maximum determined by the preceding problem is to that of the wasteboard of the same dimensons as $H\sqrt{\frac{1}{3}H} : H^{\frac{3}{2}}-(\frac{1}{2}H)^{\frac{3}{2}}$, or as $H\sqrt{\frac{1}{3}H} : H\sqrt{H}-\frac{1}{2}H\sqrt{\frac{1}{2}H}$, = 5773 : 6465, nearly = 9 : 10.

Having given the dimensions and slope of a canal, we can discover the relation between its expenditure and the time; or we can tell how much it will sink the surface of a pond in 24 hours, and the gradual progress of this effect; and this might be made the subject of a particular problem. But it is complicated and difficult. In cases where this is an interesting object, we may solve the question with sufficient accuracy, by calculating the expenditure at the beginning, supposing the bason kept full. Then from the known area of the pond, we can tell in what time this expenditure will sink an inch; do the same on the supposition that the water is one-third lower, and that it is two-thirds lower (noticing the contraction of the surface of the pond occasioned by this abstraction of its waters). Thus we shall obtain three rates of diminution, from which we can easily deduce the desired relation between the expenditure and the time.

Aqueducts derived from a bason or river are commonly furnished with a sluice at the entry. This changes exceedingly the state of things. The slope of the canal may be precisely such as will maintain the mean velocity of the water which passes under the sluice: in which case the depth of the stream is equal to that of the sluice, and the velocity is produced at once by the head of water above it. But if the slope is less than this, the velocity of the issuing water is diminished, and the water must rise in the canal. This must check the efflux at the sluice, and the water will be as it were stagnant above what comes through below it. It is extremely difficult to determine at what precise slope the water will begin to check the efflux. The contraction at the lower edge of the board hinders the water from attaining at once the whole depth which it acquires afterwards, when its velocity diminishes by the obstructions. While the regorging which these obstructions occasion does not reach back to the sluice, the efflux is not affected by it.—Even when it does reach to the sluice, there will be a less depth immediately behind it than farther down the canal, where it is in train; because the swift moving water which is next the bottom drags with it the regorged water which lies on it: but the canal must be rapid to make this difference of depth sensible. In ordinary canals, with moderate slopes and velocities, the velocity at the sluice may be safely taken as if it were that which corresponds to the difference of depths above and below the sluice, where both were in train.

Let therefore H be the depth above the sluice, and h the depth in the canal. Let e be the elevation of the sluice above the sole, and let b be its breadth. The discharge will be $eb\sqrt{H-h}\sqrt{2G}$ for the sluice, and $wh\frac{\sqrt{Ng}}{\sqrt{s}}\sqrt{\frac{wh}{w+2h}}$ for the canal. These must be the same. This gives the equation $eb\sqrt{H-h}\sqrt{2G} = wh\frac{\sqrt{Ng}}{\sqrt{s}}\sqrt{\frac{wh}{w+2h}}$ containing the solution of all the questions which can be proposed. The only uncertainty is in the quantity G, which expresses the velocity competent to the passage of the water through the orifice, circumstanced as it is, namely, subjected to contraction. This may be regulated by a proper form given to the entry into this orifice. The contraction may be almost annihilated by making the masonry of a cycloidal form on both sides, and also at the lower edge of the sluice-board, so as to give the orifice a form resembling fig. 5. D, in the article Rivers. If the sluice is thin in the face of a bason, the contraction will reduce 2G to 296. If the sluice be as wide as the canal, 2G will be nearly 500.

Question 4. Given the head of water in the bason H, the breadth b, and the elevation e of the sluice, and the breadth w and slope s of the canal, to find the depth h of the stream, the velocity, and the discharge?

We must (as in *Question* 2.) make a first supposition for h, in order to find the proper value of d. Then the equation $eb\sqrt{H-h}\sqrt{2G} = wh\frac{\sqrt{Ng}}{\sqrt{s}}$ gives $h = \frac{Ge^2b^2s}{w^2Ngd}+\sqrt{\frac{Ge^2b^2sH}{w^2Ngd}+\left(\frac{Ge^2b^2s}{w^2Ngd}\right)^2}$. If this value shall differ considerably from the one which we assumed in order to begin the computation, make use of it for obtaining a new value of d, and repeat the operation. We shall rarely be obliged to perform a third operation.

The following is of frequent use:

Question 5. Given the dimensions and the slope, with the velocity and discharge of a river in its ordinary state, required the area or section of the sluice which will raise the waters to a certain height, still allowing the same quantity of water to pass through? Such an operation may render the rivers navigable for small craft or rafts above the sluice.

The problem is reduced to the determination of the size of orifice which will discharge this water with a velocity competent to the height to which the river is to be raised; only we must take into consideration the velocity of the water above the sluice, considering it as produced by a fall which makes a part of the height productive of the whole velocity at the sluice. Therefore H, in our investigation, must consist of the height to which we mean to raise the waters, and the height which will produce the velocity with which the waters approach the sluice: h, or the depth of the stream, is the ordinary depth of the river. Then (using the former symbols) we have $eb\frac{wh\sqrt{Ngd}}{\sqrt{2Gs(H-h)}} = \frac{Q}{\sqrt{2G(H-h)}}$.

If the area of the sluice is known, and we would learn the height to which it will raise the river, we have $H-h = \frac{Q^2}{2Ge^2b^2}$ for the expression of the rise of the

water

Water-works.

water above its ordinary level. But from this we muſt take the height which would produce the velocity of the river; ſo that if the ſluice were as wide as the river, and were raiſed to the ordinary ſurface of the water, $\frac{Q^2}{2G\,c^2\,b^2}$, which expreſſes the height that produces the velocity under the ſluice, muſt be equal to the depth of the river, and H—h will be $=0$.

The performance of aqueduct drains is a very important thing, and merits our attention in this place. While the art of managing waters, and of conducting them ſo as to anſwer our demands, renders us very important ſervice by embelliſhing our habitations, or promoting our commercial intercourſe, the art of draining creates as it were new riches, fertilizing tracts of bog or marſh, which was not only uſeleſs, but hurtful by its unwholeſome exhalations, and converting them into rich paſtures and gay meadows. A wild country, occupied by marſhes which are inacceſſible to herds or flocks, and ſerve only for the haunts of water-fowls, or the retreat of a few poor fiſhermen, when once it is freed from the waters in which it is drowned, opens its lap to receive the moſt precious ſeeds, is ſoon clothed in the richeſt garb, gives life and abundance to numerous herds, and never fails to become the delight of the induſtrious cultivator who has enfranchiſed it, and is attached to it by the labour which it coſt him. In return, it procures him abundance, and ſupplies him with the means of daily augmenting its fertility. No ſpecies of agriculture exhibits ſuch long-continued and progreſſive improvement. New families flock to the ſpot, and there multiply; and there nature ſeems the more eager to repay their labours, in proportion as ſhe has been obliged, againſt her will, to keep her treaſures locked up for a longer time, chilled by the waters. The countries newly inhabited by the human race, as is a great part of America, eſpecially to the ſouthward, are ſtill covered to a great extent with marſhes and lakes; and they would long remain in this condition, if population, daily making new advances, did not increaſe induſtry, by multiplying the cultivating hands, at the ſame time that it increaſes their wants. The Author of this beautiful world has at the beginning formed the great maſſes of mountain, has ſcooped out the dales and ſloping hills, has traced out the courſes, and even formed the beds of the rivers: but he has left to man the care of making his place of abode, and the field which muſt feed him, dry and comfortable. For this taſk is not beyond his powers, as the others are. Nay, by having this given to him in charge, he is richly repaid for his labour by the very ſtate in which he finds thoſe countries into which he penetrates for the firſt time. Being covered with lakes and foreſts, the juices of the ſoil are kept for him as it were in reſerve. The air, the burning heat of the ſun, and the continual waſhing of rains, would have combined to expend and diſſipate their vegetative powers, had the fields been expoſed in the ſame degree to their action as the inhabitated and cultivated countries, the moſt fertile moulds of which are long ſince lodged in the bottom of the ocean. All this would have been completely loſt through the whole extent of South America, had it not been protected by the foreſts which man muſt cut down, by the rank herbage which he muſt burn, and by the marſh and bog which he muſt deſtroy by draining. Let not ungrateful man complain of this. It is his duty to take on himſelf the taſk of opening up treaſures, preſerved on purpoſe for him with ſo much judgment and care. If he has diſcernment and ſenſibility, he will even thank the Author of all good, who has thus huſbanded them for his uſe. He will co-operate with his beneficent views, and will be careful not to proceed by wantonly ſnatching at preſent any partial good, and by picking out what is moſt eaſily got at, regardleſs of him who is to come afterwards to uncover and extract the remaining riches of the ground. A wiſe adminiſtration of ſuch a country will think it their duty to leave a juſt ſhare of this inheritance to their deſcendants, who are entitled to expect it as the laſt legatees. National plans of cultivation ſhould be formed on this principle, that the ſteps taken by the preſent cultivators for realizing part of the riches of the infant country ſhall not obſtruct the works which will afterwards be neceſſary for alſo obtaining the remainder. This is carefully attended to in Holland and in China. No man is allowed to conduct the drains, by which he recovers a piece of marſh, in ſuch a way as to render it much more difficult for a neighbour, or even for his own ſucceſſor, to drain another piece, although it may at preſent be quite inacceſſible. There remains in the middle of the moſt cultivated countries many marſhes, which induſtry has not yet attempted to drain, and where the legiſlature has not been at pains to prevent many little abuſes which have produced elevations in the beds of rivers, and rendered the complete draining of ſome ſpots impoſſible. Adminiſtration ſhould attend to ſuch things, becauſe their conſequences are great. The ſciences and arts, by which alone theſe difficult and coſtly jobs can be performed, ſhould be protected, encouraged, and cheriſhed. It is only from ſcience that we can obtain principles to direct theſe arts. The problem of draining canals is one of the moſt important, and yet has hardly ever occupied the attention of the hydraulic ſpeculatiſt. We apprehend that M. Buat's theory will throw great light on it; and regret that the very limited condition of our preſent work will hardly afford room for a ſlight ſketch of what may be done on the ſubject. We ſhall, however, attempt it by a general problem, which will involve moſt of the chief circumſtances which occur in works of that kind.

Water-works.

Queſt. 6. Let the hollow ground A (fig. 2.) be inundated by rains or ſprings, and have no outlet but the canal AB, by which it diſcharges its water into the neighbouring river BCDE, and that its ſurface is nearly on a level with that of the river at B. It can only drain when the river ſinks in the droughts of ſummer; and even if it could then drain completely, the putrid marſh would only be an infecting neighbour. It may be propoſed to drain it by one or more canals; and it is required to determine their lengths and other dimenſions, ſo as to produce the beſt effects? Fig. 2.

It is evident that there are many circumſtances to determine the choice, and many conditions to be attended to.

If the canals AC, AD, AG, are reſpectively equal to the portions BC, BD, BE, of the river, and have the ſame ſlopes, they will have the ſame diſcharge; but they are not for this reaſon equivalent. The long canal AE may drain the marſh completely, while the ſhort

Water-works.

one AC will only do it in part; becauſe the difference of level between A and C is but inconſiderable. Alſo the freſhes of the river may totally obſtruct the operation of AC, while the canal AE cannot be hurt by them, E being ſo much lower than C. Therefore the canal muſt be carried ſo far down the river, that no freſhes there ſhall ever raiſe the waters in the canal ſo high as to reduce the ſlope in the upper part of it to ſuch a level that the current ſhall not be ſufficient to carry off the ordinary produce of water in the marſh.

Still the problem is indeterminate, admitting many ſolutions. This requiſite diſcharge may be accompliſhed by a ſhort but wide canal, or by a longer and narrower. Let us firſt ſee what ſolution can be made, ſo as to accompliſh our purpoſe in the moſt economical manner, that is, by means of the ſmalleſt equation.—We ſhall give the ſolution in the form of an example.

Suppoſe that the daily produce of rains and ſprings raiſes the water $1\frac{1}{4}$ inch on an area of a ſquare league, which gives about 120,000 cubic fathoms of water. Let the bottom of the baſon be three feet below the ſurface of the freſhes in the river at B in winter. Alſo, that the ſlope of the river is 2 inches in 100 fathoms, or $\frac{1}{1000}$dth, and that the canal is to be 6 feet deep.

The canal being ſuppoſed nearly parallel to the river, it muſt be at leaſt 1800 fathoms long before it can be admitted into the river, otherwiſe the bottom of the bog will be lower than the mouth of the canal; and even then a hundred or two more fathoms added to this will give it ſo little ſlope, that an immenſe breadth will be neceſſary to make the diſcharge with ſo ſmall a velocity. On the other hand, if the ſlope of the canal be made equal to that of the river, an extravagant length will be neceſſary before its admiſſion into the river, and many obſtacles may then intervene. And even then it muſt have a breadth of 13 feet, as may eaſily be calculated by the general hydraulic theorem. By receding from each of theſe extremes, we ſhall diminiſh the expence of excavation. Therefore,

Let x and y be the breadth and length, and h the depth (6 feet), of the canal. Let q be the depth of the bog below the ſurface of the river, oppoſite to the baſon, D the diſcharge in a ſecond, and $\frac{1}{a}$ the ſlope of the river. We muſt make hxy a minimum, or $\dot{x}y+y\dot{x}=0$.

The general formula gives the velocity.

$V=\frac{\sqrt{ng}\,(\sqrt{d}-0,1)}{\sqrt{s}-L\sqrt{s}+1,6}-0,3\,(\sqrt{d}-0,1)$. This would give x and y; but the logarithmic term renders it very complicated. We may make uſe of the ſimple form $V=\frac{\sqrt{N\,g\,d}}{\sqrt{S}}$, making $\sqrt{ng}$ nearly $2yb$. This will be ſufficiently exact for all caſes which do not deviate far from this, becauſe the velocities are very nearly in the ſubduplicate ratio of the ſlopes.

To introduce theſe data into the equation, recollect that $V=\frac{D}{hx}$; $d=\frac{hx}{x+2h}$. As to S, recollect that the canal being ſuppoſed of nearly equal length with the river, $\frac{y}{a}$ will expreſs the whole difference of height, and $\frac{y}{a}-q$ is the difference of height for the canal. This quantity being divided by y, gives the value of $\frac{1}{S}=\frac{\frac{y}{a}-q}{y}$. Therefore the equation for the canal becomes $\sqrt{Ng}\sqrt{\frac{hx}{x+2h}}\sqrt{\frac{\frac{y}{a}-q}{y}}$. Hence we deduce

$$y=\frac{\frac{N\,g\,q\,h^3x^3}{a}}{\frac{N\,g\,h^3x^3}{a}-D^2(x+2h)} \text{ and } \dot{y}=\frac{\frac{3\,N\,g\,q\,h^3x^2\dot{x}}{a}}{\frac{N\,g\,h^3x^3}{a}-D^2(x+2h)}-\frac{\frac{N\,g\,q\,h^3x^3\dot{x}}{a}\left(\frac{3\,N\,g\,h^3x^2}{a}-D^2\right)}{\left(\frac{N\,g\,h^3x^3}{a}-D^2\,(x+2h)\right)^2}.$$

If we ſubſtitute theſe values in the equation $y\dot{x}+x\dot{y}=0$, and reduce it, we obtain finally,

$$\frac{N\,g\,h^3x^3}{a\,D^2}-3x=8h.$$

If we reſolve this equation by making $Ng=(296)^2$, or 87616 inches; $h=72$, $\frac{1}{a}=\frac{1}{1000}$, and $D=518400$, we obtain $x=392$ inches, or 32 feet 8 inches, and $\frac{D}{hx}$, or $V=18,36$ inches. Now putting theſe values in the exact formula for the velocity, we obtain the ſlope of the canal, which is $\frac{1}{1606}$, nearly 0,62, inches in 100 fathoms.

Let l be the length of the canal in fathoms. As the river has 2 inches fall in 100 fathoms, the whole fall is $\frac{2l}{100}$, and that of the canal is $\frac{0,62\,l}{100}$. The difference of theſe two muſt be 3 feet, which is the difference between the river and the entry of the canal. We have therefore $\left(\frac{2-0.62}{100}\right)l=36$ inches. Hence $l=2604$ fathoms; and this multiplied by the ſection of the canal gives 14177 cubic fathoms of earth to be removed.

This may ſurely be done, in moſt caſes, for eight ſhillings each cubic fathom, which does not amount to 6000l. a very moderate ſum for completely draining of nine ſquare miles of country.

In order to judge of the importance of this problem, we have added two other canals, one longer and the other ſhorter, having their widths and ſlopes ſo adjuſted as to enſure the ſame performance.

Width. Feet.	Velocity. Inches.	Slope.	Length.	Excavation.
42	14,28	$\frac{1}{1878}$	2221	15547
$32\frac{2}{3}$	18.36	$\frac{1}{1606}$	2604	14177
21	28.57	$\frac{1}{4761}$	7381	15833

We have conſidered this important problem in its moſt ſimple ſtate. If the baſon is far from the river, ſo that the drains are not nearly parallel to it, and therefore have leſs ſlope attainable in their courſe, it is more difficult. Perhaps the beſt method is to try two very extreme caſes and a middle one, and then a fourth, nearer to that extreme which differs leaſt from the middle one in the

Water-works.

the quantity of excavation. This will point out on which ſide the minimum of excavation lies, and alſo the law by which it diminiſhes and afterwards increaſes. Then draw a line, on which ſet off from one end the lengths of the canals. At each length erect an ordinate repreſenting the excavation; and draw a regular curve through the extremities of the ordinates. From that point of the curve which is neareſt to the baſe line, draw another ordinate to the baſe. This will point out the beſt length of the canal with ſufficient accuracy. The length will determine the ſlope, and this will give the width, by means of the general theorem. *N. B.* Theſe draining canals muſt always come off from the baſon with evaſated entries. This will prevent the loſs of much fall at the entry.

Two canals may ſometimes be neceſſary. In this caſe expence may frequently be ſaved, by making one canal flow into the other. This, however, muſt be at ſuch a diſtance from the baſon, that the ſwell produced in the other by this addition may not reach back to the immediate neighbourhood of the baſon, otherwiſe it would impede the performance of both. For this purpoſe, recourſe muſt be had to Problem III. in N° 104. of the article RIVER. We muſt here obſerve, that in this reſpect canals differ exceedingly from rivers; rivers enlarge their beds, ſo as always to convey every increaſe of waters; but a canal may be gorged through its whole length, and will then greatly diminiſh its diſcharge. In order that the lower extremity of a canal may convey the waters of an equal canal admitted into it, their junction muſt be ſo far from the baſon, that the ſwell occaſioned by raiſing its waters nearly $\frac{1}{2}$ more (viz. in the ſubduplicate ratio of 1 to 2) may not reach back to the baſon.

This obſervation points out another method of economy. Inſtead of one wide canal, we may make a narrower one of the whole length, and another narrow one reaching part of the way, and communicating with the long canal at a proper diſtance from the baſon. But the lower extremity will now be too ſhallow to convey the waters of both. Therefore raiſe its banks by uſing the earth taken from its bed, which muſt at any rate be diſpoſed of. Thus the waters will be conveyed, and the expence, even of the lower part of the long canal, will ſcarcely be increaſed.

Theſe obſervations muſt ſuffice for an account of the management of open canals; and we proceed to the conſideration of the conduct of water in pipes.

This is much more ſimple and regular, and the general theorem requires very trifling modifications for adapting it to the caſes or queſtions that occur in the practice of the civil engineer. Pipes are always made round, and therefore d is always $\frac{1}{4}$th of the diameter. The velocity of water in a pipe which is in train, is

$$= V, = \frac{307\,(\sqrt{d} - 0{,}1)}{\sqrt{s} - L\sqrt{s + 1{,}6}} - 0{,}3\,(\sqrt{d} - 0{,}) \text{ or } = (\sqrt{d} - 0{,}1)\left(\frac{307}{\sqrt{s} - L\sqrt{s + 1{,}6}} - 0{,}3\right).$$

The chief queſtions are the following:

Queſt. 1. Given the height H of the reſervoir above the place of delivery, and the diameter and length of the pipe, to find the quantity of water diſcharged in a ſecond.

Let L be the length, and h the fall which would produce the velocity with which the water enters the pipe, and actually flows in it, after overcoming all obſtructions. This may be expreſſed in terms of the velocity by $\frac{V^2}{2G}$, G denoting the acceleration of gravity, correſponding to the manner of entry. When no methods are adopted for facilitating the entry of the water, by a bell-ſhaped funnel or otherwiſe, 2 G may be aſſumed as = 500 inches, or 42 feet, according as we meaſure the velocity in inches or feet. The ſlope is $\frac{1}{s}$, $= \frac{H - \frac{V^2}{2G}}{L}$, which muſt be put into the general formula. This would make it very complicated. We may ſimplify it by the conſideration that the velocity is very ſmall in compariſon of that ariſing from the height H: conſequently h is very ſmall. Alſo, in the ſame pipe, the reſiſtances are nearly in the duplicate ratio of the velocities when theſe are ſmall, and when they differ little among themſelves. Therefore make $b = \frac{L}{h}$, taking h by gueſs, a very little leſs than H. Then compute the mean velocity v correſponding to theſe data, or take it from the table. If $h + \frac{v^2}{2G}$ be = H, we have found the mean velocity $V = v$. If not, make the following proportion:

$h : \frac{v^2}{2G} = H - \frac{V^2}{2G} : \frac{V^2}{2G}$, which is the ſame with this, $h + \frac{v^2}{2G} : v^2 = H : V^2$, and V^2 is $= \frac{v^2 H}{h + \frac{v^2}{2G}}$, $= \frac{v^2 H}{\frac{2Gh + v^2}{2G}}$, $= \frac{v^2 \cdot 2GH}{v^2 + 2Gh}$.

If the pipe has any bendings, they muſt be calculated for in the manner mentioned in the article RIVER, N° 101; and the head of water neceſſary for overcoming this additional reſiſtance being called $\frac{V^2}{m}$, the laſt proportion muſt be changed for

$$h + v^2\left(\frac{1}{2G} + \frac{1}{m}\right) : v^2 = H : V^2.$$

Queſt. 2. Given the height of the reſervoir, the length of the pipe, and the quantity of water which is to be drawn off in a ſecond; to find the diameter of the pipe which will draw it off?

Let d be conſidered as $= \frac{1}{4}$th of the diameter, and let 1 : c repreſent the ratio of the diameter of a circle to its circumference. The ſection of the pipe is $4cd^2$. Let the quantity of water per ſecond be Q; then $\frac{Q}{4cd^2}$ is the mean velocity. Divide the length of the pipe by the height of the reſervoir above the place of delivery, diminiſhed by a very ſmall quantity, and call the quotient S. Conſider this as the ſlope of the conduit; the general formula now becomes

$$\frac{Q}{4d^2} = \frac{307\,(\sqrt{d} - 0{,}1)}{\sqrt{s} - L\sqrt{s + 1{,}06}} - 0{,}3\,(\sqrt{d} - 0{,}1), \text{ or}$$

$\frac{Q}{4cd^2}$

Water-works. $\frac{Q}{4cd^2} = \frac{(307(\sqrt{d}-0,1)}{\sqrt{S}} - 0,3(\sqrt{d}-0,1)$. We may neglect the laſt term in every caſe of civil practice, and alſo the ſmall quantity 0,1. This gives the very ſimple formula,

$$\frac{Q}{4cd^2} = \frac{307\sqrt{d}}{\sqrt{S}}$$

from which we readily deduce

$$d = \left|\frac{Q\sqrt{S}}{4c \times 307}\right|^{\frac{2}{5}} = \left|\frac{Q\sqrt{S}}{3858}\right|^{\frac{2}{5}}$$

This proceſs gives the diameter ſomewhat too ſmall. But we eaſily rectify this error by computing the quantity delivered by the pipe, which will differ a little from the quantity propoſed. Then obſerving, by this equation, that two pipes having the ſame length and the ſame ſlope give quantities of water, of which the ſquares are nearly as the fifth powers of the diameter, we form a new diameter in this proportion, which will be almoſt perfectly exact.

It may be obſerved that the height aſſumed for determining the ſlope in theſe two queſtions will ſeldom differ more than an inch or two from the whole height of the reſervoir above the place of delivery; for in conduits of a few hundred feet long, the velocity ſeldom exceeds four feet per ſecond, which requires only a head of three inches.

As no inconvenience worth minding reſults from making the pipes a tenth of an inch or ſo wider than is barely ſufficient, and as this generally is more than the error ariſing from even a very erroneous aſſumption of *h*, the anſwer firſt obtained may be augmented by one or two-tenths of an inch, and then we may be confident that our conduit will draw off the intended quantity of water.

We preſume that every perſon who aſſumes the name of engineer knows how to reduce the quantity of water meaſured in gallons, pints, or other denominations, to cubic inches, and can calculate the gallons, &c. furniſhed by a pipe of known diameter, moving with a velocity that is meaſured in inches per ſecond. We farther ſuppoſe that all care is taken in the conſtruction of the conduit, to avoid obſtructions occaſioned by lumps of ſolder hanging in the inſide of the pipes; and, particularly, that all the cocks and plugs by the way have waterways equal to the ſection of the pipe. Undertakers are moſt tempted to fail here, by making the cocks too ſmall, becauſe large cocks are very coſtly. But the employer ſhould be ſcrupulouſly attentive to this; becauſe a ſimple contraction of this kind may be the throwing away of many hundred pounds in a wide pipe, which yields no more water than can paſs through the ſmall cock.

The chief obſtructions ariſe from the depoſition of ſand or mud in the lower parts of pipes, or the collection of air in the upper parts of their bendings. The velocity being always very moderate, ſuch depoſitions of heavy matters are unavoidable. The utmoſt care ſhould therefore be taken to have the water freed from all ſuch things at its entry by proper filtration; and there ought to be cleanſing plugs at the lower parts of the bendings, or rather a very little way beyond them. When theſe are opened, the water iſſues with greater velocity, and carries the depoſitions with it.

I is much more difficult to get rid of the air which chokes the pipes by lodging in their upper parts. This is ſometimes taken in along with the water at the reſervoir, when the entry of the pipe is too near the ſurface. This ſhould be carefully avoided, and it coſts no trouble to do ſo. If the entry of the pipe is two feet under the ſurface, no air can ever get in. Floats ſhould be placed above the entries, having lids hanging from them, which will ſhut the pipe before the water runs too low. Water-works.

But air is alſo diſengaged from ſpring-water by merely paſſing along the pipe. When pipes are ſupplied by an engine, air is very often drawn in by the pumps in a diſengaged ſtate. It is alſo diſengaged from its ſtate of chemical union, when the pumps have a ſuction-pipe of 10 or 12 feet, which is very common. In whatever way it is introduced, it collects in all the upper part of bendings, and chokes the paſſage, ſo that ſometimes not a drop of water is delivered. Our cocks ſhould be placed there, which ſhould be opened frequently by perſons who have this in charge. Deſaguliers deſcribes a contrivance to be placed on all ſuch eminences, which does this of itſelf. It is a pipe with a cock, terminating in a ſmall ciſtern. The key of the cock has a hollow ball of copper at the end of a lever. When there is no air in the main pipe, water comes out by this diſcharger, fills the ciſtern, raiſes the ball, and thus ſhuts the cock. But when the bend of the main contains air, it riſes into the ciſtern, and occupies the upper part of it. Thus the floating ball falls down, the cock opens and lets out the air, and the ciſtern again filling with water, the ball riſes, and the cock is again ſhut.

A very neat contrivance for this purpoſe was invented by the late Profeſſor Ruſſel of Edinburgh. The cylindrical pipe BCDE (fig. 3.), at the upper end of a bending of the main, is ſcrewed on, the upper end of which is a flat plate perforated with a ſmall hole F. This pipe contains a hollow copper cylinder G, to the upper part of which is faſtened a piece of ſoft leather H. When there is air in the pipe, it comes out by the hole A, and occupies the diſcharger, and then eſcapes through the hole F. The water follows, and, riſing in the diſcharger, lifts up the hollow cylinder G, cauſing the leather H to apply itſelf to the plate CD, and ſhut the hole. Thus the air is diſcharged without the ſmalleſt loſs of water. Fig. 3.

It is of the moſt material conſequence that there be no contraction in any part of a conduit. This is evident; but it is alſo prudent to avoid all unneceſſary enlargements. For when the conduit is full of water moving along it, the velocity in every ſection is inverſely proportional to the area of the ſection: it is therefore diminiſhed wherever the pipe is enlarged; but it muſt again be increaſed where the pipe contracts. This cannot be without expending force in the acceleration. This conſumes part of the impelling power, whether this be a head of water, or the force of an engine. See what is ſaid on this ſubject in the article PUMPS, N° 83, &c. Nothing is gained by any enlargement; and every contraction, by requiring an augmentation of velocity, employs a part of the impelling force preciſely equal to the weight of a column of water whoſe baſe is the contracted paſſage, and whoſe height is the fall which would produce a velocity equal to this augmentation. This point ſeems to have been quite overlooked by engineers of the firſt eminence, and has in many inſtances greatly

Water-works.

greatly diminiſhed the performance of their beſt works. It is no leſs detrimental in open canals; becauſe at every contraction a ſmall fall is required for reſtoring the velocity loſt in the enlargement of the canal, by which the general ſlope and velocity are diminiſhed. Another point which muſt be attended to in the conducting of water is, that the motion ſhould not be ſubſultory, but continuous. When the water is to be driven along a main by the ſtrokes of a reciprocating engine, it ſhould be forced into an air-box, the ſpring of which may preſerve it in motion along the whole ſubſequent main. If the water is brought to reſt at every ſucceſſive ſtroke of the piſton, the whole maſs muſt again be put in motion through the whole length of the main. This requires the ſame uſeleſs expenditure of power as to communicate this motion to as much dead matter; and this is over and above the force which may be neceſſary for raiſing the water to a certain height; which is the only circumſtance that enters into the calculation of the power of the pump-engine.

An air-box removes this imperfection, becauſe it keeps up the motion during the returning ſtroke of the piſton. The compreſſion of the air by the active ſtroke of the piſton muſt be ſuch as to continue the impulſe in oppoſition to the contrary preſſure of the water (if it is to be raiſed to ſome height), and in oppoſition to the friction or other reſiſtances which ariſe from the motion that the water really acquires. Indeed a very conſiderable force is employed here alſo in changing the motion of the water, which is forced out of the capacious air-box into the narrow pipe; and when this change of motion is not judiciouſly managed, the expenditure of power may be as great as if all were brought to reſt and again put in motion. It may even be greater, by cauſing the water to move in the oppoſite direction to its former motion. Of ſuch conſequence is it to have all theſe circumſtances ſcientifically conſidered. It is in ſuch particulars, unheeded by the ordinary herd of engineers or pump-makers, that the ſuperiority of an intelligent practitioner is to be ſeen.

Another material point in the conduct of water in pipes is the diſtribution of it to the different perſons who have occaſion for it. This is rarely done from the riſing main. It is uſual to ſend the whole into a ciſtern, from which it is afterwards conducted to different places in ſeparate pipes. Till the diſcovery of the general theorem by the chevalier Buat, this has been done with great inaccuracy. Engineers think that the different purchaſers from water-works receive in proportion to their reſpective bargains when they give them pipes whoſe areas are proportional to theſe payments. But we now ſee, that when theſe pipes are of any conſiderable length, the waters of a larger pipe run with a greater velocity than thoſe of a ſmaller pipe having the ſame ſlope. A pipe of two inches diameter will give much more water than four pipes of one inch diameter; it will give as much as five and a half ſuch pipes, or more; becauſe the ſquares of the diſcharges are very nearly as the fifth powers of the diameters. This point ought therefore to be carefully conſidered in the bargains made with the proprietors of water-works, and the payments made in this proportion. Perhaps the moſt unexceptionable method would be to make a double diſtribution. Let the water be firſt let off in its proper proportions into a ſecond ſeries of ſmall ciſterns, and let each have a pipe which will convey the whole water that is diſcharged into it. The firſt diſtribution may be made entirely by pipes of one inch in diameter; this would leave nothing to the calculation of the diſtributor, for every man would pay in proportion to the number of ſuch pipes which run into his own ciſtern.

Water-works.

In many caſes, however, water is diſtributed by pipes derived from a main. And here another circumſtance comes into action. When water is paſſing along a pipe, its preſſure on the ſides of the pipe is diminiſhed by its velocity; and if a pipe is now derived from it, the quantity drawn off is alſo diminiſhed in the ſubduplicate ratio of the preſſures. If the preſſure is reduced to one-fourth, one-ninth, one-ſixteenth, &c. the diſcharge from the lateral pipe is reduced to one-half, one-third, one-fourth, &c.

It is therefore of great importance to determine, what this diminution of preſſure is which ariſes from the motion along the main.

It is plain, that if the water ſuffered no reſiſtance in the main, its velocity would be that with which it entered, and it would paſs along without exerting any preſſure. If the pipe were ſhut at the end, the preſſure on the ſides would be the full preſſure of the head of water. If the head of water remain the ſame, and the end of the tube be contracted, but not ſtopped entirely, the velocity in the pipe is diminiſhed. If we would have the velocity in the pipe with this contracted mouth augmented to what it was before the contraction was made, we muſt employ the preſſure of a piſton, or of a head of water. This is propagated through the fluid, and thus a preſſure is immediately excited on the ſides of the pipe. New obſtructions of any kind, ariſing from friction or any other cauſe, produce a diminution of velocity in the pipe. But when the natural velocity is checked, the particles react on what obſtructs their motion; and this action is uniformly propagated through a perfect fluid in every direction. The reſiſtance therefore which we thus aſcribe to friction, produces the ſame lateral preſſure, which a contraction of the orifice, which equally diminiſhes the velocity in the pipe, would do. Indeed this is demonſtrable from any diſtinct notions that we can form of theſe obſtructions. They proceed from the want of perfect ſmoothneſs, which obliges the particles next the ſides to move in undulated lines. This excites tranſverſe forces in the ſame manner as any conſtrained curvilineal motion. A particle in its undulated path tends to eſcape from it, and acts on the lateral particles in the ſame manner that it would do if moving ſingly in a capillary tube having the ſame undulations; it would preſs on the concave ſide of every ſuch undulation. Thus a preſſure is exerted among the particles, which is propagated to the ſides of the pipe; or the diminution of velocity may ariſe from a viſcidity or want of perfect fluidity. This obliges the particle immediately preſſed to drag along with it another particle which is withheld by adheſion to the ſides. This requires additional preſſure from a piſton, or an additional head of water; and this preſſure alſo is propagated to the ſides of the pipe.

Hence it ſhould follow, that the preſſure which water in motion exerts on the ſides of its conduit is equal to that which is competent to the head of water which impels

Water-works.

impels it into the pipe, diminiſhed by the head of water competent to the actual velocity with which it moves along the pipe. Let H repreſent the head of water which impels it into the entry of the pipe, and h the head which would produce the actual velocity; then $H-h$ is the column which would produce the preſſure exerted on its ſides.

This is abundantly verified by very ſimple experiments. Let an upright pipe be inſerted into the ſide of the main pipe. When the water runs out by the mouth of the main, it will riſe in this branch till the weight of the column balances the preſſure that ſupports it; and if we then aſcertain the velocity of the iſſuing water by means of the quantity diſcharged, and compute the head or height neceſſary for producing this velocity, and ſubtract this from the height of water above the entry of the main, we ſhall find the height in the branch preciſely equal to their difference. Our readers may ſee this by examining the experiments related by Graveſande, and ſtill better by conſulting the experiments narrated by Boſſut, § 558. which are detailed with great minuteneſs; the reſults correſponded accurately with this propoſition. The experiments indeed were not heights of water ſupported by this preſſure, but water expelled by it through the ſame orifice. Indeed the truth of the propoſition appears in every way we can conſider the motion of water. And as it is of the firſt importance in the practice of conducting water (for reaſons which will preſently appear), it merits a particular attention. When an inclined tube is in train, the accelerating power of the water (or its weight diminiſhed in the proportion of the length of the oblique column to its vertical height, or its weight multiplied by the fraction $\frac{1}{s}$, which expreſſes the ſlope), is in equilibrio with the obſtructions; and therefore it exerts no preſſure on the pipe but what ariſes from its weight alone. Any part of it would continue to ſlide down the inclined plane with a conſtant velocity, though detached from what follows it. It therefore derives no preſſure from the head of water which impelled it into the pipe. The ſame muſt be ſaid of a horizontal pipe infinitely ſmooth, or oppoſing no reſiſtance. The water would move in this pipe with the full velocity due to the head of water which impels it into the entry. But when the pipe oppoſes an obſtruction, the head of water is greater than that which would impel it into the pipe with the velocity that it actually has in it; and this additional preſſure is propagated along the pipe, where it is balanced by the actual reſiſtance, and therefore excites a *quaqua verſum* preſſure on the pipe. In ſhort, whatever part of the head of water in the reſervoir, or of the preſſure which impels it along the tube, is not employed in producing velocity, is employed in acting againſt ſome obſtruction, and excites (by the reaction of this obſtruction) an equal preſſure on the tube. The rule therefore is general, but is ſubject to ſome modifications which deſerve our attention.

Fig. 4. In the ſimply inclined pipe BC (fig. 4.) the preſſure on any point S is equal to that of the head AB of water which impels the water into the pipe, wanting or *minus* that of the head of water which would communicate to it the velocity with which it actually moves. This we ſhall call x, and conſider it as the weight of a column of water whoſe length alſo is x. In like manner H may be the column AB, which impels the water into the pipe, and would communicate a certain velocity; and h may repreſent the column which would communicate the actual velocity. We have therefore $x = H-h$. Water-works.

In the pipe HIKL, the preſſure at the point I is $AH-h-IO$, $=H-h-IO$; and the preſſure at K is $H-h+PK$.

And in the pipe DEFG, the preſſure on E is $= AR-h-EM$, $=H-h-EM$; and the preſſure at F is $H-h+FN$.

We muſt carefully diſtinguiſh this preſſure on any ſquare inch of the pipe from the obſtruction or reſiſtance which that inch actually exerts, and which is part of the cauſe of this preſſure. The preſſure is (by the laws of hydroſtatics) the ſame with that exerted on the water by a ſquare inch of the piſton or forcing head of water. This muſt balance the united obſtructions of the whole pipe, in as far as they are not balanced by the relative weight of the water in an encloſed pipe. Whatever be the inclination of a pipe, and the velocity of the water in it, there is a certain part of this reſiſtance which may not be balanced by the tendency which the water has to ſlide along it, provided the pipe be long enough; or if the pipe is too ſhort, the tendency down the pipe may more than balance all the reſiſtances that obtain below. In the firſt caſe, this overplus muſt be balanced by an additional head of water; and in the latter caſe the pipe is not in train, and the water will accelerate. There is ſomething in the mechaniſm of theſe motions which makes a certain length of pipe neceſſary for bringing it into train; a certain portion of the ſurface which acts in concert in obſtructing the motion. We do not completely underſtand this circumſtance, but we can form a pretty diſtinct notion of its mode of acting. The film of water contiguous to the pipe is withheld by the obſtruction, but glides along; the film immediately within this is withheld by the outer film, but glides through it: and thus all the concentric films glide within thoſe around them, ſomewhat like the ſliding tubes of a ſpy-glaſs, when we draw it out by taking hold of the end of the innermoſt. Thus the ſecond film paſſes beyond the firſt or outermoſt, and becomes the outermoſt, and rubs along the tube. The third does the ſame in its turn; and thus the central filaments come at laſt to the outſide, and all ſuſtain their greateſt poſſible obſtruction. When this is accompliſhed, the pipe is in train. This requires a certain length, which we cannot determine by theory. We ſee, however, that pipes of greater diameter muſt require a greater length, and this in a proportion which is probably that of the number of filaments, or the ſquare of the diameter. Buat found this ſuppoſition agree well enough with his experiments. A pipe of one inch in diameter ſuſtained no change of velocity by gradually ſhortening it till he reduced it to ſix feet, and then it diſcharged a little more water. A pipe of two inches diameter gave a ſenſible augmentation of velocity when ſhortened to 25 feet. He therefore ſays, that the ſquare of the diameter in inches, multiplied by 72, will expreſs (in inches) the length neceſſary for putting any pipe in train.

The reſiſtance exerted by a ſquare inch of the pipe makes but a ſmall part of the preſſure which the whole reſiſtances

Water-works.

reſiſtances occaſion to be exerted there before they can be overcome. The reſiſtance may be repreſented by $\frac{d}{s}$, when d is the hydraulic depth (one-fourth of the diameter), and s the length of a column whoſe vertical height is one inch, and it is the relative weight of a column of water whoſe baſe is a ſquare inch, and height is d. For the reſiſtance of any length s of pipe which is in train, is equal to the tendency of the water to ſlide down (being balanced by it); that is, is equal to the weight of this column multiplied by $\frac{1}{s}$. The magnitude of this column is had by multiplying its length by its ſection. The ſection is the product of the border h or circumference, multiplied by the mean depth d, or it is $b\,d$. This multiplied by the length, is $b\,d\,s$; and this multiplied by the ſlope $\frac{1}{s}$ is $b\,d$, the relative weight of the column whoſe length is s. The relative weight of one inch is therefore $\frac{b\,d}{s}$; and this is in equilibrio with the reſiſtance of a ring of the pipe one inch broad. This, when unfolded, is a parallelogram b inches in length. One inch of this therefore is $\frac{d}{s}$, the relative weight of a column of water having d for its height and a ſquare inch for its baſe. Suppoſe the pipe four inches in diameter, and the ſlope $= 253$, the reſiſtance is one grain; for an inch of water weighs 253 grains.

This knowledge of the preſſure of water in motion is of great importance. In the management of rivers and canals it inſtructs us concerning the damages which they produce in their beds by tearing up the ſoil; it informs us of the ſtrength which we muſt give to the banks: but it is of more conſequence in the management of cloſe conduits. By this we muſt regulate the ſtrength of our pipes; by this alſo we muſt aſcertain the quantities of water which may be drawn off by lateral branches from any main conduit.

With reſpect to the firſt of theſe objects, where ſecurity is our ſole concern, it is proper to conſider the preſſure in the moſt unfavourable circumſtances, viz. when the end of the main is ſhut. This caſe is not unfrequent. Nay, when the water is in motion, its velocity in a conduit ſeldom exceeds a very few feet in a ſecond. Eight feet per ſecond requires only one foot of water to produce it. We ſhould therefore eſtimate the ſtrain on all conduits by the whole height of the reſervoir.

In order to adjuſt the ſtrength of a pipe to the ſtrain, we may conceive it as conſiſting of two half cylinders of inſuperable ſtrength, joined along the two ſeams, where the ſtrength is the ſame with the ordinary ſtrength of the materials of which it is made. The inſide preſſure tends to burſt the pipe by tearing open theſe ſeams; and each of theſe two ſeams is equal to the weight of a column of water whoſe height is the depth of the ſeam below the ſurface of the reſervoir, and whoſe baſe is an inch broad and a diameter of the pipe in length. This follows from the common principles of hydroſtatics.

Suppoſe the pipe to be of lead, one foot in diameter and 100 feet under the ſurface of the reſervoir. Water weighs $62\frac{1}{2}$ pounds per foot. The baſe of our column is therefore $\frac{1}{12}$th of a foot, and the tendency to burſt the pipe is $100 \times 62\frac{1}{2} \times \frac{1}{12}\text{th} = \frac{6250}{12}$, $= 521$ pounds nearly. Therefore an inch of one ſeam is ſtrained by $260\frac{1}{2}$ pounds. A rod of lead one inch ſquare is pulled aſunder by 860 pounds (ſee *STRENGTH of Materials*, N° 40.). Therefore, if the thickneſs of the ſeam is $= \frac{260}{8600}$ inches, or one-third of an inch, it will juſt withſtand this ſtrain. But we muſt make it much ſtronger than this, eſpecially if the pipe leads from an engine which ſends the water along it by ſtarts. Belidor and Deſaguliers have given tables of the thickneſs and weights of pipes which experience has found ſufficient for the different materials and depths. Deſaguliers ſays, that a leaden pipe of three-fourths of an inch in thickneſs is ſtrong enough for a height of 140 feet and diameter of ſeven inches. From this we may calculate all others. Belidor ſays, that a leaden pipe 12 inches diameter and 60 feet deep ſhould be half an inch thick: but theſe things will be more properly computed by means of the liſt given in N° 40 of the article *STRENGTH of Materials*.

The application which we are moſt anxious to make of the knowledge of the preſſure of moving waters is the derivation from a main conduit by lateral branches. This occurs very frequently in the diſtribution of waters among the inhabitants of towns; and it is ſo imperfectly underſtood by the greateſt part of thoſe who take the name of engineers, that individuals have no ſecurity that they ſhall get even one half of the water they bargain and pay for; yet this may be as accurately aſcertained as any other problem in hydraulics by means of our general theorem. The caſe therefore merits our particular attention.

It appears to be determined already, when we have aſcertained the preſſures by which the water is impelled into theſe lateral pipes, eſpecially after we have ſaid that the experiments of Boſſut on the actual diſcharges from a lateral pipe fully confirm the theoretical doctrine. But much remains to be conſidered. We have ſeen that there is a vaſt difference between the diſcharge made through a hole, or even through a ſhort pipe, and the diſcharge from the far end of a pipe derived from a main conduit. And even when this has been aſcertained by our new theory, the diſcharge thus modified will be found conſiderably different from the real ſtate of things: For when water is flowing along a main with a known velocity, and therefore exerting a known preſſure on the circle which we propoſe for the entry of a branch, if we inſert a branch there water will go along it: but this will generally make a conſiderable change in the motion along the main, and therefore in the preſſure which is to expel the water. It alſo makes a conſiderable change in the whole quantity which paſſes along the anterior part of the main, and a ſtill greater change on what moves along that part of it which lies beyond the branch: it therefore affects the quantity neceſſary for the whole ſupply, the force that is required for propelling it, and the quantity delivered by other branches. This part therefore of the management of water in conduits is of conſiderable importance and intricacy. We can propoſe in this place nothing more than a ſolution of ſuch leading queſtions as involve the chief circumſtances, recommending to our readers the peruſal of original works on this ſubject. M. Boſſut's

Water-works.

experiments are fully competent to the eſtabliſhment of the fundamental principle. The hole through which the lateral diſcharges were made was but a few feet from the reſervoir. The pipe was ſucceſſively lengthened, by which the reſiſtances were increaſed, and the velocity diminiſhed. But this did not affect the lateral diſcharges, except by affecting the preſſures; and the diſcharges from the end of the main were ſuppoſed to be the ſame as when the lateral pipe was not inſerted. Although this was not ſtrictly true, the difference was inſenſible, becauſe the lateral pipe had but about the 18th part of the area of the main.

Suppoſe that the diſcharge from the reſervoir remains the ſame after the derivation of this branch, then the motion of the water all the way to the inſertion of the branch is the ſame as before; but, beyond this, the diſcharge is diminiſhed by all that is diſcharged by the branch, with the head x equivalent to the preſſure on the ſide. The diſcharge by the lower end of the main being diminiſhed, the velocity and reſiſtance in it are alſo diminiſhed. Therefore the difference between x and the head employed to overcome the friction in this ſecond caſe, would be a needleſs or inefficient part of the whole load at the entry, which is impoſſible; for every force produces an effect, or it is deſtroyed by ſome reaction. The effect of the forcing head of water is to produce the greateſt diſcharge correſponding to the obſtructions; and thus the diſcharge from the reſervoir, or the ſupply to the main, muſt be augmented by the inſertion of the branch, if the forcing head of water remains the ſame. A greater portion therefore of the forcing head was employed in producing a greater diſcharge at the entry of the main, and the remainder, leſs than x, produced the preſſure on the ſides. This head was the one competent to the obſtructions reſulting from the velocity beyond the inſertion of the branch; and this velocity, diminiſhed by the diſcharge already made, was leſs than that at the entry, and even than that of the main without a branch. This will appear more diſtinctly by putting the caſe into the form of an equation. Therefore let $H-x$ be the height due to the velocity at the entry, of which the effect obtains only horizontally. The head x is the only one which acts on the ſides of the tube, tending to produce the diſcharge by the branch, at the ſame time that it muſt overcome the obſtructions beyond the branch. If the orifice did not exiſt, and if the force producing the velocity on a ſhort tube be repreſented by $2G$, and the ſection of the main be A, the ſupply at the entry of the main would be $A\sqrt{2G}\sqrt{H-x}$; and if the orifice had no influence on the value of x, the diſcharge by the orifice would be $D\sqrt{\frac{x}{H}}$, D being its diſcharge by means of the head H, when the end of the main is ſhut; for the diſcharges are in the ſubduplicate ratio of the heads of water by which they are expelled; and therefore $\sqrt{H} : \sqrt{x} = D : D\sqrt{\frac{x}{H}} (=\vartheta)$. But we have ſeen that x muſt diminiſh; and we know that the obſtructions are nearly as the ſquare roots of the velocities, when theſe do not differ much among themſelves. Therefore calling y the preſſure or head which balances the reſiſtances of the main without a branch, while x is the head neceſſary for the main with a branch, we may inſtitute this proportion, $y : H-y = x\frac{(H-y)}{y}$; and this 4th term will expreſs the head producing the velocity in the main beyond the branch (as $H-y$ would have done in a main without a branch). This velocity beyond the branch will be $\sqrt{2G}\sqrt{\frac{x(H-y)}{y}}$, and the diſcharge at the end will be $A\sqrt{2G}\sqrt{\frac{x(H-y)}{y}}$. If to this we add the diſcharge of the branch, the ſum will be the whole diſcharge, and therefore the whole ſupply. Therefore we have the following equation, $A\sqrt{2G}\sqrt{H-y} = A\sqrt{2G}\sqrt{\frac{x(H-y)}{y}} + D\sqrt{\frac{x}{H}}$. From this we deduce the value of $x = \frac{2GHA^2}{\left(A\sqrt{2G}\sqrt{\frac{H-y}{y}} + \frac{D}{\sqrt{H}}\right)^2 + 2GA^2}$. This value of x being ſubſtituted in the equation of the diſcharge ϑ of the branch, which was $= D\sqrt{\frac{x}{H}}$, will give the diſcharges required, and they will differ ſo much the more from the diſcharges calculated according to the ſimple theory, as the velocity in the main is greater. By the ſimple theory, we mean the ſuppoſition that the lateral diſcharges are ſuch as would be produced by the head $H-h$, where H is the height of the reſervoir, and h the head due to the actual velocity in the main.

Water-works.

And thus it appears that the proportion of the diſcharge by a lateral pipe from a main that is ſhut at the far end, and the diſcharge from a main that is open, depends not only on the preſſures, but alſo on the ſize of the lateral pipe, and its diſtance from the reſervoir. When it is large, it greatly alters the train of the main, under the ſame head, by altering the diſcharge at its extremity, and the velocity in it beyond the branch; and if it be near the reſervoir, it greatly alters the train, becauſe the diminiſhed velocity takes place through a greater extent, and there is a greater diminution of the reſiſtances.

When the branch is taken off at a conſiderable diſtance from the reſervoir, the problem becomes more complicated, and the head x is reſolved into two parts; one of which balances the reſiſtance in the firſt part of the main, and the other balances the reſiſtances beyond the lateral pipe, with a velocity diminiſhed by the diſcharge from the branch.—A branch at the end of the main produces very little change in the train of the pipe.

When the lateral diſcharge is great, the train may be ſo altered, that the remaining part of the main will not run full, and then the branch will not yield the ſame quantity. The velocity in a very long horizontal tube may be ſo ſmall (by a ſmall head of water and great obſtructions in a very long tube) that it will juſt run full. An orifice made in its upper ſide will yield nothing; and yet a ſmall tube inſerted into it will carry a column almoſt as high as the reſervoir. So that we cannot judge in all caſes of the preſſures by the diſcharges, and *vice verſa*.

If

If there be an inclined tube, having a head greater than what is competent to the velocity, we may bring it into train by an opening on its upper ſide near the reſervoir. This will yield ſome water, and the velocity will diminiſh in the tube till it is in train. If we ſhould now enlarge the hole, it will yield no more water than before.

And thus we have pointed out the chief circumſtances which affect theſe lateral diſcharges. The diſcharges are afterwards modified by the conduits in which they are conveyed to their places of deſtination. Theſe being generally of ſmall dimenſions, for the ſake of economy, the velocity is much diminiſhed. But, at the ſame time, it approaches nearer to that which the ſame conduit would bring directly from the reſervoir, becauſe its ſmall velocity will produce a leſs change in the train of the main conduit.

We ſhould now treat of jets of water, which ſtill make an ornament in the magnificent pleaſure grounds of the wealthy. Some of theſe are indeed grand objects, ſuch as the two at Peterhoff in Ruſſia, which ſpout about 60 feet high a column of nine inches diameter, which falls again, and ſhakes the ground with its blow. Even a ſpout of an inch or two inches diameter, lancing to the height of 150 feet, is a gay object, and greatly enlivens a pleaſure-ground; eſpecially when the changes of a gentle breeze bend the jet to one ſide. But we have no room left for treating this ſubject, which is of ſome nicety; and muſt conclude this article with a very ſhort account of the management of water as an active power for impelling machinery.

II. *Of Machinery driven by Water.*

This is a very comprehenſive article, including almoſt every poſſible ſpecies of mill. It is no leſs important, and it is therefore matter of regret, that we cannot enter into the detail which it deſerves. The mere deſcription of the immenſe variety of mills which are in general uſe, would fill volumes, and a ſcientific deſcription of their principles and maxims of conſtruction would almoſt form a complete body of mechanical ſcience. But this is far beyond the limits of a work like ours. Many of theſe machines have been already deſcribed under their proper names, or under the articles which give an account of their manufactures; and for others we muſt refer our readers to the original works, where they are deſcribed in minute detail. The great academical collection *Des Arts et Metiers*, publiſhed at Paris in many folio volumes, contains a deſcription of the peculiar machinery of many mills; and the volumes of the *Encyclopédie Methodique*, which particularly relate to the mechanic arts, already contain many more. All that we can do in this place is, to conſider the chief circumſtances that are common to all water-mills, and from which all muſt derive their efficacy. Theſe circumſtances are to be found in the manner of employing water as an acting power, and moſt of them are comprehended in the conſtruction of water-wheels. When we have explained the principles and the maxims of conſtruction of a water-wheel, every reader converſant in mechanics knows, that the axis of this wheel may be employed to tranſmit the force impreſſed on it to any ſpecies of machinery. Therefore nothing ſubſequent to this can with propriety be conſidered as *water-works*.

Water-wheels are of two kinds, diſtinguiſhed by the manner in which water is made an impelling power, viz. by its weight, or by its impulſe. This requires a very different form and manner of adaptation; and this forms an oſtenſible diſtinction, ſufficiently obvious to give a name to each claſs. When water is made to act by its weight, it is delivered from the ſpout as high on the wheel as poſſible, that it may continue long to preſs it down: but when it is made to ſtrike the wheel, it is delivered as low as poſſible, that it may have previouſly acquired a great velocity. And thus the wheels are ſaid to be OVERSHOT or UNDERSHOT. Water-works.

Of Overſhot Wheels.

This is nothing but a frame of open buckets, ſo diſpoſed round the rim of a wheel as to receive the water delivered from a ſpout; ſo that one ſide of the wheel is loaded with water, while the other is empty. The conſequence muſt be, that the loaded ſide muſt deſcend. By this motion the water runs out of the lower buckets, while the empty buckets of the riſing ſide of the wheel come under the ſpout in their turn, and are filled with water.

If it were poſſible to conſtruct the buckets in ſuch a manner as to remain completely filled with water till they come to the very bottom of the wheel, the preſſure with which the water urges the wheel round its axis would be the ſame as if the extremity of the horizontal radius were continually loaded with a quantity of water ſufficient to fill a ſquare pipe, whoſe ſection is equal to that of the bucket, and whoſe length is the diameter of the wheel. For let the buckets BD and EF (fig. 5.) be compared together, the arches DB and EF are equal. The mechanical energy of the water contained in the bucket EF, or the preſſure with which its weight urges the wheel, is the ſame as if all this water were hung on that point T of the horizontal arm CF, where it is cut by the vertical or plumb-line BT. This is plain from the moſt elementary principles of mechanics. Therefore the effect of the bucket BD is to that of the bucket EF as CT to CF or CB. Draw the horizontal lines PB *b b*, QD *d d*. It is plain, that if BD is taken very ſmall, ſo that it may be conſidered as a ſtraight line, BD : BO=CB : BP, and EF : *b d*=CF : CT, and EF × CT=*b d* × CF. Therefore if the priſm of water, whoſe vertical ſection is *b b d d*, were hung on at F, its force to urge the wheel round would be the ſame as that of the water lying in the bucket BD. The ſame may be ſaid of every bucket; and the effective preſſure of the whole ring of water A*f* HKFI, in its natural ſituation, is the ſame with the pillar of water *a h h a* hung on at F. And the effect of any portion BF of this ring is the ſame with that of the correſponding portion *b* F*f b* of the vertical pillar. We do not take into account the ſmall difference which ariſes from the depth B or F*f*, becauſe we may ſuppoſe the circle deſcribed through the centres of gravity of the buckets. And in the farther proſecution of this ſubject, we ſhall take ſimilar liberties, with the view of ſimplifying the ſubject, and ſaving time to the reader. Fig. 5.

But ſuch a ſtate of the wheel is impoſſible. The bucket at the very top of the wheel may be completely filled with water; but when it comes into the oblique poſition BD, a part of the water muſt run over the outer edge ∂, and the bucket will only retain the quan-

Water-works.

tity ZBD ∂; and if the buckets are formed by partitions directed to the axis of the wheel, the whole water muſt be run out by the time that they deſcend to the level of the axis. To prevent this many contrivances have been adopted. The wheel has been ſurrounded with a hoop or ſweep, conſiſting of a circular board, which comes almoſt into contact with the rim of the wheel, and terminates at H, where the water is allowed to run off. But unleſs the work is executed with uncommon accuracy, the wheel made exactly round, and the ſweep exactly fitting it, a great quantity of water eſcapes between them; and there is a very ſenſible obſtruction to the motion of ſuch a wheel, from ſomething like friction between the water and the ſweep. Froſt alſo effectually ſtops the motion of ſuch a wheel. Sweeps have therefore been generally laid aſide, although there are ſituations where they might be uſed with good effect.

Mill-wrights have turned their whole attention to the giving a form to the buckets which ſhall enable them to retain the water along a great portion of the circumference of the wheel. It would be endleſs to deſcribe all theſe contrivances; and we ſhall therefore content ourſelves with one or two of the moſt approved. The intelligent reader will readily ſee that many of the circumſtances which concur in producing the ultimate effect (ſuch as the facility with which the water is received into the buckets, the place which it is to occupy during the progreſs of the bucket from the top to the bottom of the wheel, the readineſs with which they are evacuated, or the chance that the water has of being dragged beyond the bottom of the wheel by its adheſion, &c. &c.) are ſuch as do not admit of preciſe calculation or reaſoning about their merits; and that this or that form can ſeldom be evidently demonſtrated to be the very beſt poſſible. But, at the ſame time, he will ſee the general reaſons of preference, and his attention will be directed to circumſtances which muſt be attended to, in order to have a good bucketed wheel.

Fig. 6. Fig. 6. is the outline of a wheel having 40 buckets. The ring of board contained between the concentric circles QDS and PAR, making the ends of the buckets, is called the SHROUDING, in the language of the art, and QP is called the *depth of ſhrouding*. The inner circle PAR is called the SOLE of the wheel, and uſually conſiſts of boards nailed to ſtrong wooden rings of compaſs timber of conſiderable ſcantling, firmly united with the ARMS or radii. The partitions, which determine the form of the buckets, conſiſt of three different planes or boards AB, BC, CD, which are variouſly named by different artiſts. We have heard them named the START or SHOULDER, the ARM, and the WREST (probably for wriſt, on account of a reſemblance of the whole line to the human arm); B is alſo called the ELBOW. Fig. 7. repreſents a ſmall portion of the ſame bucketing on a larger ſcale, that the proportions of the parts may be more diſtinctly ſeen. AG, the ſole of one bucket, is made about $\frac{1}{6}$th more than the depth GH of the ſhrouding. The ſtart AB is $\frac{1}{2}$ of AI. The plane BC is ſo inclined to AB that it would paſs through H; but it is made to terminate in C, in ſuch a manner that FC is $\frac{5}{6}$ths of GH or AI. Then CD is ſo placed that HD is about $\frac{1}{7}$th of IH.

Fig. 7.

By this conſtruction, it follows that the area FABC is very nearly equal to DABC; ſo that the water which will fill the ſpace FABC will all be contained in the bucket when it ſhall come into ſuch a poſition that AD is a horizontal line; and the line AB will then make an angle of nearly 35° with the vertical, or the bucket will be 35° from the perpendicular. If the bucket deſcend ſo much lower that one half of the water runs out, the line AB will make an angle of 25°, or 24° nearly, with the vertical. Therefore the wheel, filled to the degree now mentioned, will *begin* to loſe water at about $\frac{1}{8}$th of the diameter from the bottom, and *half of the water will be diſcharged* from the loweſt bucket, about $\frac{1}{24}$th of the diameter farther down. Theſe ſituations of the diſcharging bucket are marked at T and V in fig. 6. Had a greater proportion of the buckets been filled with water when they were under the ſpout, the diſcharge would have begun at a greater height from the bottom, and we ſhould loſe a greater portion of the whole fall of water. The loſs by the preſent conſtruction is leſs than $\frac{1}{10}$th (ſuppoſing the water to be delivered into the wheel at the very top), and may be eſtimated at about $\frac{1}{12}$th; for the loſs is the verſed ſine of the angle which the radius of the bucket makes with the vertical. The verſed ſine of 35° is nearly $\frac{1}{5}$th of the radius (being 0.18085), or $\frac{1}{10}$th of the diameter. It is evident, that if only $\frac{1}{2}$ of this water were ſupplied to each bucket as it paſſes the ſpout, it would have been retained for 10° more of a revolution, and the loſs of fall would have been only about $\frac{1}{18}$th.

Theſe obſervations ſerve to ſhow, in general, that an advantage is gained by having the buckets ſo capacious that the quantity of water which each can receive as it paſſes the ſpout may not nearly fill it. This may be accompliſhed by making them of a ſufficient length, that is, by making the wheel ſufficiently broad between the two ſhroudings. Economy is the only objection to this practice, and it is generally very ill placed. When the work to be performed by the wheel is great, the addition of power gained by a greater breadth will ſoon compenſate for the additional expence.

The third plane CD is not very frequent; and mill-wrights generally content themſelves with continuing the board all the way from the elbow B to the outer edge of the wheel at H; and AB is generally no more than one-third of the depth AI. But CD is a very evident improvement, cauſing the wheel to retain a very ſenſible addition to the water. Some indeed make this addition more conſiderable, by bringing BC more outward, ſo as to meet the rim of the wheel at H, for inſtance, and making HD coincide with the rim. But this makes the entry of the water ſomewhat more difficult during the very ſhort time that the opening of the bucket paſſes the ſpout. To facilitate this as much as poſſible, the water ſhould get a direction from the ſpout, ſuch as will ſend it into the buckets in the moſt perfect manner. This may be obtained by delivering the water through an aperture that is divided by thin plates of board or metal, placed in the proper poſition, as we have repreſented in fig. 6. The form of bucket laſt mentioned, having the wreſt concentric with the rim, is unfavourable to the ready admiſſion of the water; whereas an oblique wreſt conducts the water which has miſſed one bucket into the next below.

The mechanical conſideration of this ſubject alſo ſhows us, that a deep ſhrouding, in order to make a capacious bucket,

Water-works.

bucket, is not a good method: it does not make the buckets retain their water any longer; and it diminiſhes the effective fall of water: for the water received at the top of the wheel immediately falls to the bottom of the bucket, and thus ſhortens the fictitious pillar of water, which we ſhowed to be the meaſure of the effective or uſeful preſſure on the wheel: and this concurs with our former reaſons for recommending as great a breadth of the wheel, and length of buckets, as economical conſiderations will permit.

A bucket wheel was ſome time ago executed by Mr Robert Burns, at the cotton mills of Houſton, Burns, and Co. at Cartſide in Renfrewſhire, of a conſtruction entirely new, but founded on a good principle, which is ſuſceptible of great extenſion. It is repreſented in fig. 8. The bucket conſiſts of a ſtart AB, an arm BC, and a wreſt CD, concentric with the rim. But the bucket is alſo divided by a partition LM, concentric with the ſole and rim, and ſo placed as to make the inner and outer portions of nearly equal capacity. It is evident, without any farther reaſoning about it, that this partition will enable the bucket to retain its water much longer. When they are filled one-third, they retain the whole water at 18° from the bottom; and they retain one half at 11°. They do not admit the water quite ſo freely as buckets of the common conſtruction; but by means of the contrivance mentioned a little ago for the ſpout (alſo the invention of Mr Burns, and furniſhed with a rack-work, which raiſed or depreſſed it as the ſupply of water varied, ſo as at all times to employ the whole fall of the water), it is found, that a ſlow-moving wheel allows one-half of the water to get into the inner buckets, eſpecially if the partition do not altogether reach the radius drawn through the lip D of the outer bucket.

g. 8.

This is a very great improvement of the bucket wheel; and when the wheel is made of a liberal breadth, ſo that the water may be very ſhallow in the buckets, it ſeems to carry the performance as far as it can go. Mr Burns made the firſt trial on a wheel of 24 feet diameter; and its performance is manifeſtly ſuperior to that of the wheel which it replaced, and which was a very good one. It has alſo another valuable property: When the ſupply of water is very ſcanty, a proper adjuſtment of the apparatus in the ſpout will direct almoſt the whole of the water into the outer buckets; which, by placing it at a greater diſtance from the axis, makes a very ſenſible addition to its mechanical energy.

We ſaid that this principle is ſuſceptible of conſiderable extenſion; and it is evident that two partitions will increaſe the effect, and that it will increaſe with the number of partitions: ſo that when the practice now begun, of making water-wheels of iron, ſhall become general, and therefore very thin partitions are uſed, their number may be greatly increaſed without any inconvenience: and it is obvious, that this ſeries of partitions muſt greatly contribute to the ſtiffneſs and general firmneſs of the whole wheel.

There frequently occurs a difficulty in the making of bucket wheels, when the half-taught mill-wright attempts to retain the water a long time in the buckets. The water gets into them with a difficulty which he cannot account for, and ſpills all about, even when the buckets are not moving away from the ſpout. This ariſes from the air, which muſt find its way out to admit the water, but is obſtructed by the entering water, and occaſions a great ſpluttering at the entry. This may be entirely prevented by making the ſpout conſiderably narrower than the wheel. This will leave room at the two ends of the buckets for the eſcape of the air. This obſtruction is vaſtly greater than one would imagine; for the water drags along with it a great quantity of air, as is evident in the *Water-blaſt* deſcribed by many authors.

Water-works.

There is another and very ſerious obſtruction to the motion of an overſhot or bucketed wheel. When it moves in back water, it is not only reſiſted by the water, when it moves more ſlowly than the wheel, which is very frequently the caſe, but it lifts a great deal in the riſing buckets. In ſome particular ſtates of back water, the deſcending bucket fills itſelf completely with water; and, in other caſes, it contains a very conſiderable quantity, and air of common denſity; while in ſome rarer caſes it contains leſs water, with air in a condenſed ſtate. In the firſt caſe, the riſing bucket muſt come up filled with water, which it cannot drop till its mouth get out of the water. In the ſecond caſe, part of the water goes out before this; but the air rarefies, and therefore there is ſtill ſome water dragged or lifted up by the wheel, by ſuction as it is uſually called. In the laſt caſe there is no ſuch back load on the riſing ſide of the wheel, but (which is as detrimental to its performance) the deſcending ſide is employed in condenſing air; and although this air aids the aſcent of the riſing ſide, it does not aid it ſo much as it impedes the deſcending ſide, being (by the form of the bucket) nearer to the vertical line drawn through the axis.

All this may be completely prevented by a few holes made in the ſtart of each bucket. Air being at leaſt 800 times rarer than water, will eſcape through a hole almoſt 30 times faſter with the ſame preſſure. Very moderate holes will therefore ſuffice for this purpoſe: and the ſmall quantity of water which theſe holes diſcharge during the deſcent of the buckets, produces a loſs which is altogether inſignificant. The water which runs out of one runs into another, ſo that there is only the loſs of one bucket. We have ſeen a wheel of only 14 feet diameter working in nearly three feet of back water. It laboured prodigiouſly, and brought up a great load of water, which fell from it in abrupt daſhes, which rendered the motion very hobbling. When three holes of an inch diameter were made in each bucket (12 feet long), the wheel laboured no more, there was no more plunging of water from its riſing ſide, and its power on the machinery was increaſed more than one-fourth.

Theſe practical obſervations may contain information that is new even to ſeveral experienced mill-wrights. To perſons leſs informed they cannot fail of being uſeful. We now proceed to conſider the action of water thus lying in the buckets of a wheel; and to aſcertain its energy as it may be modified by different circumſtances of fall, velocity, &c.

With reſpect to variations in the fall, there can be little room for diſcuſſion. Since the active preſſure is meaſured by the pillar of water reaching from the horizontal plane where it is delivered on the wheel, to the horizontal plane where it is ſpilled by the wheel, it is evident that it muſt be proportional to this pillar, and therefore we muſt deliver it as high and retain it as long as poſſible.

This maxim obliges us, in the firſt place, to uſe a wheel

Water-works.

wheel whoſe diameter is equal to the whole fall. We ſhall not gain any thing by employing a larger wheel; for although we ſhould gain by uſing only that part of the circumference where the weight will act more perpendicularly to the radius, we ſhall loſe more by the neceſſity of diſcharging the water at a greater height from the bottom: For we muſt ſuppoſe the buckets of both the wheels equally well conſtructed; in which caſe, the heights above the bottom, where they will diſcharge the water, will increaſe in the proportion of the diameter of the wheel. Now, that we ſhall loſe more by this than we gain by a more direct application of the weight, is plain, without any further reaſoning, by taking the extreme caſe, and ſuppoſing our wheel enlarged to ſuch a ſize, that the uſeleſs part below is equal to our whole fall. In this caſe the water will be ſpilled from the buckets as ſoon as it is delivered into them. All intermediate caſes, therefore, partake of the imperfection of this.

When our fall is exceedingly great, a wheel of an equal diameter becomes enormouſly big and expenſive, and is of itſelf an unmanageable load. We have ſeen wheels of 58 feet diameter, however, which worked extremely well; but they are of very difficult conſtruction, and extremely apt to warp and go out of ſhape by their weight. In caſes like this, where we are unwilling to loſe any part of the force of a ſmall ſtream, the beſt form of a bucket wheel is an inverted chain pump. Inſtead of employing a chain pump of the beſt conſtruction, ABCDEA (fig. 9.) to raiſe water through the upright pipe CB, by means of a force applied to the upper wheel A, let the water be delivered from a ſpout F, into the upper part of the pipe BC, and it will preſs down the plugs in the lower and narrower bored part of it with the full weight of the column, and eſcape at the dead level of C. This weight will urge round the wheel A without any defalcation; and this is the moſt powerful manner that any fall of water whatever can be applied, and exceeds the moſt perfect overſhot wheel. But though it excels all chains of buckets in economy and in effect, it has all the other imperfections of this kind of machinery. Though the chain of plugs be of great ſtrength, it has ſo much motion in its joints that it needs frequent repairs; and when it breaks, it is generally in the neighbourhood of A, on the loaded ſide, and all comes down with a great craſh. There is alſo a loſs of power by the immerſion of ſo many plugs and chains in the water; for there can be no doubt but that if the plugs were big enough and light enough, they would buoy and even draw up the plugs in the narrow part at C. They muſt therefore diminiſh, in all other caſes, the force with which this plug is preſſed down.

Fig. 9.

The velocity of an overſhot wheel is a matter of very great nicety; and authors, both ſpeculative and practical, have entertained different, nay oppoſite, opinions on the ſubject. Mr Belidor, whom the engineers of Europe have long been accuſtomed to regard as ſacred authority, maintains, that there is a certain velocity related to that obtainable by the whole fall, which will procure to an overſhot wheel the greateſt performance. Deſaguliers, Smeaton, Lambert, De Parcieux, and others, maintain, that there is no ſuch relation, and that the performance of an overſhot wheel will be the greater, as it moves more ſlowly by an increaſe of its load of work. Belidor maintains, that the active power of water lying in a bucket wheel of any diameter is equal to that of the impulſe of the ſame water on the floats of an underſhot wheel, when the water iſſues from a ſluice in the bottom of the dam. The other writers whom we have named aſſert, that the energy of an underſhot wheel is but one half of that of an overſhot, actuated by the ſame quantity of water falling from the ſame height.

Water-works.

To a manufacturing country like ours, which derives aſtoniſhing ſuperiority, by which it more than compenſates for the impediments of heavy taxes and luxurious living, chiefly from its machinery, in which it leaves all Europe far behind, the deciſion of this queſtion, in ſuch a manner as ſhall leave no doubt or miſconception in the mind even of an unlettered artiſt, muſt be conſidered as a material ſervice: and we think that this is eaſily attainable.

When any machine moves uniformly, the accelerating force or preſſure actually exerted on the impelled point of the machine is in equilibrio with all the reſiſtances which are exerted at the working point, with thoſe ariſing from friction, and thoſe that are excited in different parts of the machine by their mutual actions. This is an inconteſtable truth; and though little attended to by the mechanicians, is the foundation of all practical knowledge of machines. Therefore, when an overſhot wheel moves uniformly, with *any velocity whatever*, the water is acting with its whole weight: for gravity would accelerate its deſcent, if not completely balanced by ſome reaction; and in this balance gravity and the reacting part of the machine exert equal and oppoſite preſſures, and thus produce the uniform motion of the machine. We are thus particular on this point, becauſe we obſerve mechanicians of the firſt name employing a mode of reaſoning on the queſtion now before us which is ſpecious, and appears to prove the concluſion which they draw; but is nevertheleſs contrary to true mechanical principles. They aſſert, that the ſlower a heavy body is deſcending (ſuppoſe in a ſcale ſuſpended from an axis *in peritrochea*), the more does it preſs on the ſcale, and the more does it urge the machine round: and therefore the ſlower an overſhot wheel turns, the greater is the force with which the water urges it round, and the more work will be done. It is very true that the machine is more forcibly impelled, and that more work is done: but this is not becauſe a pound of water preſſes more ſtrongly, but becauſe there is more water preſſing on the wheel; for the ſpout ſupplies at the ſame rate, and each bucket receives more water as it paſſes by it.

Let us therefore examine this point by the unqueſtionable principles of mechanics.

Let the overſhot wheel A*f*H (fig. 5.) receive the water from a ſpout at the very top of the wheel; and, in order that the wheel may not be retarded by dragging into motion the water ſimply laid into the uppermoſt bucket at A, let it be received at B, with the velocity (directed in a tangent to the wheel) acquired by the head of water AP. This velocity, therefore, muſt be equal to that of the rim of the wheel. Let this be *v*, or let the wheel and the water move over *v* inches in a ſecond. Let the buckets be of ſuch dimenſions, that all the water which each receives as it paſſes the ſpout is retained till it comes to the poſition R, where it is diſcharged at once. It is plain that, in place of the ſeparate quantities of water lying in each bucket, we may ſubſtitute a continued ring of water, equal to their

Fig. 5.

ſum,

Water-works.

ſum, and uniformly diſtributed in the ſpace BER $\epsilon f \beta$. This conſtitutes a ring of uniform thickneſs. Let the area of its croſs ſection β B or Ff be called a. We have already demonſtrated, that the mechanical energy with which this water on the circumference of the wheel urges it round, is the ſame with what would be exerted by the pillar $b\,r\,r\,b$ preſſing on Ff, or acting by the lever CF. The weight of this pillar may be expreſſed by $a \times b\,r$, or $a \times$ PS; and if we call the radius CF of the wheel R, the momentum or mechanical energy of this weight will be repreſented by $a \times \mathrm{PS} \times \mathrm{R}$.

Now, let us ſuppoſe that this wheel is employed to raiſe a weight W, which is ſuſpended by a rope wound round the axis of the wheel. Let r be the radius of this axle. Then $\mathrm{W} \times r$ is the momentum of the work. Let the weight riſe with the velocity u when the rim of the wheel turns with the velocity v, that is, let it riſe u inches in a ſecond.

Since a perfect equilibrium obtains between the power and the work when the motion is uniform, we muſt have $\mathrm{W} \times r = a \times \mathrm{PS} \times \mathrm{R}$. But it is evident that $\mathrm{R} : r = v : u$. Therefore $\mathrm{W} \times u = a \times v \times \mathrm{PS}$.

Now the performance of the machine is undoubtedly meaſured by the weight and the height to which it is raiſed in a ſecond, or by $\mathrm{W} \times u$. Therefore the machine is in its beſt poſſible ſtate when $a \times v \times \mathrm{PS}$ is a maximum. But it is plain that $a \times v$ is an invariable quantity; for it is the cubic inches of water which the ſpout ſupplies in a ſecond. If the wheel moves faſt, little water lies in each bucket, and a is ſmall. When v is ſmall, a is great, for the oppoſite reaſon; but $a \times v$ remains the ſame. Therefore we muſt make PS a maximum, that is, we muſt deliver the water as high up as poſſible. But this diminiſhes AP, and this diminiſhes the velocity of the wheel: and as this has no limit, the propoſition is demonſtrated; and an overſhot wheel does the more work as it moves ſloweſt.

Convincing as this diſcuſſion muſt be to any mechanician, we are anxious to impreſs the ſame maxim on the minds of practical men, unaccuſtomed to mathematical reaſoning of any kind. We therefore beg indulgence for adding a popular view of the queſtion, which requires no ſuch inveſtigation.

We may reaſon in this way: Suppoſe a wheel having 30 buckets, and that ſix cubic feet of water are delivered in a ſecond on the top of a wheel, and diſcharged without any loſs by the way at a certain height from the bottom of the wheel. Let this be the caſe, whatever is the rate of the wheel's motion; the buckets being of a ſufficient capacity to hold all the water which falls into them. Let this wheel be employed to raiſe a weight of any kind, ſuppoſe water in a chain of 30 buckets, to the ſame height, and with the ſame velocity. Suppoſe, farther, that when the load on the riſing ſide of the machine is one half of that on the wheel, the wheel makes four turns in a minute, or one turn in 15 ſeconds. During this time 90 cubic feet of water have flowed into the 30 buckets, and each has received three cubic feet. Then each of the riſing buckets contains $1\frac{1}{2}$ feet; and 45 cubic feet are delivered into the upper ciſtern during one turn of the wheel, and 180 cubic feet in one minute.

Now, ſuppoſe the machine ſo loaded, by making the riſing buckets more capacious, that it makes only two turns in a minute, or one turn in 30 ſeconds. Then each deſcending bucket muſt contain ſix cubic feet of water. If each bucket of the riſing ſide contained three cubic feet, the motion of the machine would be the ſame as before. This is a point which no mechanician will controvert. When two pounds are ſuſpended to one end of a ſtring which paſſes over the pulley, and one pound to the other end, the deſcent of the two pounds will be the ſame with that of a four pound weight, which is employed in the ſame manner to draw up two pounds. Our machine would therefore continue to make four turns in the minute, and would deliver 90 cubic feet during each turn, and 360 in a minute. But, by ſuppoſition, it is making but two turns in a minute: this muſt proceed from a greater load than three cubic feet of water in each riſing bucket. The machine muſt therefore be raſing *more* than 90 feet of water during one turn of the wheel, and *more* than 180 in the minute.

Water-works.

Thus it appears, that if the machine be turning twice as ſlow as before, there is *more than twice the former quantity* in the riſing buckets, and more will be raiſed in a minute by the ſame expenditure of power. In like manner, if the machine go three times as ſlow, there muſt be *more than three times* the former quantity of water in the riſing buckets, and more work will be done.

But we may go farther, and aſſert, that the *more* we retard the machine, by loading it with more work of a ſimilar kind, the greater will be its performance. This does not immediately appear from the preſent diſcuſſion: But let us call the firſt quantity of water in the riſing bucket A; the water raiſed by four turns in a minute will be $4 \times 30 \times \mathrm{A}$, $= 120$ A. The quantity in this bucket, when the machine goes twice as ſlow, has been ſhown to be greater than 2 A (call it $2\,\mathrm{A} + x$); the water raiſed by two turns in a minute will be $2 \times 30 \times 2\,\mathrm{A} + x = 120\,\mathrm{A} + 60\,x$. Now, let the machine go four times as ſlow, making but one turn in a minute, the riſing bucket muſt now contain more than twice $2\,\mathrm{A} + x$, or more than $4\,\mathrm{A} + 2\,x$; call it $4\,\mathrm{A} + 2\,x + y$. The work done by one turn in a minute will now be $30 + 4\,\mathrm{A} + 2\,x + y = 120\,\mathrm{A} + 60\,x + 30\,y$.

By ſuch an induction of the work, done with any rates of motion we chooſe, it is evident that the performance of the machine increaſes with every diminution of its velocity that is produced by the mere addition of a ſimilar load of work, or that it does the more work the ſlower it goes.

We have ſuppoſed the machine to be in its ſtate of permanent uniform motion. If we conſider it only in the beginning of its motion, the reſult is ſtill more in favour of ſlow motion: For, at the firſt action of the moving power, the inertia of the machine itſelf conſumes part of it, and it acquires its permanent ſpeed by degrees; during which, the reſiſtances ariſing from the work, friction, &c. increaſe, till they exactly balance the preſſure of the water; and after this the machine accelerates no more. Now the greater the power and the reſiſtance ariſing from the work are, in proportion to the inertia of the machine, the ſooner will all arrive at its ſtate of permanent velocity.

There is another circumſtance which impairs the performance of an overſhot wheel moving with a great velocity, viz. the effects of the centrifugal force on the water

Water-works.

water in the buckets. Our mill-wrights know well enough, that too great velocity will throw the water out of the buckets; but few, if any, know exactly the diminution of power produced by this cauſe. The following very ſimple conſtruction will determine this:

Fig. 10.

Let AOB (fig. 10.) be an overſhot wheel, of which AB is the upright diameter, and C is the centre. Make CF the length of a pendulum, which will make two vibrations during one turn of the wheel. Draw FE to the elbow of any of the buckets. The water in this bucket, inſtead of having its ſurface horizontal, as NO, will have it in the direction *n* O perpendicular to FE very nearly.

For the time of falling along half of FC is to that of two vibrations of this pendulum, or to the time of a revolution of the wheel, as the radius of a circle is to its circumference: and it is well known, that the time of moving along half of AC, by the uniform action of the centrifugal force, is to that of a revolution as the radius of a circle to its circumference. Therefore the time of deſcribing one half of AC by the centrifugal force, is equal to the time of deſcribing one half of FC by gravity. Theſe ſpaces, being ſimilarly deſcribed in equal times, are proportional to the accelerating forces. Therefore $\frac{1}{2}$ FC : $\frac{1}{2}$ AC, or FC : AC = gravity : centrifugal force. Complete the parallelogram FCEK. A particle at E is urged by its weight in the direction KE, with a force which may be expreſſed by FC or KE; and it is urged by the centrifugal force in the direction CE, with a force = AC or CE. By their combined action it is urged in the direction FE. Therefore, as the ſurface of ſtanding water is always at right angles to the action of gravity, that is, to the plumb-line, ſo the ſurface of the water in the revolving bucket is perpendicular to the action of the combined force FE.

Let NEO be the poſition of the bucket, which juſt holds all the water which it received as it paſſed the ſpout when not affected by the centrifugal force; and let NDO be its poſition when it would be empty. Let the vertical lines through D and E cut the circle deſcribed round C with the radius CF in the points H and I. Draw HC, IC, cutting the circle AOB in L and M. Make the arch $d'\delta$ equal to AL, and the arch $e'\varepsilon$ equal to AM: Then Cδ and Cε will be the poſitions of the bucket on the revolving wheel, correſponding to CDO and CEO on the wheel at reſt. Water will begin to run out at ε, and it will be all gone at δ.—The demonſtration is evident.

The force which now urges the wheel is ſtill the weight *really* in the buckets: For though the water be urged in the direction with the force FE, one of its conſtituents, CE, has no tendency to impel the wheel; and KE is the only impelling force.

It is but of late years that mills have been conſtructed or attended to with that accuracy and ſcientific ſkill which are neceſſary for deducing confidential concluſions from any experiments that can be made with them; and it is therefore no matter of wonder that the opinions of mill-wrights have been ſo different on this ſubject. There is a natural wiſh to ſee a machine moving briſkly; it has the appearance of activity: but a very ſlow motion always looks as if the machine were overloaded. For this reaſon mill-wrights have always yielded ſlowly, and with ſome reluctance, to the repeated advices of the mathematicians: but they have yielded; and we ſee them adopting maxims of conſtruction more agreeable to ſound theory; making their wheels of great breadth, and loading them with a great deal of work. Mr Euler ſays, that the performance of the beſt mill cannot exceed that of the worſt above $\frac{1}{7}$th: but we have ſeen a ſtream of water completely expended in driving a ſmall flax mill, which now drives a cotton mill of 4000 ſpindles, with all its carding, roving, and drawing machinery, beſides the lathes and other engines of the ſmith and carpenters workſhops, exerting a force not leſs than ten times what ſufficed for the flax mill. Water-works.

The above diſcuſſion only demonſtrates in general the advantage of ſlow motion; but does not point out in any degree the relation between the rate of motion and the work performed, nor even the principles on which it depends. Yet this is a ſubject fit for a mathematical inveſtigation; and we would proſecute it in this place, if it were neceſſary for the improvement of practical mechanics. But we have ſeen that there is not, in the nature of things, a maximum of performance attached to any particular rate of motion which ſhould therefore be preferred. For this reaſon we omit this diſcuſſion of mere ſpeculative curioſity. It is very intricate: For we muſt not now expreſs the preſſure on the wheel by a *conſtant* pillar of water incumbent on the extremity of the horizontal arm, as we did before when we ſuppoſed the buckets completely filled; nor by a ſmaller *conſtant* pillar, correſponding to a ſmaller but equal quantity lying in every bucket. Each different velocity puts a different quantity of water into the bucket as it paſſes the ſpout; and this occaſions a difference in the place where the diſcharge is begun and completed. This circumſtance is ſome obſtacle to the advantages of very ſlow motions, becauſe it brings on the diſcharge ſooner. All this may indeed be expreſſed by a ſimple equation of eaſy management; but the whole proceſs of the mechanical diſcuſſion is both intricate and tedious, and the reſults are ſo much diverſified by the forms of the buckets, that they do not afford any rule of ſufficient generality to reward our trouble. The curious reader may ſee a very full inveſtigation of this ſubject in two diſſertations by Elvius in the Swediſh Tranſactions, and in the *Hydrodynamique* of Profeſſor Karſtner of Gottingen; who has abridged theſe Diſſertations of Elvius, and conſiderably improved the whole inveſtigation, and has added ſome compariſons of his deductions with the actual performance of ſome great works. Theſe compariſons, however, are not very ſatisfactory. There is alſo a valuable paper on this ſubject by Mr Lambert, in the Memoirs of the Academy of Berlin for the year 1775. From theſe diſſertations, and from the *Hydrodynamique* of the abbe Boſſut, the reader will get all that theory can teach of the relation between the preſſures of the power and work on the machine and the rates of its motion. The practical reader may reſt with confidence on the ſimple demonſtration we have given, that the performance is improved by diminiſhing the velocity.

All we have to do, therefore, is to load the machine, and thus to diminiſh its ſpeed, unleſs other phyſical circumſtances throw obſtacles in the way: but there are ſuch obſtacles. In all machines there are little inequalities of action that are unavoidable. In the action of a wheel and pinion, though made with the utmoſt judgement and care, there are ſuch inequalities. Theſe increaſe

Water-works. creaſe by the changes of form occaſioned by the wearing of the machine—much greater irregularities ariſe from the ſubſultory motions of cranks, ſtampers, and other parts which move unequally or reciprocally. A machine may be ſo loaded as juſt to be in equilibrio with its work, in the favourable poſition of its parts. When this changes into one leſs favourable, the machine may ſtop; if not, it at leaſt ſtaggers, hobbles, or works unequally. The rubbing parts bear long on each other, with enormous preſſures, and cut deep, and increaſe friction. Such ſlow motions muſt therefore be avoided. A little more velocity enables the machine to get over thoſe increaſed reſiſtances by its inertia, or the great quantity of motion inherent in it. Great machines poſſeſs this advantage in a ſuperior degree, and will therefore work ſteadily with a ſmaller velocity. Theſe circumſtances are hardly ſuſceptible of mathematical diſcuſſion, and our beſt reliance is on well-directed experience.

For this purpoſe, the reader will do well to peruſe with care the excellent paper by Mr Smeaton in the Philoſophical Tranſactions for 1759. This diſſertation contains a numerous liſt of experiments, moſt judiciouſly contrived by him, and executed with the accuracy and attention to the moſt important circumſtances, which is to be obſerved in all that gentleman's performances.

It is true, theſe experiments were made with ſmall models; and we muſt not, without great caution, tranſfer the reſults of ſuch experiments to large works. But we may ſafely transfer the laws of variation which reſult from a variation of circumſtances, although we muſt not adopt the abſolute quantities of the variations themſelves. Mr Smeaton was fully aware of the limitations to which concluſions drawn from experiments on models are ſubject, and has made the applications with his uſual ſagacity.

His general inference is, that, in ſmaller works, the rim of the overſhot-wheel ſhould not have a greater velocity than three feet in a ſecond; but that larger mills may be allowed a greater velocity than this. When every thing is executed in the beſt manner, he ſays that the work performed will amount to fully two-thirds of the power expended; that is, that three cubic feet of water deſcending from any height will raiſe two to the ſame height.

It is not very eaſy to compare theſe deductions with obſervations on large works; becauſe there are few caſes where we have good meaſures of the reſiſtances oppoſed by the work performed by the machine. Mills employed for pumping water afford the beſt opportunites. But the inertia of their working gear diminiſhes their uſeful performance very ſenſibly; becauſe their great beams, pump-rods, &c. have a reciprocating motion, which muſt be deſtroyed, and produced anew in every ſtroke. We have examined ſome machines of this kind which are eſteemed good ones; and we find few of them whoſe performance exceeds one half of the power expended.

By comparing other mills with theſe, we get the beſt information of their reſiſtances. The compariſon with mills worked by Watt and Boulton's ſteam-engines is perhaps a better meaſure of the reſiſtances oppoſed by different kinds of work, becauſe their power is very diſtinctly known. We have been informed by one of the moſt eminent engineers, that a ton and a half of water per minute falling one foot will grind and dreſs one buſhel of wheat per hour. This is equivalent to 9 tons falling 10 feet. Water-works.

If an overſhot-wheel oppoſed no reſiſtance, and only one bucket were filled, the wheel would acquire the velocity due to a fall through the whole height. But when it is in this ſtate of accelerated motion, if another bucket of water is delivered into it, its motion muſt be checked at the firſt, by the neceſſity of dragging forward this water. If the buckets fill in ſucceſſion as they paſs the ſpout, the velocity acquired by an unreſiſting wheel is but half of that which one bucket would give. In all caſes, therefore, the velocity is diminiſhed by the inertia of the entering water when it is ſimply laid into the upper buckets. The performance will therefore be improved by delivering the water on the wheel with that velocity with which the wheel is really moving. And as we cannot give the direction of a tangent to the wheel, the velocity with which it is delivered on the wheel muſt be ſo much greater than the intended velocity of the rim, that it ſhall be preciſely equal to it when it is eſtimated in the direction of the tangent. Three or four inches of fall are ſufficient for this purpoſe; and it ſhould never be neglected, for it has a very ſenſible influence on the performance. But it is highly improper to give it more than this, with the view of impelling the wheel by its ſtroke. For even although it were proper to employ part of the fall in this way (which we ſhall preſently ſee to be very improper), we cannot procure this impulſe; becauſe the water falls among other water, or it ſtrikes the boards of the wheel with ſuch obliquity that it cannot produce any ſuch effect.

It is a much debated queſtion among mill-wrights, Whether the diameter of the wheel ſhould be ſuch as that the water will be delivered at the top of the wheel? or larger, ſo that the water is received at ſome diſtance from the top, where it will act more perpendicularly to the arm? We apprehend that the obſervations formerly made will decide in favour of the firſt practice. The ſpace below, where the water is diſcharged from the wheel, being proportional to the diameter of the wheel, there is an undoubted loſs of fall attending a large wheel; and this is not compenſated by delivering the water at a greater diſtance from the perpendicular. We ſhould therefore recommend the uſe of the whole deſcending ſide, and make the diameter of the wheel no greater than the fall, till it is ſo much reduced that the centrifugal force begins to produce a ſenſible effect. Since the rim can hardly have a ſmaller velocity than three feet per ſecond, it is evident that a ſmall wheel muſt revolve more rapidly. This made it proper to inſert the determination that we have given, of the loſs of power produced by the centrifugal force. But even with this in view, we ſhould employ much ſmaller wheels than are generally done on ſmall falls. Indeed the loſs of water at the bottom may be diminiſhed, by nicely fitting the arch which ſurrounds the wheel, ſo as not to allow the water to eſcape by the ſides or bottom. While this improvement remains in good order, and the wheel entire, it produces a very ſenſible effect; but the paſſage widens continually by the wearing of the wheel. A bit of ſtick or ſtone falling in about the wheel tears off part of the ſhrouding or bucket, and froſty weather frequently binds all faſt. It therefore ſeldom anſwers expectations. We have nothing to add on this caſe

Water-works.

to what we have already extracted from Mr Smeaton's Diſſertation on the Subject of Breaſt or half Overſhot Wheels.

There is another form of wheel by which water is made to act on a machine by its weight, which merits conſideration. This is known in this country by the name of *Barker's mill*, and has been deſcribed by Deſaguliers, vol. ii. p. 460. It conſiſts of an upright pipe or trunk AB (fig. 11.), communicating with two horizontal branches BC, B *c*, which have a hole C *c* near their ends, opening in oppoſite directions, at right angles to their lengths. Suppoſe water to be poured in at the top from the ſpout F, it will run out by the holes C and *c* with the velocity correſponding to the depth of theſe holes under the ſurface. The conſequence of this muſt be, that the arms will be preſſed backwards; for there is no ſolid ſurface at the hole C, on which the lateral preſſure of the water can be exerted, while it acts with its full force on the oppoſite ſide of the arm. This unbalanced preſſure is equal to the weight of a column having the orifice for its baſe, and twice the depth under the ſurface of the water in the trunk for its height. This meaſure of the height may ſeem odd, becauſe if the orifice were ſhut, the preſſure on it is the weight of a column reaching from the ſurface. But when it is open, the water iſſues with nearly the velocity acquired by falling from the ſurface, and the quantity of motion produced is that of a column of twice this length, moving with this velocity. This is actually produced by the preſſure of the fluid, and muſt therefore be accompanied by an equal reaction.

Fig. 11.

Now ſuppoſe this apparatus ſet on the pivot E, and to have a ſpindle AD above the trunk, furniſhed with a cylindrical bobbin D, having a rope wound round it, and paſſing over a pulley G. A weight W may be ſuſpended there, which may balance this backward preſſure. If the weight be too ſmall for this purpoſe, the retrograde motion of the arms will wind up the cord, and raiſe the weight; and thus we obtain an acting machine, employing the preſſure of the water, and applicable to any purpoſe. A runner millſtone may be put on the top of the ſpindle; and we ſhould then produce a flour mill of the utmoſt ſimplicity, having neither wheel nor pinion, and ſubject to hardly any wear. It is ſomewhat ſurpriſing, that although this was invented at the beginning of this century, and appears to have ſuch advantage in point of ſimplicity, it has not come into uſe. So little has Dr Deſaguliers's account been attended to (although it is mentioned by him as an excellent machine, and as highly inſtructive to the hydrauliſt), that the ſame invention was again brought forward by a German profeſſor (Segner) as his own, and has been honoured by a ſeries of elaborate diſquiſitions concerning its theory and performance by Euler and by John Bernoulli. Euler's Diſſertations are to be found in the Memoirs of the Academy of Berlin, 1751, &c. and in the *Nov. Comment. Petropol.* tom. vi. Bernoulli's are at the end of his Hydraulics. Both theſe authors agree in ſaying, that this machine excels all other methods of employing the force of water. Simple as it appears, its true theory, and the beſt form of conſtruction, are moſt abſtruſe and delicate ſubjects; and it is not eaſy to give ſuch an account of its principles as will be underſtood by an ordinary reader.

We ſee, in general, that the machine muſt preſs backwards; and little inveſtigation ſuffices for underſtanding the intenſity of this preſſure, when the machine is at reſt. But when it is allowed to run backwards, withdrawing itſelf from the preſſure, the intenſity of it is diminiſhed; and if no other circumſtances intervened, it might not be difficult to ſay what particular preſſure correſponded to any rate of motion. Accordingly, Deſaguliers, preſuming on the ſimplicity of the machine, affirms the preſſure to be the weight of a column, which would produce a velocity of efflux equal to the difference of the velocity of the fluid and of the machine; and hence he deduces, that its performance will be the greateſt poſſible, when its retrograde velocity is one-third of the velocity acquired by falling from the ſurface, in which caſe, it will raiſe $\frac{8}{27}$ths of the water expended to the ſame height, which is double of the performance of a mill acted on by the impulſe of water.

But this is a very imperfect account of the operation. When the machine (conſtructed exactly as we have deſcribed) moves round, the water which iſſues deſcends in the vertical trunk, and then, moving along the horizontal arms, partakes of this circular motion. This excites a centrifugal force, which is exerted againſt the ends of the arms by the intervention of the fluid. The whole fluid is ſubjected to this preſſure (increaſing for every ſection acroſs the arm in the proportion of its diſtance from the axis), and every particle is preſſed with the accumulated centrifugal forces of all the ſections that are nearer to the axis. Every ſection therefore ſuſtains an actual preſſure proportional to the ſquare of its diſtance from the axis. This increaſes the velocity of efflux, and this increaſes the velocity of revolution; and this mutual co-operation would ſeem to terminate in an infinite velocity of both motions. But, on the other hand, this circular motion muſt be given anew to every particle of water as it enters the horizontal arm. This can be done only by the motion already in the arm, and at its expence. Thus there muſt be a velocity which cannot be overpaſſed even by an unloaded machine. But it is alſo plain, that by making the horizontal arm very capacious, the motion of the water from the axis to the jet may be made very ſlow, and much of this diminution of circular motion prevented. Accordingly, Euler has recommended a form by which this is done in the moſt eminent degree. His machine conſiſts of a hollow conoidal ring, of which fig. 12. is a ſection. The part AH *h a* is a ſort of a funnel baſon, which receives the water from the ſpout F; not in the direction pointing towards the axis, but in the direction, and with the preciſe velocity, of its motion. This prevents any retardation by dragging forward the water. The water then paſſes down between the outer conoid AC *c a* and the inner conoid HG *g h* along ſpiral channels formed by partitions ſoldered to both conoids. The curves of theſe channels are determined by a theory which aims at the annihilation of all unneceſſary and improper motions of the water, but which is too abſtruſe to find a place here. The water thus conducted arrives at the bottom CG, *c g*. On the outer circumference of this bottom are arranged a number of ſpouts (one for each channel), which are all directed one way in tangents to the circumference.

Fig. 12.

Adopting the common theory of the reaction of fluids, this ſhould be a very powerful machine, and ſhould raiſe $\frac{8}{27}$ths of the water expended. But if we admit the reaction

Water-works.

action to be equal to the force of the iſſuing fluid (and we do not ſee how this can be refuſed), the machine muſt be nearly twice as powerful. We therefore repeat our wonder, that it has not been brought into uſe. But it appears that no trial has been made even of a model; ſo that we have no experiments to encourage an engineer to repeat the trial. Even the late author, Profeſſor Segner, has not related any thing of this kind in his *Exercitationes Hydraulicæ*, where he particularly deſcribes the machine. This remiſſneſs probably has proceeded from fixing the attention on Euler's improved conſtruction. It is plain that this muſt be a moſt cumbrous maſs, even in a ſmall ſize requiring a prodigious veſſel, and carrying an unwieldy load. If we examine the theory which recommends this conſtruction, we find that the advantages, though real and ſenſible, bear but a ſmall proportion to the whole performance of the ſimple machine as invented by Dr Barker. It is therefore to be regretted, that engineers have not attempted to realize the firſt project. We beg leave to recommend it, with an additional argument taken from an addition made to it by Mr Mathon de la Cour, in Rozier's *Journal de Phyſique*, January and Auguſt 1775. This
Fig. 13. gentleman brings down a large pipe FEH (fig. 13.) from a reſervoir, bends it upward at H, and introduces it into two horizontal arms DA, DB, which have an upright ſpindle DK, carrying a millſtone in the ſtyle of Dr Barker's mill. The ingenious mechanician will have no difficulty of contriving a method of joining theſe pipes, ſo as to permit a free circular motion without loſing much water. The operation of the machine in this form is evident. The water, preſſed by the column FG, flows out at the holes A and B, and the unbalanced preſſure on the oppoſite ſides of the arms forces them round. The compendiouſneſs and other advantages of this conſtruction are moſt ſtriking, allowing us to make uſe of the greateſt fall without any increaſe of the ſize of the machine. It undoubtedly enables us to employ a ſtream of water too ſcanty to be employed in any other form. The author gives the dimenſions of an engine which he had ſeen at Bourg Argental. AB is 92 inches, and its diameter 3 inches; the diameter of each orifice is $1\frac{1}{6}$; FG is 21 feet; the pipe D was fitted into C by grinding; and the internal diameter of D is 2 inches.

When the machine was performing no work, or was unloaded, and emitted water by one hole only, it made 115 turns in a minute. This gives a velocity of 46 feet per ſecond for the hole. This is a curious fact: For the water would iſſue from this hole at reſt with the velocity of $37\frac{1}{6}$. This great velocity (which was much leſs than the velocity with which the water actually quitted the pipe) was undoubtedly produced by the prodigious centrifugal force, which was nearly 17 times the weight of the water in the orifice.

The empty machine weighed 80 pounds, and its weight was half-ſupported by the upper preſſure of the water, ſo that the friction of the pivots was much diminiſhed. It is a pity that the author has given no account of any work done by the machine. Indeed it was only working ventilators for a large hall. His theory by no means embraces all its principles, nor is it well-founded.

We think that the free motion round the neck of the feeding-pipe, without any loſs of water or any conſiderable friction, may be obtained in the following manner: AB (fig. 14.) repreſents a portion of the revolving horizontal pipe, and CE *e c* part of the feeding pipe. The neck of the firſt is turned truly cylindrical, ſo as to turn eaſily, but without ſhake, in the collar C *c* of the feeding-pipe, and each has a ſhoulder which may ſupport the other. That the friction of this joint may not be great, and the pipes deſtroy each other by wearing, the horizontal pipe has an iron ſpindle EF, fixed exactly in the axis of the joint, and reſting with its pivot F in a ſtep of hard ſteel, fixed to the iron bar GH, which goes acroſs the feeding-pipe, and is firmly ſupported in it. This pipe is made bell-ſhaped, widening below. A collar or hoſe of thin leather is fitted to the inſide of this pipe, and is repreſented (in ſection) by LKM *m k l*. This is kept in its place by means of a metal or wooden ring N *n*, thin at the upper edge, and taper-ſhaped. This is drawn in above the leather, and ſtretches it, and cauſes it to apply to the ſide of the pipe all around. There can be no leakage at this joint, becauſe the water will preſs the leather to the ſmooth metal pipe; nor can there be any ſenſible friction, becauſe the water gets at the edge of the leather, and the whole unbalanced preſſure is at the ſmall crevice, between the two metal ſhoulders. Theſe ſhoulders need not touch, ſo that the friction muſt be inſenſible. We imagine that this method of tightening a turning joint may be uſed with great advantage in many caſes.

We have only further to obſerve on this engine, that any imperfection by which the paſſage of the water is diminiſhed or obſtructed produces a ſaving of water which is in exact proportion to the diminution of effect. The only inaccuracy that is not thus compenſated is when the jets are not at right angles to the arms.

We repeat our wiſhes, that engineers would endeavour to bring this machine into uſe, ſeeing many ſituations where it may be employed to great advantage. Suppoſe, for inſtance, a ſmall ſupply of water from a great height applied in this manner to a centrifugal pump, or to a hair belt paſſing over a pulley, and dipping in the water of a deep well. This would be a hydraulic machine exceeding all others in ſimplicity and durability, though inferior in effect to ſome other conſtructions.

2. *Of Underſhot Wheels.*

All wheels go by this name where the motion of the water is quicker than that of the partitions or boards of the wheel, and it therefore impels them. Theſe are called the *float-boards*, or *floats*, of an underſhot wheel. The water, running in a mill-row, with a velocity derived from a head of water, or from a declivity of channel, ſtrikes on theſe floats, and occaſions, by its deflections ſidewiſe and upwards, a preſſure on the floats ſufficient for impelling the wheel.

There are few points of practical mechanics that have been more conſidered than the action of water on the floats of a wheel; hardly a book of mechanics being ſilent on the ſubject. But the generality of them, at leaſt ſuch as are intelligible to perſons who are not very much converſant in dynamical and mathematical diſcuſſion, have hardly done any thing more than copied the earlieſt deductions from the ſimple theory of the reſiſtance of fluids. The conſequence has been, that our practical knowledge is very imperfect; and it is ſtill

Water-works.

chiefly from experience that we muſt learn the performance of underſhot wheels. Unfortunately this ſtops their improvement; becauſe thoſe who have the only opportunities of making the experiments are not ſufficiently acquainted with the principles of hydraulics, and are apt to aſcribe differences in their performance to trifling noſtrums in their conſtruction, or in the manner of applying the impulſe of the water.

We have ſaid ſo much on the imperfection of our theories of the impulſe of fluids in the article *RESISTANCE of Fluids*, that we need not repeat here the defects of the common explanations of the motions of underſhot wheels. The part of this theory of the impulſe of fluids which agrees beſt with obſervation is, *that the impulſe is in the duplicate proportion of the velocity with which the water ſtrikes the float.* That is, if v be the velocity of the ſtream, and u the velocity of the float, we ſhall have F, the impulſe on the float when held faſt to its impulſe f on the float moving with the velocity u, as v^2 to $\overline{v-u}^2$, and $f = F \times \frac{\overline{v-u}^2}{v^2}$.

This is the preſſure acting on the float, and urging the wheel round its axis. The wheel muſt yield to this motion, if the reſiſtance of the work does not exert a ſuperior preſſure on the float in the oppoſite direction. By yielding, the float withdraws from the impulſe, and this is therefore diminiſhed. The wheel accelerates, the reſiſtances increaſe, and the impulſes diminiſh, till they become an exact balance for the reſiſtances. The motion now remains uniform, and the momentum of impulſe is equal to that of reſiſtance. The performance of the mill therefore is determined by this; and, whatever be the conſtruction of the mill, its performance is beſt when the momentum of impulſe is greateſt. This is had by multiplying the preſſure on the float by its velocity. Therefore the momentum will be expreſſed by $F \times \frac{\overline{v-u}^2}{v^2} \times u$. But ſince F and v^2 are conſtant quantities, the momentum will be proportional to $u \times \overline{v-u}^2$. Let x repreſent the relative velocity. Then $v-x$ will be $=u$, and the momentum will be proportional to $\overline{v-x} \times x^2$, and will be a maximum when $\overline{v-x} \times x^2$ is a maximum, or when $v x^2 - x^3$ is a maximum. This will be diſcovered by making its fluxion $=0$. That is,

$$2 v x \dot{x} - 3 x^2 \dot{x} = 0,$$

and $2 v x - 3 x^2 = 0$

or $2 v - 3 x = 0$

and $2 v = 3 x$, and $x = \frac{2}{3} v$; and therefore $v-x$, or u, $= \frac{1}{3} v$. That is, the velocity of the float muſt be one-third of the velocity of the ſtream. It only remains to ſay what is the abſolute preſſure on the float thus circumſtanced. Let the velocity v be ſuppoſed to ariſe from the preſſure of a head of water h. The common theory teaches that the impulſe on a given ſurface S at reſt is equal to the weight of a column h S; put this in place of F, and $\frac{4}{9} v^2$ in place of $\overline{v-u}^2$ and $\frac{1}{3} v$ for u. This gives us S $h \times \frac{4}{27} v$ for the momentum. Now the power expended is S $h v$, or the column S h moving with the velocity v. Therefore the greateſt performance of an underſhot wheel is equivalent to raiſing $\frac{4}{27}$ of the water that drives it to the ſame height.

But this is too ſmall an eſtimation; for the preſſure exerted on a plane ſurface, ſituated as the float of a mill-wheel, is conſiderably greater than the weight of the column S h. This is nearly the preſſure on a ſurface wholly immerſed in the fluid. But when a ſmall vein ſtrikes a larger plane, ſo as to be deflected on all ſides in a thin ſheet, the impulſe is almoſt double of this. This is in ſome meaſure the caſe in a mill wheel. When the ſtream ſtrikes it, it is heaped up along its face, and falls back again—and during this motion it is acting with a hydroſtatic preſſure on it. When the wheel dips into an open river, this accumulation is leſs remarkable, becauſe much eſcapes laterally. But in a mill courſe it may be conſiderable.

Water-works.

We have conſidered only the action on one float, but ſeveral generally act at once. The impulſe on moſt of them muſt be oblique, and is therefore leſs than when the ſame ſtream impinges perpendicularly; and this diminution of impulſe is, by the common theory, in the proportion of the ſine of the obliquity. For this reaſon it is maintained, that the impulſe of the whole ſtream on the loweſt floatboard, which is perpendicular to the ſtream, is equal to the ſum of the impulſes made on all the floats which then dip into the water; or that the impulſe on any oblique float is preciſely equal to the impulſe which that part of the ſtream would have made on the loweſt floatboard had it not been interrupted. Therefore it has been recommended to make ſuch a number of floatboards, that when one of them is at the bottom of the wheel, and perpendicular to the ſtream, the next in ſucceſſion ſhould be juſt entering into the water. But ſince the impulſe on a float by no means annihilates all the motion of the water, and it bends round it and hits the one behind with its remaining force, there muſt be ſome advantage gained by employing a greater number of floats than this rule will permit. This is abundantly confirmed by the experiments of Smeaton and Boſſut. Mr Boſſut formed three or four ſuppoſitions of the number of floats, and calculated the impulſe on each; according to the obſervations made in a courſe of experiments made by the Academy of Sciences, and inſerted by us in the article *RESISTANCE of Fluids*; and when he ſummed them up, and compared the reſults with his experiments, he found the agreement very ſatisfactory. He deduces a general rule, that if the velocity of the wheel is one-third of that of the ſtream, and if 72 degrees of the circumference are immerſed in the ſtream, the wheel ſhould have 36 floats. Each will dip one-fifth of the radius. The velocity being ſtill ſuppoſed the ſame, there ſhould be more or fewer floats according as the arch is leſs or greater than 72 degrees.

Such is the theory, and ſuch are the circumſtances which it leaves undetermined. The accumulation of the water on a floatboard, and the force with which it may ſtill ſtrike another, are too intricate to be aſſigned with any tolerable preciſion: For ſuch reaſons we muſt acknowledge that the theory of underſhot wheels is ſtill very imperfect, and that recourſe muſt be had to experience for their improvement. We therefore ſtrongly recommend the peruſal of Mr Smeaton's experiments on underſhot wheels, contained in the ſame diſſertation with thoſe we have quoted on overſhot wheels. We have only to obſerve, that to an ordinary reader the experiments will appear too much in favour of underſhot wheels. His aim is partly to eſtabliſh a theory, which will ſtate the relation between their performance and the velocity

Water-works.

of the ſtream, and partly to ſtate the relation between the power expended and the work done. The velocity in his experiments is always conſiderably below that which a body would acquire by falling from the ſurface of the head of water; or it is the velocity acquired by a ſhorter fall. Therefore if we eſtimate the power expended by the quantity of water multiplied by this diminiſhed fall, we ſhall make it too ſmall; and the difference in ſome caſes is very great: yet, even with theſe conceſſions, it appears that the utmoſt performance of an underſhot wheel does not ſurpaſs the raiſing one-third of the expended water to the place from which it came. It is therefore far inferior to an overſhot wheel expending the ſame power; and Mr Belidor has led engineers into very miſtaken maxims of conſtruction, by ſaying that overſhot wheels ſhould be given up, even in the caſe of great falls, and that we ſhould always bring on the water from a ſluice in the very bottom of the dam, and bring it to the wheel with as great a velocity as poſſible. Mr Smeaton alſo ſays, that the maximum takes place when the velocity of the wheel is two-fifths of that of the ſtream, inſtead of two-ſixths according to the theory; and this agrees with the experiments of Boſſut. But he meaſured the velocity by means of the quantity of water which run paſt. This muſt give a velocity ſomewhat too ſmall; as will appear by attending to Buat's obſervations on the ſuperficial, the mean, and the bottom velocities.

The reſt of his obſervations are moſt judicious, and well adapted to the inſtruction of practitioners. We have only to add to them the obſervations of Des Parcieux and Boſſut, who have evinced, by very good experiments, that there is a very ſenſible advantage gained by inclining the floatboards to the radius of the wheel about 20 degrees, ſo that the loweſt floatboard ſhall not be perpendicular, but have its point turned up the ſtream about 20 degrees. This inclination cauſes the water to heap up along the floatboard, and act by its weight. The floats ſhould therefore be made much broader than the vein of water interrupted by them is deep.

Some engineers, obſerving the great ſuperiority of overſhot wheels above underſhot wheels driven by the ſame expence of power, have propoſed to bring the water home to the bottom of the wheel on an even bottom, and to make the floatboard no deeper than the aperture of the ſluice, which would permit the water to run out. The wheel is to be fitted with a cloſe ſole and ſides, exactly fitted to the end of this trough, ſo that if the wheel is at reſt, the water may be dammed up by the ſole and floatboard. It will therefore preſs forward the floatboard with the whole force of the head of water. But this cannot anſwer; for if we ſuppoſe no floatboards, the water will flow out at the bottom, propelled in the manner thoſe perſons ſuppoſe; and it will be ſupplied from behind, the water coming *ſlowly* from all parts of the trough to the hole below the wheel. But now add the floats, and ſuppoſe the wheel in motion with the velocity that is expected. The other floats muſt drag into motion all the water which lies between them, giving to the greateſt part of it a motion vaſtly greater than it would have taken in conſequence of the preſſure of the water behind it; and the water out of the reach of the floats will remain ſtill, which it would not have done independent of the floatboards above it, becauſe it would have contributed to the expence of the hole. The motion therefore which the wheel will acquire by this conſtruction muſt be ſo different from what is expected, that we can hardly ſay what it will be. Water-works.

We are therefore perſuaded that the beſt way of delivering the water on an underſhot wheel in a cloſe mill-courſe is, to let it ſlide down a very ſmooth channel, without touching the wheel till near the bottom, where the wheel ſhould be exactly fitted to the courſe; or, to make the floats exceedingly broader than the depth of the vein of water which glides down the courſe, and allow it to be partly intercepted by the firſt floats, and heap up along them, acting by its weight, after its impulſe has been expended. If the bottom of the courſe be an arch of a circle deſcribed with a radius much greater than that of the wheel, the water which ſlides down will be thus gradually intercepted by the floats.

Attempts have been made to conſtruct water-wheels which receive the impulſe obliquely, like the ſails of a common wind-mill. This would, in many ſituations, be a very great acquiſition. A very ſlow but deep river could in this manner be made to drive our mills; and although much power is loſt by the obliquity of the impulſe, the remainder may be very great. It is to be regretted, that theſe attempts have not been more zealouſly proſecuted; for we have no doubt of their ſucceſs in a very ſerviceable degree. Engineers have been deterred, becauſe when ſuch wheels are plunged in an open ſtream, their lateral motion is too much impeded by the motion of the ſtream. We have ſeen one, however, which was very powerful: It was a long cylindrical frame, having a plate ſtanding out from it about a foot broad, and ſurrounding it with a very oblique ſpiral like a cork-ſcrew. This was plunged about one-fourth of its diameter (which was about 12 feet), having its axis in the direction of the ſtream. By the work which it was performing, it ſeemed more powerful than a common wheel which occupied the ſame *breadth* of the river. Its length was not leſs than 20 feet: it might have been twice as much, which would have doubled its power, without occupying more of the water-way. Perhaps ſuch a ſpiral, continued to the very axis, and moving in a hollow canal wholly filled by the ſtream, might be a very advantageous way of employing a deep and ſlow ſtream.

But mills with oblique floats are moſt uſeful for employing ſmall ſtreams, which can be delivered from a ſpout with a great velocity. Mr Boſſut has conſidered theſe with due attention, and aſcertained the beſt modes of conſtruction. There are two which have nearly equal performances: 1. The vanes being placed like thoſe of a wind-mill, round the rim of a horizontal or vertical wheel, and being made much broader than the vein of water which is to ſtrike them, let the ſpout be ſo directed that the vein may ſtrike them perpendicularly. By this meaſure it will be ſpread about on the vane in a thin ſheet, and exert a preſſure nearly equal to twice the weight of a column whoſe baſe is the orifice of the ſpout, and whoſe height is the fall producing the velocity.

Mills of this kind are much in uſe in the ſouth of Europe. The wheel is horizontal, and the vertical axis carries the millſtone; ſo that the mill is of the utmoſt ſimplicity: and this is its chief recommendation; for its power is greatly inferior to that of a wheel conſtructed in the uſual manner.

2. The vanes may be arranged round the rim of the wheel.

Water-works.

wheel, not like the ſails of a wind-mill, but in planes inclined to the radii, but parallel to the axis, or to the planes paſſing through the axis. They may either ſtand on a ſole, like the oblique floats recommended by De Parcieux, as above mentioned: or they may ſtand on the ſide of the rim, not pointing to the axis, but aſide from it.

This diſpoſition will admit the ſpout to be more conveniently diſpoſed either for a horizontal or a vertical wheel.

We ſhall conclude this article by deſcribing a contrivance of Mr Burns, the inventor of the double bucketed wheel, for fixing the arms of a water-wheel. It is well known to mill-wrights that the method of fixing them by making them to paſs through the axle, weakens it exceedingly, and by lodging water in the joint, ſoon cauſes it to rot and fail. They have, therefore, of late years put caſt-iron flanches on the axis, to which each arm is bolted: or the flanches are ſo faſhioned as to form boxes, ſerving as mortiſes to receive the ends of the arms. Theſe anſwer the purpoſe completely, but are very expenſive; and it is found that arms of fir bolted into flanches of iron, are apt to work looſe. Mr Burns has made wooden flanches of a very curious conſtruction, which are equally firm, and coſt much leſs than the iron ones.

Fig. 15.

This flanch conſiſts of eight pieces, four of which compoſe the ring repreſented in fig. 15. meeting in the joints $a\,b$, $a\,b$, $a\,b$, $a\,b$, directed to the centre O. The other four are covered by theſe, and their joints are repreſented by the dotted lines $\alpha\beta$, $\alpha\beta$, $\alpha\beta$, $\alpha\beta$. Theſe two rings break joint in ſuch a manner that an arm MN is contained between the two neareſt joints $a'\,b'$ of the one, and $\alpha'\,\beta'$ of the other. The tenon formed on the one end of the arm A, &c. is of a particular ſhape: one ſide, GF, is directed to the centre O; the other ſide, BCDE, has a ſmall ſhoulder BC; then a long ſide CD directed to the centre O; and then a third part DE parallel to GF, or rather diverging a little from it, ſo as to make up at E the thickneſs of the ſhoulder BC; that is, a line from B to E would be parallel to CD. This ſide of the tenon fits exactly to the correſponding ſide of the mortiſe; but the mortiſe is wider on the other ſide, leaving a ſpace GFK h a little narrower at FK than at G h. Theſe tenons and mortiſes are made extremely true to the ſquare; the pieces are put round the axle, with a few blocks or wedges of ſoft wood put between them and the axle, leaving the ſpace empty oppoſite to the place of each arm, and firmly bolted together by bolts between the arm-mortiſes. The arms are then put in, and each is preſſed home to the ſide CDE, and a wedge HF of hard wood is then put into the empty part of the mortiſe and driven home. When it comes through the flanch and touches the axle, the part which has come through is cut off with a thin chiſel, and the wedge is driven better home. The ſpaces under the ends of the arms are now filled with wedges, which are driven home from oppoſite ſides, till the circle of the arms ſtands quite perpendicular on the axle, and all is faſt. It needs no hoops to keep it together, for the wedging it up round the axle makes the two half rings draw cloſe on the arms, and it cannot ſtart at its own joints till it cruſhes the arms. Hoops, however, can do no harm, when all is once wedged up, but it would be improper to put them on before this be done.

Water-works.

A very curious hydraulic machine was erected at Zurich by H. Andreas Wirtz, a tinplate worker of that place. The invention ſhows him to be a perſon of very uncommon mechanical knowledge and ſagacity. As it is a machine which operates on a principle widely different from all other hydraulic machines, and is really excellent in its kind, we preſume that our readers will not be diſpleaſed with ſome account of it.

Fig. 16.

Fig. 16. is a ſketch of the ſection of the machine, as it was firſt erected by Wirtz at a dyehouſe in Limmat, in the ſuburbs or vicinity of Zurich. It conſiſts of a hollow cylinder, like a very large grindſtone, turning on a horizontal axis, and partly plunged in a ciſtern of water. The axis is hollow at one end, and communicates with a perpendicular pipe CBZ′, part of which is hid by the cylinder. This cylinder or drum is formed into a ſpiral canal by a plate coiled up within it like the main-ſpring of a watch in its box; only the ſpires are at a diſtance from each other, ſo as to form a conduit for the water of uniform width. This ſpiral partition is well joined to the two ends of the cylinder, and no water eſcapes between them. The outermoſt turn of the ſpiral begins to widen about three-fourths of a circumference from the end, and this gradual enlargement continues from Q to S nearly a ſemicircle: this part may be called the HORN. It then widens ſuddenly, forming a SCOOP or ſhovel SS′. The cylinder is ſupported ſo as to dip ſeveral inches into the water, whoſe ſurface is repreſented by VV′.

When this cylinder is turned round its axis in the direction ABEO, as expreſſed by the two darts, the ſcoop SS′ dips at V′, and takes up a certain quantity of water before it emerges again at V. This quantity is ſufficient to fill the taper part SQ, which we have called the HORN; and this is nearly equal in capacity to the outermoſt uniform ſpiral round.

After the ſcoop has emerged, the water paſſes along the ſpiral by the motion of it round the axis, and drives the air before it into the riſing-pipe, where it eſcapes.—In the mean time, air comes in at the mouth of the ſcoop; and when the ſcoop again dips into the water, it again takes in ſome. Thus there is now a part filled with water and a part filled with air. Continuing this motion, we ſhall receive a ſecond round of water and another of air. The water in any turn of the ſpiral will have its two ends on a level; and the air between the ſucceſſive columns of water will be in its natural ſtate; for ſince the paſſage into the riſing-pipe or MAIN is open, there is nothing to force the water and air into any other poſition. But ſince the ſpires gradually diminiſh in their length, it is plain that the column of water will gradually occupy more and more of the circumference of each. At laſt it will occupy a complete turn of ſome ſpiral that is near the centre; and when ſent farther in, by the continuance of the motion, ſome of it will run back over the top of the ſucceeding ſpiral. Thus it will run over at K 4 into the right-hand ſide of the third ſpiral. Therefore it will puſh the water of this ſpire backwards, and raiſe its other end, ſo that it alſo will run over backwards *before* the next turn be completed. And this change of diſpoſition will at laſt reach the firſt or outermoſt ſpiral, and ſome water will run over into the horn and ſcoop, and finally into the ciſtern.

But as ſoon as water gets into the riſing-pipe, and riſes

Water-works.

riſes a little in it, it ſtops the eſcape of the air when the next ſcoop of water is taken in. Here are now two columns of water acting againſt each other by hydroſtatic preſſure and the intervening column of air. They muſt compreſs the air between them, and the water and air columns will now be unequal. This will have a general tendency to keep the whole water back, and cauſe it to be higher on the left or riſing ſide of each ſpire than on the right deſcending ſide. The exceſs of height will be juſt ſuch as produces the compreſſion of the air between that and the preceding column of water. This will go on increaſing as the water mounts in the riſing-pipe; for the air next to the riſing-pipe is compreſſed at its inner end with the weight of the whole column in the main. It muſt be as much compreſſed at its outer end. This muſt be done by the water column without it; and this column exerts this preſſure partly by reaſon that *its* outer end is higher than its inner end, and partly by the tranſmiſſion of the preſſure on its outer end by air, which is ſimilarly compreſſed from without. And thus it will happen that each column of water, being higher at its outer than at its inner end, compreſſes the air on the water column beyond or within it, which tranſmits this preſſure to the air beyond it, adding to it the preſſure ariſing from its own want of level at the ends. Therefore the greateſt compreſſion, viz. that of the air next the main, is produced by *the ſum of all the tranſmitted preſſures;* and theſe are the ſum of all the differences between the elevation of the inner ends of the water columns above their outer ends: and the height to which the water will riſe in the main will be juſt equal to this ſum.

Draw the horizontal lines K′K 1, K′K 2, K′K 3, &c. and *m n*, *m n*, *m n*, &c. Suppoſe the left-hand ſpaces to be filled with water, and the right-hand ſpaces to be filled with air. There is a certain gradation of compreſſion which will keep things in this poſition. The ſpaces evidently decreaſe in arithmetical progreſſion; ſo do the hydroſtatic heights and preſſures of the water columns. If therefore the air be denſe in the ſame progreſſion, all will be in hydroſtatical equilibrium. Now this is evidently producible by the mere motion of the machine; for ſince the denſity and compreſſion in each air column is ſuppoſed inverſely as the bulk of the column, the abſolute quantity of air is the ſame in all; therefore the column firſt taken in will paſs gradually inwards, and the increaſing compreſſion will cauſe it to occupy preciſely the whole right-hand ſide of every ſpire. The gradual diminution of the water columns will be produced during the motion by the water running over backwards at the top, from ſpire to ſpire, and at laſt coming out by the ſcoop.

It is evident that this diſpoſition of the air and water will raiſe the water to the greateſt height, becauſe the hydroſtatic height of each water column is the greateſt poſſible, viz. the diameter of the ſpire. This diſpoſition may be obtained in the following manner: Take CL to CB as the denſity of the external air to its denſity in the laſt column next the riſing-pipe or main; that is, make CL to CB as 33 feet (the height of the column of water which balances the atmoſphere), to the ſum of 33 feet and the height of the riſing-pipe. Then divide BL into ſuch a number of turns, that the ſum of their diameters ſhall be equal to the height of the main; then bring a pipe ſtraight from L to the centre C. The reaſon of all this is very evident. Water-works.

But when the main is very high, this conſtruction will require a very great diameter of the drum, or many turns of a very narrow pipe. In ſuch caſes it will be much better to make the ſpiral in the form of a cork-ſcrew, as in fig. 17. inſtead of this flat form like a watch-ſpring. The pipe which forms the ſpiral may be lapped round the fruſtum of a cone, whoſe greateſt diameter is to the leaſt (which is next to the riſing-pipe) in the ſame proportion that we aſſigned to CB and CL. By this conſtruction the water will ſtand in every round ſo as to have its upper and lower ſurfaces tangents to the top and bottom of the ſpiral, and the water columns will occupy the whole aſcending ſide of the machine, while the air occupies the deſcending ſide. Fig. 17.

This form is vaſtly preferable to the flat: it will allow us to employ many turns of a large pipe, and therefore produce a great elevation of a large quantity of water.

The ſame thing will be ſtill better done by lapping the pipe on a cylinder, and making it taper to the end, in ſuch a proportion that the contents of each round may be the ſame as when it is lapped round the cone. It will raiſe the water to a greater height (but with an increaſe of the impelling power) by the ſame number of turns, becauſe the vertical or preſſing height of each column is greater.

Nay, the ſame thing may be done in a more ſimple manner, by lapping a pipe of uniform bore round a cylinder. But this will require more turns, becauſe the water columns will have leſs differences between the heights of their two ends. It requires a very minute inveſtigation to ſhow the progreſs of the columns of air and water in this conſtruction, and the various changes of their arrangement, before one is attained which will continue during the working of the machine.

We have choſen for the deſcription of the machine that conſtruction which made its principle and manner of working moſt evident, namely, which contained the ſame material quantity of air in each turn of the ſpiral, more and more compreſſed as it approaches to the riſing-pipe. We ſhould otherwiſe have been obliged to inveſtigate in great detail the gradual progreſs of the water, and the frequent changes of its arrangement, before we could ſee that one arrangement would be produced which would remain conſtant during the working of the machine. But this is not the beſt conſtruction. We ſee that, in order to raiſe water to the height of a column of 34 feet, which balances the atmoſphere, the air in the laſt ſpire is compreſſed into half its bulk; and the quantity of water delivered into the main at each turn is but half of what was received into the firſt ſpire, the reſt flowing back from ſpire to ſpire, and being diſcharged at the ſpout.

But it may be conſtructed ſo as that the quantity of water in each ſpire may be the ſame that was received into the firſt; by which means a greater quantity (double in the inſtance now given) will be delivered into the main, and raiſed to the ſame height by very nearly the ſame force.—This may be done by another proportion of the capacity of the ſpires, whether by a change of their caliber or of their diameters. Suppoſe the bore to be the ſame, the diameter muſt be made ſuch that the conſtant column of water, and the column of air, compreſſed.

Water-works.

preſſed to the proper degree, may occupy the whole circumference. Let A be the column of water which balances the atmoſphere, and h the height to which the water is to be raiſed. Let A be to $A+h$ as 1 to m.

It is plain that m will repreſent the denſity of the air in the laſt ſpire, if its natural denſity be 1, becauſe it is preſſed by the column $A+h$, while the common air is preſſed by A. Let 1 repreſent the conſtant water column, and therefore nearly equal to the air column in the firſt ſpire. The whole circumference of the laſt ſpire muſt be $1+\frac{1}{m}$, in order to hold the water 1, and the air compreſſed into the ſpace $\frac{1}{m}$ or $\frac{A}{A+h}$.

The circumference of the firſt ſpire is $1+1$ or 2. Let D and d be the diameters of the firſt and laſt ſpires; we have $2 : 1+\frac{1}{m} = D : d$, or $2m : m+1 = D : d$. Therefore if a pipe of uniform bore be lapped round a cone, of which D and d are the end diameters, the ſpirals will be very nearly ſuch as will anſwer the purpoſe. It will not be quite exact, for the intermediate ſpirals will be ſomewhat too large. The conoidal fruſtum ſhould be formed by the revolution of a curve of the logarithmic kind. But the error is very trifling.

With ſuch a ſpiral, the full quantity of water which was confined in the firſt ſpiral will find room in the laſt, and will be ſent into the main at every turn. This is a very great advantage, eſpecially when the water is to be much raiſed. The ſaving of power by this change of conſtruction is always in proportion of the greateſt compreſſion of the air.

The great difficulty in the conſtruction of any of theſe forms is in determining the form and poſition of the horn and the ſcoop; and on this greatly depends the performance of the machine. The following inſtructions will make it pretty eaſy.

Fig. 18. Let ABEO (fig. 18.) repreſent the firſt or outermoſt round of the ſpiral, of which the axis is C. Suppoſe it immerged up to the axis in the water VV', we have ſeen that the machine is moſt effective when the ſurfaces KB and O n of the water columns are diſtant the whole diameter BO of the ſpiral. Therefore let the pipe be firſt ſuppoſed of equal caliber to the very mouth E e, which we ſuppoſe to be juſt about to dip into the water. The ſurface O n is kept there, in oppoſition to the preſſure of the water column BAO, by the compreſſed air contained in the quadrant OE, and in the quadrant which lies behind EB. And this compreſſion is ſupported by the columns behind, between this ſpire and the riſing pipe. But the air in the outermoſt quadrant EB is in its natural ſtate, communicating as yet with the external air. When, however, the mouth E e has come round to A, it will not have the water ſtanding in it in the ſame manner, leaving the half ſpace BEO filled with compreſſed air; for it took in and confined only what filled the quadrant BE. It is plain, therefore, that the quadrant BE muſt be ſo ſhaped as to take in and confine a much greater quantity of air; ſo that when it has come to A, the ſpace BEO may contain air ſufficiently denſe to ſupport the column AO. But this is not enough: For when the wide mouth, now at A α, riſes up to the top, the ſurface of the water in it riſes alſo, becauſe the part AO $o\alpha$ is more capacious than the cylindric part OE $e o$ which ſucceeds it, and which cannot contain all the water that it does. Since, then, the water in the ſpire riſes above A, it will preſs the water back from O n to ſome other poſition $m' n'$, and the preſſing height of the water column will be diminiſhed by this riſing on the other ſide of O. In ſhort, the horn muſt begin to widen, not from B, but from A, and muſt occupy the whole ſemicircle ABE; and its capacity muſt be to the capacity of the oppoſite cylindrical ſide as the ſum of BO, and the height of a column of water which balances the atmoſphere to the height of that column. For then the air which filled it, when of the common denſity, will fill the uniform ſide BEO, when compreſſed ſo as to balance the vertical column BO. But even this is not enough; for it has not taken in enough of water. When it dipped into the ciſtern at E, it carried air down with it, and the preſſure of the water in the ciſtern cauſed the water to riſe into it a little way; and ſome water muſt have come over at B from the other ſide, which was drawing narrower. Therefore when the horn is in the poſition EOA, it is not full of water. Therefore when it comes into the ſituation OAB, it cannot be full nor balance the air on the oppoſite ſide. Some will therefore come out at O, and riſe up through the water. The horn muſt therefore, 1ſt, Extend at leaſt from O to B, or occupy half the circumference; and, 2dly, It muſt contain at leaſt twice as much water as would fill the ſide BEO. It will do little harm though it be much larger; becauſe the ſurplus of air which it takes in at E will be diſcharged, as the end E e of the horn riſes from O to B, and it will leave the preciſe quantity that is wanted. The overplus water will be diſcharged as the horn comes round to dip again into the ciſtern. It is poſſible, but requires a diſcuſſion too intricate for this place, to make it of ſuch a ſize and ſhape, that while the mouth moves from E to B, paſſing through O and A, the ſurface of the water in it ſhall advance from E e to O n, and be exactly at O when the beginning or narrow end of the horn arrives there.

Water-works.

We muſt alſo ſecure the proper quantity of water. When the machine is ſo much immerſed as to be up to the axis in water, the capacity which thus ſecures the proper quantity of air will alſo take in the proper quantity of water. But it may be erected ſo as that the ſpirals ſhall not even reach the water. In this caſe it will anſwer our purpoſe if we join to the end of the horn a ſcoop or ſhovel QRSB (fig. 19.), which is ſo formed as to take in at leaſt as much water as will fill the horn. This is all that is wanted in the beginning of the motion along the ſpiral, and more than is neceſſary when the water has advanced to the ſucceeding ſpire; but the overplus is diſcharged in the way we have mentioned. At the ſame time, it is needleſs to load the machine with more water than is neceſſary, merely to throw it out again. We think that if the horn occupies fully more than one half of the circumference, and contains as much as will fill the whole round, and if the ſcoop lifts as much as will certainly fill the horn, it will do very well. Fig. 19.

N. B. The ſcoop muſt be very open on the ſide next the axis, that it may not confine the air as ſoon as it enters the water. This would hinder it from receiving water enough.

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WATER WORKS.

PLATE DLXXIII.

Fig. 1.

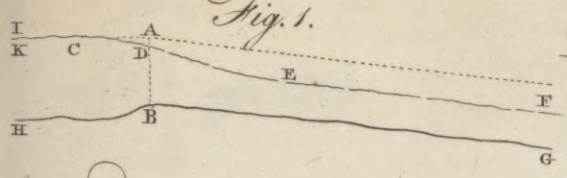


Fig. 2.

Fig. 3.

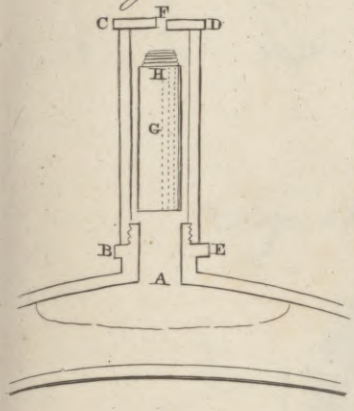


Fig. 4.

Fig. 5.

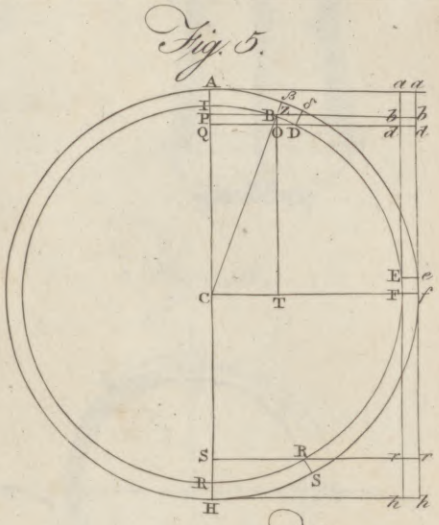


Fig. 6.

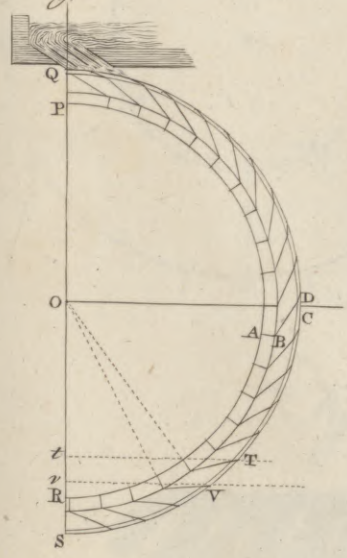


Fig. 7.

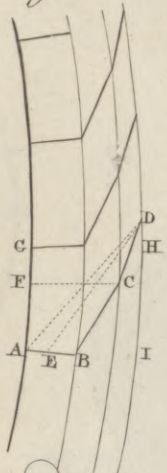


Fig. 8.

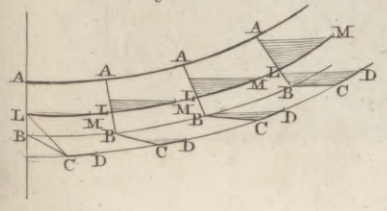


Fig. 9.

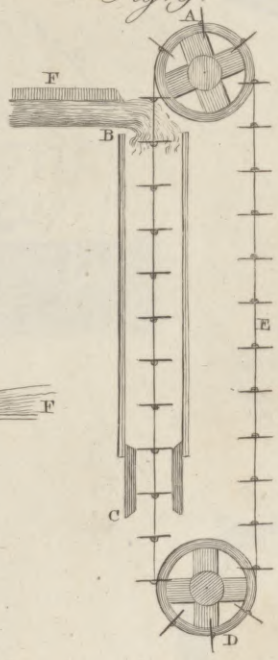
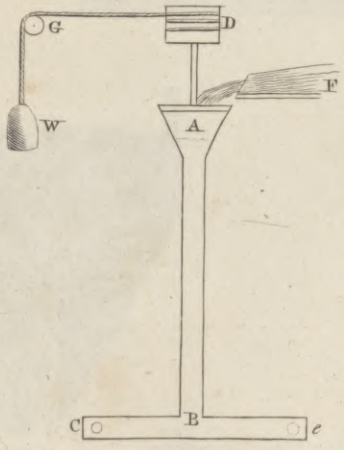


Fig. 10.

Fig. 11.



W. Train Sculpt.

Fig. 12.

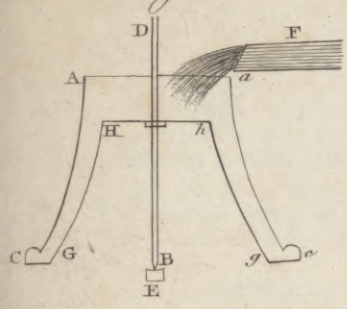


Fig. 13.

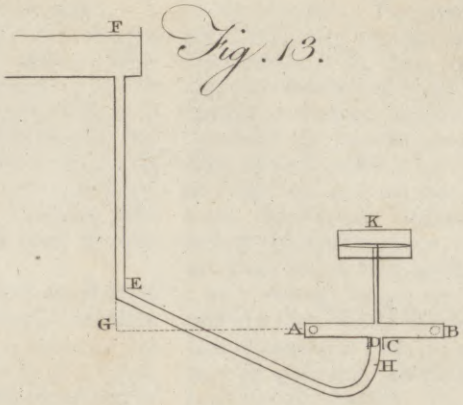


Fig. 14.

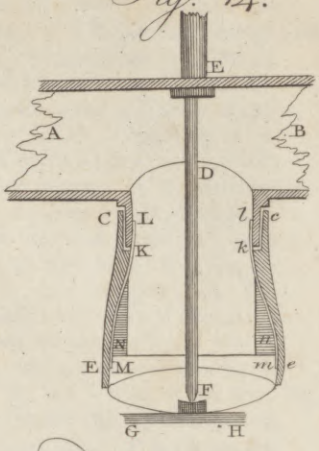


Fig. 15.

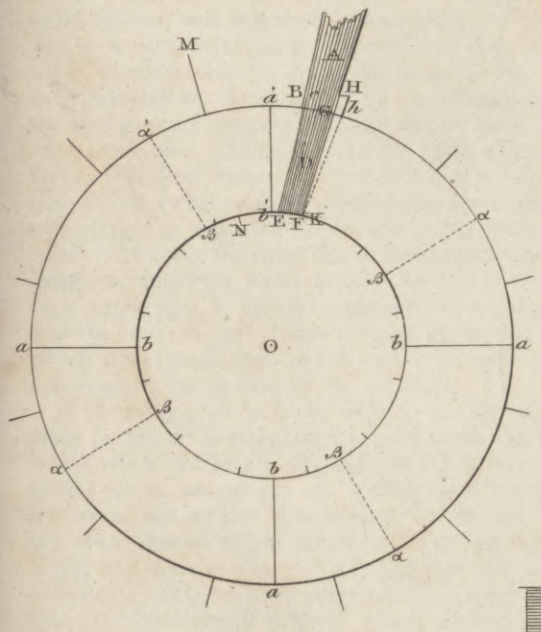


Fig. 16.

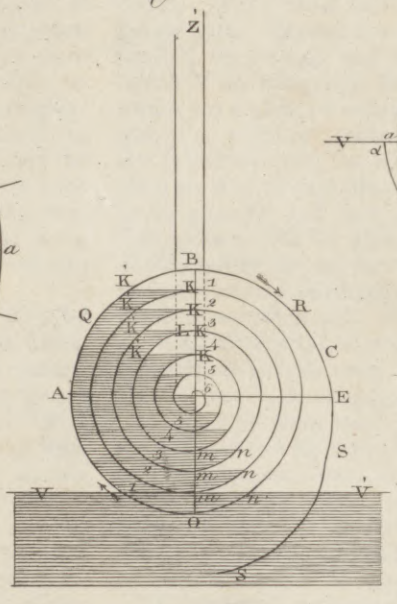


Fig. 18.

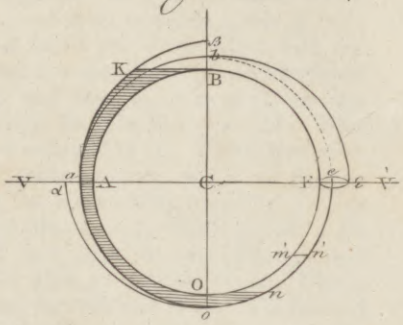


Fig. 20.

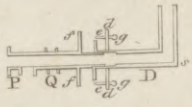


Fig. 17.

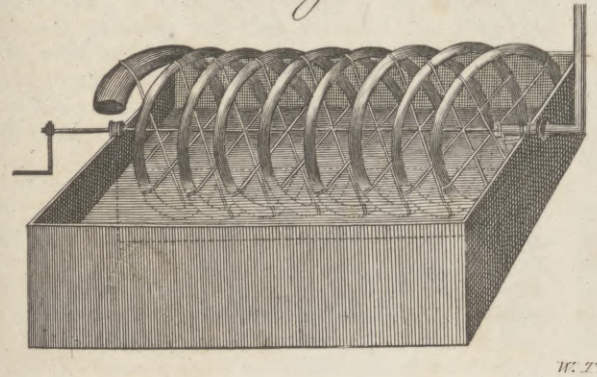
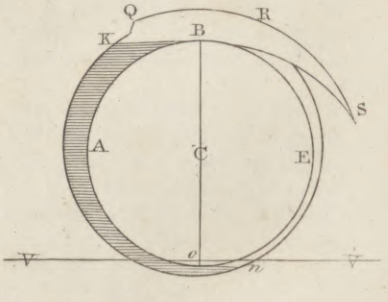


Fig. 19.



W. Train Sculpt.

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rks.

The following dimenſions of a machine erected at Florence, and whoſe performance correſponded extremely well with the theory, may ſerve as an example.

The ſpiral is formed on a cylinder of 10 feet diameter, and the diameter of the pipe is 6 inches. The ſmaller end of the horn is of the ſame diameter; and it occupies three-fourths of the circumference, and it is $7\frac{8}{10}$ths inches wide at the outer end. Here it joins the ſcoop, which lifts as much water as fills the horn, which contains 4340 Swediſh cubic inches, each = 1.577 Engliſh. The machine makes ſix turns in a minute, and raiſes 1354 pounds of water, or 22 cubic feet, 10 feet high in a minute.

The above account will, we hope, ſufficiently explain the manner in which this ſingular hydraulic machine produces its effect. When every thing is executed by the maxims which we have deduced from its principles, we are confident that its performance will correſpond to the theory; and we have the Florentine machine as a proof of this. It raiſes more than $\frac{9}{11}$ths of what the theory promiſes, and it is not perfect. The ſpiral is of equal caliber, and is formed on a cylinder. The friction is ſo inconſiderable in this machine, that it need not be mended: but the great excellency is that whatever imperfection there may be in the arrangement of the air and water columns, this only affects the elegance of the execution, cauſing the water to make a few more turns in the ſpiral before it can mount to the height required; but waſtes no power, becauſe the power employed is always in proportion to the ſum of the vertical columns of water in the riſing ſide of the machine; and the height to which the water is raiſed by it is in the very ſame proportion. It ſhould be made to move very ſlow, that the water be not always dragged up by the pipes, which would cauſe more to run over from each column, and diminiſh the preſſure of the remainder.

If the riſing-pipe be made wide, and thus room be made for the air to eſcape freely up through the water, it will riſe to the height aſſigned; but if it be narrow, ſo that the air cannot get up, it riſes almoſt as ſlow as the water, and by this circumſtance the water is raiſed to a much greater height mixed with air, and this with hardly any more power. It is in this way that we can account for the great performance of the Florentine machine, which is almoſt triple of what a man can do with the fineſt pump that ever was made: indeed the performance is ſo great, that one is apt to ſuſpect ſome inaccuracy in the accounts. The entry into the riſing-pipe ſhould be no wider than the laſt part of the ſpiral; and it would be adviſable to divide it into four channels by a thin partition, and then to make the riſing-pipe very wide, and to put into it a number of ſlender rods, which would divide it into ſlender channels that would completely entangle the air among the water. This will greatly increaſe the height of the heterogeneous column. It is ſurpriſing that a machine that is ſo very promiſing ſhould have attracted ſo little notice. We do not know of any being erected out of Switzerland except at Florence in 1778. The account of its performance was in conſequence of a very public trial in 1779, and honourable declaration of its merit, by Sig. Lorenzo Ginori, who erected another, which fully equalled it. It is ſhortly mentioned by Profeſſor Sulzer of Berlin, in the *Sammlungen Vermiſchlen Schriften* for 1754. A deſcription of it is publiſhed by the Philoſophical Society of Zurich in 1766, and in the deſcriptions publiſhed by the Society in London for the encouragement of arts in 1766. The celebrated Daniel Bernoulli has publiſhed a very accurate theory of it in the Peterſburgh Commentaries for 1772, and the machines at Florence were erected according to his inſtructions. Baron Alſtromer in Sweden cauſed a glaſs model of it to be made, to exhibit the internal motions for the inſtruction of artiſts, and alſo ordered an operative engine to be erected; but we have not ſeen any account of its performance. It is a very intricate machine in its principles; and an ignorant engineer, nay the moſt intelligent, may erect one which ſhall hardly do any thing; and yet, by a very trifling change, may become very powerful. We preſume that failures of this kind have turned the attention of engineers from it; but we are perſuaded that it may be made very effective, and we are certain that it muſt be very durable. Fig. 20. is a ſection of the manner in which the author has formed the communication between the ſpiral and the riſing pipe. P is the end of the hollow axis which is united with the ſolid iron axis. Adjoining to P, on the under ſide, is the entry from the laſt turn of the ſpiral. At Q is the collar which reſts on the ſupports, and turns round in a hole of bell-metal. *f f* is a broad flanch caſt in one piece with the hollow part. Beyond this the pipe is turned ſomewhat ſmaller, very round and ſmooth, ſo as to fit into the mouth of the riſing-pipe, like the key of a cock. This mouth has a plate *e e* attached to it. There is another plate *d d*, which is broader than *e e*, and is not fixed to the cylindrical part, but moves eaſily round it. In this plate are four ſcrews, ſuch as *g, g*, which go into holes in the plate *f f*, and thus draw the two plates *f f* and *d d* together, with the plate *e e* between them. Pieces of thin leather are put on each ſide of *e e;* and thus all eſcape of water is effectually prevented, with a very moderate compreſſion and friction. Water-works || Waterland. Fig. 20.

WATERFORD, a city and ſea-port of Ireland, in a county of the ſame name, with a biſhop's ſee. It is the ſecond place in the kingdom, and is a wealthy, populous city, enjoying many ample privileges. The ſtreets are narrow, and the air is not very healthy; but it has an excellent harbour, ſeated as well for trade as any in the world, and ſhips of the greateſt burden may ride at the quay. It ſtands on the river Sure, 8 miles north of St George's Channel, 26 ſouth of Kilkenny, and 75 ſouth by weſt of Dublin. W. Long. 7. 8. N. Lat. 52. 14.

WATERFORD, a county of Ireland, 46 miles in length, and 25 in breadth; bounded on the ſouth by St George's channel; on the weſt by Cork; on the north by the river Sure, which ſeparates it from Tipperary and Kilkenny; and on the eaſt by Waterford haven, which parts it from Wexford. It contains 71 pariſhes, and ſends 10 members to parliament. It is a fine country, very pleaſant and rich, and the principal place is of the ſame name.

WATERING, in the manufactures, is to give a luſtre to ſtuffs, &c. by wetting them lightly with gum-water, and then paſſing them through the preſs or calender whether hot or cold. The gum-water ought to be pure, thin, and clear, otherwiſe the folds of the ſtuff will all ſtick together: the operation muſt alſo be performed when the water is very hot, that it may penetrate.

WATERING Meadows. See MEADOWS.

WATERLAND, Dr DANIEL, a learned Engliſh divine

Waterland || Watſon.

divine who diſtinguiſhed himſelf greatly in theological controverſies, was born in 1683 at Waſely in Lincolnſhire, of which place his father was rector. He had his academical learning at Magdalen college, Cambridge, where he drew up a uſeful tract, which went through ſeveral editions, intitled, *Advice to a Young Student, with a Method of Study for the firſt four years*. In 1713 he became maſter of the college, was ſoon after appointed chaplain to George I. and in 1720 preached the firſt courſe of lectures founded by Lady Moyer in defence of our Lord's divinity. He went through ſeveral promotions; and at the time of his death in 1740, was canon of Windſor, archdeacon of Middleſex, and vicar of Twickenham. Beſides his controverſial writings, he publiſhed two volumes of ſermons.

WATLING-STREET. See WAY.

WATSON, DR ROBERT, an elegant hiſtorian, was born at St Andrew's in Scotland, about the year 1730. He was the ſon of an apothecary of that place, who was alſo a brewer. Having gone through the uſual courſe of languages and philoſophy at the ſchool and univerſity of his native place, and alſo entered on the ſtudy of divinity, a deſire of being acquainted with a larger circle of literati, and of improving himſelf in every branch of knowledge, carried him, firſt to the univerſity of Glaſgow, and afterwards to that of Edinburgh. The period of theological ſtudies at the univerſities of Scotland is four years: but during that period, young men of ingenious minds find ſufficient leiſure to carry on and advance the purſuits of general knowledge. Mr Watſon purſued his ſtudies with ardour. Few men ever ſtudied more conſtantly. It was a rule with him to ſtudy eight hours every day; and this law he obſerved during the whole courſe of his life. An acquaintance with the polite writers of England, after the union of the two kingdoms, became general in Scotland; and in Watſon's younger years, an emulation began to prevail of writing pure and elegant Engliſh. Mr Watſon applied himſelf with great induſtry to the principles of philoſophical or univerſal grammar; and by a combination of theſe, with the authority of the beſt Engliſh writers, formed a courſe of lectures on ſtyle or language. He proceeded to the ſtudy of rhetoric or eloquence; the principles of which he endeavoured to trace to the nature of the human mind. He delivered a courſe of lectures in Edinburgh on theſe ſubjects; and met with the countenance, approbation, and friendſhip of Lord Kames, Mr Hume, with other men of genius and learning.

At this time he had become a preacher; and a vacancy having happened in one of the churches of St Andrew's, he offered himſelf a candidate for that living, but was diſappointed. Soon after he was appointed profeſſor of logic; and he obtained alſo a patent from the crown, conſtituting him profeſſor of rhetoric and belles lettres. The ſtudy of logic in St Andrew's, as in moſt other places, was at this time confined to ſyllogiſms, modes, and figures. Mr Watſon, whoſe mind had been opened by converſation, and by reading the writings of the wits that had begun to flouriſh in the Scotch capital, prepared and read to his ſtudents a courſe of metaphyſics and logics on the moſt enlightened plan; in which he analyzed the powers of the mind, and entered deeply into the nature of the different ſpecies of evidence of truth or knowledge. By his hiſtory of Philip II. Dr Watſon attained in his lifetime a conſiderable degree of celebrity; and his hiſtory of Philip III. publiſhed after his death, has added to his fame. Of this laſt performance, however, he has only completed the firſt four books; the two laſt were written by the editor of his manuſcript, at the deſire of the guardians of his children. Watſo || Wax

On the death of Principal Tulideph, Dr Watſon, through the earl of Kinnoull, was appointed his ſucceſſor; in which ſtation he lived only a few years. He married a lady of ſingular beauty and virtue, daughter to Mr Shaw, profeſſor of divinity in St Mary's college, St Andrew's. By this lady he had five daughters, who ſurvived him.

WATTS, DR ISAAC, a learned and eminent diſſenting miniſter, was born at Southampton in 1674, of parents eminent for piety, and conſiderable ſufferers for conſcience-ſake. In 1690 he was ſent up to London for academical education under the tuition of the Rev. Mr Thomas Rowe; and in 1696 was himſelf engaged as tutor to the ſon of Sir John Hartopp, Bart. at Stoke Newington. He began to preach in 1698, and met with general acceptance; and after officiating as an aſſiſtant to the Rev. Dr Iſaac Chauncy, he ſucceeded in his paſtoral charge in 1702, and continued to preſide over that church as long as he lived. Though his whole income did not amount to an hundred a-year, he allotted one third of it to the poor. He died in 1748. His numerous works have rendered his name famous among people of every denomination, both in this and other countries, and have been tranſlated into a variety of languages. His Lyric Poems, his Pſalms and Hymns, and his Divine Songs for Children, are a ſufficient proof of his poetical talents, and have had an amazing number of editions. His logic and philoſophy have been much admired. He alſo wrote works upon a variety of other ſubjects, and printed ſeveral volumes of his ſermons. He was admired for the mildneſs and benevolence of his diſpoſition and the ſweetneſs of his manners. After his death, his works were collected, and publiſhed in ſix volumes quarto.

WAVE, in *Philoſophy*, a cavity in the ſurface of water, or other fluids, with an elevation aſide thereof.

The waves of the ſea are of two kinds, natural and accidental. The natural waves are thoſe which are exactly proportioned in ſize to the ſtrength of the wind, whoſe blowing gives origin to them. The accidental waves are thoſe occaſioned by the wind's reacting upon itſelf by repercuſſion from hills and mountains, or high ſhores, and by the waſhing of the waves themſelves, otherwiſe of the natural kind, againſt rocks and ſhoals: all theſe cauſes give the waves an elevation, which they can never have in their natural ſtate. For the height of the waves, ſee SEA.

Stilling WAVES by means of Oil. See SEA.

WAVED, in *Heraldry*, is ſaid of a bordure, or any ordinary or charge, in a coat of arms, having its outlines indented in manner of the riſing and falling of waves: it is uſed to denote, that the firſt of the family in whoſe arms it ſtands, acquired its honours by ſea-ſervice.

WAVING, in the ſea-language, is the making ſigns to a veſſel to come near or keep off.

WAX, or *Bees WAX*, in *Natural Hiſtory*, a firm and ſolid ſubſtance, moderately heavy, and of a fine yellow colour, formed by the bees from the pollen of flowers. See APIS.

The

Wax. The beſt ſort is that of a lively yellow colour, and an agreeable ſmell, ſomewhat like that of honey: when new, it is toughiſh, yet eaſy to break; but by age it becomes harder and more brittle, loſes its fine colour, and in a great meaſure its ſmell.

It appears that wax and the pollen have for their baſis a fat oil, which paſſes to the ſtate of reſin by its combination with oxygen. If the nitric or muriatic acid be digeſted upon fixed oil for ſeveral months, it paſſes to a ſtate reſembling wax. Wax, by repeated diſtillations, affords an oil which poſſeſſes all the properties of volatile oils. It is reduced into water and carbonic acid by combuſtion. The colouring matter of wax is inſoluble in water and in alcohol.

Fixed alkalies diſſolve wax, and render it ſoluble in water. It is this ſaponaceous ſolution which forms the punic wax. It may be uſed as the baſis of ſeveral colours; and may be made into an excellent paſte for waſhing the hands. Ammoniac likewiſe diſſolves it; and as this ſolvent is evaporable, it ought to be preferred when it is propoſed to uſe the wax as a varniſh.

From the common yellow wax, by bleaching, is formed white-wax, ſometimes called, very improperly, *virgin-wax*. The greater the ſurface is in proportion to the quantity, the ſooner and more perfectly this operation is performed. The uſual way is to melt the wax in hot water; when melted, they preſs it through a ſtrainer of tolerable fine linen, and pour it into round and very ſhallow moulds. When hardened by cooling, it is taken out and expoſed to the ſun and air, ſprinkling it now and then with water, and often turning it: by this means it ſoon becomes white. The beſt ſort is of a clear and almoſt tranſparent whiteneſs, dry, hard, brittle, and of an agreeable ſmell, like that of the yellow wax, but much weaker.

The common yellow wax is of very great uſe both in medicine and in many of the arts and manufactures. It has been ſometimes given internally in dyſenteries and eroſions of the inteſtines; but its great uſe is in the making ointments and plaſters, and the greater part of thoſe of the ſhops owe their conſiſtence to it. The white wax is alſo an ingredient in ſome of the cerates and ointments of the ſhops; and is uſed in making candles, and in many of the nicer arts and manufactures where wax is required.

Sealing-WAX, or *Spaniſh-WAX*, is a compoſition of gum lac, melted and prepared with reſins, and coloured with ſome ſuitable pigment.

There are two kinds of ſealing-wax in uſe; the one hard, intended for ſealing letters, and other ſuch purpoſes; the other ſoft, deſigned for receiving the impreſſions of ſeals of office to charters, patents, and ſuch written inſtruments. The beſt hard red ſealing-wax is made by mixing two parts of ſhell lac, well powdered, and reſin and vermilion, powdered, of each one part, and melting this combined powder over a gentle fire; and when the ingredients ſeem thoroughly incorporated, working the wax into ſticks. Seed-lac may be ſubſtituted for the ſhell-lac; and inſtead of reſin, boiled Venice turpentine may be uſed. A coarſer hard red ſealing-wax may be made, by mixing two parts of reſin, and of ſhell-lac, or vermilion and red lead, mixed in the proportion of one part of the vermilion to two of the red lead, of each one part; and proceeding as in the former preparation. For a cheaper kind, the vermilion may be omitted, and the ſhell-lac alſo, for very coarſe uſes. Wax of other colours is made by ſubſtituting other colouring matters for vermilion, as verditer for blue, ivory black for black wax. For uncoloured ſoft ſealing-wax, take of bees wax, one pound; of turpentine, three ounces; and of olive oil, one ounce; place them in a proper veſſel over the fire, and let them boil for ſome time; and the wax will be then fit to be formed into rolls or cakes for uſe. For red, black, green, blue, yellow, and purple ſoft ſealing-wax, add to the preceding compoſition an ounce or more of any ingredients directed above for colouring the hard ſealing-wax, and ſtir the maſs till the colouring ingredients be incorporated with the wax. Wax, Way.

WAX-Work, the repreſentation of the faces, &c. of perſons living or dead; made by applying plaſter of Paris in a kind of paſte, and thus forming a mould containing the exact repreſentation of the features. Into this mould melted wax is poured, and thus a kind of maſks are formed; which being painted and ſet with glaſs eyes, and the figures dreſſed in their proper habits, they bear ſuch a reſemblance that it is difficult to diſtinguiſh between the copy and the original.

WAY, a paſſage or road.

The Roman ways are divided into conſular, prætorian, military, and public; and of theſe we have four remarkable ones in England: the firſt, Watling-ſtreet, or Watheling-ſtreet, leading from Dover to London, Dunſtable, Touceſter, Atterſton, and the Severn, extending as far as Angleſea in Wales. The ſecond, called *Hikenild* or *Ikenild ſtreet*, ſtretches from Southampton over the river Iſis at Newbridge; thence by Camden and Litchfield; then paſſes the Derwent near Derby, and ends at Tinmouth. The third, called *Foſſe-way*, becauſe in ſome places it was never perfected, but lies as a large ditch, leads from Cornwall through Devonſhire, by Tethbury, near Stow in the Wolds; and beſide Coventry to Leiceſter, Newark, and ſo to Lincoln. The fourth, called *Erming* or *Erminage ſtreet*, extends from St David's, in Wales, to Southampton.

WAY Covert, *Gang*, *Hatch*. See *COVERT Way*, *Gang*, &c.

WAY of a Ship, is ſometimes the ſame as her rake, or run forward or backward: but this term is moſt commonly underſtood of her ſailing.

WAY-Leaves, in the coal buſineſs. See COALERY, N° 3.

Right of WAYS, in *Law*. This may be grounded on a ſpecial permiſſion; as when the owner of the land grants to another a liberty of paſſing over his grounds, to go to church, to market, or the like: in which caſe the gift or grant is particular, and confined to the grantee alone; it dies with the perſon; and if the grantee leaves the country, he cannot aſſign over his right to any other; nor can he juſtify taking another perſon in his company. A way may be alſo by preſcription; as if all the owners and occupiers of ſuch a farm have immemorially uſed to croſs another's ground; for this immemorial uſage ſuppoſes an original grant, whereby a right of way thus appurtenant to land may clearly be created. A right of way may alſo ariſe by act and operation of law; for if a man grants me a piece of ground in the middle of his field, he at the ſame time tacitly and impliedly gives me a way to come at it; and I may croſs his land for that purpoſe without treſpaſs. For

Ways || Weaving.

when the law doth give any thing to one, it giveth impliedly whatſoever is neceſſary for enjoying the ſame. By the law of the twelve tables at Rome, where a man had a right of way over another's land, and the road was out of repair, he who had the right of way might go over any part of the land he pleaſed; which was the eſtabliſhed rule in public as well as private ways. And the law of England, in both caſes, ſeems to correſpond with the Roman.

WAYFARING TREE. See VIBURNUM, BOTANY *Index*.

WAYGHTES, or WAITS, a word which is uſed only in the plural number, and ſignifies *hautboys*. It is now applied to the performers on theſe and other muſical inſtruments, by a tranſition from the inſtruments themſelves, and particularly to thoſe performers who parade the ſtreets by night, about the Chriſtmas ſeaſon of the year.

WAYWODE, is properly a title given the governors of the chief places in the dominions of the czar of Muſcovy. The palatines, or governors of provinces in Poland, alſo bear the quality of *waywodes* or *waiwodes*. The Poles likewiſe call the princes of Wallachia and Moldavia *waywodes*; as eſteeming them no other than on the foot of governors; pretending that Wallachia and Moldavia are provinces of Poland. Everywhere elſe theſe are called *hoſpodars*. Du Cange ſays, that the name *waywode* is uſed in Dalmatia, Croatia, and Hungary, for a general of an army: and Leunclavius, in his Pandects of Turkey, tells us, it uſually ſignifies *captain* or *commander*.

WEANING, putting a child away from the breaſt, and bringing it to uſe common food.

WEAR, or WEER, a great ſtank or dam in a river, fitted for the taking of fiſh, or for conveying the ſtream to a mill. New wears are not to be made, or others altered, to the nuiſance of the public, under a certain penalty. See RIVER.

WEARING, or VEERING, in *Seamanſhip*. See SEAMANSHIP.

WEASEL. See MUSTELA, MAMMALIA *Index*.

WEATHER denotes the ſtate of the atmoſphere with regard to heat and cold, wind, rain, and other meteors. See METEOROLOGY.

WEATHER, in ſea-language, is uſed as an adjective, and applied by mariners to every thing lying to windward of a particular ſituation: thus, a ſhip is ſaid to have the weather-gage of another, when ſhe is farther to windward. Thus alſo, when a ſhip under ſail preſents either of her ſides to the wind, it is then called the *weather-ſide* or *weather-board*; and all the rigging and furniture ſituated thereon are diſtinguiſhed by the ſame epithet, as the *weather ſhrouds*, the *weather-lifts*, the *weather-braces*, &c.

To WEATHER, in ſea-language, is to ſail to windward of ſome ſhip, bank, or head-land.

WEATHER-Cock, a moveable vane, in form of a cock, or other ſhape, placed on high, to be turned round according to the direction of the wind, and point out the quarter from whence it blows.

WEATHER-Glaſs. See BAROMETER.

WEATHERING, among ſailors, ſignifies the doubling or ſailing by a head-land or other place.

WEAVING, the art of working a web of cloth, ſilk, or other ſtuff, in a loom with a ſhuttle. For an idea of the manner in which this is performed, ſee CLOTH. Weaving

WEAVING-Loom, a machine for weaving cloth, ſilk, &c. by raiſing the threads of the warp in order to throw in the ſhoot, and ſtrike it cloſe. Of theſe there are various kinds, diſtinguiſhed by the different ſorts of cloths, ſtuffs, ſilks, &c. in which they are employed, and which are chiefly diſtinguiſhed by the number and variety of the threads they raiſe in order to work the warp, either plain or in figures, by making more or leſs of the woof or ſhoot appear through the warp. In order to give a general idea of weaving, we ſhall here deſcribe the parts of the common weaver's loom. Fig. 1. in which *e f*, *e f* are the front poſts, and *g*, *g* the back poſts of the loom; *l l l*, *m m*, *m m* are the *lams* in their place at Q, or, as they are called in ſome parts of Scotland, the *headles*, and in others the *ſlaves*. They are compoſed of ſtrong threads, ſtretched between two horizontal bars, an upper and a lower. The threads of one lam are ſo diſpoſed as to paſs between the upper threads of the warp, while they admit the lower threads to paſs through loops or ſmall holes in them, and the diſpoſition of the threads of the other lam is ſuch, that while they paſs between the lower threads of the warp, they admit the upper threads to paſs through the ſmall holes juſt mentioned. The lams are ſuſpended from the croſs bar or *lam-bearer* HH, by means of ropes *n*, *n* paſſing from the upper bars of the *lams* over the pulleys at EE, and balanced by weights at the other ends. From the lower bar of each *lam* or *headle* a rope paſſes to the *treadles* or moveable bars at OO; ſo that when a foot preſſes a treadle, the lam faſtened to it ſinks, while the other riſes by means of the balancing weight ſuſpended from the pulley at E. The workman then throws in the woof by means of the ſhuttle, and cloſes it by one or two ſtrokes of the *lay* or *batten*, of which WB, WB are called the *ſwords*, CC the *cap*, or in Scotland the upper *ſhell*, DD the *block* or under *ſhell*, and PP the *reed* or *comb* contained between theſe ſhells. LL is the bench on which the workmen ſit; for the loom which our figure repreſents is conſtructed for weaving cloth of ſuch a breadth as to require two workmen, who have their quills in a box *d* on the middle of the bench on which they ſit. Between the workmen's bench and the *batten* or *lay* is the *breaſt-bar* I, I, a ſmooth ſquare beam; in which there is an opening to let the web through as it is wove. From this opening the web SS paſſes to the *knee roll* or *web beam* GG, round which it is rolled by means of the ſpokes, viſible in the figure, and kept from being unrolled by a wheel with teeth and clench, viſible likewiſe in the figure. In ſome looms the web paſſes from the knee roll to the wooden frame X, to be dried as it is wove. Oppoſite to the breaſt-bar, and on the other ſide of the *batten* or *lay*, is the *cane-roll* or *yarn-beam*, on which the warp is rolled when put into the loom, and from which it is gradually unrolled as the work proceeds. TT are bobbins filled with yarn of the warp to mend ſuch threads of it as may be broke in the weaving; and B *b*, B *b* are clues of the ſame kind of yarn with the borders of the warp, to mend ſuch threads as may there be broken. Plate DLXXV fig. 1.

Fig. 2. repreſents the common ſhuttle with the vacuity in the middle, in which the quill with the woof is placed on a ſpindle or axis. As this ſhuttle is thrown with one hand in at one ſide of the warp, and received Fig. 2.

with

Weaving. with the other hand at the other ſide, it is obvious, that when the web is of a breadth too great for a man to reach from one ſide of it to the other, two workmen muſt be employed and much time loſt. To remedy this inconveniency, a new ſhuttle has, in this country, been lately brought into very general uſe, and called the *flying ſhuttle*, becauſe it flies through the warp with wonderful rapidity on two ſteel rollers RR (fig. 3.). This ſhuttle is not thrown with the hand, but moved backwards and forwards by a very ſimple piece of machinery, of which fig. 4. will give the reader a ſufficiently accurate conception. To each end of the *batten* or *lay* L is faſtened a kind of open box B, *b*, with the bottom or horizontal ſide exactly on a level with the threads of the warp of the intended web. In each of theſe boxes is a vertical piece of wood D, *d*, of conſiderable thickneſs, called a *driver*. This driver is moved eaſily on an iron ſpindle or axis from one end of the box to the other by means of a ſlender rope CCCD, and a handle H is ſeen in the figure. When the weaver is to begin his work, he lays the ſhuttle on its rollers in the box B with the iron tip T (fig. 3.) touching, or almoſt touching, the driver D (fig. 4.). Then moving the handle H, with a ſudden jerk, towards the box *b*, the driver D forces the ſhuttle with a rapid motion through the warp till it ſtrikes *d*, which is impelled by the ſtroke to the further end of the box *b*. The two drivers D and *d* have now changed their poſitions in their reſpective boxes; ſo that the driver which was at the front of its box before, is now at the further end of it, and *vice verſa*. Then by a ſudden jerk of the hand towards B the ſhuttle is driven back till it ſtrike D; and thus is the work continued without the weaver having occaſion ever to ſtretch his arms from one margin of the web to the other. That the ſhuttle may not, by the unſteadineſs of the workman's hand, be driven *zig-zag* through the warp or out of the place in which it ought to move, the guiding or driving rope CCCD is made to paſs through ſmooth holes or loops C, C, at the ends of the ropes EC, EC, ſuſpended either from the croſs bar on the top of the loom or from the ſwords of the batten.

g. 3.

g. 4.

This ſhuttle, we ſhould think, a great improvement in every kind of weaving-loom, though ſome of the older tradeſmen, with whom we have converſed on the ſubject, contend, that it is valuable only in what they call light work, ſuch as cotton or linen cloth, or when the web, if woollen, is very broad.

But as the labour of weaving is pretty ſevere, Mr Robert Millar, an ingenious callico-printer in the county of Dumbarton, Scotland, wiſhing to leſſen it, invented, ſome years ago, a weaving-loom, which may be wrought by water, ſteam, horſes, or any other power, for which invention he received a patent in 1796. The following is his own deſcription of his patent weaving-loom:

g. 5. Fig. 5. repreſents a ſide view of the loom, AA, BB, CC, DD, being the frame. *a* is an axis (which we ſhall call the ſpindle) acroſs the frame. On this axis is a ſheeve *b*, two inches thick, having a groove round it, two inches deep, and half an inch wide. The bottom of this groove is circular, except in one part *c*, where it is filled up to the top; a lever *d* reſts on the bottom of this groove, and is lifted up by it when the elevation *c* comes round to the ſituation repreſented in the figure. By this motion, the lever *d* acts on the ratchet-wheel *e* by the catch *t*, and draws it forward one tooth, each revolution of the ſheeve. This ratchet wheel is in an iron frame *g g*, which alſo properly carries the two catches *t* and *u*, which are connected with it at *v*. The catch *u* holds the ratchet-wheel in its poſition, while the lever *d* and the catch *t*, are moved by the groove *c* in the ſheeve. On the arbor of the ratchet is a ſmall pinion *h*, working in the wheel *f*; this wheel is fixed on the end of the roller *e* of fig. 7. On the ſide of the ſheeve *b* is fixed a wiper *k*, which lifts the treadle *l*. This treadle turns on its joints in the ſheeve E, which is fixed to the ſide of the frame A and D; it is kept preſſing on the bottom of the groove in the ſheeve by a ſpring *m*, fixed to the frame ſide A, and having a ſlender rod *n* from its extremity, joining it with the treadle at *l*. From the point of the treadle there goes a belt *o*, which paſſes over the pulley *p*, which is ſeen edgewiſe in this figure, and is joined to the top of the fly pin *q*, of fig. 6. At the end of the frame A is the ſhort poſt F; on this reſts the yarn-beam *j*, having a ſheeve *r*, over which paſſes a cord, having a weight *s* ſuſpended to it. The other end of this cord is faſtened to the ſpring *v*; the weight cauſes the yarn-beam to ſtretch the web from the ratchet-wheel *e*, with its catch *u*; and the ſpring *v* allows the rope to ſlide on the ſheeve as the ratchet is drawn round during the working.

Weaving.

Fig 6. is a front view of the loom. *a a* is the ſpindle which carries the ſheeve *b*, and the wipers *d* and *d*, which move the treadles *w*, *w*, of fig. 5. Theſe uſe the treadles of the headles, with which they are connected by cords from the ſhafts of the headles *s*, *s*. From the upper ſhaft there go two leathern belts *f*, *f*, to the roller *y*, furniſhed each with a buckle, for tightening them at pleaſure. The two wipers *c*, *c*, on the ſhaft *a*, which ſerve for taking back the lay, have the two treadles, *x*, *x*, in fig. 7. with a belt from each paſſing over the roller *h* 2 of fig. 6. and fixed to the ſword of the lay. From the ſwords of the lay forward is fixed a belt to each end of the roller *i*; from this roller there goes a cord to the ſpring *j*, which ſerves for taking forward the lay which is hinged on the rocking-tree *t*. The ſtar-wheel *b* of fig. 3. and the ſheeve *b* of fig. 1. are fixed to the oppoſite ends of the ſpindle *a* without the frame; and both the wheel and ſheeve have a wiper *k* fixed to them for moving the treadles. In order to drive the ſhuttle, the belts *o*, *o*, go from the points of the treadles, over the pulleys *p*, *p*, to the top of the fly-pin *q*: This turns on a pin joint in a rail *r*, which goes acroſs the loom. From its lower end there go two ſmall cords to the ſhuttle drivers *g*, *g*, which ſlide on the iron rods *n*, *n*. A long iron rod *v* goes acroſs the lay, and is hung on two centres at the ends. In this rod *v* are fixed two ſmall crooked wires *w*, *w*, which are more diſtinctly marked in the little figure *w* above, which repreſents a ſection of the lay. The dot at the lower end of the wire *w*, in this figure, is the ſection of the rod *v*. The ſhuttle paſſes between theſe wires and the lay every ſhot, and lifts them up, cauſing the rod *v* to turn round a little. But if the ſhuttle ſhould not paſs theſe wires, nor lift them, it would be drawn home by the lay, and deſtroy the web. To prevent this, there is fixed on one end of the rod *v* a ſtout crooked wire *z*, having a broad or flat head, which naturally reſts on a plate of iron, marked and fixed to the back of the lay. This plate has a ſlit in its

Fig. 6.

Weaving. its middle about an inch deep. In this ſlit reſts the rod *a* 2 of fig. 7. on which is a ſhort ſtud, which is caught by the wire *z* when the wire *w* is not lifted back by the paſſing ſhuttle. This will ſtop the lay from coming home, and will ſet off the loom.

Fig. 7. Fig. 7. is another ſide view of the loom oppoſite to fig. 5. On the ſpindle *a* is the ſtar wheel *b*, on the outſide of the loom frame, on the arms of which wheel is fixed the wiper *k*, as the ſimilar wiper is fixed to the ſheeves on the other end of the ſpindle. The wipers which drive the ſhuttles are fixed on oppoſite ſquares of the ſpindle, and work alternately. Below the ſtar-wheel is a pinion *c*, which is on a round ſpindle, turned by the water-wheel, by means of a wheel on this ſpindle. In a wheel on this ſpindle are two ſtuds, on which the pinion *c* ſlides off and on, as the loom is ſet off and on by the lever *d*. At the farther end of this lever is the weight *s*, hanging by a cord which paſſes over a pulley *t*, fixed at the outer end of the ſpring-catch on which the lever *d* reſts; and thus the loom is drawn in at the upper end of the lever *d*. But when the ſhuttle does not lift the wire *z*, it catches on the ſtud on the rod *a* 2, which is connected with the ſpring catch, and the lever *d* flies off with the weight *s*, and the loom ſtops working. On the head of the poſt F is the yarn-beam. The rollers *e* and *f* are cylinders, preſſed together by a ſcrew-lever, and take away the cloth between them at a proper rate. In the roller *f* is a groove for a band for driving the roller *g*, on which the cloth winds itſelf as it is wrought. Wherever ſprings are mentioned to be uſed in the above deſcription, weights may be uſed in their ſtead, and to the ſame effect, and more eſpecially upon the treadle of fig. 5. for driving the ſhuttle.

Fig. 8. Fig. 8. is a repreſentation of a ribband loom. 1. Is the frame of the loom. 2. The caſtle, containing 48 pulleys. 3. The branches, on which the pulleys turn. 4. The tires, or the riding-cords, which run on the pulleys, and pull up the high-liſſes. 5. The lift-ſticks, to which the high-liſſes are tied. 6. The high-liſſes, or liſts, are a number of long threads, with platines, or plate-leads at the bottom; and ringlets, or loops, about their middle, through which the cords or croſs-threads of the ground-harneſs ride. 7. The plate-leads, or platines, are flat pieces of lead, of about ſix inches long, and three or four inches broad at the top, but round at the bottom; ſome uſe black ſlates inſtead of them: their uſe is to pull down thoſe liſſes which the workman had raiſed by the treadle, after his foot is taken off. 8. The branches or cords of the ground harneſs, which go through the loops in the middle of the high-liſſes: on the well ordering of theſe cords chiefly depends the art of ribbon-weaving, becauſe it is by means of this contrivance that the weaver draws in the thread or ſilk that makes the flower, and rejects or excludes the reſt. 9. The batton: this is the wooden frame that holds the reed or ſhuttle, and beats or cloſes the work: where obſerve, that the ribbon-weaver does not beat his work; but as ſoon as the ſhuttle is paſſed, and his hand is taken away, the batton is forced, by a ſpring from the top, to beat the work cloſe. 10. The ſhuttle, or reed. 11. The ſpring of the batton, by which it is made to cloſe the work. 12. The long-harneſs are the front-reeds, by which the figure is raiſed. 13. The linguas are the long pieces of round or ſquare lead, tied to the end of each thread of the long-harneſs to keep them tight. 14. The broad piece of wood, about a foot ſquare, leaning ſomewhat forward, intended to eaſe the weaver as he ſtoops to his ſhuttle; it is fixed in the middle of the breaſt-beam. Some weavers, inſtead of this, have a contrivance of a cord or rope that is faſtened to the front-frame, and comes acroſs his breaſt; this is called a *ſlopfall*. 15. The ſeat-bench; this leans forward very much. 16. The foot-ſtep to the treadles. 17. The breaſt-beam, being a croſs-bar that paſſes from one of the ſtandards to the other, ſo as to front the workman's breaſt: to this breaſt-bar is fixed a roll, upon which the ribbon paſſes in its way, to be rolled upon the roller, that turns a little below. 18. The clamps, or pieces of wood, in which the broaches that confine the treadles reſt. 19. The treadles are long narrow pieces of wood, to the ends of which the cords that move the liſſes are faſtened. 20. The treadle-cords are only diſtinguiſhed from the riding-cords by a board full of holes, which divide them, in order to prevent the plate-leads, which are tied to the high-liſſes, from pulling them too high when the workman's foot is off the treadle: which ſtop is made by a knot in the treadle-cord, too big to be forced through that hole in the board. 21. The lams are two pieces of thin narrow boards only uſed in plain works, and then to ſupply the place of the long-harneſs. 22. The knee-roll, by which the weaver rolls up his ribbon as he ſees proper, or by bit and bit as it is finiſhed. 23. The back-rolls, on which the warp is rolled. It is to be obſerved, that there is always as many rolls as colours in the work to be wove. 24. The clamps, which ſupport the rollers. 25. The returning-ſticks, or, as others call them, the *returns*, or the *tumblers*, or *pulleys*, to which the tiers are tied, to clear the courſe of cords through the high-liſſes. 26. The catch-board for the tumblers. 27. The tire-board. 28. The buttons for the knee-rolls and treadle-board, deſcribed in N° 20.

Weaving || Webſter.

It is ſtated in the proceedings of the National Inſtitute of France, that a report was preſented to that body concerning a new machine for weaving ribbed ſtockings. The advantages which this machine poſſeſſes are ſaid to be, that it may be erected at one half of the expence of the Engliſh ſtocking frame, and that its movements are much lighter. The experience of its operations for two years has confirmed theſe advantages. Of the nature and conſtruction of this machine we have had no opportunity of obtaining any information; but we thought it worth while to inſert this ſhort notice, with the view of directing the attention of ſuch of our readers as may be intereſted in the improvement of ſuch manufactures.

WEB, a ſort of tiſſue or texture formed of threads interwoven with each other; ſome whereof are extended in length, and called the *warp;* others are drawn acroſs, and called the *woof*.

WEBERA, a genus of plants belonging to the claſs and order pentandria monogynia. See BOTANY *Index*.

WEBSTER, ALEXANDER, D. D. was the ſon of James Webſter, miniſter of the Tolbooth church in Edinburgh, and born in that city about the year 1707. He was only 13 years of age at the death of his father, and of courſe could derive little from parental inſtruction or example. He ſtudied at the univerſity of Edinburgh the ſeveral branches of learning with great approbation, particularly

Fig. 1.

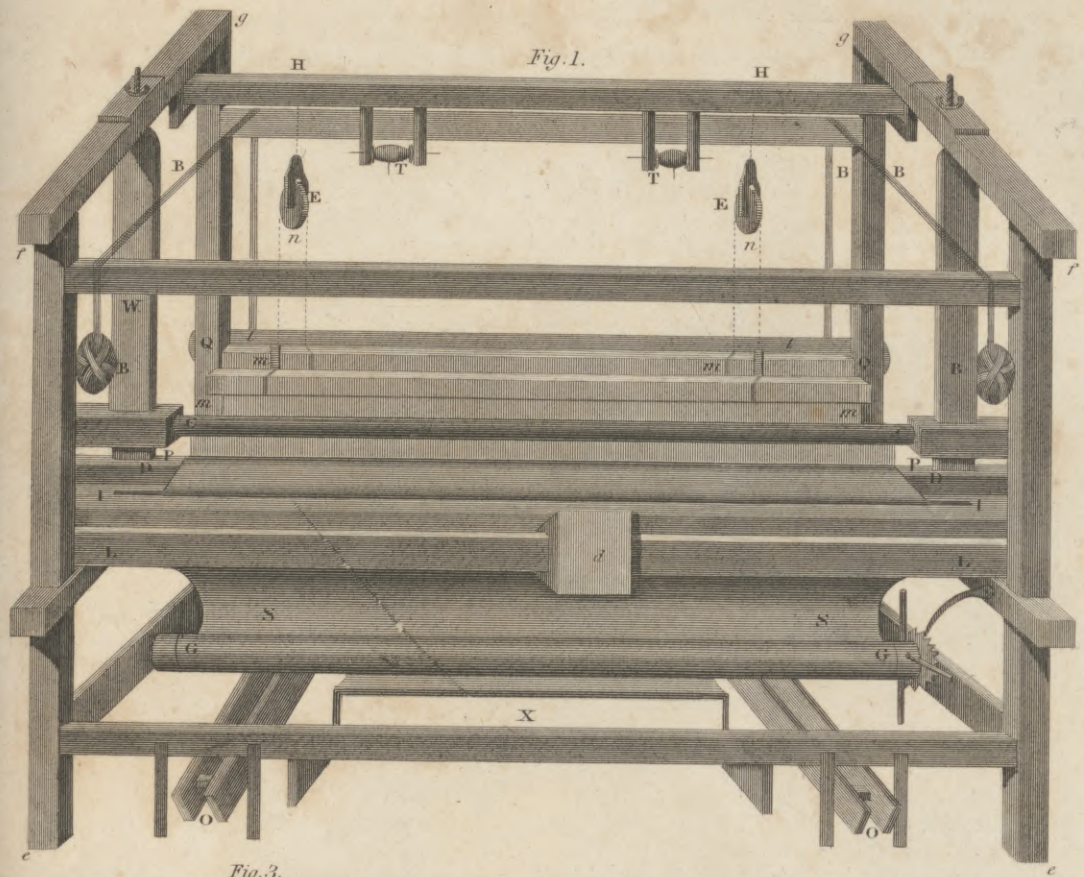

Fig. 3.

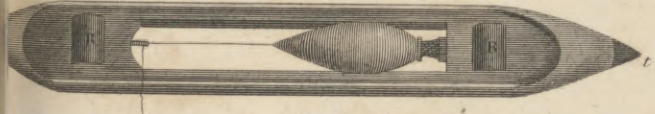

Fig. 2.

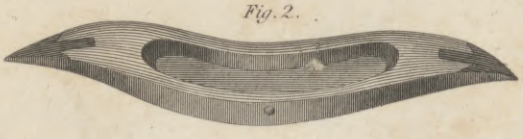

Fig. 4.

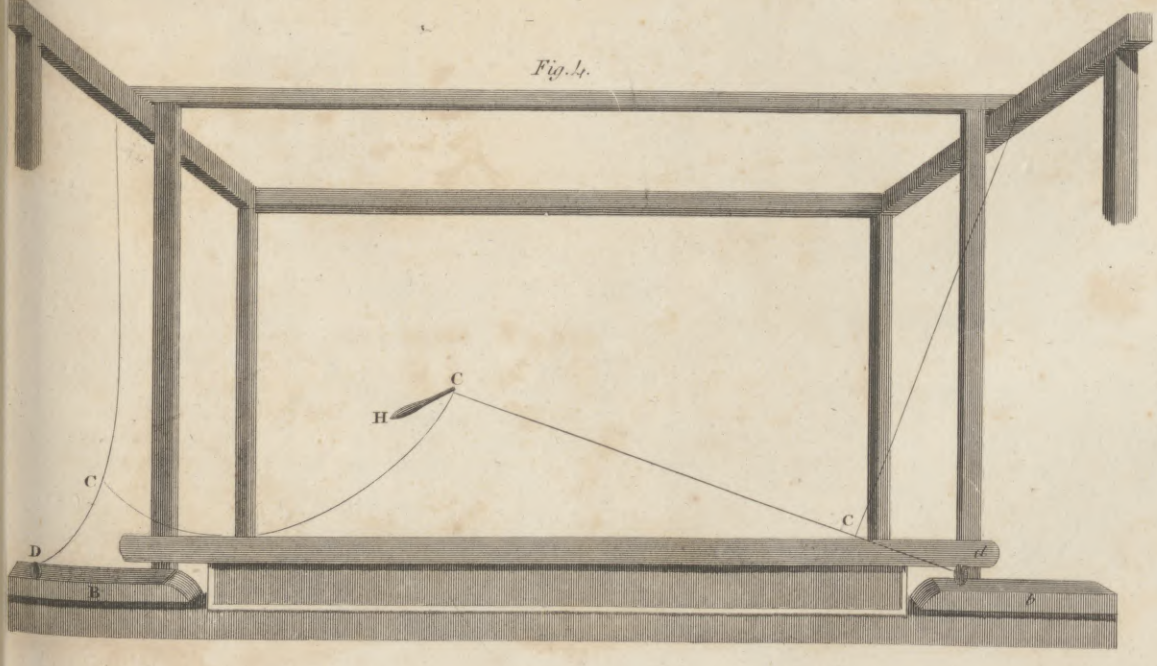

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Fig. 5.

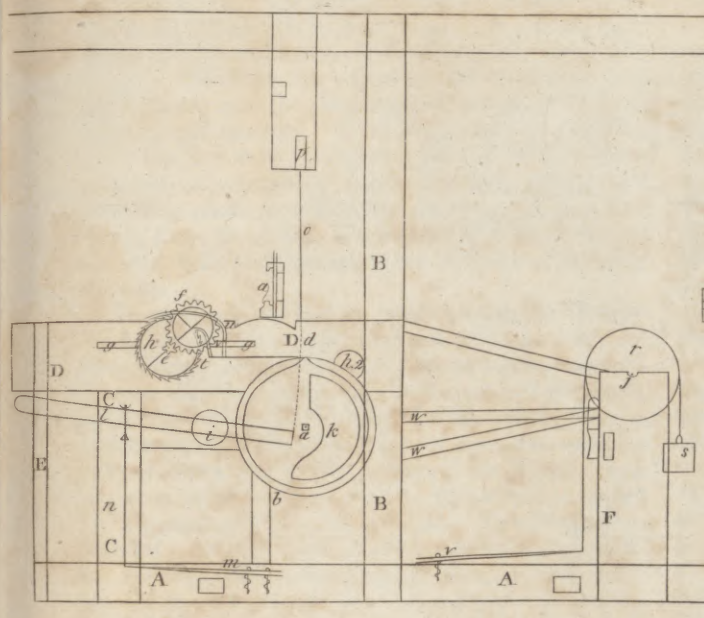


Fig. 6.

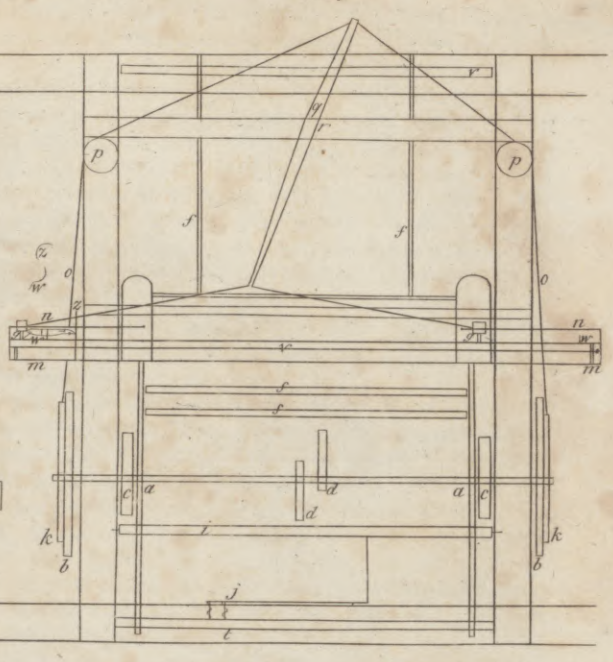


Fig. 7.

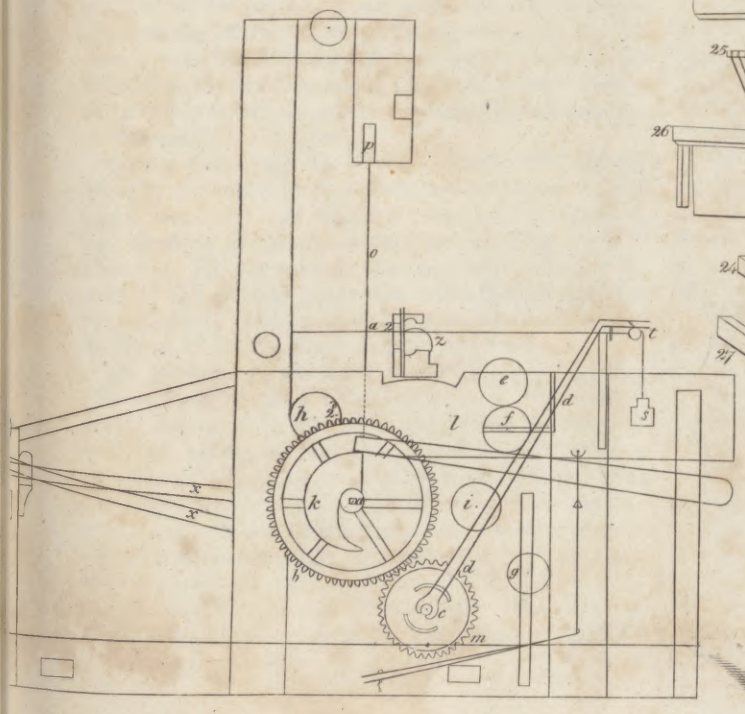
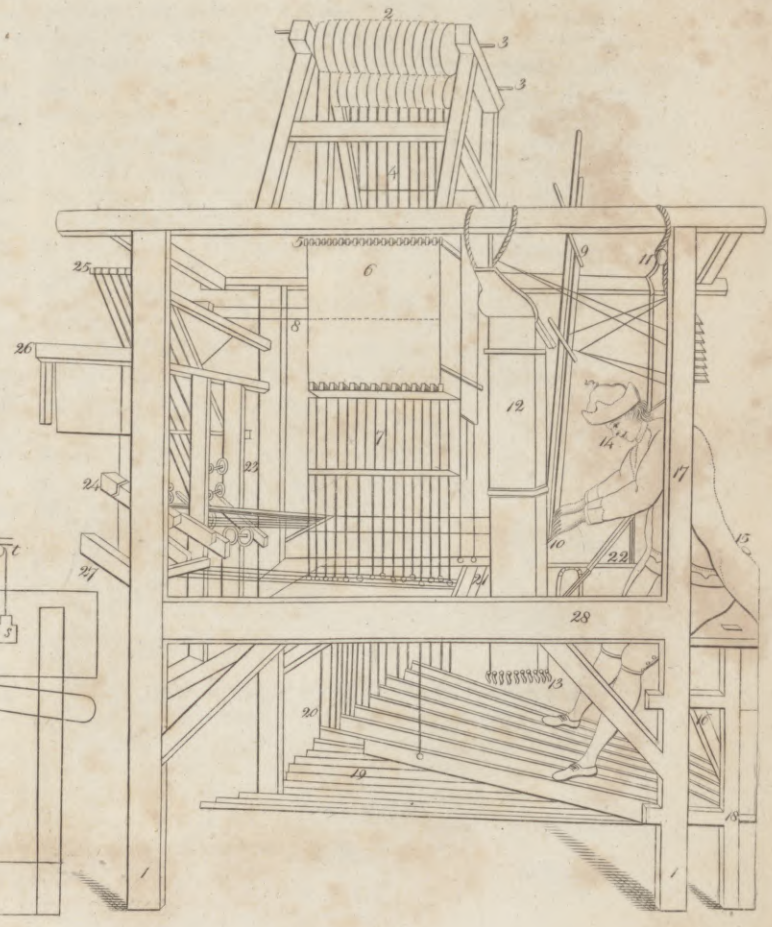


Fig. 8.



Webſter. particularly thoſe connected with the mathematics, for which he diſcovered an early predilection. He afterwards attended the lectures of the profeſſor of divinity, and in the year 1733 he was ordained miniſter of the pariſh of Culroſs, and in June 1737, he was admitted to be one of the miniſters of the Tolbooth church of Edinburgh. His eloquence was noble and manly, his piety conſpicuous, and the diſcharge of his paſtoral duties faithful and laborious. To theſe qualities he added an enlightened zeal for the external intereſts of the church, a jealouſy of corruption, a hatred of falſe politics and tyrannical meaſures, which ſometimes expoſed him to calumny from the guilty, but ſecured him the eſteem of all who could value independence of ſoul and integrity of heart.

The proſperity of fortune which placed Mr Webſter in the church of his father, and reſtored him to the poliſhed ſociety of his native city, was not confined to theſe favours. Eleven days after his ſettlement in Edinburgh, he obtained the hand of Mary Erſkine, a young lady of conſiderable fortune, and nearly related to the noble family of Dundonald. The genius of Mr Webſter now began to unfold itſelf. Family connections extended his acquaintance with the nobility. Edinburgh then poſſeſſed a number of men, both in civil and eccleſiaſtical ſtations, who have ſaved or adorned their country. With theſe he was ſoon to co-operate in defending the Proteſtant intereſts from the arms and artifices of rebellion.

In the year 1733, five or ſix miniſters ſeceded from the church, and being anxious to draw away as many as poſſible from the communion which they had renounced, they invited down to Scotland in 1741, Mr George Whitefield, a young preacher of great piety and extraordinary pulpit talents. On his way to Dunfermline, he was met and entertained at Edinburgh by Mr Webſter and ſome of his brethren. From them he learned the ſtate of church parties in Scotland; and though he kept his promiſe of preaching firſt in Fife, he declined connecting himſelf with any particular ſect. Diſappointed of his influence and aſſiſtance, the Seceders aſcribed the effects of his preaching to ſorcery and the devil, while Mr Webſter, in a pamphlet which he publiſhed on the occaſion, attributed them to the influence of the Holy Spirit, an opinion regarded by the Seceders as unſpeakable wickedneſs.

In the year 1745, Mr Webſter remained in the city when it was taken by the rebels, and employed his univerſal popularity and vigorous eloquence in retaining the minds of the people in the intereſts of the houſe of Hanover. His exertions in this were not overlooked by moſt of the ſpirited gentlemen who acted in quelling the rebellion. He became an intimate friend of Duncan Forbes of Culloden, Lord Milton, and others.

He preſerved to the lateſt period of his career, that activity both of mind and body, which diſtinguiſhed him in the prime of life, obtaining at laſt his frequent wiſh and prayer, an eaſy and peaceful death, after a very ſhort indiſpoſition, on the 25th of January 1784. His remains were depoſited in the Grayfriars churchyard; and it is not a little remarkable that neither private friendſhip nor public generoſity has yet come forward to teſtify its regard for two of the moſt eminent characters of the church of Scotland. The aſhes of Webſter and Blair repoſe in the ſame cemetry, undiſtinguiſhed from the leſs illuſtrious dead. No monumental ſtone marks the place of their duſt. Webſter || Weeks.

Nature endowed Dr Webſter with ſtrong faculties, which were afterwards improved by a conſiderable ſhare of erudition. He was a maſter in the knowledge of the world and of human nature; his addreſs was engaging; his wit ſtrong as his mind; his convivial powers, as they are called, enchanting. He had a conſtitutional ſtrength againſt intoxication, which made it dangerous in moſt men to attempt bringing him into ſuch a ſtate. His character as a miniſter was popular in the extreme. His voice was harmonious, and his figure noble. To the poor he was a father and a friend, a liberal patron to poor ſtudents. In his perſon he was tall, and of a thin and meagre habit. His features were ſtrongly marked, and the conformity of the whole indicated genius and independence.

To him the widows of the clergy are indebted for the eſtabliſhment of the celebrated *Scheme*, the plan of which he matured in his mind ſoon after he was appointed a miniſter of the Tolbooth church. By it the widows of miniſters are entitled to the annual ſum of 10, 15, 20, or 25 pounds, according as the clergy pay into the fund yearly, 2l. 12s. 6d.—3l. 18s. 9d.—5l. 5s. or 6l. 11s. 3d, or to their children in ſums of 100—150—200—or 250l. in favour of which an act of parliament was obtained in terms of a petition (17 Geo. II.) with liberty to employ the ſurplus of the annual payments and expences in loans of 30l. each among the contributors, and to put out the remainder at intereſt, on proper ſecurity. A ſecond act was procured in the 22d year of the ſame reign (1748) granting liberty to raiſe the capital to 80,000l. including the ſums lent to contributors. The fund is conceived to commence from the 25th March 1744. This was followed by another act in the year 1770, diſcontinuing the loan granted to contributors, and granting liberty to raiſe the capital to 100,000l.; and the whole economy of the inſtitution was then fixed and determined, a report of the ſtate of the fund being ordered to be made annually to the General Aſſembly by the truſtees, which was to be afterwards printed. The ſucceſs of the ſcheme has been complete.

WEDGE, one of the mechanical powers. See MECHANICS.

WEDNESDAY, the fourth day of the week, ſo called from a Saxon idol named *Woden*, ſuppoſed to be Mars, worſhipped on this day.

Aſh-WEDNESDAY, the firſt day of Lent, ſo called from the cuſtom obſerved in the ancient Chriſtian church of penitents expreſſing their humiliation at this time, by appearing in ſackcloth and aſhes.

WEED, a common name for all rank and wild herbs, that grow of themſelves, to the detriment of other uſeful herbs they grow among.

WEED, in the miners language, denotes the degeneracy of a load or vein of fine metal into an uſeleſs marcaſite.

WEEDS, alſo denote a peculiar habit, worn by the relicts of perſons deceaſed, by way of mourning.

WEEK, in chronology, a diviſion of time compriſing ſeven days. See *PLANETARY Days* and SABBATH.

Paſſion-WEEK, or the *Holy WEEK*, is the laſt week in Lent, wherein the church celebrates the myſtery of our Saviour's death and paſſion.

WEEKS

Weeks || Weight.

WEEKS, Ember. See EMBER.

Feaſt of WEEKS. See PENTECOST.

WEEVER. See TRACHINUS, ICHTHYOLOGY *Index.*

WEEVIL, in *Zoology*, a ſpecies of curculio. See CURCULIO, ENTOMOLOGY *Index*; and for the method of deſtroying this troubleſome and deſtructive inſect, ſee GRANARY and VERMIN.

WEIGELIA, a genus of plants belonging to the claſs and order pentandria monogynia. See BOTANY *Index.*

WEIGH, a weight of cheeſe, wool, &c. containing 256 pounds avoirdupois. Of corn, the weigh contains 40 buſhels; of barley or malt, ſix quarters. In ſome places, as Eſſex, the weigh of cheeſe is 300 pounds.

WEIGHING, the act of examining a body in the balance to find its weight.

WEIGHING Anchor, is the drawing it out of the ground it had been caſt into, in order to ſet ſail, or quit a port, road, or the like.

WEIGHT, in *Phyſics*, a quality in natural bodies, whereby they tend downwards towards the centre of the earth. Or, weight may be defined in a leſs limited manner, to be a power inherent in all bodies, whereby they tend to ſome common point, called the *centre of gravity*, or, to ſpeak more accurately, to one another: and that with a greater or leſs velocity, as they are more or leſs denſe, or as the medium they paſs through is more or leſs rare. See MECHANICS.

WEIGHT, in commerce, denotes a body of a known weight appointed to be put in the balance againſt other bodies whoſe weight is required.

The ſecurity of commerce depending, in a good meaſure, on the juſtneſs of weights, which are uſually of lead, iron, or braſs, moſt nations have taken care to prevent the falſification thereof, by ſtamping or marking them by proper officers, after being adjuſted by ſome original ſtandard. Thus, in England, the ſtandard of weights is kept in the exchequer by a particular officer, called the *clerk of the market.*

Weights may be diſtinguiſhed into ancient and modern.

I. ANCIENT WEIGHTS.

1. Thoſe of the ancient Jews, reduced to the Engliſh troy weight, will ſtand as in the following table:

		lib.	oz.	dwt.	gr.
Shekel		0	0	9	$2\frac{4}{7}$
60	Maneh	2	3	6	$10\frac{2}{7}$
3000 50	Talent	113	10	1	$10\frac{2}{7}$

2. Roman weights, reduced to Engliſh troy weight, will ſtand as is in the following table:

										oz.	dwt.	gr.
Lentes										0	0	$0\frac{8}{11}\frac{5}{2}$
4	Siliquæ									0	0	$3\frac{1}{2}\frac{1}{8}$
12	3	Obolus								0	0	$9\frac{3}{2}\frac{3}{8}$
24	6	2	Scriptulum							0	0	$18\frac{3}{1}\frac{3}{4}$
72	18	6	3	Drachma						0	2	$6\frac{9}{1}\frac{9}{4}$
96	24	8	4	$1\frac{1}{3}$	Sextula					0	3	$0\frac{6}{7}$
144	36	12	6	2	$1\frac{1}{2}$	Sicilicus				0	4	$13\frac{2}{7}$
192	48	16	8	$2\frac{2}{3}$	2	$1\frac{1}{3}$	Duella			0	6	$1\frac{5}{7}$
576	144	48	24	8	6	4	3	Uncia		0	18	$5\frac{1}{7}$
6912	1728	576	288	96	72	48	36	12	Libra	10	18	$13\frac{5}{7}$

The Roman ounce is the Engliſh avoirdupois ounce, which they divided into ſeven denarii, as well as eight drachmas.

3. *Attic Weights.*

		Engliſh Troy Weight lb.	oz.	dwt.	gr.
Drachma		0	0	2	16.9
100	Mina	1	1	10	10
6000 60	Talent	67	7	5	0

II. MODERN WEIGHTS.

1. *Engliſh Weights.*—Mr Renardſon, in a paper publiſhed in the Philoſophical Tranſactions, has proved, that at firſt there was but one weight in England, and that this was the avoirdupois. Troy weight was introduced in the time of Henry VII.: At preſent, both the troy and avoirdupois weights are uſed in England. Troy weight ſeems to have derived its name from *Troyes*, a town in France, where a celebrated fair was kept. It is uſed for weighing gold, ſilver, jewels, ſilk, and all liquors. The avoirdupois is uſed for weighing other things.

TABLE of Troy Weight, as uſed by the Goldſmiths, &c.

Grains.			
24	Penny-weights.		
480	20	Ounce.	
5760	240	12	Pound.

Apothecaries.

Grains.				
20	Scruple. ℈			
60	3	Dram. ʒ		
480	24	8	Ounce. ℥	
5760	288	96	12	Pound.

The troy pound in Scotland, which by ſtatute is to be the ſame as the French pound, is commonly ſuppoſed equal

Weight. equal to 15 ounces and three quarters troy Engliſh weight, or 7560 grains. But by a mean of the ſtandards kept by the dean of guild of Edinburgh, it weighs $7599\frac{2}{3\frac{2}{3}}$ or 7600 grains.

TABLE of Avoirdupois Weight.

Drams.					
16	An ounce.				
256	16	A pound.			
7168	448	28	A quarter.		
28672	1792	112	4	A hundred.	
573440	35840	2240	80	20	A ton.

The avoirdupois pound is equal to 7004 troy grains, the avoirdupois ounce to 437.75 grains; and it follows of conſequence, that the troy pound is to the avoirdupois pound as 88 to 107 nearly; for as 88 to 107, ſo is 5760 to 7003.636: that the troy ounce is to the avoirdupois ounce as 80 to 73 nearly; for as 80 to 73, ſo is 480 to 438. An avoirdupois pound is equal to 1 lb. 2 oz. 11 dwts. 20 gr. troy; a troy ounce is equal to 1 oz. 1.55 dr. avoirdupois; an avoirdupois dram contains 27.34375 grains; 175 troy pounds are equal to 144 avoirdupois pounds.

The moneyers have a peculiar ſubdiviſion of the grain troy: thus,

The { Grain, Mite, Droit, Periot } into { 20 Mites. 24 Droits. 20 Periots. 24 Blanks. }

The Engliſh weights are uſed in the United Provinces of America.

2. *French Weights.*—Different weights were formerly uſed in moſt of the different provinces of France: Theſe, however, have undergone very material alterations ſince the revolution in that kingdom. See MEASURE. But as a knowledge of the ancient weights of that country is of importance, on account of the books in which they are uſed, we inſert the following tables. The Paris pound contains 16 ounces, and is divided two ways.

Grains.					
24	Penny-weight.				
72	3	Gros.			
576	24	8	Ounce.		
4608	192	64	8	Marc.	
9216	384	128	16	2	Pound.

Half-ounce.						
2	Ounce.					
4	2	Half-quarter pound.				
8	4	2	Quarter-pound.			
16	8	4	2	Half-pound.		
32	16	8	4	2	Pound.	
3200	1600	800	400	200	100	Quintal.

The weights of the firſt diviſion are uſed to weigh gold, ſilver, and the richer commodities; and the weights of the ſecond diviſion for commodities of leſs value.

The Paris 2 marc, or pound weight, is equal to 7560 grains troy, and the Paris ounce equal to 472.5 grains troy.

	lb.	oz.	dwt.	gr.	
The Paris pound =	1	3	15	0	troy.
The Paris ounce =	0	0	19	16.5	troy.

A grain troy = 1.2186507 of a Paris grain.

But the pound was not the ſame throughout France. At Lyons, *e. gr.* the city pound was only 14 ounces: ſo that 100 Lyons pounds, made only 86 Paris pounds. But beſide the city pound, they had another at Lyons for ſilk, containing 15 ounces. At Thouloufe, and throughout the Upper Languedoc, the pound was 13 ounces and a half of Paris weight. At Marſeilles, and throughout Provence, the pound was $13\frac{1}{2}$ ounces of Paris weight. At Rouen, beſide the common Paris pound and mark, they had the weight of the vicomte; which was 16 ounces, a half, and five-ſixths of the Paris weight. The weights enumerated under the two articles of Engliſh and French weights are the ſame that are uſed throughout the greateſt part of Europe; only under ſomewhat different names, diviſions, and proportions.

French weights were formerly uſed in all the French American ſettlements.

3. *Dutch Weights.*—The weight uſed in Amſterdam and all over Holland is called *Troy weight*, and is exactly the ſame with that uſed at Bruſſels. The Dutch weights are as follows:

Deuſkens.						
2	Troyken.					
4	2	Vierling.				
16	8	4	As.			
512	256	128	32	Angle.		
10240	5120	2560	640	20	Ounce.	
81920	40960	20480	5120	160	8	Marc.

The marc is equal, according to M. Tillet, to 4620 French grains.

Weight. The Amſterdam pound uſed in commerce is divided into 16 ounces, 32 loots, or 128 drams. This pound contains 2 marcs troy, and ought therefore to weigh only 10240 *as*: but it weighs 10280; ſo that it is a little heavier than the troy pound of Amſterdam: 256lb. of commerce are equal to 257lb. troy of Holland. Two different pounds are uſed by apothecaries; the one containing 2 marcs, the other only $1\frac{1}{2}$. The firſt is called *arſenic* pound weight; it contains 16 ounces, the ounce 8 drams, the dram 8 ſcruples, the ſcruple 20 grains. The ſecond is called the *apothecary's* pound; it is divided into 12 ounces, or 24 loots. Three arſenic pounds are equal to 4 apothecary's pounds.

The Dutch ſtone -	= 8 commercial lb.
The Liſpundt, or Ll.	= 15
The hundred weight	= 100
The Schippondt, or Sch. lb.	= 300

4. *Spaniſh Weights.*—The marc of Caſtile, uſed for weighing gold and ſilver, is divided as follows:

Grains (gold weight).							
$1\frac{1}{24}$	Grain (ſilver weight).						
12	$11\frac{13}{25}$	Tomine (gold weight).					
$12\frac{1}{2}$	12	$1\frac{1}{24}$	Tomine (ſilver weight).				
$37\frac{1}{2}$	36	$3\frac{1}{8}$	3	Adarme.			
75	72	$6\frac{1}{4}$	6	2	Ochava.		
96	$92\frac{4}{25}$	8	$7\frac{17}{25}$	$2\frac{14}{25}$	$1\frac{7}{25}$	Caſtellano.	
600	576	50	48	16	8	$6\frac{1}{4}$	Ounce.
4800	4608	400	384	128	64	50	8 Marc.

The marc, according to Tillet, is equal to 7 oz. 4 gros, 8 grains French, which is equal to 4785 *as* of Holland. One hundred marcs of Caſtile = about $93\frac{1}{2}$ marcs of Holland; 100 marcs of Holland = 107 marcs of Caſtile. Medicines are ſold by the ſame marc; but it is divided differently, containing 8 ounces, 64 drachms, 192 ſcruples, 384 obolos, 1152 caracteras, 4608 grains.

The Spaniſh commercial pound is divided into two marcs, called *marcs of Tejo*, each of which is equal to the marc of Caſtile. This pound is divided into 16 ounces, 256 adarmes, 9,216 grains.

5. *Weights of Portugal.*—The Liſbon marc for eſſaying ſilver coin of 12 deniers, and the denier of 24 grains. The marc of Portugal for weighing gold and ſilver is equal, according to Tillet, to 7 ounces $3\frac{1}{2}$ gros, and 34 grains French, which makes 4776 *as* of Holland; ſo that it is exactly the ſame with the Liſbon pound. It is divided into 8 ounces, 64 outavas, 192 ſcruples, 4608 grains.

The pound conſiſts of 2 marcs, 16 ounces, or 96 outavas; the arroba of 32 lb.; the quintal of 4 arrobas, or 128 lb. 100 Oporto pounds make $87\frac{1}{2}$th pounds of commerce of Amſterdam.

6. *Weights of Italy.—Genoa.* Two kinds of weights are uſed at Genoa, the *peſo groſſo* (heavy weight), and the *peſo ſottile* (light weight): the latter is uſed for weighing gold and ſilver, the former for other things. The pound of the peſo ſottile is equal, according to Tillet, to 1 marc, 2 ounces, $2\frac{1}{2}$ gros, 30 grains French. It is divided into 8 ounces, the ounce into 24 deniers, and the denier into 24 grains. The pound of the peſo groſſo is equal to 1 marc, 2 ounces, 3 gros, 5 grains, French. It is divided into 12 ounces:

The cantaro	= 100 lbs. peſo groſſo.
The rubbo	= 25 lbs.
The rotolo	= $1\frac{1}{2}$ lb.
100 lbs. peſo groſſo	= $64\frac{1}{3}$ lb. of commerce of Amſterdam.
100 lbs. peſo ſottile	= 129 marcs troy of Holland.

Rome. The Roman pound conſiſts of 12 ounces, the ounce of 24 deniers, the denier of 24 grains. The Roman pound, according to Tillet, is equal to 1 marc, 3 ounces, $\frac{1}{2}$ gros, 14 grains, French.

Venice. The marc for weighing gold and ſilver contains 8 ounces, 32 quarti, 1152 carati, or 4608 grani. An hundred marcs of Venice = $97\frac{1}{3}$ marcs troy of Holland, 100 marcs of Holland = 103 of Venice. In Venice they alſo uſe a *peſo groſſo* and *peſo ſottile*. 100 lbs. peſo groſſo = $94\frac{4}{5}$ commercial lbs. of Amſterdam. 100 lbs. peſo ſottile = $61\frac{1}{7}$ ditto.

7. *Swediſh Weights.*—The marc for weighing gold and ſilver is equal to 16 lods, 64 quentins, or 4384 as. The pound of 32 lods, uſed for weighing food, is equal, according to Tillet, to 1 marc, 5 ounces, 7 gros, 8 grains French, which makes $8848\frac{1}{2}$ as troy of Holland. This anſwers exactly to the weight of the different pounds, as fixed in Sweden, viz. 8848 as = the pound for weighing articles of food; $7821\frac{70}{125}$ as = marc uſed in the mines; $7450\frac{2}{125}$ as = marc uſed in towns and in the country; $7078\frac{2}{5}$ as = marc uſed for weighing iron; 7416 as = pound uſed in medicine.

The ſkippund	= 400 lbs. for weighing food.
The centner	= 120 lbs.
The waag	= 165 lbs.
The ſten	= 32 lbs.
The Swediſh as	= 1 as of Holland troy.

8. *German Weights.—Vienna.* The marc of Vienna for weighing gold and ſilver is divided into 16 loths, 64 quintals, or 256 deniers or pfenings; the loth into 4 quintals, or 16 pfenings. This marc, according to Tillet, is equal to 1 marc, 1 ounce, 1 gros, 16 grains, French, = 5831 as troy Holland. The pound of Vienna is divided into 2 marcs, or 4 viertings; the mark into 8 ounces, 16 loths, 64 quintals, or 266 pfenings.

Hamburgh. The marc for eſſaying gold is divided into 24 carats; the carat into 12 grains. The marc for ſilver is divided into 16 loths, and the loth into 18 grains. Theſe marcs conſiſt each of 288 grains, and are therefore equal. This marc, uſed in Hamburgh for gold and ſilver, is the marc of Cologne, which is equal, according to Tillet, to 7 ounces, 5 gros, $7\frac{1}{4}$ grains, French, = 4866 as troy of Holland. It is divided into 8 ounces, 16 loths, 64 quentins, 256 pfenings, 4352 eſches, or 65536 richt pfenings theile. The apothecary pound uſed in Hamburgh, and almoſt all Germany, is divided into 12 ounces, 96 drachms, 288 ſcruples, or 5760 grains; an ounce is equal to 621 as of Holland.

The

Weight. The pound of commerce is equal, according to Tillet, to 10085 as of Holland; for half a pound is equal to 7 ounces, 7 gros, 23 grains, French. This pound is divided into 16 ounces, 32 loths, 128 quentins, or 512 pfenings.

9. *Ruſſian Weights.*—The berckowitz = 400 lbs.
The poud - - - = 40 lbs.

The pound is divided into 32 loths, or 96 ſolotnuks. One hundred Ruſſian lbs. = 166½ marcs, or 82⅝ lbs. of Amſterdam. One hundred lbs. of commerce of Amſterdam = 120¾th lbs. of Ruſſia.

10. *Weights uſed in the ſeveral parts of Aſia, the Eaſt Indies, China, Perſia,* &c.—In Turkey, at Smyrna, &c. they uſe the batman, or battemant, containing 7½ occos; the occo contains 4 chekys or pounds, each of which, according to Tillet, is equal to 1 marc 2 oz. 3 gros. 28 gr. French. The Turkiſh weights are divided as follows:

Cantaras.	Batmans.	Occos.	Rotolos.	Chekis.	Meſcals.	Drachms.
1 =	7½ =	44 =	100 =	176 =	11733⅓ =	17600
	1 =	6 =	13 1/11 =	24 =	1600 =	2400
		1 =	2 1/11 =	4 =	266⅔ =	400
			1 =	1 10/88 =	117⅓ =	176
				1 =	66⅔ =	100
					1 =	1½

At Aleppo there are three ſorts of rottos; the firſt 720 drachms, making about 7 pounds Engliſh, and ſerving to weigh cottons, galls, and other large commodities; the ſecond is 680 drachms, uſed for all ſilks but white ones, which are weighed by the third rotto of 700 drachms. At Seyda the rotto is 600 drachms.

The other ports of the Levant, not named here, uſe ſome of theſe weights; particularly the occa, or ocqua, the rottoli, and rotto.

The Chineſe weights are, the piece for large commodities: it is divided into 100 catis or cattis, though ſome ſay into 125; the cati into 16 taels or tales, each tael equivalent to 1⅓ of an ounce Engliſh, or the weight of one rial and 1/12, and containing 12 mas or maſſes, and each mas 10 condrins. So that the Chineſe piece amounts to 137 pounds Engliſh avoirdupois, and the cati to 1 pound 8 ounces. The picol for ſilk containing 66 catis and ¾; the bahar, bakaire, or barr, containing 300 catis.

Tonquin has alſo the ſame weights, meaſures, &c. as China. Japan has only one weight, viz. the cati; which, however, is different from that of China, as containing 20 taels. At Surat, Agra, and throughout the ſtates of the Great Mogul, they uſe the man, or maund, whereof they have two kinds; the king's maund, or king's weight; and the maund ſimply; the firſt uſed for the weighing of common proviſions, containing 40 ſeers, or ſerres; and each ſeer a juſt Paris pound. The common maund, uſed in the weighing of merchandiſe, conſiſts likewiſe of 40 ſeers, but each ſeer is only eſtimated at 12 Paris ounces, or ¾ of the other ſeer.

The maund may be looked upon as the common weight of the Eaſt Indies, though under ſome difference of name, or rather of pronunciation; it being called *mao* at Cambaya, and in other places *mein* and *maun*. The ſeer is properly the Indian pound, and of univerſal uſe; the like may be ſaid of the bahar, tael, and catti, above mentioned.

The weights of Siam are the piece, containing two ſhans or cattis; but the Siameſe catti is only half the Japaneſe, the latter containing 20 taels and the former only 10; though ſome make the Chineſe catti only 16 taels, and the Siameſe 8. The tael contains 4 baats, or ticals, each about a Paris ounce; the baat 4 ſelings or mayons; the mayon 2 ſouangs; the ſouang 4 payes; the paye 2 clams; the ſompaye half a ſouang. Weight.

It is to be obſerved, that theſe are the names of their coins as well as weights; ſilver and gold being commodities there ſold, as other things, by their weights.

In the iſle of Java, and particularly at Bantam, they uſe the gantan, which amounts to near 3 Dutch pounds. In Golconda, at Viſapour, and Goa, they have the furatelle, containing 1 pound 14 ounces Engliſh; the mangalis, or mangelin, for weighing diamonds and precious ſtones, weighing at Goa 5 grains, at Golconda, &c. 5½ grains. They have alſo the rotolo, containing 14¼ ounces Engliſh; the metricol, containing the ſixth part of an ounce; the wall for piaſtres and ducats, containing the 73d part of a rial.

In Perſia they uſe two kinds of batmans or mans; the one called *cahi* or *cheray*, which is the king's weight, and the other *batman of Tauris*. The firſt weighs 13 pounds 10 ounces Engliſh; the ſecond 6½ pounds. Its diviſions are the ratel, or a 16th; the derhem, or drachm, which is the 50th; the meſchal, which is half the derhem; the dung, which is the ſixth part of the meſchal, being equivalent to 6 carat grains; and, laſtly, the grain which is the fourth part of the dung. They have alſo the vakie, which exceeds a little our ounce; the ſah-cheray, equal to the 1170th part of the derhem; and the toman, uſed to weigh out large payments of money without telling; its weight is that of 50 abaſſes.

11. *Weights at Cairo in Egypt.*—Almoſt every kind of goods has its own weight; theſe are regulated by the cantaren or principal weight.

	Rotels.
The ordinary cantaren, or hundred weight, weighs	100
The cantaren of quickſilver and tin -	102
coffee, wine, and iron -	105
ivory - - - -	100
almonds and other fruits	115
woods for dyeing - -	120
arſenic and other drugs -	125
minium and cinnabar -	130
gum-arabic, aloes, and other aromatics - - -	133

The ratel or rotoli is nearly equal to the pound of Marſeilles; 108 lbs. of Marſeilles are equal to 110 rotels. The Marſeilles pound conſiſts of 13 ounces of Paris; ſo that the 100 lbs. of Marſeilles are equal to 81 lbs. Paris, and 100 lbs. Paris = 123 lbs. of Marſeilles.

We ſhall ſubjoin here Mr Ferguſon's table for comparing the Engliſh avoirdupois pound with foreign pounds:

London pound	1.0000	Bruges	1.0204	*Ferguſon's Tables and Tracts.*
Antwerp	1.04	Calabria	0.73	
Amſterdam	1.1111	Calais	0.9345	
Abeville	1.0989	Dieppe	1.0989	
Ancona	0.78	Dantzic	0.862	
Avignon	0.8928	Ferrara	0.75	
Bourdeaux	1.0989	Flanders	0.9433	
Bologna	0.8	Geneva	1.07	

Weight.

Genoa, groſs	0.7	Rochelle	0.8928
Hamburgh	1.0865	Rome	0.7874
Liſbon	1.135	Rouen	1.1089
Leghorn	0.75	Seville	0.9259
Norimberg	1.1363	Thouloufe	0.8928
Naples	0.71	Turin	0.82
Paris	1.1235	Venice	1.06
Prague	1.2048	Vienna	1.23
Placentia	0.72		

In order to ſhow the proportion of the ſeveral weights uſed throughout Europe, we ſhall add a reduction of them to one ſtandard, viz. the London pound.

The 100 lb. of England, Scotland, and Ireland are equal to

lb.	oz.	
91	8	of Amſterdam, Paris, &c.
96	8	of Antwerp or Brabant.
88	0	of Rouen, the viſcounty weight.
106	0	of Lyons, the city weight.
90	9	of Rochelle.
107	11	of Thouloufe and Upper Languedoc.
113	0	of Marſeilles or Provence.
81	7	of Geneva.
93	5	of Hamburgh.
89	7	of Francfort, &c.
96	1	of Leipſic, &c.
137	4	of Genoa.
132	11	of Leghorn.
153	11	of Milan.
152	0	of Venice.
154	10	of Naples.
97	0	of Seville, Cadiz, &c.
104	13	of Portugal.
96	5	of Liege.
112	$\frac{2}{3}$	of Ruſſia.
107	$\frac{1}{2}\frac{1}{4}$	of Sweden.
89	$\frac{1}{2}$	of Denmark.

A curious weighing machine was ſome time ago invented by M. Hanin of Paris, whereby the weights of the principal countries in Europe, and the relative proportions they bear to each other, are ſhown at one view. For this he received a bounty of 20 guineas from the Society inſtituted at London for the Encouragement of Arts, Manufactures, and Commerce. The following is a deſcription of this ingenious machine.

Plate DLXXVII. fig. 1.

Figure 1. repreſents the back of the machine, which being ſuſpended by the ring A, and a weight hung to the hook B, the ſpring C, C, C, made faſt by ſtrong ſcrews at *g*, is drawn downwards; and the bar D having a rack thereon at *e*, turns the pinion *f*, in proportion to the weight of the body hanging thereto. Figure 2. ſhows the face of the machine, on which is a number of concentric circles, and the weights of ſeveral countries of Europe engraved thereon, as expreſſed by the words on a line with them. In the centre of this face is a ring fixed to the ſmall plate, turned by the pinion *f*, ſhown at figure 1. From this ring a hand projects, which, by the turning of the pinion, points to ſuch part of the circle as is marked with the weight hung to the hook B; and thereby ſhows what weight of any of the countries mentioned, is equal to the pounds troy of London, which are engraved on the outer circle, or to the pounds avoirdupois, which are engraved on the ſecond circle, and ſo of the reſt. A ſlider moves on the hand, which may be brought to any of the circles at pleaſure, in order to point out the relative weight with greater preciſion.

Fig. 2.

Many attempts have been made to introduce an uniformity of weights and meaſures into the commercial world; but hitherto they have all failed. The accompliſhment of ſuch an undertaking would be of infinite advantage to mankind, and certainly claims the moſt ſerious attention of thoſe who by their ſituation can alone bring it about. The undertaking is indeed difficult, but ſurely not impoſſible. Something of this kind has been attempted and adopted in France; and, as the method is ſimple, and exceedingly well adapted for calculation, it ſurely deſerves to be imitated. See MEASURE.

WEIGHT of Air. See PNEUMATICS, N° 14—19.

Regulation of WEIGHTS and Meaſures, is a branch of the king's prerogative. See PREROGATIVE and MEASURE.

As weight and meaſure are things in their nature arbitrary and uncertain, it is therefore expedient that they be reduced to ſome fixed rule or ſtandard: which ſtandard it is impoſſible to fix by any written law or oral proclamation; for no man can, by words only, give another an adequate idea of a foot rule, or a pound weight. It is therefore neceſſary to have recourſe to ſome viſible, palpable, material ſtandard; by forming a compariſon with which all weights and meaſures may be reduced to one uniform ſize; and the prerogative of fixing this ſtandard, our ancient law veſted in the crown, as in Normandy it belonged to the duke. This ſtandard was originally kept at Wincheſter: and we find in the laws of King Edgar, near a century before the conqueſt, an injunction that the one meaſure, which was kept at Wincheſter, ſhould be obſerved throughout the realm. Moſt nations have regulated the ſtandard of meaſures of length by compariſon with the parts of the human body; as the palm, the hand, the ſpan, the foot, the cubit, the ell (*ulna* or arm), the pace, and the fathom. But as theſe are of different dimenſions in men of different proportions, our ancient hiſtorians inform us, that a new ſtandard of longitudinal meaſure was aſcertained by King Henry the Firſt; who commanded that the *ulna*, or ancient ell, which anſwers to the modern yard, ſhould be made of the exact length of his own arm. And one ſtandard of meaſure of length being gained, all others are eaſily derived from thence; thoſe of greater length by multiplying, thoſe of leſs by dividing, that original ſtandard. Thus, by the ſtatute called *compoſitio ulnarum et perticarum*, five yards and a half make a perch; and the yard is ſubdivided into three feet, and each foot into 12 inches; which inches will be each of the length of three grains of barley. Superficial meaſures are derived by ſquaring thoſe of length; and meaſures of capacity by cubing them. The ſtandard of weights was originally taken from corns of wheat, whence the loweſt denomination of weights we have is ſtill called a *grain*; 32 of which are directed, by the ſtatute called *compoſitio menſurarum*, to compoſe a penny weight, whereof 20 make an ounce, 12 ounces a pound, and ſo upwards. And upon theſe principles the firſt ſtandards were made; which, being originally ſo fixed by the crown, their ſubſequent regulations have been generally made by the king in parliament. Thus, under King Richard I. in his parliament holden at Weſtminſter, A. D. 1197, it was ordained that there ſhould be only one weight and one meaſure

Weight || Well.

measure throughout the kingdom, and that the cuſtody of the aſſize, or ſtandard of weights and meaſures, ſhould be committed to certain perſons in every city and borough; from whence the ancient office of the king's aulnager ſeems to have been derived, whoſe duty it was, for a certain fee, to meaſure all cloths made for ſale, till the office was aboliſhed by the ſtatute 11th and 12th William III. c. 20. In King John's time this ordinance of King Richard was frequently diſpenſed with for money; which occaſioned a proviſion to be made for enforcing it, in the great charters of King John and his ſon. Theſe original ſtandards were called *pondus regis*, and *menſura domini regis*, and are directed by a variety of ſubſequent ſtatutes to be kept in the exchequer chamber, by an officer called the *clerk of the market*, except the wine gallon, which is committed to the city of of London, and kept in Guildhall.

The *Scottiſh* ſtandards are diſtributed among the oldeſt boroughs. The elwand is kept at Edinburgh, the pint at Stirling, the pound at Lanark, and the firlot at Linlithgow.

Various ſtatutes have been enacted for regulating and enforcing an uniformity of weights and meaſures; and by the articles of union, the Engliſh ſtandards are eſtabliſhed by law over all Great Britain. But the force of cuſtom is ſo ſtrong, that theſe ſtatutes have been ill obſerved. The Scottiſh ſtandards are ſtill univerſally retained for many purpoſes; and likewiſe a variety of local weights and meaſures are uſed in particular places of both countries, which differ from the general ſtandards of either.

WEINMANNIA, a genus of plants of the claſs *octandria*, order *monogynia*, and arranged in the natural claſſification with thoſe plants the order of which is doubtful. The calyx is four-leaved, the corolla has four petals, and the capſule is bilocular and biroſtrated. There are ſix ſpecies, none of which are natives of Britain.

WELD, or WOLD. See RESEDA, BOTANY *Index*, and DYEING.

WELDING HEAT, in ſmithery, a degree of heat given to iron, &c. ſufficient to make the ſurfaces of two pieces incorporate upon being beaten together with a hammer.

WELL, a hole under ground, uſually of a cylindrical figure, and walled with ſtone and mortar: its uſe is to collect the water of the ſtrata around it.

WELL, an apartment formed in the middle of a ſhip's hold to incloſe the pumps, from the bottom to the lower decks. It is uſed as a barrier to preſerve thoſe machines from being damaged by the friction or compreſſion of the materials contained in the hold, and particularly to prevent the entrance of ballaſt, &c. by which the tubes would preſently be choked, and the pumps rendered incapable of ſervice. By means of this incloſure, the artificers may likewiſe more readily deſcend into the hold, in order to examine the ſtate of the pumps, and repair them as occaſion requires.

WELL-Room of a Boat, the place in the bottom where the water lies between the ceiling and the platform of the ſtern-ſheets, whence it is thrown out into the ſea with a ſcoop.

Burning-WELL. See *BURNING-Spring*.

WELL of a Fiſhing-veſſel, an apartment in the middle of the hold, which is entirely detached from the reſt, being lined with lead on every ſide, and having the bottom thereof penetrated with a competent number of ſmall holes paſſing alſo through the ſhip's floor; ſo that the ſalt-water running into the well is always kept as freſh as that in the ſea, and yet prevented from communicating itſelf to the other parts of the hold.

Well || Werturian.

WELL-hole, in building, is the hole left in a floor for the ſtairs to come up through.

WELLS, a city of Somerſetſhire, and ſee of a biſhop; the biſhop of Bath being alſo that of Wells.—It is ſuppoſed to take its name from the many ſprings and wells that are near it. It is not very large; but is adorned with handſome buildings, both public and private. Its cathedral is a very beautiful ſtructure, adorned with images and carved ſtone work. The biſhop's palace joins to the cathedral; and on the other ſide are the houſes for the prebendaries. In the market-place is a fine market houſe, ſupported by pillars. It is governed by a mayor, and ſends two members to parliament. The chief manufacture is knit hoſe. W. Long. 2. 50. N. Lat. 51. 12.

WEN, a tumor or excreſcence ariſing on different parts of the body, and containing a cyſtus or bag filled with ſome peculiar kind of matter. See NÆVUS, SURGERY *Index*.

WEREGILD, the price of *homicide;* paid partly to the king for the loſs of a ſubject, partly to the lord whoſe vaſſal he was, and partly to the next of kin of the perſon ſlain.

WERST, WURST, or *Verſt*, a Ruſſian meaſure equal to 3500 Engliſh feet. A degree of a great circle of the earth contains about 104 werſts and a half.

WERTURIAN or *URALIAN Mountains*, a famous chain of mountains forming part of the boundary of Aſia. It begins diſtinctly (for it may be traced interruptedly farther ſouth) near the town of Kungur, in the government of Kaſan, in latitude 57° 20′; runs north, and ends oppoſite to the Waygatz ſtrait, and riſes again in the iſle of *Nova Zemlja*. The Ruſſians alſo call this range *Semennoi Poias*, or, *the girdle of the world;* from a ſuppoſition that it encircled the univerſe. Theſe were the *Riphæi montes: Pars mundi damnata a natura rerum, et denſa merſa caligine*;* of which only the ſouthern part was known to the ancients, and that ſo little as to give riſe to numberleſs fables. Beyond theſe were placed the happy *Hyperborei*, a fiction moſt beautifully related by Pomponius Mela. Moderns have not been behind-hand in exaggerating ſeveral circumſtances relative to theſe noted hills. Yſbrand Ides, who croſſed them in his embaſſy to China, aſſerts that they are 5000 toiſes or fathoms high; others, that they are covered with eternal ſnow. The laſt may be true in their more northern parts; but in the uſual paſſages over them, they are free from it three or four months.

* *Plinii Hiſt. Nat.* lib. iv. cap. 12.

The heights of part of this chain have been taken by M. l'Abbé d'Auteroche: who, with many aſſurances of his accuracy, ſays, that the height of the mountain Kyria near Solikamſkaia, in latitude 60°, does not exceed 471 toiſes from the level of the ſea, or 286 from the ground on which it ſtands. But, according to M. Gmelin, the mountain Pauda is much higher, being 752 toiſes above the ſea. From Peterſburgh to this chain is a vaſt plain, mixed with certain elevations or platforms, like iſlands in the midſt of an ocean. The eaſtern ſide deſcends gradually to a great diſtance into the wooded and moraſſy Siberia, which forms an immenſe

Worturian, Wesley.

menſe inclined plane to the Icy ſea. This is evident from all the great rivers taking their riſe on that ſide, ſome at the amazing diſtance of latitude 46°; and, after a courſe of about 27 degrees, falling into the Frozen ocean, in latitude 73° 30′. The Yaik alone, which riſes near the ſouthern part of the eaſtern ſide, takes a ſouthern direction, and drops into the Caſpian ſea. The Dwina, the Peczora, and a few other rivers in European Ruſſia, ſhew the inclined plane of that part. All of them run to the northern ſea; but their courſe is comparatively ſhort. Another inclination directs the Dnieper and the Don into the Euxine, and the vaſt Wolga into the Caſpian ſea.

WESLEY, JOHN, a very extraordinary character, and founder of the ſect of Methodiſts, was the ſon of the Reverend Samuel Weſley, rector of Epworth in the iſle of Axholme in Lincolnſhire, and was born in that village in the year 1703. His very infancy was diſtinguiſhed by an extraordinary incident; for when he was only ſix years old, the parſonage-houſe at Epworth was burnt to the ground, and the flames had ſpread with ſuch rapidity, that few things of value could be ſaved. His mother, in a letter to her ſon Samuel Weſley, then on the foundation at Weſtminſter ſchool, thanks God that no lives were loſt, although for ſome time they gave up *Poor Jacky*, as ſhe expreſſes herſelf; for his father had twice attempted to reſcue the child, but was beaten back by the flames. Finding all his efforts ineffectual, he reſigned him to Divine Providence. But parental tenderneſs prevailed over human fears, and Mr Weſley once more attempted to ſave his child. By ſome means equally unexpected and unaccountable, the boy got round to a window in the front of the houſe, and was taken out, by one man's leaping on the ſhoulders of another, and thus getting within his reach. Immediately on his reſcue from this very perilous ſituation, the roof fell in. This extraordinary eſcape explains a certain device, in a print of Mr John Weſley, engraved by Vertue, in the year 1745, from a painting by Williams. It repreſents a houſe in flames, with this motto from the prophet, "Is he not a brand plucked out of the burning?" Many have ſuppoſed this device to be merely emblematical of his ſpiritual deliverance; but from this circumſtance it is apparent that it has a primary as well as a ſecondary meaning; it is real as well as alluſive.

In the year 1713 he was entered a ſcholar at the Charter-houſe in London, where he continued ſeven years under the tuition of the celebrated Dr Walker, and of the Rev. Andrew Tooke author of The Pantheon. Being elected to Lincoln college, Oxford, he became a fellow of that college about the year 1725, took the degree of Maſter of Arts in 1726, and was joint tutor with the Rev. Dr Hutchins the rector. He diſcovered very early an elegant turn for poetry. Some of his gayer poetical effuſions are proofs of a lively fancy and a fine claſſical taſte; and ſome tranſlations from the Latin poets, while at college, are allowed to have great merit. He had early a ſtrong impreſſion, like Count Zinzendorff, of his deſignation to ſome extraordinary work. This impreſſion received additional force from ſome domeſtic incidents; all which his active fancy turned to his own account. His wonderful preſervation, already noticed, naturally tended to cheriſh the idea of his being deſigned by Providence to accompliſh ſome purpoſe or other, that was out of the ordinary courſe of human events. The late Rev. Samuel Badcock, in a letter inſerted in the Bibliotheca Topographica Britannica, N° XX. ſays, "There were ſome ſtrange phenomena perceived at the parſonage at Epworth, and ſome uncommon noiſes heard there from time to time, which he was very curious in examining into, and very particular in relating. I have little doubt that he conſidered himſelf the chief object of this wonderful viſitation. Indeed his father's credulity was in ſome degree affected by it; ſince he collected all the evidences that tended to confirm the ſtory, arranged them with ſcrupulous exactneſs, in a manuſcript conſiſting of ſeveral ſheets, and which is ſtill in being. I know not what became of the ghoſt of Epworth; unleſs, conſidered as the prelude to the noiſe Mr John Weſley made on a more ample ſtage, it ceaſed to ſpeak when he began to act." Weſley.

"The dawn of Mr Weſley's public miſſion (continues Mr Badcock) was clouded with myſticiſm; that ſpecies of it which affects ſilence and ſolitude; a certain inexplicable introverſion of the mind, which abſtracts the paſſions from all ſenſible objects; and, as the French Quietiſts expreſs it, perfects itſelf by an abſorption of the will and intellect, and all the faculties, into the Deity." In this *palpable obſcure* the excellent Fenelon led himſelf, when he forſook the ſhades of Pindus, to wander in queſt of *pure love* with Madam Guyon! Mr Weſley purſued for a while the fame *ignis fatuus* with Mr William Law and the Ghoſt of De Renty. A ſtate, however, ſo torpid and ignoble, ill-ſuited the active genius of this ſingular man. His elaſtic mind gained ſtrength by compreſſion; thence burſting glorious, he paſſed (as he himſelf ſomewhere ſays) "the immenſe chaſm, upborne on an eagle's wings."

The reading of the writings of this Mr William Law, the celebrated author of Chriſtian Perfection, and of A Serious Addreſs to the Chriſtian World, contributed moreover, to lead Mr John Weſley and his brother Charles, with a few of their young fellow-ſtudents, into a more than common ſtrictneſs of religious life. They received the ſacrament of the Lord's Supper every week; obſerved all the faſts of the church; viſited the priſons; roſe at four in the morning; and refrained from all amuſements. From the exact method in which they diſpoſed of every hour, they acquired the appellation of *Methodiſts*; by which their followers have been ever ſince diſtinguiſhed.

But a more particular account of the origin of this ſect, we ſhall give from a celebrated publication. "The Methodiſts (ſays the editor of this work) form a very conſiderable claſs, principally of the lower people in this country. They ſprung up about fifty years ago at Oxford, and were ſoon divided into two parties; the one under the direction of Mr George Whitefield, and the other under that of two brothers, John and Charles Weſley. Theſe leaders, and, if we except Mr William Law, founders of the Methodiſts, were educated at Oxford, received epiſcopal ordination, and always profeſſed themſelves advocates for the articles and liturgy of the eſtabliſhed church; though they more commonly practiſed the diſſenting mode of worſhip. But conceiving a deſign of forming ſeparate communities, ſuperior in ſanctity and perfection to all other Chriſtian churches, and impreſſed to a very conſiderable degree by a zeal of an extravagant and enthuſiaſtic kind, they became itinerant preachers; and, being excluded from moſt of our churches, exerciſed their miniſtry in private houſes, fields,

Wesley. fields, &c. not only in Great Britain and Ireland, but also in America; thus collecting a very considerable number of hearers and proselytes, both among the members of the established church and the dissenters. The theological system of Mr Whitefield and his followers is Calvinistic; that of Mr Wesley and his disciples Arminian; and the latter maintains the possibility of attaining sinless perfection in the present state. The subordinate teachers of both these classes of Methodists are generally men of no liberal education; and they pretend to derive their ministerial abilities from special communications of the Spirit. The Methodists of both parties, like other enthusiasts, make true religion to consist principally in certain affections and inward feelings which it is impossible to explain; but which, when analysed, seem to be mechanical in their spring and operation; and they generally maintain, that Christians will be most likely to succeed in the pursuit of truth, not by the dictates of reason, or the aids of learning, but by laying their minds open to the direction and influence of divine illumination; and their conduct has been directed by impulses."

Our readers will judge for themselves, according to their various modes of education, and to the different lights in which they may respectively view the doctrines of our common Christianity, whether this representation of the origin of the Methodists, and of their distinguishing tenets, be accurate and just.—Not presuming to sit in judgment on the religious opinions of any man, we shall only observe, that an appellation originally given in reproach, has been gloried in ever since by those who have distinguished themselves as the followers either of Mr Whitefield or of Mr Wesley. "After the way called *Methodism*, so worship they the God of their fathers." But the ridicule and contempt which the singularity of their conduct produced, both John and Charles Wesley were well qualified to bear. They were not to be intimidated by danger, actuated by interest, or deterred by disgrace.

The boundaries of this island were soon deemed by Mr Wesley too confined for a zeal which displayed the piety of an apostle, and of an intrepidity to which few missionaries had been superior. In 1735 he embarked for Georgia, one of our colonies, which was at that time in a state of political infancy; and the great object of this voyage was to preach the gospel to the Indian nations in the vicinity of that province. He returned to England in 1737. Of his spiritual labours, both in this country and in America, he himself has given a very copious account, in a series of Journals printed at different periods. These journals drew upon our laborious preacher and his coadjutors some severe animadversions from two right reverend prelates; Dr George Lavington bishop of Exeter, and Dr William Warburton bishop of Gloucester. The former published, in three parts, The Enthusiasm of the Methodists and Papists compared; the third part of this performance containing a personal charge of immoral conduct. Mr Wesley, in his vindication, published a letter to his lordship, which produced a reply from the latter.

Bishop Warburton's attack is contained in his celebrated treatise, entitled The Doctrine of Grace: or, The Office and Operations of the Holy Spirit vindicated from the Insults of Infidelity, and the Abuses of Fanaticism: concluding with some thoughts, humbly offered to the consideration of the Established Clergy, with regard to the Right Method of defending Religion against the Attacks of either party; 2 vols. small 8vo, 1762. There is much acute reasoning, and much poignant and sprightly wit, in his Doctrine of Grace; but there is too much levity in it for a grave bishop, and too much abuse for a candid Christian. On this occasion, Mr Wesley published a letter to the bishop, in which, with great temper and moderation, as well as with great ingenuity and address, he endeavoured to shelter himself from his lordship's attacks; not only under the authority of the Holy Scriptures, but of the church itself, as by law established. Wesley.

On his return from Georgia, Mr Wesley paid a visit to Count Zinzendorf, the celebrated founder of the sect of Moravians, or Hernhutters, at Hernhut in Upper Lusatia. In the following year he appeared again in England, and with his brother Charles, at the head of the Methodists. He preached his first field-sermon at Bristol, on the 2d of April 1738, from which time his disciples have continued to increase. In 1741, a serious altercation took place between him and Mr Whitefield. In 1744, attempting to preach at an inn at Taunton, he was regularly silenced by the magistrates. Although he chiefly resided for the remainder of his life in the metropolis, he occasionally travelled through every part of Great Britain and Ireland, establishing congregations in each kingdom. In 1750 he married a lady, from whom he was afterwards separated. By this lady, who died in 1781, he had no children.

We have already mentioned Mr Wesley as a very various and voluminous writer. Divinity, both devotional and controversial, biography, history, philosophy, politics, and poetry, were all, at different times, the subjects of his pen: and, whatever opinion may be entertained of his theological sentiments, it is impossible to deny him the merit of having done very extensive good among the lower classes of people. He certainly possessed great abilities, and a fluency which was well accommodated to his hearers, and highly acceptable to them. He had been gradually declining for three years before his death; yet he still rose at four in the morning, and preached, and travelled, and wrote as usual. He preached at Leatherhead in Surrey, on the Wednesday before that event. On the Friday following, appeared the first symptoms of his approaching dissolution. The four succeeding days he spent in praising God; and he left this scene, in which his labours had been so extensive and so useful, at a quarter before ten in the morning of the 2d of March 1791, in the 88th year of his age. His remains, after lying in a kind of state at his chapel in the city-road, dressed in the sacerdotal robes which he usually wore, and on his head the old clerical cap, a bible in one hand, and a white handkerchief in the other, were, agreeably to his own directions, and after the manner of the interment of the late Mr Whitefield, deposited in the cemetry behind his chapel, on the morning of the 9th March, amid an innumerable concourse of his friends and admirers; many of whom appeared in deep mourning on the occasion. One singularity was observable in the funeral service. Instead of, "We give thee hearty thanks, for that it hath pleased thee to deliver this our brother;" it was read "our father." A sermon, previously to the funeral, had been preached by Dr Thomas Whitehead, one of the physicians to the

London

Wesley, West.

London hoſpital; and on the 13th the different chapels of his perſuaſion in London were hung with black.

It has been juſtly obſerved of Mr Weſley, that his labours were principally devoted to thoſe who had no inſtructor; to the highways and hedges; to the miners in Cornwall, and the coalliers in Kingſwood. Theſe unhappy creatures married and buried among themſelves, and often committed murders with impunity, before the Methodiſts ſprung up. By the humane and active endeavours of Mr Weſley and his brother Charles, a ſenſe of decency, morals, and religion, was introduced into the loweſt claſſes of mankind; the ignorant were inſtructed, the wretched relieved, and the abandoned reclaimed. His perſonal influence was greater, perhaps, than that of any other private gentleman in any country.—But the limits of this article will not permit us to expatiate further on the character of this extraordinary man.

WEST, GILBERT, was the ſon of Dr Weſt, prebendary of Wincheſter, and chaplain to King George I. but at 12 years of age loſt his father. He ſtudied at Wincheſter and Eton ſchools, and from thence was placed in Chriſt-church college, Oxford. His ſtudious and ſerious turn inclined him to take orders; but Lord Cobham, his uncle, diverted him from that purſuit, and gave him a cornetcy in his own regiment. This profeſſion he ſoon quitted, on account of an opening of another nature, which preſented him with a flattering proſpect of advancement in life. A number of young gentlemen were to be elected from the univerſities, and, at the expence of government, were to be taught foreign languages; and then ſent to the ſecretaries office, to be initiated into buſineſs, and trained there for public ſervices, as envoys, ambaſſadors &c. Mr Gilbert Weſt was one of the few pitched upon; and on his firſt introduction into that office, Lord Townſend, ſecretary of ſtate, treated him with ſingular marks of regard, and the ſtrongeſt inclinations to ſerve him were teſtified from all quarters. But his uncle Lord Cobham's ſtrong oppoſition to the meaſures of the government, rendered theſe advantages entirely fruitleſs; and the miniſters honeſtly told Mr Weſt, that he muſt not expect them to diſtinguiſh his merit, as any favours conferred upon him would be imputed as done to his uncle Lord Cobham. Mr Weſt now left that office, and all his views of making his fortune; and entering into marriage, retired to Wickham in Kent, where he lived in great domeſtic comfort and tranquil happineſs. He was there viſited by his valuable friends, who held the moſt delightful converſe of wit, humour, and learning, ſupported upon the principles of virtue, ſound reaſoning, and ſolid friendſhip, which rendered the whole cheerful, animating, and inſtructive. Mr William Pitt, who was one of thoſe that compoſed this happy ſociety, becoming paymaſter, appointed Mr Weſt treaſurer to Chelſea-hoſpital; and he obtained a ſeat at the council board, in conſequence of a friendſhip contracted at the ſchool with one of the duke of Devonſhire's ſons, who procured of his grace his being nominated one of the clerks extraordinary of that office. Towards the latter part of Mr Weſt's life, he wholly applied himſelf to the ſtudy of the Scriptures; being extremely anxious to try his utmoſt endeavours to reconcile the ſeeming inconſiſtencies which gave the enemies to revealed religion a handle to doubt and diſcredit their authenticity. His obſervations on the reſurrection, which, it has been ſaid, were written to confirm the wavering faith of his great friends Pitt and Lyttleton, bear ample teſtimony to his reaſoning powers and the ſincerity of his religion; while his tranſlations of Pindar ſhow him to have been an eminent Greek ſcholar, and very conſiderable poet. He had a mind replete with virtue, and was an honour to his country; but died at 50 years of age.

West ‖ Weſtmoreland.

WEST, one of the cardinal points of the horizon, diametrically oppoſite to the eaſt; and ſtrictly defined the interſection of the prime vertical with the horizon on that ſide the ſun ſets in.

WESTMINSTER, a city which forms the weſt part of the capital of Britain, but has a government diſtinct from the reſt. This city had its name from the ſituation of its abbey, anciently called a *minſter*, in reſpect of that of St Paul. That part properly called the city of Weſtminſter, comprehending the pariſhes of St John and St Margaret, was once an iſland formed by the Thames, called *Thorney iſland*, from the thorns with which it was overrun; and the abbey that ſtood in it, Thorney-abbey. The liberties of Weſtminſter contain the ſeveral pariſhes of St Martin in the Fields, St James's, St Anne, St Paul, Covent-Garden, St Mary le Strand, St Clement Danes, St George, Hanover Square, and the precinct of the Savoy. The government, both of the city and liberties, is under the juriſdiction of the dean and chapter of Weſtminſter, in civil as well as eccleſiaſtical affairs; and their authority extends to the precinct of St Martin le Grand, by Newgate-ſtreet, and in ſome towns of Eſſex, which are exempted from the juriſdiction of the biſhop of London and the archbiſhop of Canterbury; but the management of the civil part has, ever ſince the Reformation, been in the hands of laymen, elected from time to time, and confirmed by the dean and chapter. The chief of theſe laymen are the high-ſteward, the deputy-ſteward, and the high-bailiff, who hold their offices for life. There are alſo 16 burgeſſes and their aſſiſtants, out of which are elected two head-burgeſſes, one for the city, and the other for the liberties. Another officer is the high-conſtable, who has all the other conſtables under his direction.

WESTMORELAND, a county of England, bounded on the north and north-weſt by Cumberland; on the ſouth and ſouth-eaſt by Yorkſhire; and on the ſouth and ſouth-weſt by Lancaſhire. Its extent from north-eaſt to ſouth, is 40 miles, and its breadth from the eaſt projection to that in the weſt, 42. It is generally divided into the baronies of Kendal and Weſtmoreland: the former is very mountainous, but the latter is a large champaign country. Theſe are the only principal diviſions of this county, which contains eight market towns, 26 pariſhes, and 41,617 inhabitants. It lies partly in the dioceſe of Cheſter, and partly in that of Carliſle. The earl of Thanet is hereditary ſheriff of the county, which ſends only four members to parliament. The air is clear, ſharp, and ſalubrious, the natives being ſeldom troubled with diſeaſes, and generally living to old age. The ſoil is various; that on the mountains is very barren, while that in the valleys is fertile, producing good corn and graſs, eſpecially in the meadows near the rivers. In the hilly parts on the weſtern borders it is generally believed there are vaſt quantities of copper ore, and veins of gold; ſome mines of copper are worked, but moſt of the ore lies ſo deep that it will not anſwer the

the expence. This county yields the fineſt ſlate, and abundance of excellent hams are cured here. The principal rivers are, the Eden, the Lone, and the Ken. It has alſo ſeveral fine lakes, the principal of which is Winander Mere, or Windermere water. In the foreſt of Martindale, to the ſouth of Ulls-water, the breed of red deer ſtill exiſts in a wild ſtate.—Appleby is the county town.

WESTPHALIA, formerly a duchy of Germany, bounded to the eaſt by the biſhopric of Paderborn, and the territories of Waldeck and Heſſe; to the ſouth by the counties of Witgenſtein and Naſſau, and the duchy of Berg; to the north by the biſhopric of Munſter and the county of Lippe. It is about 40 miles in length and 30 in breadth. The lower part of it is very fruitful, yielding plenty of corn and cattle, and ſome ſalt ſprings. The higher affords iron ore, calamine, lead, copper, ſome ſilver and gold, fine woods, cattle, game, fiſh, with a little corn. The rivers, that either paſs through the duchy or along its borders, are the Rahr, the Lenne, the Bigge, the Dimel, and the Lippe. There are 28 towns in it, beſides boroughs and cloiſters. The provincial diets are held at Arenſberg. In the year 1180, the emperor Frederic I. made a donation of this duchy to the archbiſhopric of Cologne, which was confirmed by ſucceeding emperors; and in 1638, the laſt duke of Arenſberg ceded to it alſo the county of Arenſberg.

WESTPHALIA, one of the circles of Germany, anciently the people inhabiting between the Weſer and the Rhine, were called *Weſtphalians;* and hence that tract got the name of *Weſtphalia:* but the circle of that name is of a larger extent, being ſurrounded by the circle of Burgundy, or the Auſtrian Netherlands, the United Provinces, and the North ſea, with the circles of the Upper and Lower Rhine, and compriſing a great many different ſtates.

The ſummoning princes and directors of the circle of Weſtphalia, were the biſhops of Munſter, alternately with the electors of Brandenburg and Palatine, as dukes of Cleve and Juliers. The archives belonging to it were before the war (1797) kept at Duſſeldorp. Its quota of men and money is ſomewhat more than the ninth part of the whole ſum granted by the empire. With reſpect to religion, it is partly Proteſtant and partly Catholic; but the Proteſtants predominate, and are, at leaſt the greater part of them, Calviniſts. The air of this country is not reckoned very wholeſome, and towards the north is extremely cold in winter. The ſoil in general is marſhy and barren; yet there is ſome good corn and paſture land; but the fruit is chiefly uſed to feed hogs; and hence it is that their bacon and hams are ſo much valued and admired.

Weſtphalia now forms one of the kingdoms eſtabliſhed by Bonaparte.

WESTRINGIA, a genus of plants, formed from *cunila fruticoſa*, which was diſcovered by Dr Solander in New Holland. Dr Smith deſcribes it as approaching nearer to roſemary, and places it after *teucrium* in the claſs didynamia.

WET-COUCH, *Coming-heap*, a term uſed by the maltſters for one of the principal articles of malt-making. See BREWING, N° 4.

WETSTEIN, JOHN JAMES, a learned German divine, was born at Baſil in 1693. On his admiſſion to the miniſtry, he maintained a theſis *De variis Novi Teſtamenti Lectionibus;* in which he ſhowed that the great variety of readings of the New Teſtament afford no argument againſt the authenticity of the text. He had made theſe various readings the object of his attention; and travelled into foreign countries to examine all the MSS. he could come at. In 1730, he publiſhed *Prolegomena ad Novi Teſtamenti Græci editionem accuratiſſimam, &c.* Some divines, dreading his unſettling the preſent text, procured a decree of the ſenate of Baſil againſt his undertaking, and even got him prohibited from officiating in the miniſtry; on which he went to Amſterdam, where the Remonſtrants named him to ſucceed the famous Le Clerc, then ſuperannuated, as profeſſor of philoſophy and hiſtory. At laſt he publiſhed his edition of the New Teſtament, in 2 vols. folio, 1752; in which he left the text as he found it, placing the various readings, with a critical commentary, underneath; ſubjoining two epiſtles of Clemens Romanus, till then unknown to the learned, but diſcovered by him in a Syriac MS. of the New Teſtament. He alſo publiſhed ſome ſmall works; and is ſaid to have been not only an univerſal ſcholar, but to have abounded in good and amiable qualities. He died at Amſterdam in 1754.

WETTERAVIA, the ſouthern diviſion of the landgravate of Heſſe in Germany, lying along the northern bank of the river Maine, and comprehending the counties of Hanau and Naſſau.

WEXFORD, a county of Ireland, in the province of Munſter, 38 miles in length, and 24 in breadth; bounded on the north by Wicklow, on the eaſt by St George's channel, on the ſouth by the Atlantic ocean, on the weſt by Waterford and Kilkenny, and on the north by Catherlough. It contains 109 pariſhes, and formerly ſent 18 members to the Iriſh parliament. It is a fruitful country in corn and graſs; and the principal town is of the ſame name.

WEXFORD, a ſea-port of Ireland, capital of a county of the ſame name. It was once reckoned the chief city in Ireland, being the firſt colony of the Engliſh, and is ſtill a large handſome town, with a very commodious harbour at the mouth of the river Slana, on a bay of St George's channel, 63 miles ſouth of Dublin. W. Long. 6. 3. N. Lat. 52. 18.

WHALE. See BALÆNA and PHYSETER, CETOLOGY *Index*.

WHALE, one of the conſtellations. See ASTRONOMY.

WHALE-Bone. For its natural hiſtory, ſee CETOLOGY *Index*.

A patent was granted in October 1806 to Robert Bowman of Leith, in Scotland, for making hats, caps, and bonnets for men and women, of whalebone; harps for harping or cleanſing corn or grain; and alſo the bottoms of ſieves and riddles, and girths for horſes; and alſo a cloth or webbing for making into hats, caps, &c.; and for the backs and ſeats of chairs and ſofas, gigs, coaches, and other ſimilar carriages; and the bottoms of beds; as alſo reeds for weavers.

WHALE-Fiſhery. See CETOLOGY.

WHARF, a ſpace on the banks of a haven, creek, or hithe, provided for the convenient loading and unloading of veſſels.

WHARTON, PHILIP DUKE OF, a nobleman of the moſt brilliant parts, but of the moſt whimſical, extravagant, and inconſiſtent turn of mind, was educated by his

Wharton. father's expreſs order at home. He very early married a young lady, the daughter of Major-General Holmes, which diſappointed his father's views of diſpoſing of him in ſuch a marriage as would have been a conſiderable addition to the fortune and grandeur of his illuſtrious family; yet that amiable lady deſerved infinitely more felicity than ſhe met with by this alliance. This precipitate marriage is thought to have haſtened the death of his father; after which the duke, being free from paternal reſtraints, plunged into thoſe exceſſes which rendered him, as Pope expreſſes it,

"A tyrant to the wife his heart approv'd;
"A rebel to the very king he lov'd."

In the beginning of the year 1716, he began his travels; and as he was deſigned to be inſtructed in the ſtricteſt Whig principles, Geneva was thought a proper place for his reſidence. He firſt paſſed through Holland, and viſited ſeveral courts of Germany; and being arrived at Geneva, conceived ſuch a diſguſt againſt his governor, that he left him, and ſet out poſt for Lyons, where he wrote a letter to the chevalier de St George, who then reſided at Avignon, and preſented him a very fine ſtout horſe; which the chevalier no ſooner received than he ſent a man of quality to him, who took him privately to his court, where he was entertained with the greateſt marks of eſteem, and had the title of duke of Northumberland conferred upon him. He, however, remained there but one day, and then returned poſt to Lyons, whence he ſet out for Paris. He likewiſe paid a viſit to the conſort of James II. who then reſided at St Germains, to whom he alſo paid his court. During his ſtay at Paris, his winning addreſs and abilities gained him the eſteem and admiration of all the Britiſh ſubjects of rank of both parties.

About the latter end of December 1716, he arrived in England, whence he ſoon after ſet out for Ireland, where, though under age, he was allowed the honour to take his ſeat in the houſe of peers, and immediately diſtinguiſhed himſelf, notwithſtanding his former conduct, as a violent partizan for the miniſtry; in conſequence of which zeal the king created him a duke. He no ſooner came of age than he was introduced to the houſe of lords in England with the ſame blaze of reputation. In a little time he oppoſed the court, and appeared one of the moſt vigorous in defence of the biſhop of Rocheſter; and ſoon after printed his thoughts twice a-week, in a paper called the *True Briton*, ſeveral thouſands of which were circulated.

The duke's boundleſs profuſion had by this time ſo burdened his eſtate, that by a decree of Chancery it was veſted in the hands of truſtees for the payment of his debts, allowing him a proviſion of 1200l. per annum for his ſubſiſtence. This being inſufficient to ſupport his title with ſuitable dignity, he went abroad, and ſhone to great advantage, with reſpect to his perſonal character, at the imperial court. From thence he made a tour to Spain: the Engliſh miniſter was alarmed at his arrival, fearing that his grace was received in the character of an ambaſſador: upon which the duke received a ſummons under the privy ſeal to return home; but inſtead of obeying it, he endeavoured to inflame the Spaniſh court againſt that of Great Britain, for exerciſing an act of power, as he calls it, within the juriſdiction of his Catholic majeſty. He then acted openly in the ſervice of the Pretender, and was received at his court with the greateſt marks of favour. Wharton

While his grace was thus employed, his neglected ducheſs died in England on the 14th of April 1726, without iſſue. Soon after the duke fell violently in love with M. Oberne, one of the maids of honour to the queen of Spain, the daughter of an Iriſh colonel, whoſe fortune chiefly conſiſted in her perſonal accompliſhments. All his friends, and particularly the queen of Spain, oppoſed the match; but he falling into a lingering fever, occaſioned by his diſappointment, the queen gave her conſent, and they were ſoon after married. He then ſpent ſome time at Rome, where he accepted of a blue garter, aſſumed the title of duke of Northumberland, and for a while enjoyed the confidence of the exiled prince. But not always keeping within the bounds of Italian gravity, it became neceſſary for him to remove from hence; when, going by ſea to Barcelona, he wrote a letter to the king of Spain, acquainting him that he would aſſiſt at the ſiege of Gibraltar as a volunteer. Soon after he wrote to the chevalier de St George, expreſſing a deſire to viſit his court; but the chevalier adviſed him to draw near to England.

The duke ſeemed reſolved to follow his advice; and ſetting out with his ducheſs, arrived in Paris in May 1728, whence he ſoon after proceeded to Rouen, where he took up his reſidence; and was ſo far from making any conceſſion to the government of England, that he did not give himſelf the leaſt trouble about his eſtate, or any other concern there, though, on his arrival at Rouen, he had only about 600l. in his poſſeſſion, and a bill of indictment was preferred againſt him in England for high-treaſon. Soon after the chevalier ſent him 2000l. which he ſquandered away in a courſe of extravagance; when, to ſave the charges of travelling by land, he went from Orleans to Nantz by water, and ſtaid there till he got a remittance from Paris, which was ſquandered almoſt as ſoon as received. At Nantz he was joined by his ragged ſervants, and from hence took ſhipping with them for Bilboa, when the queen of Spain took the ducheſs to attend her perſon. About the beginning of the year 1731, the duke, who commanded a regiment, was at Lerida, but declined ſo faſt that he could not move without aſſiſtance; yet when free from pain did not loſe his gaiety. He, however, received benefit from ſome mineral waters in Catalonia; but ſoon after relapſed at a ſmall village, where he was utterly deſtitute of all the neceſſaries of life, till ſome charitable fathers of a Bernardine convent removed him to their houſe, and gave him all the relief in their power. Under their hoſpitable roof he languiſhed a week, and then died, without one friend or acquaintance to cloſe his eyes; and his funeral was performed in the ſame manner in which the fathers inter thoſe of their own fraternity.

Thus died Philip duke of Wharton, "who, like Buckingham and Rocheſter (ſays Mr Walpole), comforted all the grave and dull, by throwing away the brighteſt profuſion of parts on witty fooleries, debaucheries, and ſcrapes, which mix graces with a great character, but never can compoſe one.

"With attachment to no party, though with talents to govern any party, this lively man changed the free air of Weſtminſter for the gloom of the Eſcurial, the proſpect of King George's garter for the Pretender's; and

arton, heat. and with indifference to all religion, the frolic lord who had written the ballad on the archbiſhop of Canterbury, died in the habit of a capuchin. It is difficult to give an account of the works of a man whoſe library was a tavern, and women of pleaſure his muſes. A thouſand ſallies of his imagination may have been loſt. There are only two volumes in 8vo, called *his Life and Writings*. Theſe contain nothing of the latter, but 74 numbers of the True Briton, and his ſpeech in defence of the biſhop of Rocheſter. His other works are the ballads above mentioned; the Drinking Match at Eden-hall, in imitation of the Chevy Chace, printed in a miſcellany called *Whartoniana;* and a parody of a ſong ſung at the opera houſe by Mrs Tofts. His lordſhip alſo began a play on the ſtory of the queen of Scots."

WHEAT. See TRITICUM, BOTANY *Index;* and for the culture of wheat, ſee AGRICULTURE *Index*.

The three principal kinds of bad wheat are, the *blighted*, the *ſmutty*, and the *worm-eaten*. Blighted wheat is that of which the ſtalk is a little twiſted and rickety, the blade being of a bluiſh green and curled up, the grain alſo is green and tubercled: ſmutty wheat appears as if great part of the ear had been burnt, ſome ſmall parts only being free, and, in particular, the ſtem that riſes in the centre of the ear, round which the grain is ranged: worm-eaten or rotten wheat is corrupted without loſing much of its natural form, or external appearance; the huſk is filled with a greaſy black powder, that is inſufferably fetid. It appeared, from the experiments of M. Tillet, that there was a kind of infectious quality in all thoſe kinds of wheat: ſo that if ſound wheat was ſprinkled with the flour of ſmutty or rotten wheat, the crop produced would be rotten or ſmutty. It appeared alſo, that among the grain which was produced from ground manured with the ſtraw of diſtempered wheat, there was a much greater proportion of diſtempered wheat than in that produced from ground manured with the ſtraw of good wheat: the great ſecret then was to deſtroy the principle of this contagion in the wheat that was put into the ground; and M. Tillet found, as the reſult of a great number of experiments, that if the grain, before it is ſowed, be well moiſtened with a ſolution of ſea-ſalt, or nitre, in common water, none of the enſuing crop will be ſmutty, or otherwiſe defective, either in kind or quality; not only ſuppoſing the grain that is ſowed to be ſound, and the ſoil to be good, but even ſuppoſing the grain to be ſtrewed with the flour of ſmutty wheat, and the ſtraw manured with bad ſtraw.

e Diſ- tion by t Acade- f Bour- x.

The following receipt for preventing ſmutty wheat was publiſhed in 1769 by order of the Society for the Encouragement of Arts: they received it from Mr John Reynolds of Adiſham in Kent.

A tub is to be procured that has a hole at bottom, in which a ſtaff and tap-hoſe is to be fixed over a whiſp of ſtraw, to prevent any ſmall pieces of lime paſſing (as in the brewing way); this done, we put 70 gallons of water, then a corn buſhel heap-full of ſtone-lime, unſlaked, ſtirring it well till the whole is diſſolved or mixed, letting it ſtand about 30 hours, and then run it off into another tub as clear as we can (as practiſed in beer): this generally produces a hogſhead of good ſtrong lime-water; then add three pecks of ſalt, 42 pounds, which, with a little ſtirring, will ſoon diſſolve; thus we have a proper pickle for the purpoſe of brining and liming our ſeed-wheat without any manner of obſtacle, which is more than can be ſaid in doing it the common way, and greatly facilitates the drilling. Wheat || Wheel-carriages.

Herein we ſteep the wheat in a broad-bottomed baſket of about 24 inches diameter, and 20 inches deep (for large ſowing, made on purpoſe), running in the grain gradually in ſmall quantities from 10 to 12 gallons up to 16 gallons, ſtirring the ſame. What floats, we ſkim off with a ſtrainer, and is not to be ſown: then draw up the baſket to drain over the pickle, for a few minutes; all which may be performed within half an hour, ſufficiently pickled; and ſo proceed as before. This done, the wheat will be fit for ſowing in 24 hours, if required; but if deſigned for drilling, two hours pickled will be found beſt; and if prepared four or five days beforehand, in either caſe it makes no difference at all; but ſhould the ſeed be clammy, and ſtick to the notches in the drill-box, more lime muſt be added to the lime-water: here the maſter muſt uſe his diſcretion, as the caſe requires; for ſome lime has much more drying or aſtringent qualities in it than others. If ſea-water can be obtained conveniently, much leſs ſalt will ſuffice, but ſome will be found neceſſary even then, otherwiſe the light grains will not float, a thing of more conſequence than is generally imagined, and it ought to be ſkimmed off and thrown aſide for poultry, &c.

WHEEL, in *Mechanics*, a ſimple machine, conſiſting of a round piece of wood, metal, or other matter, which revolves on its axis. See MECHANICS.

WHEEL-Carriages. See MECHANICS for an account of the general principles.

No kind of wheel-carriages are of more importance to a commercial and manufacturing country than ſtage coaches; and perhaps in no kingdom of Europe has the ſyſtem of travelling in public vehicles been carried to greater perfection, as to comfort and ſpeed, than in Britain. The danger, however, of travelling by theſe coaches makes conſiderable deduction from their accommodation otherwiſe: it is but too well known that this mode of travelling is liable to frequent and ſerious accidents. Every attempt therefore that promiſes to be uſeful in diminiſhing ſuch danger ſhould have all poſſible publicity. With this view we are much gratified in having an opportunity of laying before our readers the following account of an invention to render ſtage coaches more ſecure from danger, obligingly tranſmitted to us by the inventor, the reverend William Milton of Heckfield, Hants. For this invention that gentleman has obtained a patent.

The danger of ſtage coaches ariſes ſometimes from *overturning*, and ſometimes from *breaking down*. The *overturn* is, in general, occaſioned *either* by taking two ſide-wheels into too deep a hole or ditch, or over too high a bank; *or*, ſecondly, by running down more quickly than the carriage is calculated to do, from the top to the ſides of a rounded road; *or*, laſtly, by turning a ſharp corner with too great velocity. In the two firſt caſes the danger ariſes from the centre of gravity of the total coach and load being placed too high; and in the laſt inſtance, of turning the ſharp corner, from the ſame centre (but which we muſt now conſider as the centre of the *vis inertiæ*) being alſo placed too high. The danger in the two firſt caſes grows often out of the very circumſtances of the road, and meets every one's

Wheel-carriages.

comprehenſion: the laſt, which is leſs obvious, is generally owing to the mere will of the driver; and the better the road, the more is he tempted, without any intention, to go on to produce it: it requires therefore to be more generally underſtood than it is. It may be thus explained:—A carriage is going along a ſtraight level road at the rate of nine miles an hour: then, though you imagine the horſes or pulling power to be in an inſtant withdrawn, yet will the carriage continue its motion for ten, fifteen, or more yards, and at firſt with the ſame velocity, *and in the ſame ſtraight line, in conſequence of the acquired motion.* Suppoſing, now, the coach with its four horſes going the nine miles an hour along a fine level road, but which has *a ſharp and ſudden corner to turn*;—the coachman knows it, and wiſhes to keep his velocity; the horſes are aware of both—and by the animal dexterity with which they are gifted, *contrive to make the turn* without remitting any thing of their ſpeed. *Not ſo the coach which follows them;* that has a tendency to perſevere *in its ſtraight line;* and the centre of its effort to do ſo is the centre of its *vis inertiæ*, the very centre of its gravity. If this centre be *low*, the turn of the corner may be made with no other inconvenience than a ſhort awkward ſlide of the hind wheels, *onward in the original direction;* whereas, if it *be high*, there will be no ſlide, but *the coach will be overturned*, and overturned nearly at that point where its broadſide is at rectangles to the ſtraight line of road it has been thus forced to quit: for at that point the baſe againſt ſuch an overturn will be the moſt diſadvantageous, and the check to the onward motion the greateſt. The *remedy* offered againſt all theſe *cauſes of the overturn*, (whether by a *ditch*, *bank*, *rounded road*, or *ſharp corner*), *is to bring down this centre*, by placing as much of the luggage as poſſible *in a luggage-box, below the body of the carriage;* the body not being higher than uſual.

From the *overturn*, we paſs to the conſideration of the *breaking-down;* this we muſt reckon on happening as often in theſe patent ſtage coaches as in others. Wheels will come off or fail, or axles will break, *in future, as they have done heretofore;* but againſt the diſaſtrous and fatal conſequences of ſuch accidents the remedy offered may be thus deſcribed.—On each ſide of *the luggage-box*, with their periphery below its floor, and each as near as may be requiſite to its reſpective *active wheel*, there is placed a *ſmall ſtrong idle wheel, ready* in caſe of *breaking down, on either ſide, to catch the falling carriage, and inſtantly to continue its previous velocity*, till the coachman can pull up his horſes, thereby preventing *that ſudden ſtop to rapid motion*, which at preſent conſtantly attends the *breaking-down;* and which has ſo frequently proved fatal to the coachman and outſide paſſengers. In caſe a fore-wheel comes off, each end of the fore-carriage has its *idle wheel.* By this proviſion we ſhall be, *to all effect of ſafety*, continually travelling with two carriages under us. The bottom of this luggage-box is meant to be about fourteen inches from the ground; and the *idle wheels* ſeven, ſix, or five; but if at a ſtill leſs diſtance, little inconvenience would reſult; for when either of them takes over an obſtacle in the road, it inſtantly, and during the need, diſcharges its reſpective *active wheel* from the ground, and works in its ſtead. If theſe two principles of ſafety were applied to the deſcription of the ſeveral ſtage-coach accidents we meet with, there is no doubt but a general conviction would ariſe, *that* the ſafety by theſe modes is (in vehicles of all kinds), perhaps *as great as can conſiſt with rapid loco-motion; and that*, ſooner or later, *legiſlative authority*, in ſome ſhape or other, may judge it neceſſary to interpoſe, for the purpoſe of controlling a prejudice againſt *the form eſſential to this mode of ſafety.* The trial and proof which theſe principles have been brought to, have not only been by public exhibition, and with preparation; but *in all the ſuddenneſs*, alſo, *of actual heavy work:* and the reſult in both caſes has been ſo exactly the ſame, as to give *continual aſſurance* of the full effect of the remedy, as often as the caſualties of the road ſhall bring it into action.

Wheel-carriage || Wheele

The aim in the arrangement of this *coach of ſafety*, has been to bring down the load, and conſequently the centre of gravity, as low as poſſible: this is thought to make the coach *look heavy;* and this word, by the ready operation of a prejudice, has been transferred to its going; and one ſpecific reaſon added withal, that, *becauſe the load is low*, the draught *muſt* be heavy. This point, however, has, in the preſence of 10 or 12 competent perſons, been brought to the moſt deciſive proof; and it comes out, that it is as indifferent to draught, as it is material to danger or ſafety, whether *a ton* be placed on the roof of a coach, or *a ton* on the floor of the patent luggage-box, about 15 or 16 inches from the ground.

It has been aſked, "*What would this coach do in ſnow?*" The queſtion has been thus anſwered by the reſult of actual work; for the patent coach, after being detained on the road with ſeveral other coaches, by a ſudden fall of ſnow, when at laſt they ſtarted together, *came in ſix or ſeven hours before any of them.* They were bound in prudence, to go cautiouſly along the ground, whoſe unevenneſs was inviſible; while the patent coach daſhed along it with all the confidence and ſafety of a poſt-chaiſe. See Plate DLXXVII.

Wheel-Animal. See Animalcule, N° 16—23.

Wheel, Perſian. See Agriculture.

Wheel, Potter's. See Porcelain.

Wheel is alſo the name of a kind of puniſhment to which great criminals are put in divers countries. In ſome, aſſaſſins, parricides, and robbers on the highway, are ſaid to be condemned to the wheel, when they are to have their bones firſt broken with an iron bar on a ſcaffold, and then to be expoſed, and left to expire on the circumference of a wheel. In Germany they break their bones on the wheel itſelf.—Of this cruel puniſhment, it is not certain who was the inventor: it was firſt uſed in Germany, and was, indeed, but rarely practiſed anywhere elſe, till the time of Francis I. of France; who, by an edict of the year 1534, appointed it to be inflicted on robbers on the highway.

WHEELER, Sir George, a learned traveller and divine, was the ſon of Colonel Wheeler of Charing in Kent, and was born in 1650 at Breda, where his parents as royaliſts were then in exile. He travelled through various parts of Greece and the Eaſt, in company with Dr James Spon of Lyons; and taking orders on his return, was inſtalled a prebend of Durham, made vicar of Baſingſtoke, and afterward rector of Houghton le Spring. He publiſhed an account of his Travels in 1682 in folio; and in 1689, his Obſervations on Ancient Edifices of Churches yet remaining in the Eaſt, compared

WEIGHING.

Fig. 1.

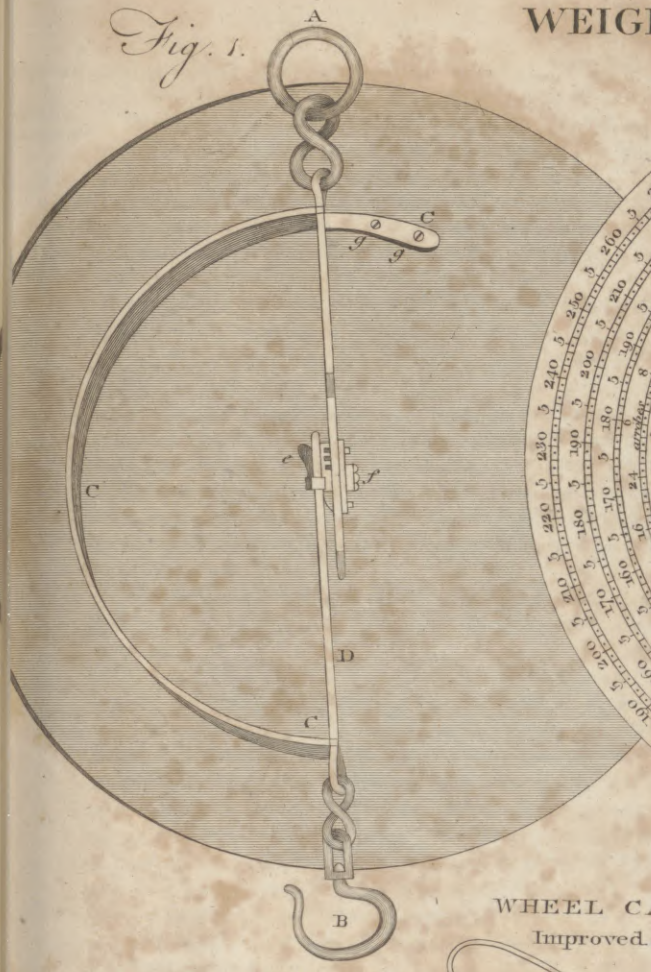
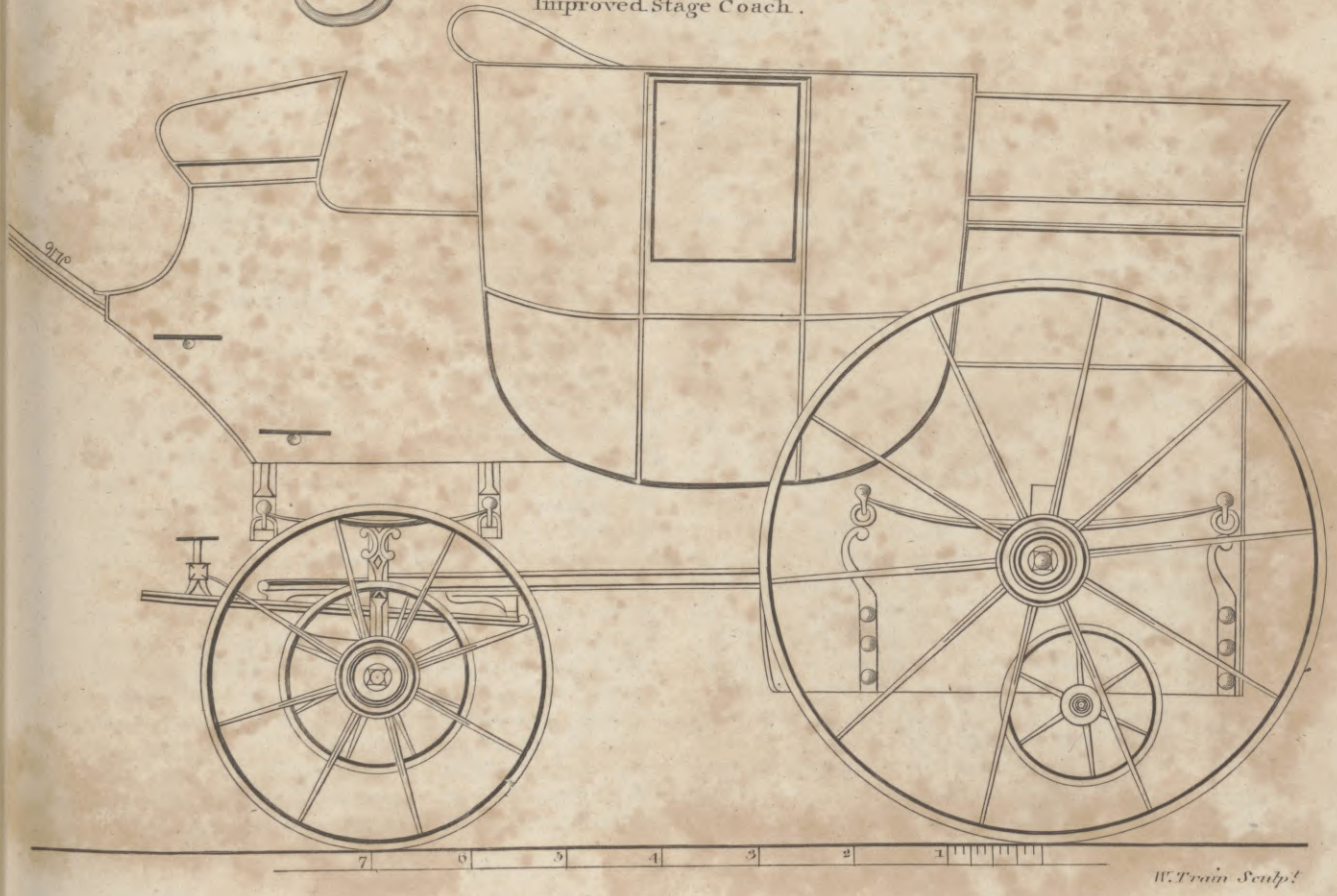


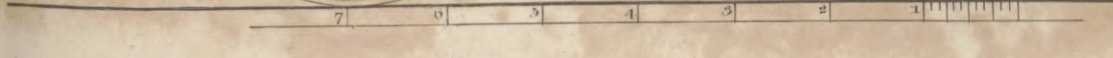
Fig. 2.

PLATE DLXXVII.

WHEEL CARRIAGES

Improved Stage Coach.





W. Train Sculp.

Wheeler || Whidah.

compared with Eusebius: also the Protestant Monastery, or Christian Oeconomics. He died in 1724.

WHEELINGS, in the military art, are different motions made both by horse and foot, either to the right and left, or to the right and left about.

General Rules for WHEELING.—The circle is divided into four equal points: thence, wheeling to the right or left, is only a quarter of the circle; wheeling to the right or left about, is one half of the circle.

When you wheel to the right, you are to close to the right, so near as to touch your right-hand man, but without pressing him; and to look to the left, in order to bring the rank about even.

When you wheel to the left, you are to close to the left, and look to the right as above directed. This rule will serve for all the wheeling by ranks; as when a battalion is marching by subdivisions with their ranks open, then each rank wheels distinctly by itself, when it comes to the ground on which the ranks before it wheeled, but not before.

In wheeling, the men are to take particular care neither to open nor close their ranks, and to carry their arms well.

In wheeling, the motion of each man is quicker or slower, according to the distance he is from the right or the left: thus, when you wheel to the right, each man moves quicker than his right-hand man; and wheeling to the left, each man moves quicker than his left-hand man; the circle that every man wheels being larger, according to the distance he is from the hand he wheels to; as may be seen by describing several circles within one another, at two feet distance from each, which is nearly the space every man is supposed to take up.

WHELK, a species of shell-fish. See BUCCINUM, CONCHOLOGY *Index*.

WHELP, the young of a dog, fox, lion, or any wild beast.

WHELPS, in a ship, the seaman's term for those brackets which are set up on the capstan close under the bars; they give the sweep to it, and are so contrived that the cable winding about them may not surge so much as it might otherwise do if the body of the capstan were quite round and smooth.

WHETSTONE, a stone so called, because it serves for the whetting of edge tools upon. See MINERALOGY *Index*.

WHEY, the serum or watery part of milk.

WHIDAH, a kingdom of Africa, on the coast of Guinea, and to the west of the Gold Coast; extending about 10 miles along the sea. It is a populous country, well furnished with large villages; and there are so many small ones, that they are not above a musket-shot from each other.—The houses are small, round at the top, and encompassed with mud walls or hedges, together with a great number of all sorts of beautiful and lofty trees, which afford the most beautiful prospect in the world, insomuch that those that have been here represent it as a perfect paradise. The fields are always green, and they cultivate beans, potatoes, and fruits; nor will the negroes here let a foot of ground remain uncultivated. They sow again the very next day after they have reaped. The inhabitants are greatly civilized, very respectful to each other, especially to their superiors, and very industrious. The women brew the beer, dress the victuals, and sell all sorts of commodities at the market. Those that are rich employ their wives and slaves in tilling the land, and they carry on a considerable trade with the product, as well as in slaves; for some of them are able to deliver 1000 of the latter every month. The chief men have generally 40 or 50 wives, the principal captains 300 or 400, and the king 4000 or 5000. They are extremely jealous, and, on the least suspicion, will sell them to the Europeans for slaves. If any one happen to touch one of the king's wives accidentally, he is doomed to perpetual slavery. It is no wonder then that the women are not fond of being the king's wives; and some of them will prefer a speedy death to such a miserable life. They have no distinction of hours, days, weeks, months, or years. The rite of circumcision is used here; but they are not able to tell why they use it, nor whence it is derived. They are such great gamesters, that they will stake all they have at play, not excepting their wives and children. They have a vast number of idols; and they deify the most contemptible animal that they see first in a morning, and even stocks and stones. Their principal regard is for snakes, very high trees, and the sea. An English factor, just arrived, found a snake in the house belonging to the factory, and killed it without the least scruple; which so incensed the negroes, that they were for revenging the death of the snake, not only upon him that killed it, but upon the whole factory; but by means of presents, and the interposition of the people of the other factories, the affair was made up, and the snake honourably interred. However, to prevent such accidents, they gave them warning not to do the like for the future. They have oxen, cows, goats, sheep, hogs, turkeys, ducks, and hens; which last are extremely plentiful. There are many elephants, buffaloes, tigers, several kinds of deer, and a sort of hares. The fruits are citrons, lemons, oranges, bananas, tamarinds, &c. and they have vast numbers of palm-trees, from which they obtain wine. Whidah was conquered by the king of Dahomy. Their trade consists of slaves, elephants teeth, wax, and honey. The English factory is 200 miles east of Cape Coast Castle, within land. Bows, arrows, beautiful assaguays, and clubs, are the principal weapons of the nation.

Whidah || Whirlpool.

WHIDAW-BIRD. See EMBERIZA, ORNITHOLOGY *Index*.

WHIG, a person belonging to a political party in Britain, opposite to the Tories. See TORIES, and BRITAIN.

WHIMBREL. See SCOLOPAX, ORNITHOLOGY *Index*.

WHIN. See ULEX, BOTANY *Index*.

WHINCHAT. See MOTACILLA, ORNITHOLOGY *Index*.

WHIP, or *Whip-Staff*, in a ship, a piece of timber, in form of a strong staff, fastened into the helm, for the steersman, in small ships, to hold in his hand, in order to move the rudder, and direct the ship.

WHIRLPOOL, an eddy, vortex, or gulf, where the water is continually turning round.

Those in rivers are very common, from various accidents, and are usually very trivial, and of little consequence. In the sea they are more rare, but more dangerous. Sibbald has related the effects of a very remarkable marine whirlpool among the Orcades, which would prove very dangerous to strangers, though it is

of

Whirlpool, Whirlwind.

of no conſequence to the people who are uſed to it. This is not fixed to any particular place, but appears in various parts of the limits of the ſea among theſe iſlands. Wherever it appears, it is very furious; and boats, &c. would inevitably be drawn in and periſh with it; but the people who navigate them are prepared for it, and always carry an empty veſſel, a log of wood, or large bundle of ſtraw, or ſome ſuch thing in the boat with them; as ſoon as they perceive the whirlpool, they toſs this within its vortex, keeping themſelves out: this ſubſtance, whatever it be, is immediately received into the centre, and carried under water; and as ſoon as this is done, the ſurface of the place where the whirlpool was becomes ſmooth, and they row over it with ſafety; and in about an hour they ſee the vortex begin again in ſome other place, uſually at about a mile's diſtance from the firſt.

WHIRLWIND, a wind which moves in a ſpiral direction, as well as horizontally, which is exceedingly rapid and impetuous, but only of ſhort duration.

Dr Franklin's opinion of the origin of whirlwinds has been already given in the article *WATER-Spout*. If his theory be true, it will follow, that no hurricane ever can be ſo violent as to remove an obſtacle of the ſize of only one cubic inch, provided that was ſupported by a power equivalent to 15 pounds; for this is the utmoſt force of the atmoſphere when ruſhing into a perfect vacuum, which never could take place in the centre of a whirlwind or water-ſpout. Indeed, notwithſtanding the dreadful effects ſometimes obſerved from hurricanes and whirlwinds, we ſhall eaſily perceive, that the utmoſt of their power always falls very far ſhort of this. The diminution of the ſpecific gravity of the air by only one-fourth in the middle of the column, would produce ſuch an afflux of air from all quarters, that an obſtacle preſenting a ſurface of one foot ſquare, would require a force of 504 pounds to prevent it from being carried away; which the ſtrongeſt walls that can be built by human art could ſcarce reſiſt. Nay, even the tenth part of this, or the diminution of the gravity of the atmoſphere by one-fortieth part, would produce a preſſure of upwards of 50 pounds on every ſquare foot of ſurface, which, it is to be doubted, whether any of our common houſes could reſiſt.

Some philoſophers aſcribe the vacuum in the atmoſphere, to which, according to Dr Franklin's theory, whirlwinds are owing, to a ſtream of electric matter ruſhing with violence into the atmoſphere out of the earth. But they do not inform us how this matter comes to be accumulated in that part of the earth; what induces it to paſs out of the earth; how it paſſes inviſibly through pure air; or what ſerves it for a conductor. It ſeems to be the faſhion among certain philoſophers to aſcribe every phenomenon, with the cauſe of which we are unacquainted, to electricity. But this is merely ſubſtituting a new name, and ſerves rather to retard than advance our knowledge of nature.

Some kinds of whirlwinds move with a ſlow motion, and are injurious only by their vortex; while others ſeem to do miſchief as well by their progreſſive as their whirling motion. Of this kind are thoſe called *typhons*; which, by their frequently following the courſe of rivers, ſeem thus alſo to diſcover their electrical origin. Of the deſtructive effects of theſe, we have an inſtance in what happened in Charleſtown in South Carolina, on the 1ſt of June 1761. It was firſt obſerved about noon, on land, upwards of 50 miles weſt by ſouth of Charleſtown, and deſtroyed ſeveral houſes, &c. as it paſſed along, in many places making wide avenues through the woods; from whence every tree and ſhrub was torn up, and great branches of trees were driven about in the column as it paſſed along. It directed its courſe to Aſhley river, down which it came with ſurpriſing velocity; in its appearance reſembling a column of ſmoke or vapour, whoſe motion was very irregular and tumultuous. Its momentum was ſo great, that Aſhley river was ploughed to the bottom, and the channel laid bare. As it came down this river, it made a conſtant noiſe like thunder; its diameter being computed about 300 fathoms. It was met at White Point by another of the ſame kind which came down Cooper's river, but with inferior ſtrength; however, on their meeting together, the agitation of the air was much greater, while the clouds, which were driving in all directions to the place, ſeemed to be precipitated, and whirled round with incredible velocity. It then fell upon the ſhipping in the road; entirely deſtroying ſome, and damaging others; being ſcarce three minutes in its paſſage, though the diſtance was near two leagues. In that ſhort time it did damage to the amount of 20,000l.; and had not its direction been altered by that guſt which came down Cooper's river, it muſt have totally deſtroyed Charleſtown, as no obſtacle whatever ſeemed capable of reſiſting its fury.

Whirlwind || Whiſt.

WHISKY, a term ſignifying *water*, and applied in Scotland and in Ireland to a diſtilled liquor drawn from barley.

WHISPERING-PLACES. See ACOUSTICS, N° 24.

WHIST, a well known game at cards, which requires great attention and ſilence; hence the name.

This game is played by four perſons, who cut for partners; the two higheſt and the two loweſt are together, and the partners ſit oppoſite to each other: the perſon who cuts the loweſt card is to deal firſt, giving one at a time to each perſon, till he comes to the laſt card, which is turned up for the trump, and remains on the table till each perſon has played a card. The perſon on the left hand ſide of the dealer plays firſt, and whoever wins the trick is to play again, thus going on till the cards are played out. The ace, king, queen, and knave of trumps, are called *honours*; in caſe any three of theſe honours have been played between, or by either of the two partners, they reckon for two points towards the game; and if the four honours have been played between, or by either of the two partners, they reckon for four points towards the game, the game conſiſting of ten points. The honours are reckoned after the tricks; all above ſix tricks reckoning alſo towards the game.

General Rules for playing the Game of WHIST.—1. He who is to play firſt ſhould lead from the ſtrongeſt ſuit. If he has a ſequence of king, queen, and knave, or queen, knave and ten, he may ſafely lead the higheſt of the ſequence; but if he has five or ſix in number, he muſt begin with the loweſt. He muſt always begin with the higheſt trump, by which he forces out the ſuperior trumps, and can come in again, to make his ſtrong ſuit.

2. He ſhould never be afraid to play trumps when he has five in his hand, even of the ſmalleſt, although he may not have any good cards of any other ſuit.

3. With

Whiſt. 3. With ace and king of any two ſuits, and only two or three ſmall trumps, the aces and kings ſhould be played out, in order to make as many tricks as poſſible; and having but two or three ſmall trumps, he ſhould never force his partner to trump, if he finds he cannot follow ſuit; but endeavour to throw the lead into his partner's hand.

4. He ſhould in general return his partner's lead, unleſs he has ſome capital cards of his own.

5. As this game is played with the lurch, that is, to ſave half the ſtake, five points muſt be made before the game is out: he ſhould not venture to play trumps when he is four of the game, unleſs he is very ſtrong, having at leaſt an honour and three trumps, or ace, king, and two ſmall ones.

6. When the game is ſcored nine, at which ſtage the honours reckon for nothing, he ſhould be ſtill more cautious how he plays trumps, even if he is ſtrong in hand, and give his partner an opportunity of trumping the adverſaries ſuits, in caſe he is deficient in them.

7. If his adverſaries are ſix or ſeven love of the game, he ſhould play a forward or bold game, that he may have a chance, at the riſk of a trick or two, to come up with them. If he has but three trumps and other good cards, he may play trumps, eſpecially if he has a ſequence, or queen, knave, and a ſmall one.

8. He ſhould always riſk a trick or two when the game is much in his favour; becauſe a new deal is of greater conſequence to the adverſary than one or two points are to him.

9. When the player finds there is a likelihood of either ſaving the game or his lurch, he ſhould riſk the odd trick; but if the game is five all, and he can make two tricks in his own hand, he ſhould make them, in order to ſecure the difference of two points, which make the game near two to one in his favour.

10. A good player ſhould begin with a ſmall trump, when he has ace, king, and four ſmall ones; for this reaſon, if his partner has a better trump than the laſt player, which is an equal wager but he has, he has a chance of fetching out all the trumps, by having three rounds of them.

11. The odds are always in his favour that his partner holds an honour; conſequently if he has king, queen, and four ſmall ones, he ſhould begin with a ſmall one.

12. When queen, knave, and four ſmall trumps are dealt him, he ſhould play a ſmall one firſt, the odds being in his favour that his partner holds an honour; if he has knave, ten, and four ſmall trumps, he ſhould alſo begin with a ſmall one, for the ſame reaſon.

13. If he has knave, ten, eight, and three ſmall trumps, the knave ſhould be played firſt, by which means the nine may be prevented from winning a trick, the odds being in his favour that three honours are played in two rounds.

14. If an honour is turned up againſt him on his left hand, and he has ten, nine, and eight, with two or three ſmall trumps; when he is to play, he ſhould play through the honours with the ten, which will force the dealer to play his honour to a diſadvantage, if the dealer does not chooſe to leave it to the option of his adverſary whether he will paſs it or not; but if he has ſix trumps of a lower denomination, and not ten, nine, and eight, and no honour turned up againſt him, he ſhould begin with a ſmall one. Whiſt.

15. In general, when he has two capital cards in trumps, and two or three ſmall ones, he ſhould begin with a ſmall one, for the reaſon aſſigned in N° 12.

16. When he has ace, king, knave, and two ſmall trumps, or even one ſmall trump, by firſt playing the king, and putting the lead into his partner's hand, who will play a trump; judging him to have ace and knave, from his beginning with the king: in this caſe the knave ſhould be fineſſed (A), nothing being againſt him but the queen.

17. If he has knave, ten, eight, and two ſmall trumps, by playing the knave firſt, it is odds but in two rounds of trumps the nine falls, or he may fineſſe the eight when his partner returns trumps.

18. With five trumps of a lower denomination, he ſhould begin with the ſmalleſt, unleſs he has a ſequence of ten, nine, and eight; then he ſhould begin with the ten.

19. When he has king, queen, ten, and one ſmall trump, he muſt begin with the king, and wait for his partner's return of the trumps, in order to fineſſe the ten, by which means he may win the knave.

20. In order to prevent the ten from winning, when he has queen, knave, nine, and one ſmall trump, he muſt begin with the queen. And in caſe he has knave, ten, eight, and one ſmall trump, he ſhould begin with the knave, that the nine may not win.

21. If he has ten, nine, eight, and one ſmall trump, he ſhould begin with the ten; thereby he ſtrengthens his partner's hand, leaving it at his option to take it or not.

22. He ſhould begin with a ſmall one, when he has the ten and three ſmall trumps.

23. If he has a good ſuit, and ace, king, and four ſmall trumps, he muſt play three rounds of trumps, in order to ſecure his ſtrong ſuit from being trumped.

24. When he has king, queen, ten, and three ſmall trumps, he ſhould begin with the king, becauſe he has a chance of the knave's coming down in the ſecond round; and to ſecure his ſtrong ſuit, he ſhould not wait to fineſſe the ten. If he ſhould have queen, knave, and three ſmall trumps, and ſome good ſuit to make, he muſt begin with a ſmall one.

25. If he has knave, ten, eight, and two ſmall trumps, with a ſtrong ſuit, he ſhould begin with the knave, in order to make the nine fall in the ſecond round; but if he has knave, ten, and three ſmall trumps, with a good ſuit, he ſhould play a ſmall one firſt.

26. With ten, nine, eight, and one ſmall trump, provided he has a good ſuit, he ſhould begin with the ten; by which means he may get the trumps out, and have a chance of making his ſtrong ſuit.

The following obſervations will enable a player to know that his partner has no more of a ſuit which either of

(A) *Fineſſe*, is to play a ſmall card which may win, keeping the ſuperior card or cards to lay over the right-hand adverſary.

Whift. of them has played. Suppoſe he leads from queen, ten, nine, and two ſmall cards of any ſuit, the ſecond hand puts on the knave, his partner plays the eight; in this caſe, he having queen, ten, and nine, it is a demonſtration, if his partner plays well, that he can have no more of that ſuit. By that diſcovery, he may play his game accordingly, either by forcing his partner to trump that ſuit, if he is ſtrong in trumps, or by playing another ſuit. If he has king, queen, and ten of a ſuit, and he leads his king, his partner plays the knave; this alſo demonſtrates he has no more of that ſuit. If he has king, queen, and many more of a ſuit, and begins with the king, in ſome caſes it is good play in a partner, when he has the ace and one ſmall card in that ſuit only, to win the king with the ace; for ſuppoſe the partner to be very ſtrong in trumps, by taking the king with the ace, he gets the lead and trumps out, and having cleared the board of trumps, his partner returns his lead; and the ace being out, there is room for him to make that whole ſuit, which could not have been done if the partner had kept the ace. Suppoſe he has no other good card in his hand beſides that ſuit, he loſes nothing by the ace's taking his king; and if it ſhould ſo happen that he has a good card to bring in that ſuit, he gains all the tricks which he makes to that ſuit by this method of play: as his partner has taken his king with the ace, and trumps out upon it, he has reaſon to imagine that his partner has one of that ſuit to return him; for which reaſon he ſhould not throw away any of that ſuit, even to keep a king or queen guarded.

Method of playing when an honour is turned up on the right hand.—Suppoſe the knave is turned up on his right hand, and that he has king, queen, and ten; in order to win the knave, he muſt begin with the king; by which means, his partner may ſuppoſe him to have queen and ten remaining, eſpecially if he has a ſecond lead, and he does not proceed to play the queen.

Suppoſe the knave turned up as before, and he has ace, queen, and ten, by playing his queen, it anſwers the purpoſe of the former rule.

When the queen is turned up on his right hand, and he has ace, king, and knave, by playing his king, it anſwers the ſame purpoſe of the former rule.

In caſe an honour is turned up on his left hand, ſuppoſing he ſhould hold no honour, he ſhould play trumps through the honour as ſoon as he gets the lead; but if he ſhould hold an honour (except the ace), he muſt be cautious how he plays trumps, becauſe, in caſe his partner holds no honour, his adverſary will play his own game upon him.

Method of playing the ſequences.—The higheſt in ſequences of trumps ſhould be played, unleſs he has ace, king, and queen; and then he ſhould play the loweſt, which informs his partner of the ſtate of his game.

When he has king, queen, and knave, and two ſmall ones, which are not trumps, he ſhould begin with the knave, whether he is ſtrong in trumps or not, as he makes way for the whole ſuit by getting the ace out.

If he is ſtrong in trumps, and has a ſequence of queen, knave, ten, and two ſmall cards of a ſuit, he ſhould play the higheſt of his ſequence; for if either of the adverſaries ſhould trump that ſuit in the ſecond round, being alſo ſtrong in trumps, he will make the remainder of that ſuit, by fetching out the trumps. When he has knave, ten, and nine, and two ſmall cards of a ſuit, he may play in the like manner. Whift.

If king, queen, and knave, and one ſmall card of any ſuit, is the caſe, whether ſtrong in trumps or not, he ſhould play the king; and when there are only four in number, the ſame method of play ſhould be obſerved by inferior ſequences.

When weak in trumps, he ſhould begin by the loweſt of the ſequence, provided he has five in number, becauſe if his partner has the ace of that ſuit he will make it. If he has the ace and four ſmall cards of a ſuit, and weak in trumps, leading from that ſuit, he ſhould play the ace. When ſtrong in trumps, the game may be played otherwiſe.

How to make a ſlam, or *win every trick.*—Suppoſe A and B partners againſt C and D, and C to deal, A to have the king, knave, and nine, and ſeven of hearts, which are trumps, a quart-major in ſpades, a tierce-major in diamonds, and the ace and king of clubs. Then ſuppoſe B to have nine ſpades, two clubs, and two diamonds. Alſo ſuppoſe D to have ace, queen, ten, and eight of trumps, with nine clubs, and C to have five trumps and eight diamonds. A leads a trump, which D wins, and D is to play a club, which his partner C is to trump; C leads a trump, which his partner D wins; D then will lead a club, which C will trump; and C will play a trump, which D will win; and D having the beſt trump will play it; after which D having ſeven clubs in his hand, makes them, ſo that he ſlams A and B.

How to play any hand of cards according to the neareſt calculations of his partner's holding certain winning cards:

1. That he has not one certain winning card, is - - -	2 to 1
2. That he has not two certain winning cards, is - - -	17 to 2
But it is about 5 to 4 that he has one or both, or - -	32 to 25
3. That he has one card out of any three certain winning cards, is about	5 to 2
4. That he has not three certain winning cards is about 31 to 1, or -	681 to 22
5. That he has not two of them, is about 7 to 2, or - - -	547 to 156
6. That he has not one of them, is about 7 to 6, or - - -	378 to 325
7. That he holds one or two of them, is in his favour about 13 to 6, or	481 to 222
8. And about 5 to 2, that he holds 1, 2, or all three of them.	

The uſe of theſe calculations is for a whiſt-player to play his cards to the moſt advantage. For inſtance,

As the firſt calculation is two to one that his partner does not hold one certain winning card.—Suppoſe then a ſuit is led, of which the ſecond player has the king and a ſmall one only, he ſhould put on the king, becauſe the odds are in his favour, that the third player cannot win it. For the ſame reaſon, when he is ſecond player, and to lead, he ſhould play a king in preference to a queen, becauſe it is two to one the ace does not take it; but it is five to four the queen will be taken by either ace or king, which may be in the third hand.

According

According to the ſecond calculation, of its being five to four that his partner holds one certain winning card out of any two: If he has two honours in any ſuit, he can play to an advantage, knowing it is five to four in favour of his partner's having one of the two honours; and by the ſame rule, if he is ſecond player, having a queen and one ſmall card, by playing the queen he plays five to four againſt himſelf.

It is obvious, from the third calculation, which proves it to be five to two that his partner has one card out of any three certain winning cards, that he who plays the knave ſecond hand, having but the knave and one ſmall card of the ſame ſuit, muſt play five to two againſt himſelf, and diſcovers his game to a great diſadvantage; for which reaſon, he ſhould play the loweſt of any ſequence which he may hold in his hand, as the knave, if he has king, queen, and knave; the ten, if he has queen, knave, and ten, &c. By ſo doing, his partner has an opportunity of judging what card to play in that ſuit, according to the odds for or againſt him.

Hoyle's nes improved by ufort.

From the above calculation, if he has ace, king, and two ſmall trumps, he is entitled to win four tricks out of ſix, provided he has four winning cards of any ſuit; or five tricks out of ſeven, if he has five winning cards of any ſuit: by playing two rounds of trumps, and taking out eight of them, it is five to two but his partner has a third trump; and if it ſhould be ſo, he makes the tricks intended.

WHISTON, William, an Engliſh divine of great parts, uncommon learning, and of ſingular character, was born in 1667 at Norton near Twycroſſe in the county of Leiceſter, where his father was rector. He was admitted of Clarehall, Cambridge, where he purſued his ſtudies, particularly in the mathematics, and commenced tutor; which his ill health at length forced him to decline. Having entered into orders, he became chaplain to Dr More biſhop of Norwich in 1694; and in this ſtation he publiſhed his firſt work, entitled A New Theory of the Earth, &c. in which he undertook to prove the Moſaic doctrine of the earth perfectly agreeable to reaſon and philoſophy. This work brought no ſmall reputation to the author. In the beginning of the 18th century he was made Sir Iſaac Newton's deputy, and afterwards his ſucceſſor, in the Lucaſian profeſſorſhip of mathematics; when he reſigned a living he had in Suffolk, and went to reſide at Cambridge. About this time he publiſhed ſeveral ſcientifical works, explanatory of the Newtonian philoſophy; and he had the honour to be one of the firſt, if not the very firſt, who rendered theſe principles popular and intelligible to the generality of readers. About the year 1710, he was known to have adopted Arian principles, and was forming projects to ſupport and propagate them: among other things, he had tranſlated the Apoſtolical Conſtitutions into Engliſh, which favoured the Arian doctrine, and which he aſſerted to be genuine. The conſequence was, that he was deprived of his profeſſorſhip, and baniſhed the univerſity; he nevertheleſs purſued his ſcheme, by publiſhing the next year his Primitive Chriſtianity Revived, 4 vols. 8vo, for which the convocation fell upon him very vehemently. On his expulſion from Cambridge, Mr Whiſton ſettled in London; where, without ſuffering his zeal to be intimidated, he continued to write, and propagate his Primitive Chriſtianity, with as much ardour as if he had been in the moſt flouriſhing circumſtances. In 1721, a ſubſcription was made for the ſupport of his family, which amounted to 470l. For though he drew profits from reading aſtronomical and philoſophical lectures, and alſo from his publications, which were very numerous, yet theſe of themſelves would have been very inſufficient: nor, when joined with the benevolence and charity of thoſe who loved and eſteemed him for his learning, integrity, and piety, did they prevent his being frequently in great diſtreſs. He continued long a member of the church of England, and regularly frequented its ſervice, though he diſapproved of many things in it: but at laſt he went over to the Baptiſts, and attended Dr Forſter's meeting at Pinner's hall, Broadſtreet. Among other performances not ſpecified above, he wrote Memoirs of his own life and writings, which contain ſome curious particulars.

He was remarkable for ſpeaking the plaineſt truths on every occaſion, and to perſons of every degree. During the year 1725, that he, with Dr Clarke, Dr Berkeley, and others, had the honour to attend Queen Caroline on a certain day of every week, to talk of the progreſs of ſcience, her majeſty one evening took occaſion to pay him a juſt compliment on his truth and integrity, requeſting that he would, with his uſual plainneſs, point out to her any fault that he might have obſerved in her conduct. At firſt he begged to be excuſed, adding, that few perſons could bear to have their faults plainly told to them, and leaſt of all royal perſonages, who, from their elevation, are neceſſarily ſurrounded by flatterers, to whoſe lips truth is a ſtranger. Her majeſty replied, that he was to conſider her not as a queen, but as a philoſopher; and that philoſophy is of very little uſe, if it cannot enable its profeſſors to bear without offence truths neceſſary to their own improvement. Upon this he told her, that the greateſt fault which he had obſerved in her conduct, was her indecent behaviour in the houſe of God, which, he aſſured her, had made very unfavourable impreſſions on the minds of many perſons, who coming to town from diſtant parts of the country, had gone to the chapel to obtain a ſight of her majeſty, the king, and the royal family. The queen made no reply; but in about ſix weeks afterwards renewed her requeſt, that Mr Whiſton would point out the moſt glaring improprieties in her conduct. To this he anſwered, that he had laid down a maxim, from which he could not deviate, never to point out to any perſon more than one fault at a time, and never to give a ſecond reproof till he had obſerved ſome good conſequence to have ariſen from the firſt (A). Much to the queen's honour, ſhe was pleaſed with this plain-dealing, and continued to think favourably of Mr Whiſton. This honeſt, but whimſical and credulous man, died in 1762, at the advanced age of 95.

WHITBY, Dr Daniel, a very learned Engliſh divine, was born in 1638, and bred at Oxford; where, in 1664, he was elected perpetual fellow of his college. He afterwards became chaplain to Dr Seth Ward, biſhop

(A) Biſhop Berkeley was preſent at theſe converſations, and from his ſon we received the account we have given of them. They are likewiſe mentioned, but not ſtated ſo accurately, by Biſhop Newton in his own Life.

Whitby || Whitefield.

ſhop of Saliſbury; who collated him in 1668 to the prebend of Yateſbury in that church, and ſoon after to that of Huſborn and Burbach.' In 1672 he was admitted chanter of the ſaid church, on the death of Mr John South, and then, or ſoon after, rector of St Edmund's church in Saliſbury. He was made a prebendary of Taunton Regis in 1696, and died in 1726. He was ever ſtrangely ignorant of worldly affairs, even to a degree that is ſcarcely to be conceived. His writings are numerous, and well known; particularly his Commentary on the New Teſtament.

WHITBY, a ſea-port town in the north riding of Yorkſhire, ſeated on the river Eſk, near the place where it falls into the ſea. The houſes are neat, ſtrong, and convenient; the number of inhabitants about 9000. Ship-building is their principal employment. W. Long. 0. 24. N. Lat. 54. 30.

WHITE, one of the colours of natural bodies.

WHITE of the Eye, denotes the firſt tunic or coat of the eye, called *albuginea*. See ANATOMY, N° 142.

WHITE of Egg. See ALBUMEN and EGG.

WHITE Friars, a name common to ſeveral orders of monks, from being clothed in a white habit.

WHITE Sea, is a bay of the Frozen ocean, ſo called in the north part of Muſcovy, lying between Ruſſian Lapland and Samoieda; at the bottom of which ſtands the city of Archangel. This was the chief port the Ruſſians had before their conqueſt of Livonia.

WHITE Colour, white lead for painting. See CHEMISTRY, N° 1856.

WHITE Iron, or *Tin-plate*, iron-plates covered over with tin; for the method of making which, ſee LATTEN, CHEMISTRY, N° 1956.

In 1681 tin-plates were manufactured in England by one Andrew Yarranton, who had been ſent to Bohemia to learn the method of making them. But the manufacture was ſoon afterwards diſcontinued. It was revived in 1740, and has now arrived at as great, if not greater, perfection in this country than in any other.

WHITE Lead. See CHEMISTRY, N° 1856.

WHITE-Throat. See MOTACILLA, ORNITHOLOGY *Index*.

WHITEFIELD, GEORGE, the celebrated preacher among the people called *Methodiſts*, was born in the year 1714, at the Bell in the city of Glouceſter, which was then kept by his mother. At about 12 years of age he was put to a grammar-ſchool; but his mother entering into a ſecond marriage, which proved a diſadvantageous one, he, when about 15, put on a blue apron, and ſerved her in the capacity of a drawer or waiter. After continuing about a year in this ſervile employment, ſhe turned over the buſineſs to his brother; who marrying, and George not agreeing with his ſiſter-in-law, he left the inn. Some time after, meeting with an old ſchool-fellow, then a ſervitor in Pembroke college, Oxford, he was induced to attempt getting into the ſame college in a like capacity, and ſucceeded. Here Mr Whitefield, who from his own account appears to have always had a ſtrong tincture of enthuſiaſm in his conſtitution from his very childhood, diſtinguiſhed himſelf by the auſterity of his devotion, and acquired conſiderable eminence in ſome religious aſſemblies in that city. At the age of 21, the fame of his piety recommended him ſo effectually to Dr Benſon, then biſhop of Glouceſter, that he made him a voluntary offer of ordination. Immediately after this regular admiſſion into the miniſtry, Mr Whitefield applied himſelf to the moſt extraordinary, the moſt indefatigable, duties of his character, preaching daily in priſons, fields, and open ſtreets, wherever he thought there would be a likelihood of making proſelytes. Having at length made himſelf univerſally known in England, he embarked for America, where the tenets of Methodiſm began to ſpread very faſt under his friends the Weſleys; and firſt determined upon the inſtitution of the orphan-houſe at Georgia, which he afterwards effected. After a long courſe of peregrination, his fortune increaſed as his fame extended among his followers, and he erected two very extenſive buildings for public worſhip, under the name of *Tabernacles;* one in Tottenham-Court Road, and the other in Moorfields. Here, with the help of ſome aſſiſtants, he continued for ſeveral years, attended by very crowded congregations, and quitting the kingdom only occaſionally. Beſides the two tabernacles already mentioned, Mr Whitefield, by being chaplain to the counteſs dowager of Huntingdon, was connected with two other religious meetings, one at Bath, and the other at Tunbridge, chiefly erected under that lady's patronage. By a lively, fertile, and penetrating genius, by the moſt unwearied zeal, and by a forcible and perſuaſive delivery, he never failed of the deſired effect upon his ever crowded and admiring audiences. In America, however, which always engaged much of his attention, he was deſtined to finiſh his courſe; and he died at Newberry, about 40 miles from Boſton in New England, in 1770.

Whitefield || Whitſunday.

WHITEHAVEN, a ſea-port town of Cumberland, with a market on Tueſday, and one fair on Auguſt 1ſt for merchandiſe and toys. It is ſeated on a creek of the Iriſh ſea, on the north end of a great hill, waſhed by the tide of flood on the weſt ſide, where there is a large rock or quarry of hard white ſtone, which gives name to the place, and which, with the help of a ſtrong ſtone-wall, ſecures the harbour, into which ſmall barks may enter. It is lately much improved in its buildings, and noted for its trade in pit-coal and ſalt, there being near it a valuable coal-mine, which runs a conſiderable way under the ſea. They have a cuſtom-houſe here; and they carry on a good trade to Ireland, Scotland, Cheſter, Briſtol, and other parts. It is 10 miles ſouth-weſt of Cockermouth, and 305 north-weſt of London. W. Long. 2. 55. N. Lat. 55. 30.

WHITENESS, the quality which denominates or conſtitutes a body white.

WHITES, or FLUOR *Albus*. See MEDICINE, N° 250.

WHITING. See GADUS, ICHTHYOLOGY *Index*.

WHITLOW, or WHITLOE. See SURGERY *Index*.

WHITSUN-FARTHINGS, otherwiſe called *Smoke-farthings* or *Quadrantes Pentecoſtales*, a compoſition for offerings which were anciently made in Whitſun-week by every man in England, who occupied a houſe with a chimney, to the cathedral church of the dioceſe in which he lived.

WHITSUNDAY, a ſolemn feſtival of the Chriſtian church, obſerved on the fiftieth day after Eaſter, in memory of the deſcent of the Holy Ghoſt upon the apoſtles in the viſible appearance of fiery cloven tongues, and of thoſe miraculous powers which were then conferred upon them.

It

itſun- It is called *Whitſunday*, or *White Sunday*; becauſe
lay this being one of the ſtated times for baptiſm in the an-
ll cient church, thoſe who were baptiſed put on white gar-
hytt. ments, as types of that ſpiritual purity they received in baptiſm. As the deſcent of the Holy Ghoſt upon the apoſtles happened upon the day which the Jews called *Pentecoſt*, this feſtival retained the name of *Pentecoſt* among the Chriſtians.

WHITSUNDAY Iſle, one of the New Hebrides, which lies about four miles to the ſouth, runs in the ſame direction, and is of the ſame length, having more ſloping expoſures than Aurora: it appears to be better inhabited, and to contain more plantations.

WHORTLEBERRY. See VACCINIUM, BOTANY *Index*.

WHYTT, DR ROBERT, an eminent phyſician, born at Edinburgh on the 6th September 1714, was the ſon of Robert Whytt, Eſq. of Bennochy, advocate. This gentleman died ſix months before the birth of our author, who had alſo the misfortune to be deprived of his mother before he had attained the ſeventh year of his age. After receiving the firſt rudiments of ſchool-education, he was ſent to the univerſity of St Andrew's; and after the uſual courſe of inſtruction there, in claſſical, philoſophical, and mathematical learning, he came to Edinburgh, where he entered upon the ſtudy of medicine, under thoſe eminent medical teachers, Monro, Rutherford, Sinclair, Plummer, Alſton, and Innes. After learning what was to be acquired at this univerſity, in the proſecution of his ſtudies he viſited foreign countries; and after attending the moſt eminent teachers at London, Paris, and Leyden, he had the degree of Doctor of Phyſic conferred upon him by the univerſity of Rheims in 1736, being then in the 22d year of his age.

Upon his return to his native country, he had the ſame honour alſo conferred upon him by the univerſity of St Andrew's; where he had before obtained, with applauſe, the degree of Maſter of Arts.

Not long afterwards, in the year 1737, he was admitted a Licentiate of Medicine by the Royal College of Phyſicians of Edinburgh; and the year following he was raiſed to the rank of a Fellow of the College. From the time of his admiſſion as a licentiate, he entered upon the practice of phyſic at Edinburgh; and the reputation which he acquired for medical learning, pointed him out as a fit ſucceſſor for the firſt vacant chair in the univerſity. Accordingly, when Dr Sinclair, whoſe eminent medical abilities, and perſuaſive powers of oratory, had contributed not a little to the rapid advancement of the medical ſchool of Edinburgh, found that thoſe conſpicuous talents which he poſſeſſed could no longer be exerted in the manner which they once had been, when he enjoyed bodily vigour unimpaired by age and powers of mind unclouded by diſeaſe, he reſigned his academical appointments in favour of Dr Whytt.

This admiſſion into the college took place on the 20th of June 1746; and he began his firſt courſe of the inſtitutions of medicine at the commencement of the next winter-ſeſſion. The abilities which he diſplayed from his academical chair, in no particular diſappointed the expectations which had been formed of his lectures. The Latin tongue was the language of the univerſity of Edinburgh; and he both ſpoke and wrote in Latin with ſingular propriety, elegance, and perſpicuity. At Whytt. that time the ſyſtem and ſentiments of Dr Boerhaave, which, notwithſtanding their errors, muſt challenge the admiration of lateſt ages, were very generally received by the moſt intelligent phyſicians in Britain. Dr Whytt had no ſuch idle ardour for novelties as to throw them entirely aſide becauſe he could not follow them in every particular. The inſtitutions of Dr Boerhaave, therefore, furniſhed him with a text for his lectures; and he was no leſs ſucceſsful in explaining, illuſtrating, and eſtabliſhing the ſentiments of the author, when he could freely adopt them, than in refuting them by clear, connected, and deciſive arguments, when he had occaſion to differ from him. The opinions which he himſelf propoſed, were delivered and enforced with ſuch acuteneſs of invention, ſuch diſplay of facts and force of argument, as could rarely fail to gain univerſal aſſent from his numerous auditors; but free from that ſelf-ſufficiency which is ever the offspring of ignorance and conceit, he delivered his concluſions with becoming modeſty and diffidence.

From the time that he firſt entered upon an academical appointment, till the year 1756, his prelections were confined to the inſtitutions of medicine alone. But at that period his learned colleague Dr Rutherford, who then filled the practical chair, who had already taught medicine at Edinburgh with univerſal applauſe for more than thirty years, and who had been the firſt to begin the inſtitution of clinical lectures at the Royal Infirmary, found it neceſſary to retire from the fatiguing duties of an office to which the progreſs of age rendered him unequal. On this criſis Dr Whytt, Dr Monro, ſen. and Dr Cullen, each agreed to take a ſhare in an appointment in which their united exertions promiſed the higheſt advantages to the univerſity. By this arrangement ſtudents, who had an opportunity of daily witneſſing the practice of three ſuch teachers, and of hearing the grounds of that practice explained, could not fail to derive the moſt ſolid advantages.

In theſe two departments, the inſtitutions of medicine in the univerſity, and the clinical lectures in the Royal Infirmary, Dr Whytt's academical labours were attended with the moſt beneficial conſequences both to the ſtudents and to the univerſity. But not long after the period we have laſt mentioned, his lectures on the former of theſe ſubjects underwent a conſiderable change. About this time the illuſtrious Gaubius, who had ſucceeded to the chair of Boerhaave, favoured the world with his *Inſtitutiones Pathologicæ*. This branch of medicine had indeed a place in the text which Dr Whytt formerly followed; but, without detracting from the character of Dr Boerhaave, it may juſtly be ſaid, that the attention he had beſtowed upon it was not equal to its importance. Dr Whytt was ſenſible of the improved ſtate in which pathology now appeared in the writings of Boerhaave's ſucceſſor; and he made no delay in availing himſelf of the advantages which were then afforded.

In the year 1762, his pathological lectures were entirely new-modelled. Following the publication of Gaubius as a text, he delivered a comment, which was read by every intelligent ſtudent with the moſt unfeigned ſatisfaction. In theſe lectures he collected and condenſed the fruits of accurate obſervation and long experience. Enriched by all the opportunities of information

Whytt. which he had enjoyed, and by all the diſcernment which he was capable of exerting, they were juſtly conſidered as his moſt finiſhed production.

For a period of more than twenty years, during which he was juſtly held in the higheſt eſteem as a lecturer at Edinburgh, it may readily be ſuppoſed that the extent of his practice correſponded to his reputation. In fact, he received both the firſt emoluments, and the higheſt honours, which could here be obtained. With extenſive practice in Edinburgh, he had numerous conſultations from other places. His opinion on medical ſubjects was daily requeſted by his moſt eminent contemporaries in every part of Britain. Foreigners of the firſt diſtinction, and celebrated phyſicians in the moſt remote parts of the Britiſh empire, courted an intercourſe with him by letter. Beſides private teſtimonies of eſteem, many public marks of honour were conferred upon him both at home and abroad. In 1752, he was elected a fellow of the Royal Society of London; in 1761, he was appointed firſt phyſician to the king of Scotland; and in 1764, he was choſen preſident of the Royal College of Phyſicians at Edinburgh.

But the fame which Dr Whytt acquired as a practitioner and teacher of medicine, were not a little increaſed by the information which he communicated to the medical world in different publications. His celebrity as an author was ſtill more extenſive than his reputation as a profeſſor.

His firſt publication, An Eſſay on the Vital and other Involuntary Motions of Animals, although it had been begun ſoon after he had finiſhed his academical courſe of medical education, did not come from the preſs till 1751; a period of fifteen years from the time that he had finiſhed his academical courſe, and obtained a degree in medicine: but the delay of this publication was fully compenſated by the matter which it contained, and the improved form under which it appeared.

The next ſubject which employed the pen of Dr Whytt was one of a nature more immediately practical. His Eſſay on the Virtues of Lime-water and Soap in the Cure of the Stone, firſt made its appearance in a ſeparate volume in 1752. Part of this ſecond work had appeared ſeveral years before in the Edinburgh Medical Eſſays: but it was now preſented to the world as a diſtinct publication with many improvements and additions.

His third work, intitled Phyſiological Eſſays, was firſt publiſhed in the year 1755. This treatiſe conſiſted of two parts; 1ſt, An Inquiry into the Cauſes which promote the Circulation of the Fluids in the very ſmall Veſſels of Animals; and 2dly, Obſervations on the Senſibility and Irritability of the Parts of Men and other Animals, occaſioned by Dr Haller's treatiſe on that ſubject. The former of theſe may be conſidered as an extenſion and farther illuſtration of the ſentiments which he had already delivered in his Eſſay on the Vital Motions, while the latter was on a ſubject of a controverſial nature. In both he diſplayed that acuteneſs of genius and ſtrength of judgment which appeared in his former writings.

From the time at which his Phyſiological Eſſays were publiſhed, ſeveral years were probably employed by our author in preparing for the preſs a larger and perhaps a more important work than any yet mentioned, his Obſervations on the Nature, Cauſes, and Cure of thoſe Diſorders which are commonly called *nervous*, *hypochondriac*, and *hysteric*. This elaborate and uſeful work was publiſhed in the year 1764. Whytt || Wicke

The laſt of Dr Whytt's writings is intitled, Obſervations on the Dropſy in the Brain. This treatiſe did not appear till two years after his death; when all his other works were collected and publiſhed in one quarto volume, under the direction of his ſon and of his intimate friend the late Sir John Pringle.

Beſides theſe five works, he wrote many other papers, which appeared in different periodical publications; particularly in the Philoſophical Tranſactions, the Medical Eſſays, the Medical Obſervations, and the Phyſical and Literary Eſſays.

At an early period of life, ſoon after he had ſettled as a medical practitioner in Edinburgh, he entered into the married ſtate. His firſt wife was Miſs Robertſon, ſiſter to General Robertſon, governor of New York. By her he had two children; both of whom died in early infancy, and their mother did not long ſurvive them. A few years after the death of his firſt wife, he married as a ſecond wife Miſs Balfour, ſiſter to James Balfour, Eſq. of Pilrig. By her he had fourteen children; but in theſe alſo he was in ſome reſpects unfortunate; for ſix of them only ſurvived him, three ſons and three daughters, and of the former two are ſince dead. Although the feeling heart of Dr Whytt, amidſt the diſtreſſes of his family, muſt have often ſuffered that uneaſineſs and anxiety which in ſuch circumſtances is the unavoidable conſequence of parental affection and conjugal love; yet he enjoyed a large ſhare of matrimonial felicity. But his courſe of happineſs was terminated by the death of his wife, which happened in the year 1764: and it is not improbable that this event had ſome ſhare in haſtening his own death; for in the beginning of the year 1765 his health was ſo far impaired, that he became incapable of his former exertions. A tedious complication of chronical ailments, which chiefly appeared under the form of diabetes, was not to be reſiſted by all the medical ſkill which Edinburgh could afford; and at length terminated in death, on the 15th of April 1766, in the 52d year of his age.

WIBURGH, a conſiderable town of Denmark, in North Jutland, with a biſhop's ſee, remarkable for being the ſeat of the chief court of juſtice in the province. The hall where the council aſſembles has the archives of the country, and eſcaped the terrible fire that happened in the year 1726, and which burned the cathedral-church, that of the Black Friars, the town-houſe, and the biſhop's palace; but they have all been rebuilt more magnificent than before. It is ſeated on the lake Weter, in a peninſula, 25 miles north-weſt of Sleſwick, and 110 north-by-weſt of Copenhagen. E. Long. 9. 50. N. Lat. 56. 20.

WICK, a royal borough on the eaſt coaſt of the county of Caithneſs. It is ſmall, and the ſtreets narrow, but a few of its buildings are an ornament to the place. The preſent harbour is very inconvenient, but it is propoſed to erect a new one, which will be of great importance to the ſafety of navigation along that coaſt. The population of the whole pariſh in 1793 amounted to 5000.

WICKER, ſignifies made of ſmall twigs.

WICKET, a ſmall door in the gate of a fortified place,

Wicket, Wickliff.

place, &c. or a hole in a door through which to view what passes without.

WICKLIFF, JOHN, the first divine in Europe who had resolution to attempt a reformation of religion, was born about the year 1324, in the parish of Wycliff, near Richmond, in Yorkshire. He was educated at Oxford, first in Queen's and afterwards in Merton college, of which he was a probationer-fellow. Having acquired the reputation of a man of great learning and abilities, in 1361 he was chosen master of Baliol-hall, and in 1365 constituted warden of Canterbury college, by the founder Archbishop Simon de Islip; but in 1367, he was ejected by the regulars, together with three secular fellows. He thought their proceedings arbitrary, and therefore appealed to the pope; but instead of obtaining redress, the ejectment was confirmed in 1370. This disappointment probably contributed somewhat towards his enmity to the see of Rome, or rather to confirm that enmity; for he had long before written against the pope's exactions and corruptions of religion. However, his credit in the university continued; for having taken the degree of doctor in divinity, he read public lectures with great applause; in which he frequently exposed the impositions of the Mendicant friars. About this time he published a defence of his sovereign Edward III. against the pope, who had insisted on the homage to which his predecessor King John had agreed. This defence was the cause of Wickliff's introduction at court, and of his being sent one of the ambassadors in 1374 to Bruges, where they met the pope's nuncios, in order to settle several ecclesiastical matters relative to the pope's authority. In the mean time Wickliff was presented by the king to the rectory of Lutterworth in Leicestershire, and in 1375 he obtained a prebend in the church of Westbury in Gloucestershire. Wickliff continued hitherto, without molestation, to oppose the papal authority; but in 1377 a bull was sent over to the archbishop of Canterbury, and to Courtney bishop of London, ordering them to secure this arch-heretic, and lay him in irons; at the same time the pope wrote to the king, requesting him to favour the bishops in the prosecution; he also sent a bull to Oxford, commanding the university to give him up. Before these bulls reached England Edward III. was dead; and Wickliff, protected by John duke of Lancaster, uncle to Richard II. favoured by the queen-mother, and supported by the citizens of London, eluded the persecution of Pope Gregory IX. who died in 1378. In the following year this intrepid reformer presented to parliament a severe paper against the tyranny of Rome, wrote against the papal supremacy and infallibility, and published a book *On the Truth of the Scriptures*, intended to prepare the way for an English translation of them, in which he had made considerable progress. In 1381 he published *Sixteen Conclusions*; in the first of which he ventured to expose the grand article of transubstantiation. These conclusions being condemned by the chancellor of Oxford, Wickliff appealed to the king and parliament; but being deserted by his unsteady patron the duke of Lancaster, he was obliged to make a confession at Oxford; and by an order from the king was expelled the university. He now retired to his living of Lutterworth, where he finished his translation of the bible. This version, of which there are several manuscript copies in the libraries of the universities, British Museum, &c. is a very literal translation from the Latin vulgate. In 1383 he was suddenly struck with a palsy; a repetition of which put an end to his life in December 1384. He was buried in his own church, where his bones were suffered to rest in peace till the year 1428, when, by an order from the pope, they were taken up and burnt.—Besides a number of works that have been printed, he left a prodigious number of manuscripts; an accurate list of which may be seen in Bishop Tanner's *Bib. Brit. Hib.* Some of them are in the Bodleian Library, others in the British Museum, &c.

Wickliff || Wight.

Wickliff was doubtless a very extraordinary man, considering the times in which he lived. His natural sagacity discovered the absurdities and impositions of the church of Rome, and he had the honesty and resolution to promulgate his opinions, which a little more support would probably have enabled him to establish: they were evidently the foundation of the subsequent reformation.

WICKLOW, a county of Ireland, in the province of Leinster; bounded on the north by the county of Dublin; on the east by the Irish sea; on the south by Wexford; and on the west by Kildare and Catherlough. It is 33 miles in length, 20 in breadth, and indifferently fruitful. It contains 54 parishes, and formerly sent 10 members to the Irish parliament.

WICKLOW, the capital of a county of the same name, in Ireland; seated on the sea-side, with a narrow harbour, at the mouth of the river Leitrim, over which stands a rock, instead of a castle, surrounded by a strong wall, 24 miles south of Dublin. W. Long. 6. 7. N. Lat. 52. 55.

WIDGEON. See ANAS, ORNITHOLOGY *Index*.

WIDOW, a woman who has lost her husband.

WIFE, a married woman, or one joined with, and under the protection of, an husband. See HUSBAND.

ISLE OF WIGHT, an island lying on the south coast of Hampshire, from which it is separated by a narrow channel. It is about 21 miles in length and 13 in breadth. It is nearly divided into equal parts by the river Mede or Cowes, which rising in the southern angle, enters at the northern, into the channel, opposite the mouth of Southampton bay. The south-coast is edged with very steep cliffs of chalk and freestone, hollowed into caverns in various parts. The west side is fenced with ridges of rocks, of which the most remarkable are those called, from their sharp extremities, the *Needles*. Between the island and the main are various sand-banks, especially off the eastern part, where is the safe road of St Helen's. Across the island, from east to west, runs a ridge of hills, forming a tract of fine downs, with a chalky or marly soil, which feed a great number of fine-fleeced sheep. Rabbits are also very plentiful here. To the north of this ridge the land is chiefly pasture: to the south of it is a rich arable country, producing great crops of corn. The variety of prospects which this island affords, its mild air, and the neat manner in which the fields are laid out, render it a very delightful spot. It is devoted almost solely to husbandry, and has no manufactory. It is one of the principal resources of the London market for unmalted barley. Among its products are to be reckoned a pure white pipe-clay, and a fine white crystalline sand; of the latter of which great quantities are exported for the use of the glass works in various parts. Its principal town is

the

Wight || Wilderneſs.

the borough of Newport; it likewiſe contains the two ſmall boroughs of Newton and Yarmouth.

WIGTON, a royal borough, and capital of that diſtrict of Galloway to which it gives name. It is of conſiderable antiquity, and few of its houſes have been lately erected. It is ſuppoſed to have been a place of ſome conſequence in the ninth century, and that it was made a royal borough in the reign of Robert Bruce. It is governed by a provoſt, two bailies, and 12 counſellors; is extremely healthy, and furniſhes many inſtances of longevity. In 1755, the population amounted to 1032, and the whole pariſh in 1793 was 1350.

WIGTONSHIRE, ſometimes denominated *Upper* or *Weſt Galloway*, is about 30 miles long, and 12 broad. It is bounded on the ſouth-eaſt by the bay of Wigton, by which it is ſeparated from Kirkcudbright; on the ſouth and weſt by the ocean; on the north by Ayrſhire; and on the eaſt by Kirkcudbright. The coaſt is tolerably fertile, but improvements in agriculture are ſtill in their infancy. The interior and northern parts are hilly and barren, fit only for ſheep and black cattle. It contains three royal boroughs, viz. Wigton, Stranraer, and Whithorn, with a number of ſeats belonging to noblemen and gentlemen. It is divided into 17 pariſhes; and, according to a cenſus taken ſince the paſſing of the population act in 1801, the population amounted to 22,918, being an increaſe of 6452 ſince the return to Dr Webſter in 1755. The valued rent is 67,646l. Scots, while the real rent is computed at 53,890l. Sterling.

The following is the population according to the pariſhes at two different periods *:

* *Statiſt. Hiſt.* vol. xx.

	Pariſhes.	Population in 1755.	Population in 1790—1798.
	Glaſſerton	809	900
	Inch	1513	1450
	Kirkcolm	765	945
	Kirkinner	792	1152
5	Kirkmaiden	1051	1380
	Kirkowan	795	690
	Leſwalt	652	1194
	Luce, New	459	400
	Luce, Old	1509	1200
10	Mochrum	828	1400
	Penninghame	1509	2000
	Port Patrick	611	996
	Sorbie	968	1069
	Stranraer	610	1602
15	Stoneykirk	1151	1365
	Whithorn	1412	1890
17	Wigton	1032	1350
	Total,	16,466	20,983
			16,466
	Increaſe,		4,517

WILD-FIRE. See *Wild-FIRE*.

WILDERNESS, in *Gardening*, a kind of grove of large trees, in a ſpacious garden, in which the walks are commonly made either to interſect each other in angles, or have the appearance of meanders and labyrinths.

Wilderneſſes (ſays Mr Miller) ſhould always be proportioned to the extent of the gardens in which they are made; for it is very ridiculous to ſee a large wilderneſs planted with tall trees in a ſmall ſpot of ground; and, on the other hand, nothing can be more abſurd than to ſee little paltry ſquares, or quarters of wilderneſs-work, in a magnificent large garden. As to the ſituation of wilderneſſes, they ſhould never be placed too near the habitation, nor ſo as to obſtruct any diſtant proſpect of the country, there being nothing ſo agreeable as an unconfined proſpect: but where, from the ſituation of the place, the light is confined within the limits of the garden, nothing can ſo agreeably terminate the proſpect as a beautiful ſcene of the various kinds of trees judiciouſly planted; and if it is ſo contrived that the termination is planted circularly, with the concave towards the ſight, it will have a much better effect than if it end in ſtraight lines or angles. The plants ſhould always be adapted to the ſize of the plantation; for it is very abſurd for tall trees to be planted in the ſmall ſquares of a little garden; and in large deſigns ſmall ſhrubs will have a mean appearance. It ſhould alſo be obſerved never to plant evergreens amongſt deciduous trees; but always to place the evergreens in a wilderneſs in a ſeparate part by themſelves, and that chiefly in ſight. Wilderneſs.

As to the walks, thoſe that have the appearance of meanders, where the eye cannot diſcover more than twenty or thirty yards in length, are generally preferable to all others, and theſe ſhould now and then lead into an open circular piece of graſs; in the centre of which may be placed either an obeliſk, ſtatue, or fountain; and if in the middle of the wilderneſs there be contrived a large opening, in the centre of which may be erected a dome or banqueting houſe, ſurrounded with a green plot of graſs, it will be a conſiderable addition to the beauty of the whole. From the ſides of the walks and openings, the trees ſhould riſe gradually one above another to the middle of the quarters; where ſhould always be planted the largeſt growing trees, ſo that the heads of all the trees may appear to view, while their ſtems will be hid from the ſight. Thus, in thoſe parts which are planted with deciduous trees, roſes, honeyſuckles, ſpiræa frutex, and other kinds of low flowering ſhrubs, may be planted next the walks and openings; and at their feet, near the ſides of the walks, may be planted primroſes, violets, daffodils, &c. not in a ſtraight line, but ſo as to appear accidental, as in a natural wood. Behind the firſt row of ſhrubs ſhould be planted ſyringas, althæa frutex, mezereons, and other flowering ſhrubs of a middle growth; and theſe may be backed with many other ſorts of trees riſing gradually to the middle of the quarters.

The part planted with evergreens may be diſpoſed in the following manner, viz. in the firſt line next the great walks may be placed the lauruſtinus, boxes, ſpurge laurel, juniper, ſavin, and other dwarf evergreens. Behind theſe may be placed laurels, hollies, arbutuſes, and other evergreens of a larger growth. Next to theſe may be planted alaternuſes, phyllireas, yews, cypreſſes, Virginian cedars, and other trees of the ſame growth; behind theſe may be planted Norway and ſilver firs, the true pine, and other ſorts of the fir growth; and in the middle ſhould be planted Scotch pines, pinaſter, and other ſorts of the larger growing evergreens;

Wilderneſs, Wilkie.

evergreens; which will afford a moſt delightful proſpect if the different ſhades of the greens are curiouſly intermixed.

But beſide the grand walks and openings (which ſhould always be laid with turf, and kept well mowed), there ſhould be ſome ſmaller ſerpentine walks through the middle of the quarters, where perſons may retire for privacy; and by the ſides of theſe private walks may alſo be ſcattered ſome wood-flowers and plants; which, if artfully planted, will have a very good effect.

In the general deſign of theſe wilderneſſes, there ſhould not be a ſtudied and ſtiff correſpondency between the ſeveral parts; for the greater diverſity there is in the diſtribution of them, the more pleaſure they will afford.

WILKIE, WILLIAM, D. D. author of a heroic poem called the *Epigoniad*, was born in the pariſh of Dalmeny in Weſt Lothian in Scotland, in October 1721. His father was a ſmall farmer, and was not very fortunate in his worldly affairs. He gave his ſon, however, a liberal education, the early part of which he received at the pariſh ſchool of Dalmeny, and at the age of 13 he was ſent to the univerſity of Edinburgh, where he was ſoon diſtinguiſhed as a young man of genius. Among his fellow-ſtudents were Dr Robertſon the hiſtorian, Mr Home the poet, and ſome other eminent literary characters. He became acquainted alſo, in the courſe of his education, with David Hume and Dr Adam Ferguſon.

Before he completed his ſtudies at the univerſity, his father died, leaving him only the ſtock and unexpired leaſe of his farm, with the care of three ſiſters, one of whom being afterwards married to an experienced farmer, Wilkie availed himſelf of his practical knowledge. He formed a ſyſtem of farming which fully anſwered his own expectations, and ſecured to him the approbation of all his neighbours. After becoming a preacher in the church of Scotland, he ſtill continued his former mode of living, cultivating his farm, reading the claſſics, and occaſionally preaching for the miniſters in the neighbourhood. In 1753, he was preſented to the church of Ratho by the earl of Lauderdale, who was ſenſible of his worth, and admired his genius. The duties of his new office he diſcharged with fidelity, and was celebrated for his impreſſive mode of preaching, while he did not neglect the amuſements of huſbandry, and the ſtudy of the belles lettres. He publiſhed his Epigoniad in the year 1757, the reſult of fourteen years ſtudy, and a ſecond edition of it was called for in 1759, in which year he was choſen profeſſor of natural philoſophy in the univerſity of St Andrews. His whole fortune, when he removed to this place, did not exceed 200l. which he laid out in the purchaſe of a few acres of land in the vicinity of the city. He lived in the univerſity in the ſame ſtudious and retired manner as he had done at Ratho. In the year 1768, he publiſhed a volume of fables of no great celebrity, prior to which the univerſity conferred on him the degree of D. D. He died, after a lingering illneſs, on the 10th of October 1772.

The manners of Dr Wilkie were in many reſpects very ſingular, and in ſome quite diſguſting. For the purpoſe of promoting perſpiration, and thus removing an aguiſh complaint, with which he had been ſeized during his reſidence at Ratho, he generally ſlept in winter under no fewer than 24 blankets. His averſion to clean linen is altogether unaccountable. It is ſaid that when he ſlept from home, he not only ſtipulated for the proper quantity of blankets, but requeſted to be indulged with ſheets which had been previouſly uſed by ſome other perſon. It is ſcarcely neceſſary to add, that his dreſs was ſlovenly in the extreme. It is ſomewhat remarkable, that Dr Wilkie never could read aloud the ſmootheſt verſe in ſuch a manner as to preſerve either the meaſure or the ſenſe, although his own compoſitions in verſe are greatly diſtinguiſhed by their ſmoothneſs and elegance.

Wilkie || Will.

It is ſaid that Dr Wilkie, from having ſtudied Homer with great attention, was led to project an epic poem on the model of that ancient poet. The ſubject of it is drawn from the fourth book of the Iliad, where Sthenelus gives Agamemnon a ſhort account of the ſacking of Thebes; and as that city was taken by the ſons of thoſe who had fallen before it, our author gave to his poem the title of Epigoniad, from the Greek word επιγονοι, ſignifying *deſcendants*. This title, it is ſuppoſed, is not very appropriate, and is not altogether free from quaintneſs. The ſubject of the poem has not been ſelected with much judgment; for the learned reader will prefer ſtudying the manners and actions of ancient heroes in the ſublime deſcriptions of Homer and Virgil, and others will be little intereſted in ſcenes and characters ſo different from thoſe with which they are familiar, and ſo far removed from their own times. Accordingly, the Epigoniad, with all its merit as an epic poem (and it is not deſtitute of many of the eſſential requiſites of that ſpecies of poetical compoſition), is now little known.

WILKINS, DR JOHN, a moſt ingenious and learned Engliſh biſhop, was the ſon of a goldſmith of Oxford, and was born in 1614. He adhered to the parliament during the civil wars, by whom he was made warden of Wadham college in 1648: he married afterwards the ſiſter of Oliver Cromwell, and procured a diſpenſation to retain his wardenſhip notwithſtanding. Richard Cromwell made him maſter of Trinity college, Cambridge, from which he was ejected on the Reſtoration. He then became preacher to Gray's-Inn, rector of St Laurence Jewry, London, dean of Rippon, and in 1688 was promoted to the biſhopric of Cheſter. He died in 1672. Biſhop Wilkins thought it prudent to ſubmit to the powers in being; he therefore ſubſcribed to the ſolemn league and covenant while it was enforced, and was equally ready to ſwear allegiance to King Charles when he was reſtored: this, with his moderate ſpirit toward diſſenters, rendered him not very agreeable to churchmen. His mathematical and philoſophical works, which contain many ingenious and curious pieces, conſidering the time when they were written, have been collected in one vol. 8vo. He publiſhed alſo ſome theological tracts. He was the firſt preſident of the Royal Society.

WILL, that faculty of the mind by which it embraces or rejects any thing offered to it. See METAPHYSICS.

WILL, or *Laſt WILL*, in *Law*, ſignifies the declaration of a man's mind and intent relating to the diſpoſition of his lands, goods, or other eſtate, or of what he would have done after his death. In the common law there is a diſtinction made between a will and a teſtament:

Will, William.

ment: that is called a *will* where lands or tenements are given; and when the diſpoſition concerns goods and chattels alone, it is termed a *teſtament*. See TESTAMENT.

WILL-with-a-wiſp, or *Jack with-a-lanthorn*, two popular names for the meteor called *ignis fatuus*. See LIGHT, N° 46.

WILLIAM *of* MALMSBURY, an hiſtorian of conſiderable merit in the reign of King Stephen; but of whoſe life few particulars are known. According to Bale and Pits, he was ſurnamed *Somerſetus*, from the county in which he was born. From his own preface to his ſecond book *De Regibus Anglorum*, it appears that he was addicted to learning from his youth; that he applied himſelf to the ſtudy of logic, phyſic, ethics, and particularly to hiſtory. He retired to the Benedictine convent at Malmſbury, became a monk, and was made precentor and librarian; a ſituation which much favoured his intention of writing the hiſtory of this kingdom. In this monaſtery he ſpent the remainder of his life, and died in the year 1142. He is one of our moſt ancient and moſt faithful hiſtorians. His capital work is that intitled *De Regibus Anglorum*, in five books; with an Appendix, which he ſtyles *Hiſtoriæ Novellæ*, in two more. It is a judicious collection of whatever he found on record relative to England, from the invaſion of the Saxons to his own times.

WILLIAM of Newbury, ſo called from a monaſtery in Yorkſhire, of which he was a member, wrote a hiſtory which begins at the Conqueſt and ends at the year 1197. His Latin ſtyle is preferred to that of Matthew Paris; and he is entitled to particular praiſe, for his honeſt regard to truth, in treating the fables of Jeffrey of Monmouth with the contempt they deſerve; as well as for expreſſing his approbation of Henry II.'s deſign of reforming the clergy, by bringing them under the regulation of the ſecular power.

WILLIAM of Wykeham, biſhop of Wincheſter, was born in the village of Wykeham, in the county of Southampton, in 1324. He was educated at Wincheſter and Oxford; and having continued near ſix years in the univerſity, his patron Nicholas Wedal, governor of the province of Southampton, took him into his family, and appointed him his counſellor and ſecretary. He could not have made choice of a fitter perſon for that employment, no man in that age writing or ſpeaking more politely than Wykeham. For this reaſon Edington, biſhop of Wincheſter, lord-high treaſurer of the kingdom, appointed him his ſecretary three years after, and alſo recommended him to King Edward III. who took him into his ſervice. Being ſkilled in geometry and architecture, he was appointed ſurveyor of the royal buildings, and alſo chief juſtice in eyre: he ſuperintended the building of Windſor-caſtle. He was afterward chief ſecretary of ſtate, a keeper of the privy ſeal; and in 1367 ſucceeded Edington in the ſee of Wincheſter. A little after he was appointed lord-high chancellor and preſident of the privy-council. That he might well diſcharge the ſeveral functions of his employments, both eccleſiaſtical and civil, he endeavoured on one hand, to regulate his own life according to the ſtricteſt maxims, and to promote ſuch pariſh-prieſts only as were able to give due inſtructions to their pariſhioners, and at the ſame time led exemplary lives: on the other hand, he did all in his power to cauſe juſtice to be impartially adminiſtered. In 1371 he reſigned his chancellorſhip, and ſome time after the great ſeal. Edward returning to England, after having carried on a very ſucceſsful war in France, found his exchequer in great diſorder. The duke of Lancaſter, one of his ſons, at the head of ſeveral lords, having brought complaints againſt the clergy, who then enjoyed the chief places in the kingdom, the king removed them from their employments. But the laymen, who were raiſed to them, behaved ſo ill, that the king was forced to reſtore the eccleſiaſtics. The duke of Lancaſter ſhowed ſtrong animoſity to the clergy, and ſet every engine at work to ruin Wykeham. He impeached him of extortion, and of diſguiſing things, and obliged him to appear at the King's-bench. He got ſuch judges appointed as condemned him; and not ſatisfied with depriving him of all the temporalities of his biſhopric, he adviſed Edward to baniſh him: but this prince rejected the propoſal, and afterward reſtored to Wykeham all that he had been diveſted of. Richard II. was but eleven years old when Edward died: ſo that the duke of Lancaſter had an eaſy opportunity of reviving the accuſations againſt the biſhop of Wincheſter; nevertheleſs Wykeham cleared himſelf. Then he founded two noble colleges, the one in Oxford, the other in Wincheſter. Whilſt he was exerting his utmoſt endeavours to improve theſe two fine foundations, he was recalled to court, and in a manner forced to accept of the office of lord-high chancellor in 1389.—Having excellently diſcharged the duties of that employment for three years, he obtained leave to reſign it, foreſeeing the diſturbances that were going to break out. Being returned to his church, he finiſhed his college, and built there ſo magnificent a cathedral, that it almoſt equals that of St Paul's in London. He laid out ſeveral ſums in things advantageous to the public and to the poor; notwithſtanding which, in 1397 he was in great danger; for he and ſome others were impeached of high-treaſon in open parliament: however, he was again fully cleared. From that time till his death he kept quiet in his dioceſe, and there employed himſelf in all the duties of a good prelate. He died in 1404, in the 81ſt year of his age.

WILLIAM, the name of ſeveral kings of England. See ENGLAND, N° 87—92, and BRITAIN, N° 302.

William, William's Fort.

Fort-WILLIAM, a fortreſs in the Highlands of Scotland, erected in King William's reign, as was alſo a ſmall town adjoining, called *Maryburgh*, in honour of his queen. It is ſituated in Inverneſs-ſhire, on a narrow arm of the ſea called *Loch Eil*, which by the completion of the Caledonian canal, will be united to the Weſtern ſea. Fort-William is of a triangular form, having two baſtions, and is capable of admitting a garriſon of 800 men; but could not be defended againſt an attack, as it is commanded by ſeveral hills in the neighbourhood.

WILLIAM'S Fort, is a factory of Aſia belonging to the Eaſt-India Company, ſeated on one of the branches of the river Ganges, in the kingdom of Bengal. The fort was firſt built in the ſhape of an irregular tetragon of brick and mortar; and the town has nothing regular in it, becauſe every one built a houſe as he liked beſt, and for his own conveniency. The governor's houſe is within the fort, and is the beſt piece of architecture in theſe parts. Here there are alſo convenient lodgings for the factors and writers, with ſtore-houſes for the company's

William Willis. company's goods, and magazines for ammunition. About 50 yards from the fort is the church, which was originally built by the merchants. The town of *Calcutta* is contiguous, containing 500,000 inhabitants. It is governed by a mayor and aldermen, as moſt of the company's factories in the Eaſt Indies now are. In 1757 it was ſurpriſed by the nabob of Bengal, who took it, and put moſt of thoſe that had made reſiſtance into a place called the *Black-Hole*, where the greater number was ſuffocated. This nabob was afterwards killed, and another ſet up in his room, more friendly to the Engliſh; and the factory was re-eſtabliſhed. E. Long. 86. 0. N. Lat. 22. 27. See CALCUTTA.

Sweet-WILLIAM. See DIANTHUS, BOTANY *Index*.

WILLIAMSBURG, a town of North America, in Virginia, and formerly capital of that ſtate. It is ſituated between two creeks; one falling into James and the other into York River. The diſtance of each landing place is about a mile from the town, which, with the diſadvantage of not being able to bring up large veſſels, and the want of enterpriſe in the inhabitants, has occaſioned its decay. Here is a college, deſigned for the education of the Indians, but which, on account of their averſion to learning, never anſwered the purpoſe. It is 60 miles eaſt of Richmond. W. Long. 76. 30. N. Lat. 37. 10.

WILLIAMSTADT, a ſea-port town of Holland. It is a handſome ſtrong place, and the harbour is well frequented. It was built by William prince of Orange in 1585; and in 1732 belonged to the ſtadtholder of Frieſland. The river near which it is built is called *Butterfliet* or *Holland Diep;* and is one of the bulwarks of the Dutch on the ſide of Brabant, where they always keep a garriſon. This place made a gallant defence in 1793 againſt the French, who were obliged to raiſe the ſiege. It is 15 miles north-eaſt of Bergen-op-Zoom, and 12 ſouth-weſt of Dort. E. Long. 4. 30. N. Lat. 51. 39.

WILLIS, Dr THOMAS, a celebrated Engliſh phyſician, was born at Great Bodwin, in Wiltſhire, in 1621, and ſtudied at Chriſt-church college, Oxford. When that city was garriſoned for the king, he, among other ſcholars, bore arms for his majeſty, and devoted his leiſure hours to the ſtudy of phyſic. The garriſon of Oxford at length ſurrendering to the parliament, he applied himſelf to the practice of his profeſſion; and ſoon rendered himſelf famous by his care and ſkill. He appropriated a room as an oratory for divine ſervice according to the church of England, whither moſt of the loyaliſts in Oxford daily reſorted. In 1660, he became Sedleian profeſſor of natural philoſophy, and the ſame year took the degree of doctor of phyſic. In 1664, he diſcovered the famous medicinal ſpring at Alſtropp, near Brackley. He was one of the firſt members of the Royal Society, and ſoon made his name illuſtrious by his excellent writings. In 1666, after the fire of London, he removed to Weſtminſter; and his practice became greater than that of any of the phyſicians his contemporaries. Soon after his ſettlement in London, his only ſon Thomas falling into a conſumption, he ſent him to Montpelier in France for the recovery of his health; and it proved ſucceſsful. His wife alſo labouring under the ſame diſorder, he offered to leave the town; but ſhe, not ſuffering him to neglect the means of providing for his family, died in 1670. He died at his houſe in St Martin's in 1675, and was buried near her in Weſtminſter-abbey. Dr Willis was extremely modeſt and unambitious, and refuſed the honour of knighthood. He was remarkably pious: As he roſe early in the morning, that he might be preſent at divine ſervice, which he conſtantly frequented before he viſited his patients, he procured prayers to be read beyond the accuſtomed times while he lived; and at his death ſettled a ſtipend of 20l. per annum to continue them. He was a liberal benefactor to the poor whereever he came, having from his early practice allotted part of his profits to charitable uſes. He was exact and regular in all his hours: and though his table was the reſort of moſt of the great men of London, yet he was remarkable for his plainneſs, and his being a man of little diſcourſe, complaiſance, or ſociety; but he was juſtly admired for his deep inſight into natural and experimental philoſophy, anatomy, and chemiſtry; for his ſucceſsful practice; and for the elegance and purity of his Latin ſtyle. He wrote, 1. A treatiſe in Engliſh, intitled *A plain and eaſy Method for preſerving thoſe that are well from the Infection of the Plague, and for curing ſuch as are infected.* 2. Several Latin works, which were collected and printed at Amſterdam, in 1682, in 2 vols 4to.

Willis Wilmot. WILLUGHBY, FRANCIS, a celebrated natural hiſtorian, was the only ſon of Sir Francis Willughby, knight. He was fond of ſtudy from his childhood, and held idleneſs in abhorrence; he being ſo great an economiſt with regard to his time, as not willingly to loſe or miſapply the leaſt part of it, by which means he attained great ſkill in all branches of learning, and particularly in the mathematics. But to the hiſtory of animals, which was in a great meaſure neglected by his countrymen, he particularly applied himſelf; and for this purpoſe carefully read over what had been written on that ſubject by others. He then travelled ſeveral times over his native country; and afterwards into France, Spain, Italy, Germany, and the Low Countries, attended by his ingenious friend Mr John Ray. It is remarkable, that, notwithſtanding the advantages of birth, fortune, and parts, he was as humble as any man of the meaneſt fortune; was ſober, temperate, and chaſte; ſcrupulouſly juſt; ſo true to his word and promiſe, that a man might venture his eſtate and life upon it; ſo faithful and conſtant to his friend, as never to deſert him when fortune frowned upon him; and remarkably pious, patient, and ſubmiſſive to the divine will. This is the character given of him by Mr Ray, whoſe veracity none will doubt. This ingenious and learned gentleman died in 1672, at 37 years of age; having impaired his health by his application. He wrote, 1. *Ornithologiæ libri tres*, folio, which was afterwards tranſlated into Engliſh, with an Appendix, by Mr Ray, in folio. 2. *Hiſtoriæ Piſcium libri quatuor*, folio. 3. Letters of Francis Willughby, Eſq. added to Philoſophical Letters between the learned Mr Ray and ſeveral of his correſpondents, publiſhed, in 8vo, by William Derham. 4. Several ingenious papers in the Philoſophical Tranſactions.

WILMOT, JOHN, earl of Rocheſter, a great wit in the reign of Charles II. the ſon of Henry earl of Rocheſter, was born in 1648. He was taught grammar and claſſical learning at the free-ſchool at Burford;

Wilmot. where he obtained a quick reliſh of the beauties of the Latin tongue, and afterwards became well verſed in the authors of the Auguſtan age. In 1659, he was admitted a nobleman of Wadham college, where he obtained the degree of maſter of arts. He afterwards travelled through France and Italy; and at his return was made one of the gentlemen of the bedchamber to the king, and comptroller of Woodſtock Park. In 1665, he went to ſea, and was in the Revenge, commanded by Sir Thomas Tiddiman, when an attack was made on the port of Bergen in Norway: during the whole action he ſhowed the greateſt reſolution, and gained a high reputation for courage; which he ſupported in a ſecond expedition, but afterwards loſt it in a private adventure with Lord Mulgrave.

Before the earl of Rocheſter travelled, he had indulged in the moſt diſorderly and intemperate way of living; at his return, however, he ſeemed to have got the better of it entirely. But falling into the company of the courtiers, who continually practiſed theſe exceſſes, he became ſo ſunk in debauchery, that he was for five years together ſo given up to drinking, that during all that time he was never cool enough to be maſter of himſelf. His violent love of pleaſure, and his diſpoſition to extravagant mirth, carried him to great exceſſes. The firſt involved him in ſenſuality, and the other led him into many adventures and ridiculous frolics. Once diſguiſing himſelf ſo that he could not be known by his neareſt friends, he ſet up in Tower-ſtreet for an Italian mountebank, and there diſperſed his noſtrums for ſome weeks. He often diſguiſed himſelf as a porter, or as a beggar, ſometimes to follow a mean amour; at other times, he would go about merely for diverſion, in odd ſhapes; and acted his part ſo naturally, that he could not be known even by his friends. In ſhort, by his conſtant indulgence in wine, women, and irregular frolics, he entirely wore out an excellent conſtitution before he was 30 years of age. In October 1679, when recovering from a violent diſeaſe, which ended in a conſumption, he was viſited by Dr Burnet, upon an intimation that ſuch a viſit would be agreeable to him. Dr Burnet publiſhed an account of his conferences with Lord Rocheſter; in which it appears, that though he had lived the life of a libertine and atheiſt, yet he died the death of a penitent Chriſtian. His death happened in 1680; ſince which time his poems have been various times printed, both ſeparately and together: but when once he obtained the character of a lewd and obſcene writer, every thing in that ſtrain was aſcribed to him; and thus many pieces not of his writing have crept into the later editions of his works. The author of the Catalogue of Royal and Noble Authors ſays, he was "a man whom the Muſes were fond to inſpire, and aſhamed to avow, and who practiſed without the leaſt reſerve that ſecret which can make verſes more read for their defects than their merits. Lord Rocheſter's Poems have much more obſcenity than wit, more wit than poetry, and more poetry than politeneſs." His writings, beſides thoſe already mentioned, are, A Satire againſt Mankind; Nothing, a poem; Valentinian, a tragedy; Fifty-four Letters to Henry Saville, and others; Seven more to his wife and Son: a Letter on his deathbed to Dr Burnet. He alſo left behind him ſeveral other papers, and a Hiſtory of the Intrigues of the Court of Charles II.; but his mother, a very devout lady, ordered all his papers to be burned. Wilmot, Wilſon.

WILSON, Florence, known in the republic of letters by the name of *Florentius Voluſinus*, was born at Elgin in the ſhire of Murray in Scotland, and educated in the univerſity of Aberdeen. Travelling to England with an intention to improve his fortune, he had the felicity to be introduced to Cardinal Wolſey, who appointed him tutor to one of his nephews. In that capacity he went to Paris, and continued there till the Cardinal's death. During his reſidence in that city he became acquainted with the learned Cardinal Bellai, archbiſhop of Paris, who allowed him a penſion, and meant to have appointed him royal profeſſor of the Greek and Latin languages in the univerſity of Paris: but Bellai being diſgraced, Wilſon's proſpects faded with the fortunes of his patron, whom nevertheleſs he attended on his journey to Rome. Wilſon was taken ill at Avignon, and the cardinal proceeded without him. After his recovery, he paid a viſit to the celebrated Cardinal Sabolet, the Mecænas of his time, who was alſo biſhop of Carpentras, where he then reſided. The cardinal was ſo charmed with his erudition, that he appointed him profeſſor of the learned languages, with a ſtipend of 100 piſtoles per annum.

During his reſidence at Carpentras, he wrote his celebrated treatiſe *De Animi Tranquillitate*. Mackenzie ſays that he afterwards taught philoſophy in Italy; and that, being at length deſirous of returning to Scotland, he began his journey homeward, was taken ill at Vienne in Dauphiny, and died there in the year 1547. He was generally eſteemed an accompliſhed linguiſt, an admirable philoſopher, and an excellent Latin poet. He wrote, beſide the above treatiſe, 1. *Poemata*, London 1619, 4to. 2. *Commentatio quædam theologica in aphoriſmos diſſecta, per Sebaſt. Gryph.* 3. *Philoſophiæ Ariſtot. Synopſis*, lib. iv.

Wilson, *Thomas*, lord biſhop of Sodor and Man, was born in 1663, at Burton, in the county of Cheſter. He received the rudiments of his education at the county town, and from thence was removed to the univerſity of Dublin. His allowance at the univerſity was 20l. a-year; a ſum, ſmall as it may now appear, which was in thoſe days ſufficient for a ſober youth in ſo cheap a country as Ireland.

His firſt intention was to have applied to the ſtudy of phyſic; but from this he was diverted by Archdeacon Hewetſon, by whoſe advice he dedicated himſelf to the church. He continued at college till the year 1686, when, on the 29th of June, he was ordained deacon.

The exact time of Mr Wilſon's leaving Dublin is not known: but on account of the political and religious diſputes of thoſe days, it was ſooner than he intended. On the 10th of December, in the ſame year, he was licenſed to the curacy of New Church in Winwick, of which Dr Sherlock, his maternal uncle, was rector. His ſtipend was no more than 30l. a-year; but being an excellent economiſt, and having the advantage of living with his uncle, this ſmall income was not only ſufficient to ſupply his own wants, but it enabled him to ſupply the wants of others; and for this purpoſe he ſet apart one-tenth of his income. In 1692 he was appointed domeſtic chaplain to William earl of Derby, and tutor to his ſon James Lord Strange, with a ſalary of

Wilſon. of 30l. a-year. He was ſoon after elected maſter of the alms-houſe at Latham, which brought him in 20l. a-year more. Having now an income far beyond his expectations, or his wiſhes, except as it increaſed his ability to do good, he ſet apart one-fifth of his income for pious uſes, and particularly for the poor. In ſhort, as his income increaſed, he increaſed the portion of it which was allotted to the purpoſes of charity. At firſt he ſet apart a tenth, then a fifth, afterwards a third, and laſtly, when he became a biſhop, he dedicated the full half of his revenues to pious and charitable uſes.

He had not been long in the ſervice of Lord Derby, before he was offered the valuable living of Buddeſworth in Yorkſhire; which he refuſed to accept, as being inconſiſtent with the reſolves of his conſcience againſt non-reſidence, Lord Derby chooſing ſtill to retain him as chaplain and tutor to his ſon. In 1697 he was promoted, not without ſome degree of compulſion on the part of his patron, to the biſhopric of the Iſle of Man; a preferment which he held 58 years. In 1698 he married Mary, daughter of Thomas Patten, Eſq. of Warrington. By this lady, who ſurvived her marriage above ſix years, he had four children; none of whom ſurvived him, except the late Dr Wilſon, prebendary of Weſtminſter.

"The annual receipts of the biſhopric (ſays the author of his memoirs) did not exceed 300l. in money. Some neceſſaries in his houſe, as ſpices, ſugar, wine, books, &c. muſt be paid for with money; diſtreſſed or ſhipwrecked mariners, and ſome other poor objects, required to be relieved with money; but the poor of the iſland were fed and clothed, and the houſe in general ſupplied from his demeſnes, by exchange, without money. The poor, who could weave or ſpin, found the beſt market at Biſhop's-court, where they bartered the produce of their labour for corn. Taylors and ſhoemakers were kept in the houſe conſtantly employed, to make into garments or ſhoes that cloth or leather which his corn had purchaſed; and the aged and infirm were ſupplied according to their ſeveral wants. Mr Moore of Douglas informed the editor, that he was once witneſs to a pleaſing and ſingular inſtance of the Biſhop's attention to ſome aged poor of the iſland. As he was diſtributing ſpectacles to ſome whoſe eyeſight failed them, Mr Moore expreſſed his ſurpriſe, as he well knew not one of them could read a letter. 'No matter (ſaid the Biſhop with a ſmile), they will find uſe enough for them; theſe ſpectacles will help them to thread a needle, to mend their clothes, or, if need be, to keep themſelves free from vermin.'

So great was the biſhop's attachment to his flock, that no temptation could ſeduce him from their ſervice. He more than once refuſed the offer of an Engliſh biſhopric. There is an anecdote of his lordſhip and Cardinal Fleury, which does great credit to them both. The cardinal wanted much to ſee him, and ſent over on purpoſe to inquire after his health, his age, and the date of his conſecration, as they were the two oldeſt biſhops, and he believed the pooreſt, in Europe; at the ſame time inviting him to France. The biſhop ſent the cardinal an anſwer, which gave him ſo high an opinion of him, that the cardinal obtained an order that no French privateer ſhould ravage the iſle of Man.

This good prelate lived till the year 1755, dying at the advanced age of 93. His works have lately been publiſhed in 2 vols 4to.

Wilſon || Win helſea.

WILTON, a market town in Wiltſhire, three miles weſt of Saliſbury. It was once ſo conſiderable as to give title to the county. It had formerly 12 churches; and Odo, brother-in-law to William I. was biſhop of Wilton. Only one now remains. It ſends members to parliament, and is the place where the knights of the ſhire are choſen. It has a great manufactory of carpets, which are brought to high perfection. Wilton is famous for Lord Pembroke's ſeat, ſo well known through Europe for its containing a grand aſſemblage of the productions of the greateſt and moſt ancient maſters in painting and ſculpture.—Two fairs are held here annually.

WILTSHIRE, a county of England, bounded on the weſt by Somerſetſhire, on the eaſt by Berkſhire and Hampſhire, on the north by Glouceſterſhire, and on the ſouth by Dorſetſhire and part of Hampſhire. The length amounts to 39 miles; its breadth to 30; and its circumference to 140. It contains 29 hundreds, 23 market-towns, 304 pariſhes, and about 185,107 ſouls. Beſides two members for the ſhire, and two for the city of Saliſbury, each of the following towns ſends two members to parliament, viz. Wilton, Downton, Hindon, Heyteſbury, Weſtbury, Calne, Devizes, Chippenham, Malmſbury, Cricklade, Great Bedwin, Ludgerſhall, Old Sarum, Wooton-Baſſet, Marlborough.

The air of this county is very healthy, not only in the more low and level parts, but alſo on the hills. The ſoil of the vales is very rich, and produces corn and graſs in great plenty. The beautiful downs in the ſouth yield the fineſt paſture for ſheep, with which they are overſpread. The greateſt diſadvantage the county labours under is want of fuel, as there are no coal-pits, and but little wood. This county is noted for great quantities of very fine cheeſe, and for its manufacture of broad cloth, to which it was invited by the great plenty and fineneſs of its wool. Beſides a number of leſſer ſtreams, it is watered by the rivers Iſis, Kennet, Upper and Lower Avon, Willy, Burne, and Nadder, which are well ſtored with fiſh.

WINCHELSEA, a town in Suſſex, which has no market, but has one fair on May 14th for cattle and pedlars ware. It was an ancient place, at leaſt the old town, which was ſwallowed up by the ocean in 1250. It is now dwindled to a mean place, though it retains its privileges, and ſends two members to parliament. It is ſeated on a rocky cliff, on an inlet of the ſea; and had a haven, now choked up. It had 18 pariſh-churches, now reduced to one. The market-houſe is in the midſt of the town, from whence run four paved ſtreets, at the end of which are four ways, which had formerly buildings on each ſide for a conſiderable diſtance. It is two miles ſouth-weſt of Rye, and 71 ſouth-eaſt of London. It is governed by a mayor and jurats, though it has but about 70 houſes. Three of the gates are ſtill ſtanding, but much decayed. E. Long. 0. 44. N. Lat. 50. 58.

WINCHELSEA, *Anne Counteſs of*, a lady of excellent genius, eſpecially in poetry, was maid of honour to the ducheſs of York, ſecond wife to King James II. and was afterwards married to Heneage, ſecond ſon of the earl of Winchelſea. One of the moſt conſiderable of the counteſs of Winchelſea's poems was that on the

Winchelſea || Winckleman.

Spleen. A collection of her poems was printed at London in 1713, containing a tragedy never acted, intitled *Ariſtomenes*. The counteſs died in 1720 without iſſue, as her huſband did in 1726.

WINCHESTER, the capital of the county of Hampſhire in England. It is a very ancient city, ſuppoſed to have been built ſeveral centuries before Chriſt. The Romans called it *Venta Belgarum*, the Britons *Caer Givent*, and the Saxons *Wittanceaſter;* whence came the preſent name. It ſtands upon the river Itchin, in a bottom ſurrounded with chalky hills; and is generally allowed to have been a conſiderable place in the time of the Romans. Some of the firſt converts to Chriſtianity are ſuppoſed to have lived here. In the caſtle, near the weſt gate, many of the Saxon kings anciently kept their court. The cathedral was founded by Kenegulfe, a king of the Mercians; but there were many Chriſtians, and places for their worſhip here, long before that period. It is a large pile, and has a venerable look, but is not very elegant. Beſides the tombs, there are many curious pieces of workmanſhip in it; the chief of which are, 1. The font, erected in the time of the Saxons. 2. Copper ſtatues of James I. and Charles I. 3. The biſhop's throne. 4. The ſtalls of the dean and prebendaries. 5. The aſcent to the choir and altar. 6. The pavement inlaid with marble of diverſe colours, in various figures. 7. The altar-piece, reckoned the nobleſt in England. 8. The paintings in the windows, eſpecially the great eaſt window. At the hoſpital of the Holy Croſs, every traveller that knocks at the door may claim a manchet of white bread and a cup of beer; of which a great quantity is provided every day for that purpoſe. This hoſpital was intended for the maintenance of a maſter and 30 penſioners, but only 14 are now maintained in it; and the maſter enjoys a revenue of 800l. a-year. This city is about a mile and a half in compaſs, and almoſt ſurrounded with a wall of flint; has ſix gates, large ſuburbs, broad clean ſtreets; but the private houſes are in general but ordinary, many of them being very old. The city is interſperſed with a great many gardens, which contribute to its beauty and healthineſs. The corporation conſiſts of a mayor, high-ſteward, recorder, aldermen, two coroners, two bailiffs, 24 common-council men, a town-clerk, four conſtables, and four ſerjeants at mace; and the city gives title of *marquis* to the duke of Bolton. A Roman highway leads from hence to Alton; and went formerly, as it is thought, from thence to London. The charming downs in the neighbourhood contribute greatly to the health and pleaſure of the inhabitants. The river Itchin is navigable for barges from hence to Southampton. The population in 1801 amounted to 6000 perſons nearly. W. Long. 1. 16. N. Lat. 51. 4.

WINCKLEMAN, Abbe John, was born at Stendall, in the old Marche of Brandenburg, in 1718. His father was a ſhoemaker. This wonderful man, to all appearance deſtined by his birth to ſuperintend a little ſchool in an obſcure town of Germany, raiſed himſelf to the office of preſident of antiquities in the Vatican. After having been ſeven years profeſſor in the college of Seehauſen near Salſwedel, he went into Saxony, where he reſided ſeven years more, and was librarian to Count Bunau at Nothenitz. When he left this place, 1754, he went to Dreſden, where he formed an acquaintance with the ableſt artiſts, and particularly with M. Oeſer, an excellent painter, and one of the beſt draughtſmen of the age. In that year he abjured Lutheraniſm, and embraced the Roman Catholic religion. In September 1755, he ſet out for Italy, and arrived at Rome in December following. His principal object was to ſee the Vatican library, and to examine the ruins of Herculaneum. Winckleman.

Mr Winckleman carried with him into Italy a ſenſe of beauty and art, which led him inſtantly to admire the maſterpieces of the Vatican, and with which he began to ſtudy them. He ſoon increaſed his knowledge; and it was not till after he had thus purified his taſte and conceived an idea of ideal beauty, which led him into the greateſt ſecrets of art, that he began to think of the explanation of other monuments, in which his great learning could not fail to diſtinguiſh him. His erudition enabled him to fill up his principal plan of writing the "Hiſtory of Art." In 1756, he planned his "Reſtoration of Ancient Statues," and a larger work on the Taſte of the Greek Artiſts; and deſigned an account of the galleries of Rome and Italy, beginning with a volume on the Belvidere ſtatues, in the manner of Richardſon, who, he ſays, only ran over Rome. He alſo intended a hiſtory of the corruption of taſte in art, the reſtoration of ſtatues, and an illuſtration of the obſcure points of mythology. All theſe different eſſays led him to his "Hiſtory of Art," and his "Monumenti Inediti." It muſt, however, be confeſſed, that the firſt of theſe works has not all the clearneſs and preciſion that might be expected in its general plan and diviſion of its parts and objects; but it has enlarged and extended the ideas both of antiquaries and collectors. The deſcription of the gems and ſulphurs of the Stoſch cabinet contributed not a little to extend Mr Winckleman's knowledge. Few perſons have opportunities of contemplating ſuch vaſt collections. The engravings of Lippet and Count Caylus are all that many can arrive at. Mr Winckleman's Monumenti Inediti, of which he had begun the third volume 1767, ſeem to have ſecured him the eſteem of antiquaries. Had he lived, we ſhould have had a work long wiſhed for; a complete collection of the basreliefs diſcovered from the time of Bartoli to the preſent, the greater part of which are in the poſſeſſion of Cardinal Albani.

When Cardinal Albani ſucceeded to the place of librarian of the Vatican, he endeavoured to get a place for the Hebrew language for Winckleman, who refuſed a canonry, becauſe he would not take the tonſure. The elector of Saxony gave him, 1761, unſolicited, the place of Counſellor Richter, the direction of the royal cabinet of medals and antiquities at Dreſden. Upon the death of the abbé Venuti, 1762, he was appointed preſident of the antiquities of the apoſtolic-chamber, with power over all diſcoveries and exportations of antiquities and pictures. This is a poſt of honour, with an income of 160 ſcudi per annum. He had a proſpect of the place of preſident of antiquities in the Vatican, going to be created at 16 ſcudi per month, and was named correſponding member of the Academy of Inſcriptions. The king of Pruſſia offered him, by Col. Quintus Icilius, the place of librarian and director of his cabinet of medals and antiquities, void by the death of M. Gautier de la Croze, with a handſome appointment. He made no ſcruple of accepting the offer; but when it came to the pope's ears, he added an appointment out of his own purſe, and kept him at Rome.

Winckleman, Wind.

In April 1768, he left Rome to go with M. Cavaceppi over Germany and Switzerland. When he came to Vienna, he was ſo pleaſed with the reception he met with, that he made a longer ſtay there than he had intended. But, being ſuddenly ſeized with a ſecret uneaſineſs and extraordinary deſire to return to Rome, he ſet out for Italy, putting off his viſits to his friends in Germany to a future opportunity. As he paſſed through Trieſte, he was aſſaſſinated, June 8. 1768, by a wretch named Arcangeli, a native of Campiglio, a town in the territory of Piſtoia, with whom he had made an acquaintance on the road. This miſcreant had been condemned for a robbery to work in fetters four years, and then to be baniſhed the Auſtrian territories, on an oath never to return. He had obtained a mitigation of one of his ſentences, and retired to Venice; but, changing his quarters backwards and forwards, he was ſo reduced in circumſtances that he at length took up his lodgings at the inn to which the Abbé happened to come. Arcangeli paid ſuch aſſiduous court to him, that he entirely gained his confidence; and having been favoured with a ſight of the valuable preſents which he had received at Vienna, formed a deſign to murder and rob him. He bought a new ſharp knife on purpoſe; and as the Abbé (who had in the moſt friendly manner invited him to Rome) was ſitting down in his chair, early in the morning, he threw a rope over his head, and before he could diſengage himſelf, ſtabbed him in five different places. The Abbé had ſtill ſtrength to get down to the ground floor, and call for help; and being laid on a bed in the midſt of the moſt violent pain, he had compoſure ſufficient to receive the laſt ſacraments, and to make his will, in which he appointed Cardinal Alexander Albani his reſiduary legatee, and expired in the afternoon. The murderer was ſoon after apprehended; and executed on the wheel oppoſite the inn, June 26.

Abbé Winckleman was a middle-ſized man; he had a very low forehead, ſharp noſe, and little black hollow eyes, which gave him an aſpect rather gloomy than otherwiſe. If he had any thing graceful in his phyſiognomy, it was his mouth. A fiery and impetuous diſpoſition often threw him into extremes. Naturally enthuſiaſtic, he often indulged an extravagant imagination; but as he poſſeſſed a ſtrong and ſolid judgment, he knew how to give things a juſt and intrinſic value. In conſequence of this turn of mind, as well as a neglected education, a cautious reſerve was a quality he little knew. If he was bold in his deciſions as an author, he was ſtill more ſo in his converſation, and has often made his friends tremble for his temerity. If ever man knew what friendſhip was, that man was Mr Winckleman, who regularly practiſed all his duties; and for this reaſon he could boaſt of having friends among perſons of every rank and condition.

WIND is a ſenſible agitation of the atmoſphere, occaſioned by a quantity of air flowing from one place to another. See METEOROLOGY.

Hot WINDS. See SAMIEL.

Wind-Flower. See ANEMONY, BOTANY *Index*.

Wind-Mill, a kind of mill, the internal parts of which are much the ſame with thoſe of a water mill: from which, however, it differs, in being moved by the impulſe of the wind upon its ſails or vanes, which are to be conſidered as a wheel in axis. See MECHANICS *Index*.

Wind ‖ Windlaſs.

Wind-Gage. See *Wind-GAGE*.

Wind-Galls. See FARRIERY *Index*.

Wind-Gun. See *AIR-GUN*, under *SCIENCE*, *Amuſements of*.

Inſtruments for meaſuring the ſtrength, velocity, &c. *of the* WIND. See *Wind-GAGE*, ANEMOMETER and ANEMOSCOPE.

Wind-Hatch, in mining, a term uſed to expreſs the place at which the ore is taken out of the mines.

Wind-Shock, a name given by our farmers to a diſtemper to which fruit trees, and ſometimes timber trees, are ſubject. It is a ſort of bruiſe and ſhiver throughout the whole ſubſtance of the tree; but the bark being often not affected by it, it is not ſeen on the outſide, while the inſide is twiſted round, and greatly injured. It is by ſome ſuppoſed to be occaſioned by high winds; but others attribute it to lightning. Thoſe trees are moſt uſually affected by it whoſe boughs grow more out on one ſide than on the other. The beſt way of preventing this in valuable trees, is to take care in the plantation that they are ſheltered well, and to cut them frequently in a regular manner while young.

Wind-Taught, in ſea language, denotes the ſame as ſtiff in the wind. Too much rigging, high maſts, or any thing catching or holding wind aloft, is ſaid to hold a ſhip wind-taught; by which they mean, that ſhe ſtoops too much in her ſailing in a ſtiff gale of wind. Again, when a ſhip rides in a main ſtreſs of wind and weather, they ſtrike down her top-maſts, and bring her yards down, which elſe would hold too much wind, or be too much diſtended and wind-taught.

Wind-Sails, a ſort of wide tube or funnel of canvas, employed to convey a ſtream of freſh air downward into the lower apartments of a ſhip.

This machine is uſually extended by large hoops ſituated in different parts of its height. It is let down perpendicularly through the hatches, being expanded at the lower end like the baſe of a cone; and having its upper ſide open on the ſide which is placed to windward, ſo as to receive the full current of wind; which entering the cavity, fills the tube, and ruſhes downwards into the lower regions of the ſhip. There are generally three or four of theſe in our capital ſhips of war, which, together with the ventilators, contribute greatly to preſerve the health of the crew.

WINDAGE *of a Gun*, is the difference between the diameter of the bore and the diameter of the ball.

WINDLASS, a machine uſed for raiſing huge weights, as guns, ſtones, anchors, &c.

It is very ſimple, conſiſting only of an axis or roller, ſupported horizontally at the two ends by two pieces of wood and a pulley; the two pieces of wood meet at top, being placed diagonally ſo as to prop each other; the axis or roller goes through the two pieces, and turns in them. The pulley is faſtened at top where the pieces join. Laſtly, there are two ſtaves or handſpikes which go through the roller, whereby it is turned, and the rope which comes over the pulley is wound off and on the ſame.

WINDLASS, in a ſhip, is an inſtrument in ſmall ſhips, placed upon the deck, juſt abaft the fore-maſt. It is made of a piece of timber ſix or eight feet ſquare, in form

Windlaſs || Wine.

form of an axletree, whoſe length is placed horizontally upon two pieces of wood at the ends thereof, and upon which it is turned about by the help of handſpikes put into holes made for that purpoſe. This inſtrument ſerves for weighing anchors, or hoiſting of any weight in or out of the ſhip, and will purchaſe much more than any capſtan, and that without any danger to thoſe that heave; for if in heaving the windlaſs about, any of the handſpikes ſhould happen to break, the windlaſs would pall of itſelf.

WINDOW, an aperture or open place in the wall of a houſe to let in the light. See ARCHITECTURE, N° 78.

The word is Welch, *wynt dor*, ſignifying the paſſage for the wind. Window is yet provincially denominated *windor* in Lancaſhire; i. e. *wind-door*, or the paſſage for air, as that for people was peculiarly called the *door*.

Before the uſe of glaſs became general, which was not till towards the end of the 12th century, the windows in Britain ſeem generally to have been compoſed of paper. Properly prepared with oil, this forms no contemptible defence againſt the intruſions of the weather, and makes no incompetent opening for the admiſſion of the light. It is ſtill uſed by our architects for the temporary windows of unfiniſhed houſes, and not unfrequently for the regular ones of our work ſhops. But ſome of the principal buildings we may reaſonably ſuppoſe to have been windowed in a ſuperior manner. They could, however, be furniſhed merely with lattices of wood or ſheets of linen, as theſe two remained the only furniture of our cathedrals nearly to the eighth century; and the lattices continued in ſome of the meaner towns of Lancaſhire to the 18th; and in many diſtricts of Wales, and many of the adjoining parts of England, are in uſe even to the preſent moment. Theſe ſeem all to have been fixed in frames that were called *capſumenta*, and now therefore *caſements* in Wales and Lancaſhire.

WINDSOR, a borough town of Berkſhire, 22 miles weſt of London, moſt remarkable for the magnificent roval palace or caſtle ſituated there on an eminence, which commands the adjacent country for many miles, the river Thames running at the foot of the hill. The knights of the Garter are inſtalled in the royal chapel here. It ſends two members to parliament. The number of inhabitants in 1801 was 3361. W. Long. 0. 36. N. Lat. 51. 30.

WINDWARD, in the ſea language, denotes any thing towards that point from whence the wind blows, in reſpect of a ſhip: thus windward-tide, is the tide which runs againſt the wind.

WINE, an agreeable ſpirituous liquor, produced by fermentation from thoſe vegetable ſubſtances that contain ſaccharine matter. A very great number of vegetable ſubſtances may be made to afford wine, as grapes, currants, mulberries, elders, cherries, apples, pulſe, beans, peas, turnips, radiſhes, and even graſs itſelf. Hence, under the claſs of wines or vinous liquors, come not only wines, abſolutely ſo called, but alſo ale, cyder, &c.

Chaptal's Chemiſtry, part iv. ſect. v. chap. 6.

1 Method of making wine.

Wine, however, is in a more particular manner appropriated to the liquor drawn from the fruit of the vine. The proceſs of making wine is as follows: When the grapes are ripe, and the ſaccharine principle is developed, they are then preſſed, and the juice which flows out is received in veſſels of a proper capacity, in which the fermentation appears, and proceeds in the following manner: At the end of ſeveral days, and frequently after a few hours, according to the heat of the atmoſphere, the nature of the grapes, the quantity of the liquid, and temperature of the place in which the operation is performed, a movement is produced in the liquor, which continually increaſes; the volume of the fluid increaſes; it becomes turbid and oily; carbonic acid is diſengaged, which fills all the unoccupied part of the veſſel, and the temperature riſes to the 72.5th degree. At the end of ſeveral days theſe tumultuous motions ſubſide, the maſs falls, the liquid becomes clearer, and is found to be leſs ſaccharine, more odorant, and of a red colour, from the reaction of the ardent ſpirit upon the colouring matter of the pellicle of the grape. Wine.

The wine is uſually taken out of the fermenting veſſels at the period when all the phenomena of fermentation have ſubſided. When the maſs is ſettled, the colour of the liquor is well developed, when it has become clear, and its heat has diſappeared; it is put into caſks, where, by a ſecond inſenſible fermentation, the wine is clarified, its principles combine more perfectly together, and its taſte and ſmell become more and more developed. If this fermentation be ſtopped or ſuffocated, the gaſeous principles are retained, and the wine is briſker, and more of the nature of muſt.

It appears, from the intereſting experiments of the Marquis de Bullion, that the vinous fermentation does not take place unleſs tartar be preſent.

2 Cauſes of imperfect fermentation.

The cauſes of an imperfect fermentation are the following: 1. If the heat be too little, the fermentation languiſhes, the ſaccharine and oily matters are not ſufficiently elaborated, and the wine is unctuous and ſweet. 2. If the ſaccharine body be not ſufficiently abundant, as happens in rainy ſeaſons, the wine is weak, and the mucilage, which predominates, cauſes it to become ſour by its decompoſition. 3. If the juice be too watery, concentrated and boiling muſt is added. 4. If the ſaccharine principle be not ſufficiently abundant, the defect may be remedied by the addition of ſugar. Macquer has proved that excellent wine may be made of verjuice and ſugar; and M. de Bullion has made wine at Bellejames, with the verjuice of his vine rows and moiſt ſugar.

There have been many diſputes to determine whether grapes ſhould be preſſed with the ſtalks or without. This depends on the nature of the fruit. When they are highly charged with ſaccharine and mucilaginous matter, the ſtalk corrects the inſipidity of the wine by its bitter principle: but when, on the contrary, the juice is not too ſweet, the ſtalk renders it drier, and very rough.

3 Colouring matter of wine.

The colouring principle of wine is of a reſinous nature, and is contained in the pellicle of the grape; and the fluid is not coloured until the wine is formed; for until then there is nothing which can diſſolve it: and hence it is that white wine may be made of red grapes, when the juice of the grape is expreſſed, and the huſk thrown away. If wine be evaporated, the colouring principle remains in the reſidue, and may be extracted by ſpirit of wine. Old wines loſe their colour; a pellicle being precipitated, which is either depoſited on the ſides of the bottles, or falls to the bottom. If wine be expoſed to the heat of the ſun during the ſummer, the colouring matter is detached in a pellicle, which falls to the bottom: when the veſſel is opened, the diſcolouring

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Wine. is more ſpeedy, and it is effected in two or three days during the ſummer. The wine thus deprived of its colour is not perceptibly weakened.

4 Vinous fermentation explained.

The vinous fermentation has been examined with great accuracy by M. Lavoiſier. According to him, the vegetable juice of which wine is to be made conſiſts of oxygen, hydrogen, and carbone, combined with one another in different proportions, ſo as to form chiefly water and ſugar. The fermentation produces a ſeparation of the elements, and a new combination of them; a quantity of the oxygen and carbone combine and fly off in the ſtate of carbonic acid; part of the carbone, oxygen, and hydrogen, combine firſt with each other, and then all together, to form alcohol; another part forms acetous acid; the water ſtill remains, and a reſiduum falls to the bottom compoſed of the three elements combined in other proportions.

5 Ingredients of different wines.

The different kinds of wines produced in Europe and other parts of the world are many; the principal of them and their qualities are well known: a catalogue of them would ſerve no purpoſe here. We ſhall, however, ſubjoin a table of the quantities of the ingredients of the principal kinds from Neumann's Chemiſtry.

A quart of	Highly rectified Spirit.	Thick, oily, unctuous, reſinous matter.	Gummy and tartarous matter.	Water.
	oz. dr. gr.	oz. dr. gr.	oz. dr. gr.	lb. oz. dr. gr
Aland	1 6 00	3 2 00	1 5 00	2 5 3 00
Alicant	3 6 00	6 0 20	0 1 40	2 2 6 00
Burgundy	2 2 00	0 4 00	0 1 40	2 9 0 20
Carcaſſone	2 6 00	0 4 10	0 1 20	2 8 4 30
Champagne	2 5 30	0 6 40	0 1 00	2 8 3 00
French	3 0 00	0 6 40	0 1 00	2 8 0 20
Frontignac	3 0 00	3 4 00	0 5 20	2 4 6 30
Vin Grave	2 0 00	0 6 00	0 2 00	2 9 0 00
Hermitage	2 7 00	1 2 00	0 1 40	2 7 5 20
Madeira	2 3 00	3 2 00	2 0 00	2 4 3 00
Malmſey	4 0 00	4 3 00	2 3 00	2 1 2 00
Vino de Monte Pulciano	2 6 00	0 3 00	0 2 40	2 8 0 20
Moſelle	2 2 00	0 4 20	0 1 30	2 9 0 10
Muſcadine	3 0 00	2 4 00	1 0 00	2 5 4 00
Neufſchatel	3 2 00	4 0 00	1 7 00	2 2 7 00
Palm Sec	2 3 00	2 4 00	4 4 00	2 2 5 00
Pontac	2 0 00	0 5 20	0 2 00	2 9 0 40
Old Rheniſh	2 0 00	1 0 00	0 2 20	2 8 5 40
Rheniſh	2 2 00	0 3 20	0 1 34	2 9 1 06
Salamanca	3 0 00	3 4 00	2 0 00	2 3 4 00
Sherry	3 0 00	6 0 00	2 2 00	2 0 6 00
Spaniſh	1 2 00	2 4 00	9 4 00	1 10 6 00
Vino Tinto	3 0 00	6 4 00	1 6 00	2 0 6 00
Tokay	2 2 00	4 3 00	5 0 00	2 0 3 00
Tyrol red wine	1 4 00	1 2 00	0 4 00	2 8 6 00
Red wine	1 6 00	0 4 40	0 2 00	2 9 3 20
White	2 0 00	0 7 00	0 3 00	2 7 0 00

The colour of wine is frequently artificial; a deep red is almoſt always the effect of artificial additions, as of the red woods, elder berries, bilberries, &c. In France no ſecret is made of theſe practices, the colouring matters being publicly thrown out after they have been uſed. Wine.

6 Adulteration of wine.

It is well known to be a common practice among wine-coopers, innkeepers, and other dealers in wines, to adulterate bad wine in order to conceal its defects: if, for inſtance, the wine be ſour, they throw into it a quantity of ſugar of lead, which entirely takes away the ſour taſte. For ſimilar purpoſes alum is often mixed with wine. Such ſubſtances, however, are well known to be extremely pernicious to the human conſtitution; it becomes of importance therefore to be able to detect them whenever they happen to be contained in wine. Several chemiſts who have turned their attention to this ſubject, have furniſhed us with teſts for this purpoſe.

7 To detect lead in wine.

To diſcover lead diſſolved in wine, boil together in a pint of water an ounce of quicklime and half an ounce of flour of brimſtone; and when the liquor, which will be of a yellow colour, is cold, pour it into a bottle, and cork it up for uſe. A few drops of this liquor being dropt into a glaſs of wine or cyder containing *lead*, will change the whole into a colour more or leſs *brown*, according to the quantity of lead which it contains. If the wine be wholly free from lead, it will be rendered turbid by the liquor, but the colour will be rather a dirty white than a black brown. *Watſon's Chemical Eſſays*, vol. iii. p. 371.

By this teſt, however, iron is alſo precipitated when diſſolved in wine, and is apt to be taken for lead; a miſtake which has ruined ſeveral honeſt merchants. The following teſt is therefore preferable, as not liable to the ſame inconvenience.

8 Another method.

Take equal parts of calcined oyſter-ſhells and crude ſulphur in fine powder, and put them in a crucible, which put into a fire, and raiſe the heat ſuddenly till it has been expoſed to a white heat for 15 minutes. Then take it out, let it cool, beat the ingredients to powder, and put them into a well corked bottle. To prepare the teſt liquor, put 20 grains of this powder together with 120 grains of cream of tartar, and put them into a ſtrong bottle, fill it up with water, boil it for an hour, and let it cool. Cork the bottle immediately, and ſhake it from time to time. After ſome hours repoſe, decant off the clear liquor into an ounce vial, having firſt put 22 drops of muriatic acid into each vial. Cork theſe vials accurately with a little wax mixed up with a little turpentine. One part of this liquor, mixed with three parts of ſuſpected wine, will diſcover the preſence of the ſmalleſt quantity of lead or copper, by a very ſenſible black precipitate, and of arſenic by an orange precipitate: but will have no effect on iron, if there be any; the preſence of which, however, may be aſcertained by adding a little potaſh, which will turn the liquor black if there be any iron. Pure wine remains limpid after the addition of this liquor *. * *Journal de Phyſique*, October 1791.

9 State of lead in wine.

As this ſubject is of importance, we ſhall add M. Fourcroy's obſervations on the ſtate in which lead exiſts in wine, and on the methods of diſcovering its preſence: "Of the different principles which compoſe wine, there was no doubt (ſays he) but that acids were the only ones which were capable of diſſolving oxide (*calx*) of lead. But was it the tartareous acid always contained in larger or ſmaller quantity in wine, or the acetous acid developed in thoſe which have become ſharp, and which there is a greater temptation to ſweeten? Experience

Wine.

rience had proved to me that the acidulous tartrate of potaſh, or the cream of tartar, takes oxide of lead from the acetous acid, and a precipitate of tartrate of lead is formed; the pure tartareous acid prepared in Scheele's method produces the ſame effect. In order to underſtand how the ſharp wine which contains theſe two acids can hold the oxide of lead in ſolution, I made the experiments which gave me the following reſults: 1. The acidulous tartrite (*crem. tart.*) has no ſenſible action upon the oxides of lead. 2. The pure tartareous acid has a ſlight action upon the oxides, and forms on their ſurface a little tartrite of lead (*tartariſed lead*), in a white powder. 3. Wine which only contains the tartareous acidule, would not have any action upon the ſemi-vitrous oxide of lead or litharge. 4. Sharp wine which we attempt to ſweeten by this oxide of lead, acts firſt upon it by the acetous acid it contains. 5. When this acetite of lead is formed, the tartareous acid precipitates it in the form of tartrite of lead: this is proved by the precipitate which the ſolution of the acetite of lead or ſugar of lead forms in the wine. 6. But the acetous acid, if it be in large enough quantity, rediſſolves the tartrite of lead in the wine juſt as diſtilled water would. Bergman has pointed out this ſolution of tartrite of lead in acetous acid for diſtinguiſhing the tartareous ſalt from the ſulphate of lead (*vitriol of lead*). 7. As this ſolution of tartrite of lead in the acetous acid is much quicker, and more eaſy in ſharp wines than in diſtilled water and vinegar, it is probable that the cauſe of this difference depends upon the citric and malic acids which I have found in wine, and which I ſhall take notice of again on another occaſion. 8. Litharged wine then, or wine ſweetened with lead, contains tartrite diſſolved in the acetous acid, and perhaps at the ſame time in the malic and citric acids.

10 It forms an aceto-tartrite of lead.

"It was neceſſary afterwards to know the properties of this combination. What experience has taught me is as follows: I particularly examined the tartrite of lead and its ſolution in acetous acid. The tartrite of lead is ſcarcely at all ſoluble in water; it is in the form of powder, or of ſmall white grains which have no ſenſible taſte; when it is diſſolved in vinegar, the vinegar is ſoftened, its ſharpneſs is diminiſhed remarkably, and the ſolution takes a ſlight ſweetiſh taſte, much leſs ſtrong than that of the pure acetite of lead. This taſte proves that the union of the tartrite of lead with vinegar is not only a ſolution like that of ſalt in water, by which the properties of the ſalt are not changed, but a combination which gives occaſion to new properties. It is a kind of a triple ſalt, different from thoſe we have hitherto known, formed of two acids and of one baſe; whereas the other triple ſalts deſcribed hitherto are compoſed of one acid and two baſes. I name this new triple ſalt *aceto-tartrite of lead*. The acetous acid adheres to it more than water in a common ſolution: what is remarkable in this combination is, that the two acids appear to adhere to the baſe with an equal force, although they have a different attraction for it: nothing is neceſſary to produce this equilibrium, but to unite firſt the oxide of lead with the acid to which it adheres the moſt ſtrongly, and afterwards to put this firſt compound in contact with the weaker acid.

11 Other methods of detecting this ſalt.

"It was neceſſary, in order to diſcover eaſy and certain methods of aſcertaining the preſence of lead in wine, to examine with care the properties and phenomena of the decompoſitions of the aceto-tartrite of lead. Fixed alkalies and ammoniac (*volatile alkali*) precipitate from this ſalt an oxide of lead, which is of a grayiſh white colour; but as they occaſion a precipitate in pure wine, they cannot be of any uſe. The ſulphuric (*vitriolic*) acid decompoſes the aceto-tartrite of lead, and forms with it inſtantly ſulphate of lead; which being very little ſoluble, and very heavy, is precipitated. The oxalic, or pure ſaccharine acid, and the acidulous oxalate, or the ſalt of ſorrel of the ſhops, likewiſe decompoſe this ſalt, and take from it the lead. The oxalate of lead is precipitated in great abundance: theſe two acids, the ſulphuric and oxalic acids, not producing any precipitate in pure wine, are very proper to ſhow the preſence of lead in wine. The ſulphate and oxalate of lead, when they are precipitated from wine, are coloured, whereas they are very white when they are formed in diſtilled water; but their red or brown colour does not prevent us from diſcovering them by a very ſimple method. If the precipitates be collected with care, and are cautiouſly heated upon a coal with a blow-pipe, they ſmoke, become white, exhale vapours, paſs ſucceſſively through the ſtates of the red and yellow oxides of lead, and at length are reduced into metallic globules at the inſtant they are perceived to be agitated by a very evident effervеſcence: if we ceaſe to blow at this inſtant, we obtain globules upon the charcoal. In order to this, it is neceſſary, however, that the charcoal be ſolid, and be not cracked, and that we ſhould not have blowed too ſtrongly; otherwiſe the globules would be abſorbed, and would diſappear. The ſulphate of lead requires a longer time to be reduced than the oxalate of the ſame metal, and there is a greater hazard of loſing the metallic particles, which, beſide, are in ſmall quantity.

Wine.

"To theſe two firſt proceſſes, already ſufficiently certain of themſelves, I wiſhed to be able to add one which might be capable of pointing out inſtantly the preſence of lead, by an appearance belonging excluſively to this metal, and which might unite to this advantage that of manifeſting very ſmall quantities of it. Diſtilled water impregnated with ſulphurated hydrogenous gas, or hepatic gas, extricated from ſolid alkaline ſulphurets (*livers of ſulphur*) by acids, preſented me with theſe properties. This ſolution blackens very deeply that of the aceto-tartrite of lead, and renders $\frac{1}{10000}$ of this ſalt in water or in wine very ſenſible. The ſenſibility of this reactive is ſuch, that we may dilute litharged wine with a ſufficient quantity of water to take away almoſt entirely the colour of the wine, and this reactive will ſtill produce a very manifeſt alteration. The ſulphurated water has, beſides, the advantage not to occaſion any change in the wines which do not contain a metallic ſubſtance, and it is not precipitated by the acids of wine, like the ſolutions of alkaline ſulphurets. In order to procure this reactive pure, it is neceſſary to prepare it at the inſtant of the experiment, by receiving in a vial full of diſtilled water, and inverted upon a ſhelf of a ſmall hydro-pneumatic apparatus, filled with diſtilled water, the ſulphurated hydrogenous gas, ſeparated from the ſolid ſulphuret of potaſh by the ſulphuric or muriatic acid, and firſt filtrated through water in another vial; when the ſecond vial contains the third of its volume of the ſulphurated hydrogenous gas, the gas is ſhaken ſtrongly with the water, which fills the two-thirds of

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Wine. the vial; and when the abſorption is over, the teſt liquor is prepared. This re-active changes very quickly in the air: it is neceſſary to make it the moment it is to be employed, and to keep it in a veſſel quite full and well corked. If there were any fear that the black colour and the precipitation by the gaſeous ſulphurated water ſhould not be ſufficient to prove the preſence of lead in ſpirituous liquors, I would obſerve, that this fear would be diminiſhed by employing the three re-actives mentioned in this memoir, and by depending only on the correſpondent effects of theſe three re-actives: but all ſuſpicion would be removed, by reducing the three precipitates by the blow-pipe, and obtaining globules of lead from each of them."

12 thod of ecting m diſ- ed in ie.

Some years ago, the Academy of Lyons propoſed the following prize-queſtion: What is the beſt method of aſcertaining the preſence and the quantity of *alum* diſſolved in wine, eſpecially in very deep coloured red wine? The prize was gained by M. J. S. Beraud. From his experiments, it appears that a mixture of lime-water and wine in any proportion whatever, will at the end of 12 or 15 hours furniſh a quantity of cryſtals, which may be ſeparated by filtration, and that theſe cryſtals will be eaſieſt diſcovered when the quantities of wine and lime-water are equal; but that wine containing alum diſſolved in it, will not form cryſtals when mixed with lime-water, but merely depoſits a muddy ſediment. To know therefore whether any wine contains alum or not, we have only to mix a ſmall quantity of it with lime-water: if cryſtals are formed, it contains no alum; if not, it does. Again, if wine contains alum, the reſiduum that remains after filtration will, as it dries, ſplit into quadrilateral ſegments, which will detach themſelves from the paper which contains them; but if the wine contains no alum, the reſiduum, after it is dry, will remain united and attached to the paper. If one meaſure of wine and two-thirds of a meaſure of lime-water depoſit cryſtals, we are certain that if the wine contains alum, the proportion of that alum to the wine will be leſs than 1 to 1152; if, when equal parts of wine and lime-water are mixed, no cryſtals be depoſited, we may be ſure that more than $\frac{1}{4000}$th part of the maſs of wine conſiſts of alum.

A great proportion of the wine conſumed in this country is brought from Spain and Portugal; government has always diſcouraged the importation of French wines by heavy taxes. We are not ſure how far ſuch conduct is founded on good policy, as the French wines are confeſſedly the beſt, and might be the cheapeſt; but ſuch is the jealouſy and enmity that has always ſubſiſted between Britain and France, that both nations have been contented to injure themſelves, provided they could do a greater injury to their neighbours. Beſides, the advantages which Britain derives from the Portugal trade are very great, and it would not be eaſy perhaps to ſecure them on any other terms.

13 ections the tment mport- wines.

It may be worth while to inſert here a few directions about the treatment of wines after they have been imported into this country.—On landing, the leſs they are expoſed the better; for they are affected by the ſeaſons, and more or leſs by climate. March and April are the proper times for ſhipping wines from France, and they will be landed in England and Ireland in the ſame degree of temperature. The great art in keeping wines is to prevent their fretting, which is done by keeping them in the ſame degree of heat. In ſpring and fall, the wines in Bourdeaux are ſubject to changes that may be dangerous, if not prevented by neceſſary rackings: theſe changes are ſolely the effects of the ſeaſons. If wines are chilled, and of courſe turn foul, from being ſhipped and landed in cold weather, they will ſoon recover by putting them in a warm vault, well covered with ſaw-duſt. As ſoon as they are in the vault, they ought to be covered up. But if ſhipped and landed in ſummer, if the ſmalleſt degree of fermentation be found on them, it will be requiſite to dip the bung cloths in brandy, and leave the bungs looſe for ſome days, to give it time to cool; and if in a fortnight or three weeks the fermentation do not ceaſe, and the wine become bright, it will be proper to rack it (matching the hogſheads well with brimſtone), and force it with the whites of eight eggs. If it then becomes fine, bung it tight, and let it remain ſo until it is bottled. If wines new landed are wanted ſoon for the bottle, it will be neceſſary to force them immediately, and let them remain bunged cloſe for at leaſt a month, to recover from the forcing, or if two months the better; for wines bottled in high order come much ſooner into drinking than if bottled when flat, which all wines are after forcing. Wine muſt never be bottled the leaſt foul, which produces a tendency to fret; and if bottled in this ſtate, will never come in order, but may poſſibly be loſt; for this there is no remedy but repeated rackings; and care muſt be taken (after rinſing the hogsheads well and drawing them) to burn a good piece of match in them. This cools the wine, and there is no danger of hurting the colour, for it recovers it in a little time: but if it did, it is abſolutely neceſſary; for if wine is ſuffered to continue on the fret, it will wear itſelf to nothing. Wines bottled in good order may be fit to drink in ſix months; but they are not in perfection before twelve: from that to two years they may continue ſo; but it would be improper to keep them longer, for wines in general have not the body they had formerly, from the vines being too much forced.

Wine.

It ſometimes happens that wines ſcuddy and ſtubborn will not fall with one or even two forcings. It will then be proper to give them five or ſix gallons of good ſtrong wine, and force them with the whites of a dozen eggs, with a tea-ſpoonful of ſand produced from ſawing-marble, or a ſmall ſpoonful of fine ſalt. Bottled wine in winter ſhould be well covered with ſaw-duſt, and if the vaults are cold and damp, ſtrew it deep on the floor; if ſaw-duſt is thrown upon the hogſheads, and their ſides are bedded ſome inches thick, it will keep them from the fret.

The ſame treatment is to be regarded with white wines, except that they require to be higher matched, particularly Muſcat wines; ſuch as Frontignac, Beziers, &c. which being often ſweetened with honey, are very ſubject to fret; and theſe only frequent rackings, with a great deal of brimſtone, can cool. Hermitage, from not being ſufficiently dried, and poſſeſſing more richneſs than claret, is alſo very liable to come on the fret, and will require much the ſame treatment as the Muſcat wines. Attention ſhould be had to bottle in fine weather, when the wind is north; but to avoid cold or froſty weather. The months of April and October are favourable. The beſt time to bottle port wine is four

Wine. years after the vintage, and to keep them two years in bottle before you begin to uſe them. When wines are racked, and the lees immediately paſſed through flannel bags into cloſe-necked jars, and directly bottled, there will be very little loſt by rackings, as the wine when fine may ſerve for filling up.

When wines are deſtined for warm climates, it may be proper to rinſe the hogſheads with brandy; and in bottling many rinſe the bottles and corks with it. Wines that have remained a certain time (three or four months) in a vault, and made leſs or more lee, ought never to be ſent into the country without firſt racking them, otherwiſe they may be liable to fret; and if bottled in that ſtate, may riſk being loſt.

Wines which may be ordered for immediate drinking will be forced on the ſhipping, and in a few weeks after they are landed will be fit for the bottle. The forcings proper for claret are the whites of a dozen eggs, beat up with a tea-ſpoonful of fine ſalt, and well worked with a forcing rod. Take care to uſe no bad egg. This is for one hogſhead.

The forcing for white wine is iſinglaſs diſſolved in wine. One ounce is ſufficient for two hogſheads. No ſalt is to be uſed in forcing the white wines. See *Croft on Wines*, 8vo, 1788.

14 Receipt for making raiſin wine. We ſhall inſert here the following receipt for making *raiſin wine*.—To a 20 gallon veſſel take 100 pounds of raiſins; pick off the ſtalks, chop them groſsly, and put them into an open tub more wide than deep. Add two parts in three to the water of them, and let them ſtand 15 days, ſtirring them well every day. Then ſtrain and preſs them, putting aſide the liquor that runs from them. Add the remainder of the water to the raiſins that have thus been preſſed, and let it ſtand upon them one week, frequently ſtirring them as before. Then preſs off the liquor, and add it to what you firſt collected; putting both runnings together into your veſſel, together with one quart of brandy. To colour it, burn three-fourths of a pound of ſugar into a ſmall quantity of the liquor, and add this to the wine. When the liquor in the barrel has done ſinging, ſtop the veſſel cloſe, and let it ſtand till fit to be bottled. The greater the quantity which the veſſel holds, and the longer it is kept in the wood, the better will it be.

As ſome of the hints for making wines in Champagne may be uſeful in the manufacture of the wines of this country, we inſert the following abridged account of the different proceſſes that are followed in making white and red champagne.

Great care is neceſſary for making white wine. The ripeſt bunches muſt be carefully gathered, freed from rotten, dry, and bruiſed grapes, put into large baſkets covered with a cloth to keep them from the ſun, carried to the ſhade, and kept there till the evening, when they are to be ſpeedily preſſed. The grapes being laid on the bed of the preſs, they are covered with three or four layers of flat ſtones, and the preſs turned. The juice having run for four or five minutes, the preſs is turned backward, the ſtones removed, the grapes which have protruded thruſt into the heap, the ſtones replaced, and the preſs turned again. The juice from three of ſuch preſſures, which will not require an hour, is put by itſelf for the beſt wine into a vat, where it is left all night to ſettle.

The next morning the juice is poured off from the ſediment, and put into new well rinſed caſks. In theſe it ferments violently at firſt, but afterwards imperceptibly, till about the end of December it becomes fine, having gone through all the ſtages of depuration. It is then racked off in dry weather, on a clear froſty day, and fined with iſinglaſs. About a pound is ſufficient for 40 puncheons. The iſinglaſs being diſſolved is well beaten, diluted with wine taken from the caſk, then poured into it, and the whole well ſtirred by an inſtrument introduced at the bung-hole. The wine thus left to ſettle ferments ſlightly again, till it be ſtopped by the cold weather, or by time. In a month or ſix weeks it is racked off again, and has another fining with half the quantity of iſinglaſs. Wine || Winter

For making red wine, the grapes are gathered with the ſame precautions as for making white, taking only the black grapes. Theſe are bruiſed in particular veſſels, by men treading on them with ſtrong wooden ſhoes: part of the ſtalks are thrown away, and the *muſt* is left in covered veſſels to ferment ſufficiently to extract the colouring matter from the pellicles. In ſome years, three or four days are ſufficient; in others it requires 10, 15, or even 20. When the fermentation begins, the huſks and ſtalks are forced down ſo as to be covered with the muſt, either by means of ſtrong poles furniſhed with croſs pegs, or, which is better, by a couple of ſtrong men going into the vat, and well treading and mixing its contents. When the air above the vat extinguiſhes a candle, the ſtalks and huſks riſe forcibly, whatever pains be taken frequently to ſink them, that the muſt may not acquire a diſagreeable taſte; the contents of the vat experience a degree of ebullition, and the colouring matter is decompoſed. The fermentation muſt be made to ſtop here, that the wine may not acquire a hard taſte, which even time cannot deſtroy.

About the end of December, when the fermentation has ceaſed, the wine is racked off from the lees; about the middle of May it is racked off again; the barrels are freſh hooped, and the wine is put into the cellar. When it is to be ſent to the conſumer, it is racked a third time; the whites of five or ſix freſh eggs are well beaten up in a pint of water, for every puncheon holding 240 bottles. Good red champagne will keep in bottles from ſix to twelve years.

WINE-Preſs, a machine contrived to ſqueeze the juice out of grapes, and conſiſting of ſeveral pieces of timber, variouſly diſpoſed, which compoſe three bodies of timber-work, cloſely united to the axis, which ſerves as a ſwing whereby it may be moved by the vice. Of theſe there are different ſizes as well as different conſtructions; for an account of which, illuſtrated by figures, ſee Miller's Gardener's Dictionary, article *WINE-Preſs*.

Spirit of WINE, or *Alcohol*, a name given by chemiſts to every ardent ſpirit produced by diſtillation. See CHEMISTRY *Index*.

WING, that part of a bird, inſect, &c. whereby it is enabled to fly. See BIRD and ORNITHOLOGY.

WINGS, in military affairs, are the two flanks or extremes of an army, ranged in form of a battle; being the right and left ſides thereof.

WINTER, one of the four ſeaſons or quarters of the year. See SEASON, &c.

Winter commences on the day when the ſun's diſtance from the zenith of the place is greateſt, and ends on the

day

Winter || Wire.

day when its diſtance is at a mean between the greateſt and leaſt.

Under the equator, the winter as well as other ſeaſons returns twice every year; but all other places have only one winter in the year: which in the northern hemiſphere begins when the ſun is in the tropic of Capricorn, and in the ſouthern hemiſphere when in the tropic of Cancer; ſo that all places in the ſame hemiſphere have their winter at the ſame time.

WINTER-Berry. See PHYSALIS, BOTANY *Index.*

WINTERA, a genus of plants of the claſs of polyandria, and in the natural ſyſtem arranged under the 12th order, *Holoraceæ.* See BOTANY and MATERIA MEDICA *Index.*

WINTON, ANDREW, a Scottiſh poet and hiſtorian of the 14th century; but very little is known of his life. He was a canon regular of St Andrews, and was prior of the monaſtery of St Serf in the iſland of Loch Leven in Kinroſs-ſhire; for in the chartulary of the priory of St Andrews there are ſeveral public inſtruments of Andrew Winton, as prior of Loch Leven. They are dated between the years 1395 and 1413, ſo that Winton muſt have been cotemporary with Barbour, whoſe merits are on ſeveral occaſions celebrated by him. Winton is beſt known as the author of the *Orygynale Cronykill of Scotland.* This work was undertaken at the requeſt of Sir John Wemyſs, the anceſtor of the noble family of that name. It remained neglected for ſeveral centuries, but in 1795 a ſplendid edition of that part of it relative to Scottiſh affairs, was publiſhed by Mr Macpherſon. The time of Winton's death is unknown; but, as he mentions the death of Robert duke of Albany, which happened in 1420, the hiſtorian muſt have been alive at that time.

WIRE, a piece of metal drawn through the hole of an iron into a thread of a fineneſs anſwerable to the hole it paſſed through.

Wires are frequently drawn ſo fine as to be wrought along with other threads of ſilk, wool, flax, &c.

The metals moſt commonly drawn into wire are gold, ſilver, copper, and iron. Gold-wire is made of cylindrical ingots of ſilver, covered over with a ſkin of gold, and thus drawn ſucceſſively through a vaſt number of holes, each ſmaller and ſmaller, till at laſt it is brought to a fineneſs exceeding that of a hair. That admirable ductility which makes one of the diſtinguiſhing characters of gold, is nowhere more conſpicuous than in this gilt wire. A cylinder of 48 ounces of ſilver, covered with a coat of gold, only weighing one ounce, as Dr Halley informs us, is uſually drawn into a wire, two yards of which weigh no more than one grain; whence 98 yards of the wire weigh no more than 49 grains, and one ſingle grain of gold covers the 98 yards; ſo that the ten-thouſandth part of a grain is above one-eighth of an inch long.

In 1784, Mr Roſwag of Straſbourg preſented to the board of trade ſome gauze made of iron wire, for which he received a reward; and the loom he invented for making it was lodged in the collection of machines at Vaucanſon. In 1799 Mr Rochon made others, and ceated them with a tranſparent glue, to be ſubſtituted inſtead of horn for ſhip lanterns, to be uſed between decks, and in engagements by night. He has ſince conceived, that with a thin coating of plaſter they might be employed to preſerve ſhips from fire, and buildings on ſhore ſtill more eaſily; or at leaſt that they might render the ravages of fire leſs frequent, and leſs terrible. Theſe gauzes might be very uſeful too for theatrical decorations, which would not be liable to take fire. Their only inconvenience is their being ſo little flexible; but Mr Rochon does not deſpair of means being found by chemiſtry to remedy this imperfection, and it was with a view of calling attention to this ſubject, that he read a paper on it to the claſs.

Wire || Wit.

WIRE of Lapland. The inhabitants of Lapland have a ſort of ſhining ſlender ſubſtance in uſe among them on ſeveral occaſions, which is much of the thickneſs and appearance of our ſilver wire, and is therefore called, by thoſe who do not examine its ſtructure or ſubſtance, *Lapland wire.* It is made of the ſinews of the rein deer, which being carefully ſeparated in the eating, are, by the women, after ſoaking in water and beating, ſpun into a ſort of thread, of admirable fineneſs and ſtrength, when wrought to the ſmalleſt filaments; but when larger, is very ſtrong, and fit for the purpoſes of ſtrength and force. Their wire, as it is called, is made of the fineſt of theſe threads covered with tin. The women do this buſineſs; and the way they take is to melt a piece of tin, and placing at the edge of it a horn, with a hole through it, they draw theſe ſinewy threads, covered with the tin, through the hole, which prevents their coming out too thick covered. This drawing is performed with their teeth; and there is a ſmall piece of bone placed at the top of the hole, where the wire is made flat; ſo that we always find it rounded on all ſides but one, where it is flat.

This wire they uſe in embroidering their clothes, as we do gold and ſilver; they often ſell it to ſtrangers, under the notion of its having certain magical virtues.

WISDOM, uſually denotes a higher and more refined notion of things immediately preſented to the mind, as it were, by intuition, without the aſſiſtance of ratiocination.

Sometimes the word is more immediately uſed, in a moral ſenſe, for what we call *prudence*, or *diſcretion*, which conſiſts in the ſoundneſs of the judgment, and a conduct anſwerable thereto.

WISDOM of Solomon, one of the books of the Apocrypha. It abounds with Platonic language, and was probably written after the Cabaliſtic philoſophy was introduced among the Jews.

WIT, is a quality of certain thoughts and expreſſions, much eaſier perceived than defined. According to Mr Locke, wit lies in the aſſemblage of ideas, and putting thoſe together with quickneſs and variety, wherein can be found any reſemblance or congruity, thereby to make up pleaſant pictures and agreeable viſions to the fancy. Mr Addiſon limited this definition conſiderably, by obſerving, that every reſemblance of ideas does not conſtitute wit, but thoſe only which produce delight and ſurpriſe. Mr Pope defined wit to be a quick conception and an eaſy delivery: while, according to a late writer, it conſiſts in an aſſimilation of diſtant ideas.

The word *wit* originally ſignified *wiſdom.* A *witte* was anciently a *wiſe man:* the *wittenagemot*, or Saxon parliament, an aſſemblage of wiſe men. So late as the reign of Elizabeth, a man of pregnant *wit*, of great

Wit. *wit*, was a man of vaſt *judgment*. We ſtill ſay, *in his wits*, *out of his wits*, for in or out of ſound mind. The word, however, is now applied in a more limited ſenſe.

Without attempting to expoſe the inaccuracy of the definitions above mentioned, or hazarding a definition of our own where ſo many eminent men have failed, we ſhall endeavour to ſhow in what true wit conſiſts.

It is evident that wit excites in the mind an agreeable ſurpriſe, and that this is owing entirely to the ſtrange aſſemblage of related ideas preſented to the mind. This end is effected, 1. By debaſing things pompous or *ſeemingly* grave; 2. By aggrandizing things little or frivolous; 3. By ſetting ordinary objects in a particular and uncommon point of view, by means not only remote but apparently contrary. Of ſo much conſequence are ſurpriſe and novelty, that, nothing is more taſteleſs, and ſometimes diſguſting, than a joke that has become ſtale by frequent repetition. For the ſame reaſon, even a pun or happy alluſion will appear excellent when thrown out extempore in converſation, which would be deemed execrable in print. In like manner, a witty repartee is infinitely more pleaſing than a witty attack: for though, in both caſes, the thing may be equally new to the reader or hearer, the effect on him is greatly injured, when there is acceſs to ſuppoſe that it may be the ſlow production of ſtudy and premeditation. This, however, holds moſt with regard to the inferior tribes of witticiſm, of which their readineſs is the beſt recommendation.

Campbell's Philoſophy of Rhetoric, vol. i.

We ſhall illuſtrate theſe obſervations by ſubjoining a ſpecimen or two of each of theſe ſorts of wit:

Of the firſt ſort, which conſiſts in the debaſement of things great and eminent, Butler, amongſt a thouſand other inſtances, hath given us thoſe which follow:

> And now had Phœbus in the lap
> Of Thetis taken out his nap:
> And, like a lobſter boil'd, the morn
> From black to red began to turn.
>
> *Hudibras*, part ii. canto 2.

Here the low allegorical ſtyle of the firſt couplet, and the ſimile uſed in the ſecond, afford us a juſt notion of this loweſt ſpecies, which is diſtinguiſhed by the name of the *ludicrous*. Another ſpecimen from the ſame author you have in theſe lines:

> Great on the bench, great in the ſaddle,
> That could as well bind o'er as ſwaddle,
> Mighty he was at both of theſe,
> And ſtyl'd of *war*, as well as *peace:*
> So ſome rats of amphibious nature,
> Are either for the *land* or *water*.
>
> *Ibid.* part i. canto 1.

In this coarſe kind of drollery, thoſe laughable tranſlations or paraphraſes of heroic and other ſerious poems, wherein the authors are ſaid to be traveſtied, chiefly abound.

The ſecond kind, conſiſting in the aggrandiſement of little things, which is by far the moſt ſplendid, and diſplays a ſoaring imagination, theſe lines of Pope will ſerve to illuſtrate:

> As Berecynthia, while her offſpring vie
> In homage to the mother of the ſky,
> Surveys around her in the bleſt abode,
> An hundred ſons, and every ſon a god:
> Not with leſs glory mighty Dulneſs crown'd,
> Shall take thro' Grubſtreet her triumphant round;
> And her Parnaſſus glancing o'er at once,
> Behold a hundred ſons, and each a dunce.

Wit.

This whole ſimilitude is ſpirited. The parent of the celeſtials is contraſted by the daughter of night and chaos; heaven by Grubſtreet; gods by dunces. Beſides, the parody it contains on a beautiful paſſage in Virgil adds a particular luſtre to it. This ſpecies we may term *thraſonical*, or *the mock-majeſtic*. It affects the moſt pompous language, and ſonorous phraſeology, as much as the other affects the reverſe, the vileſt and moſt grovelling dialect.

To this claſs alſo we muſt refer the application of grave reflections to mere trifles. For that *great* and *ſerious* are naturally aſſociated by the mind, and likewiſe little and trifling, is ſufficiently evinced by the common modes of expreſſion on theſe ſubjects uſed in every tongue. An oppoſite inſtance of ſuch an application we have from Philips:

> My galligaſkins, that have long withſtood
> The winter's fury and encroaching froſts,
> By time ſubdued, (*What will not time ſubdue!*)
> An horrid chaſm diſcloſe. *Splendid Shilling.*

Of the third ſpecies of wit, which is by far the moſt multifarious, and which reſults from what may be called the queerneſs or ſingularity of the imagery, we ſhall give a few ſpecimens that will ſerve to mark ſome of its principal varieties. To illuſtrate all would be impoſſible. The firſt ſhall be where there is an apparent contrariety in the things ſhe exhibits as connected. This kind of contraſt we have in theſe lines of Garth:

> Then Hydrops next appears amongſt the throng;
> Bloated and big ſhe ſlowly ſails along:
> But like a miſer in exceſs ſhe's poor,
> And pines for thirſt amidſt her watery ſtore.
>
> *Diſpenſary.*

A ſecond ſort is, where the things compared are what with dialecticians would come under the denomination of *diſparates*, being ſuch as can be ranked under no common genus. Of this we ſhall ſubjoin an example from Young.

> Health chiefly keeps an Atheiſt in the dark;
> A fever argues better than a *Clarke:*
> Let but the logic in his pulſe decay,
> The Grecian he'll renounce, and learn to pray.
>
> *Univerſal Paſſion.*

A third variety in this ſpecies ſprings from confounding artfully the proper and the metaphorical ſenſe of an expreſſion. In this way, one will aſſign as a motive what is diſcovered to be perfectly abſurd, when but ever ſo little attended to; and yet from the ordinary meaning of the words, hath a ſpecious appearance on a ſingle glance. Of this kind we have an inſtance in the ſubſequent lines:

> While thus the lady talk'd, the knight
> Turn'd th' outſide of his eyes to white,

Wit || Witchcraft.

As men of inward light are wont
To turn their optics in upon't.
Hudibras, part iii. canto 1.

For whither can they turn their eyes more properly than to the light?

A fourth variety, much reſembling the former, is when the argument or compariſon (for all argument is a kind of compariſon) is founded on the ſuppoſal of corporeal or perſonal attributes in what is ſtrictly not ſuſceptible of them; as in this,

But Hudibras gave him a twitch
As quick as lightning in the breech,
Juſt in the place where honour's lodg'd,
As wiſe philoſophers have judg'd:
Becauſe a kick in that place more
Hurts honour than deep wounds before.
Ibid. part ii. canto 3.

The fifth, and only other variety which we ſhall mention, is that which ariſes from a relation, not in the things ſignified, but in the ſigns of all relations, no doubt the ſlighteſt. Identity here gives riſe to puns and clinches; reſemblance to quibbles, cranks, and rhimes: Of theſe it is quite unneceſſary to exhibit ſpecimens.

WIT, *John de*, a celebrated penſionary of Holland, and one of the greateſt politicians of his time, was the ſon of Jacob de Wit, burgomaſter of Dort, and was born in 1625. He became well ſkilled in civil law, politics, mathematics, and other ſciences; and wrote a treatiſe on the Elements of Curved lines, publiſhed by Francis Schooten. Having taken his degree of doctor of law, he travelled into foreign courts, where he became eſteemed for his genius and prudence. At his return to his native country in 1650, he became penſionary of Dort, then counſellor-penſionary of Holland and Weſt Frieſland, intendant and regiſter of the fiefs, and keeper of the great ſeal. He was thus at the head of affairs in Holland; but his oppoſition to the reeſtabliſhment of the office of ſtadtholder, which he thought a violation of the freedom and independence of the republic, coſt him his life, when the prince of Orange's party prevailed. He and his brother Cornelius were aſſaſſinated by the populace at the Hague in 1674, aged 47.

WITCH, a perſon guilty of witchcraft.

WITCHCRAFT, a ſupernatural power which perſons were formerly ſuppoſed to obtain the poſſeſſion of by entering into a compact with the devil. They gave themſelves up to him body and ſoul; and he engaged, that they ſhould want for nothing, and that he would avenge them upon all their enemies. As ſoon as the bargain was concluded, the devil delivered to the witch an imp, or familiar ſpirit, to be ready at a call, and do whatever it was directed. By the aſſiſtance of this imp and the devil together, the witch, who was almoſt always an old woman, was enabled to tranſport herſelf in the air on a broomſtick or a ſpit to diſtant places to attend the meetings of the witches. At theſe meetings the devil always preſided. They were enabled alſo to transform themſelves into various ſhapes, particularly to aſſume the forms of cats and hares, in which they moſt delighted; to inflict diſeaſes on whomſoever they thought proper; and to puniſh their enemies in a variety of ways. Witchcraft.

The belief that certain perſons were endowed with ſupernatural power, and that they were aſſiſted by inviſible ſpirits, is very ancient. The *fagæ* of the Romans ſeem rather to have been ſorcerers than witches; indeed the idea of a witch, as above deſcribed, could not have been prevalent till after the propagation of Chriſtianity, as the heathens had no knowledge of the Chriſtian *devil*.

Witchcraft was univerſally believed in Europe till the 16th century, and even maintained its ground with tolerable firmneſs till the middle of the 17th. Vaſt numbers of reputed witches were convicted and condemned to be burnt every year. The methods of diſcovering them were various. One was, to weigh the ſuppoſed criminal againſt the church bible, which, if ſhe was guilty, would preponderate: another, by making her attempt to ſay the Lord's Prayer; this no witch was able to repeat entirely, but would omit ſome part or ſentence thereof. It is remarkable, that all witches did not heſitate at the ſame place; ſome leaving out one part, and ſome another. Teats, through which the imps ſucked, were indubitable marks of a witch: theſe were always raw, and alſo inſenſible; and, if ſqueezed, ſometimes yielded a drop of blood. A witch could not weep more than three tears, and that only out of the left eye. This want of tears was, by the witch-finders, and even by ſome judges, conſidered as a very ſubſtantial proof of guilt. Swimming a witch was another kind of popular ordeal generally practiſed; for this ſhe was ſtripped naked, and croſs-bound, the right thumb to the left toe, and the left thumb to the right toe. Thus prepared, ſhe was thrown into a pond or river, in which, if guilty, ſhe could not ſink; for having, by her compact with the devil, renounced the benefit of the water of baptiſm, that element, in its turn, renounced her, and refuſed to receive her into its boſom. Sir Robert Filmer mentions two others by fire: the firſt, by burning the thatch of the houſe of the ſuſpected witch; the other, burning any animal ſuppoſed to be bewitched by her, as a hog or ox. Theſe, it was held, would force a witch to confeſs. *Provincial Gloſſary.*

The trial by the ſtool was another method uſed for the diſcovery of witches. It was thus managed: Having taken the ſuſpected witch, ſhe was placed in the middle of a room upon a ſtool or table, croſs-legged, or in ſome other uneaſy poſture; to which if ſhe ſubmitted not, ſhe was then bound with cords: there ſhe was watched, and kept without meat or ſleep for the ſpace of 24 hours (for, they ſaid, within that time they ſhould ſee her imp come and ſuck). A little hole was likewiſe made in the door for imps to come in at; and leſt it ſhould come in ſome leſs diſcernible ſhape, they that watched were taught to be ever and anon ſweeping the room, and, if they ſaw any ſpiders or flies, to kill them: if they could not kill them, then they might be ſure they were imps. If witches, under examination or torture, would not confeſs, all their apparel was changed, and every hair of their body ſhaven off with a ſharp razor, leſt they ſhould ſecrete magical charms to prevent their confeſſing. Witches were moſt apt to confeſs on Fridays.

By ſuch trials as theſe, and by the accuſation of children,

Witchcraft. dren, old women, and fools, were thouſands of unhappy women condemned for witchcraft, and burnt at the ſtake. In the 18th volume of the Statiſtical Account of Scotland there is the trial of two witches, William Coke and Aliſon Dick, in Kirkaldy, in 1636. The evidence on which they were condemned is abſolutely ridiculous: they were, however, burnt for witchcraft. The expences which the town and kirk-ſeſſion were put to on this occaſion were as follows:

In primis.—To Mr James Miller, when he went to Preſtowne for a man to try them, 47s. - -	L.	2	7
Item.—To the man of Culroſs, (the executioner), when he went away the firſt time, 12s. - -		0	12
Item.—For coals for the witches, 24s.		1	4
Item.—In purchaſing the commiſſion,		9	3
Item.—For one to go to Finmouth for the laird to ſit upon their aſſize as judge, - - - -		0	6
Item.—For harden to be jumps to them,		3	10
Item.—For making of them, -		0	8

Summa for the kirk's part L. 17 10 Scots.

The Town's part of expences deburſed extraordinarily upon William Coke and Aliſon Dick.

In primis.—For 10 loads of coals to burn them, 5 merks, -	L.	3	6 8
Item. For a tar barrel, 14s. -		0	14 0
Item.—For towes, - -		0	6 0
Item.—To him that brought the executioner, - -		2	18 0
Item.—To the executioner for his pains, - - -		8	14 0
Item.—For his expences here,		0	16 4
Item.—For one to go to Finmouth for the laird, - -		0	6 0

Summa town part, L. 17 1 0 Scots.
Both, L. 34 11 0
Or L. 2 17 7 Ster.

Dr Ferriar, Manchester Tranſ. vol. iii. For a conſiderable time after the inquiſition was erected, the trials of witches (as heretics) were confined to that tribunal; but the goods of thoſe who were condemned being confiſcated to the holy office, its miniſters were ſo active in diſcovering ſorcerers, that the different governments found it neceſſary to deprive them of the cogniſance of this crime. On the continent, commiſſioners were then appointed for the diſcovery and conviction of witches, who, though leſs active than the inquiſitors, were but too zealous in proſecuting their function. In 1494, Sprenger and Inſtitor, two perſons employed in this commiſſion, publiſhed a collection of trials, moſt of which had come before themſelves, under the title of *Malleus Maleficarum*: this ſerved as a kind of inſtitute for their ſucceſſors.

The firſt writers againſt witchcraft were ſtigmatized as Atheiſts, though they only endeavoured to prove the imbecility of the perſons accuſed, and the infatuation or the knavery of their accuſers. Such were the epithets beſtowed by Dr Henry More, and even by Cudworth himſelf. Wierus, the diſciple of the celebrated Agrippa, gave riſe to the firſt great controverſy on this ſubject. His maſter had taught him humanity; and he endeavoured, but with too feeble a hand, to ſtop the bloody proceedings of the judges. Wierus appears to have been a well-diſpoſed, weak man, with extenſive reading on his ſubject, but too narrow-minded to comprehend it thoroughly. He involved himſelf in unſpeakable difficulties, by admitting the action of ſupernatural powers in certain diſeaſes, and in poſſeſſions, while he denied that witches had any concurrence in them. Theſe appearances (ſaid he) are illuſions of the devil, who perſuades ſimple and melancholy perſons that the miſchief he himſelf performs, is done by them, and at their pleaſure. He was weak enough to attempt the explanation of every ſtory alleged by his antagoniſts, without queſtioning the truth of the facts. Witchcraft.

Bodinus, a French lawyer of eminence, who had aſſiſted at ſeveral trials of witches, wrote againſt Wierus, in his *Demonomania*. He urged the concurrent teſtimonies of ſufficient witneſſes, and the confeſſions of the witches themſelves, to eſtabliſh the exiſtence of ſorcery. Wierus owned that the unhappy perſons believed themſelves to be guilty of the crimes alleged againſt them, but that they were deceived by the devil. But what do you make of the witches meetings, cried Bodinus? The witches (replied his antagoniſt) are atrabilious. This explanation was ſo unſatisfactory that Wierus paſſed for a magician, whom the devil had furniſhed with ſpecious arguments to ſave others from puniſhment. Lerchemer Godelmann, Ewichius, Ewaldus, and ſome others, followed him, notwithſtanding this ſtigma; but they were oppoſed by men of more acuteneſs and conſiſtency than themſelves; by Remigius, who had condemned ſeveral hundreds of ſorcerers to the flames; Delrio, whoſe book is a complete Corpus Magiæ; Cujas, Eraſtus, Scribonius, Camerarius, and a crowd of others.

In this country, while the belief in witchcraft was ſupported by royal authority (for James I. is univerſally known to have written on demonology) countenanced by Bacon, and generally adopted among the people, only one writer was hardy enough to oppoſe it. This was Reginald Scott, who publiſhed a collection of impoſtures detected, under the title of Diſcoveries of Witchcraft. James ordered the book to be burnt by the common executioner, and the judges continued to burn witches as uſual. During the civil wars, upwards of eighty were hanged in Suffolk, on the accuſations of Hopkins the witch-finder. Webſter was the next writer againſt witchcraft; but he had a different fate from that of Scott, for moſt of his arguments were refuted by Glanville. This very acute writer was induced to publiſh his Philoſophical Conſiderations about Witchcraft, by the apprehenſion, that the increaſing diſbelief of witches and apparitions tended to affect the evidences of religion, and even of a Deity. In reſpect of argument, he was certainly ſuperior to his adverſaries; his reaſoning is perſpicuous, though ſometimes ſubtle, reſted on the moſt ſpecious foundations of evidence, and arranged with great ſkill.

On the continent, this controverſy ſeemed almoſt forgotten, till Bekker publiſhed his *Monde Enchantée*, in which he denied the exiſtence of witches, on the Carteſian principle, that the Deity is the ſource of all action, conſequently actions ſo oppoſite to his nature and attributes cannot be ſuppoſed to exiſt. He was anſwered by Frederick

Witchcraft || Witneſs.

Frederick Hoffman, the father of the modern theory and practice of medicine, in his diſſertation *De Diaboli Potentia in Corpora.*

The lateſt witchcraft frenzy was in New England, about 1692, when the execution of witches became a calamity more dreadful than the ſword or the peſtilence. The accuſers became ſo daring, that neither civil nor religious authority would have proved a ſecurity againſt their attacks, if all the proſecutions had not been ſuddenly dropped, and the priſoners ſet at liberty. So far did thoſe wretches proceed in abſurdity, that a dog was accuſed of throwing perſons into fits by looking at them. As ſoon as the proſecutions were ſtopped, all reports of witchcraft ceaſed.

It would be ridiculous to attempt a ſerious refutation of the exiſtence of witches; and at preſent, luckily, the taſk is unneceſſary. In this country, at leaſt, the diſcouragement long given to all ſuſpicion of witchcraft, and the repeal of the ſtatutes againſt that crime, have very much weakened, though perhaps they have not entirely eradicated, the perſuaſion. On the continent, too, it is evidently on the decline; and notwithſtanding the exertions of Dr De Haen, and of the celebrated Lavater, we have little doubt but that in a ſhort time poſterity will wonder at the credulity of their anceſtors. That there ever were witches, is an opinion that cannot for a moment be believed by a thinking man. The actions imputed to them were either abſurd or impoſſible; the witneſſes by whoſe evidence they were condemned, either weak enthuſiaſts or downright villians: and the confeſſions aſcribed to the witches themſelves, effects of a diſordered imagination produced by cruel treatment and exceſſive watchings. As to the nightly meetings, demonologiſts themſelves have been obliged to confeſs, that they were nothing elſe but uneaſy dreams, often produced by ſoporific compoſitions. The facts which have been brought forward by the advocates for witchcraft bear in their front the moſt evident marks of trick and impoſture; and this has conſtantly been found out whenever theſe facts have been properly examined. See SORCERY.

WITENA MOT, or WITENA *Gemot*, among the Anglo-Saxons, was a term which literally ſignified the aſſembly of the wiſe men; and was applied to the great council of the nation, of latter days called the *parliament.*

WITHERS *of a* HORSE, the juncture of the ſhoulder-bones at the bottom of the neck and mane, towards the upper part of the ſhoulder.

WITNESS, in *Law*, a perſon who gives evidence in any cauſe, and is ſworn to ſpeak the truth, the whole truth, and nothing but the truth.

Trial by WITNESS, a ſpecies of trial without the intervention of a jury. This is the only method of trial known to the civil law, in which the judge is left to form in his own breaſt his ſentence upon the credit of the witneſſes examined: but it is very rarely uſed in the Engliſh law, which prefers the trial by jury before it in almoſt every inſtance. Save only that when a widow brings a writ of dower, and the tenant pleads that the huſband is not dead; this being looked upon as a dilatory plea, is in favour of the widow, and for greater expedition allowed to be tried by witneſſes examined before the judges: and ſo, ſaith Finch, ſhall no other caſe in our law. But Sir Edward Coke mentions ſome others; as, to try whether the tenant in a real action was duly ſummoned, or the validity of a challenge to a juror: ſo that Finch's obſervation muſt be confined to the trial of direct and not collateral iſſues. And in every caſe Sir Edward Coke lays it down, that the affirmative muſt be proved by two witneſſes at the leaſt. Witneſs || Woahoo.

WITTENBERG, a city of Germany, capital of the circle of Upper Saxony, 50 miles north of Dreſden. It is under immediate vaſſalage, and the ſeat of an aulic judicatory, a general ſuperintendency, an inſpection and conſiſtory. The town is not large; but is well fortified, and contains a famous univerſity, in which Melancthon was a profeſſor. In this place Martin Luther firſt began to preach againſt the pope's indulgences; and in the cathedral of All Saints he is ſaid to have been buried. In the old citadel of this town the ancient Saxon electors uſed to reſide. Beſides the univerſity, there is a Latin ſchool in the town, with ſix maſters. The library belonging to the univerſity is ſaid to be very valuable. In 1756, the Pruſſians being maſters of the town, deſtroyed a part of its fortifications. E. Long. 12. 47. N. Lat. 51. 49.

WOAD. See ISATIS, BOTANY *Index;* ſee alſo DYEING.

The preparation of woad for dyeing, as practiſed in France, is minutely deſcribed by Aſtruc, in his Memoirs for a Natural Hiſtory of Languedoc. The plant puts forth at firſt five or ſix upright leaves, about a foot long and ſix inches broad: when theſe hang downwards, and turn yellow, they are fit for gathering: five crops are gathered in one year. The leaves are carried directly to a mill, much reſembling the oil or tan mills, and ground into a ſmooth paſte. If this proceſs was deferred for ſome time, they would putrefy, and ſend forth an inſupportable ſtench. The paſte is laid in heaps, preſſed cloſe and ſmooth, and the blackiſh cruſt, which forms on the outſide, reunited if it happens to crack: if this was neglected, little worms would be produced in the cracks, and the woad would loſe a part of its ſtrength. After lying for fifteen days, the heaps are opened, the cruſt rubbed and mixed with the inſide, and the matter formed into oval balls, which are preſſed cloſe and ſolid in wooden moulds. Theſe are dried upon hurdles: in the ſun, they turn black on the outſide; in a cloſe place, yellowiſh, eſpecially if the weather be rainy. The dealers in this commodity prefer the firſt, though it is ſaid the workmen find no conſiderable difference betwixt the two. The good balls are diſtinguiſhed by their being weighty, of an agreeable ſmell, and when rubbed, of a violet colour within. For the uſe of the dyer, theſe balls require a farther preparation: they are beat with wooden mallets, on a brick or ſtone floor, into a groſs powder; which is heaped up in the middle of the room to the height of four feet, a ſpace being left for paſſing round the ſides. The powder, moiſtened with water, ferments, grows hot, and throws out a thick fetid fume. It is ſhovelled backwards and forwards, and moiſtened every day for twelve days; after which it is ſtirred leſs frequently, without watering, and at length made into a heap for the dyer.

WOAHOO, one of the Sandwich iſlands, lying to the north-weſt of Morotoi, at the diſtance of ſeven leagues. From the appearance of the north-eaſt and north-weſt parts, it is the fineſt iſland of the group. Nothing can exceed the verdure of the hills, the variety

of

Woahoo Island Wodrow.

of wood and lawn, and rich cultivated valleys, which the whole face of the country diſplays. A bay is formed by the north and weſt extremities, into which a fine river empties itſelf, through a deep valley; but as the water is brackiſh for 200 yards from the entrance, watering in it is not convenient. It contains about 60,000 inhabitants. Lieutenant Hergeſt, commander of the Dædalus ſtore-ſhip, who had been ſent from England, in 1791, to New South Wales, and thence to the Southern Pacific ocean, with a ſupply of proviſions for the Diſcovery ſloop, Captain Vancouver, then on a voyage of diſcovery, was here ſurpriſed and murdered by the natives, together with Mr Gooch, the aſtronomer. W. Long. 157. 51. N. Lat. 21. 43.

WODEN. See ODIN, and MYTHOLOGY, N° 40.

WODEVILLE, ANTHONY, earl of Rivers, brother to the queen of Edward IV. was born in the end of 1442, or in the beginning of 1443. Though one of the moſt accompliſhed men of his age, very little is known of his private hiſtory. He was early and conſtantly employed either in the tumults of thoſe turbulent times, or in diſcharging the duties of ſome of the higheſt offices of the ſtate, with which he was inveſted. Yet he found leiſure to cultivate letters, and to be the author of works which, though of little value now, made ſome noiſe in that age, when learning was at a low ebb in England. Theſe conſiſted chiefly of tranſlations from the French; and his lordſhip and his printer Caxton, were the firſt Engliſh writers who had the pleaſure to ſee their works publiſhed from the preſs. This accompliſhed, brave, and amiable nobleman was treacherouſly impriſoned by Richard III. in Pomfret caſtle, where, during his confinement, he compoſed a ſhort poem, which has been preſerved by John Rous of Warwick, and breathes, ſays Dr Henry, a noble ſpirit of pious reſignation to his approaching fate. He was beheaded on the 23d of June 1483, in the 41ſt year of his age.

WODROW, ROBERT, a clergyman of the weſt of Scotland who lived in the beginning of the 18th century, well known as the author of an Eccleſiaſtical Hiſtory of that kingdom during the latter part of the preceding century. His father, Mr James Wodrow, was a man of learning and piety. He preached occaſionally to the perſecuted Preſbyterians, and taught a little academy of their ſtudents of philoſophy and theology at Glaſgow, before the Revolution. About that time he was ordained one of the miniſters of that city, continuing his connexion with the academy till he was elected profeſſor of theology by the univerſity in the year 1692. He taught with reputation and ſucceſs till his death in 1708.

His ſon Robert was born in the year 1679; his mother being then in the 51ſt year of her age. Her death (though it did not happen till ſeveral years after), was then fully expected; and his father, obnoxious to a tyrannical government, narrowly eſcaped impriſonment, or ſomething worſe, by attempting to obtain a laſt ſhort interview with her. As he paſſed the town guard-houſe, he was marked, and ſoon followed by the ſoldiers into his own houſe, and even into his wife's bedchamber, where he was concealed. Their officer checked this violence; ſent them out of the room, and left the houſe himſelf; placing, however, centinels both within and without, till the birth ſhould be over. In half an hour after, Mr Wodrow at his wife's ſuggeſtion, aſſumed the bonnet and great-coat of the ſervant of the phyſician then in attendance; and carrying the lantern before him, made an eaſy eſcape through the midſt of the guards. They ſoon renewed their ſearch with marks of irritation, thruſting their ſwords into the very bed where the lady lay; who pleaſantly deſired them to deſiſt, "for the bird (ſaid ſhe) is now flown." Wodrow.

His ſon Robert went through the uſual courſe of literary education at Glaſgow, entered the univerſity in 1691; and proſecuted the ſtudy of the languages and the different branches of philoſophy, till he became a ſtudent of theology under the tuition of his father. He was choſen librarian to the univerſity in the year 1698, and continued in that office four years. There he began his reſearches into every thing connected with the eccleſiaſtical hiſtory of his country, which he continued to purſue to the end of his life; and alſo imbibed his taſte for medals, inſcriptions, and whatever ſeemed curious or illuſtrative of Roman, Celtic, and Britiſh antiquities.

He was among the firſt in Scotland who attended to the ſtudy of natural hiſtory. From a great number of letters in his own hand writing, begun about this time, it appears that he was in habits of the utmoſt intimacy with a ſelect number of literary gentlemen, animated with the ſame ardour of reſearch; that they correſponded regularly with one another, made collections of ſingular ſtones, of foſſils, petrified plants, fiſhes, &c. and exchanged what they could ſpare from their reſpective ſtores. Among his correſpondents were Mr William Nicolſon, archdeacon, afterwards biſhop of Carliſle, and at laſt of Derry, author of the Hiſtorical Libraries; Mr Edward Lhwyd keeper of the Aſhmolean cloſet at Oxford; Sir Robert Sibbald, phyſician in Edinburgh, author of a natural hiſtory of Scotland, and another of Fife; Lord Pitmedan; Meſſrs James Sutherland, Laughlan Campbell miniſter of Campbelton, and others. In a letter to Mr Lhwyd dated Auguſt 1709, Mr Wodrow tells him his manſe was but at a little diſtance from a place where they had been lithoſcoping together, during a viſit of Mr Lhwyd to Scotland. "My parochial charge (he continues) does not allow me the ſame time I had then for thoſe ſubterranean ſtudies; but my inclination is equally ſtrong, perhaps ſtronger. I take it to be one of the beſt diverſions from ſerious ſtudy, and in itſelf a great duty, to admire my Maker's works. I have gotten ſome ſtore of foſſils here from our marle, limeſtone, &c. and heartily wiſh I had the knowing Mr Lhwyd here to pick out what he wants, and help me to claſs a great many ſpecies which I know not what to make of." He informs him, in the end of the letter, that he had 500 or 600 ſpecies of one thing or another relative to natural hiſtory.

Mr Wodrow, when he left Glaſgow, reſided a ſhort time in the neighbourhood, in the houſe of a very diſtant relation, Sir ——— Maxwell of Nether Pollock, then one of the Scots judges. It being within the bounds of the preſbytery of Paiſley, he offered himſelf to them for probationary trials, and obtained their licence to preach the goſpel in March 1703. In the ſummer following, the pariſh of Eaſtwood, where Lord Pollock lived, becoming vacant, by the death of Mr Matthew Crawford (another Scots hiſtorian), a petition, with an unanimous *call* or invitation from the pariſh to Mr Wodrow to be their miniſter, was preſented to the preſbytery;

odrow. presbytery; and they, waving part of the usual second trials, in order to expedite the business, ordained Mr Wodrow to be minister of Eastwood on the 28th of October 1703. In this charge he continued to the end of his life. Notwithstanding his ministerial duty, he still found some time to gratify the early bent of his mind towards natural history, and his curiosity to learn every thing in his power, not only at home, but concerning the natural productions of other countries, and the opinions, customs, manners, and way of living of their inhabitants. In his farewell letters to his friends, about to sail to the Scottish settlement of Darien or to the coast of Africa, &c. he directed their attention and enquiries to these subjects; and something similar he suggested to other friends going to reside in remote places of the Highlands, or even on the continent of Europe. The collection of his MS. letters bound up in five or six thick 8vo volumes, though reaching nearly to the end of his life, seems to consist only of the first draught of his own letters to his friends, not a single scrap is now to be found of their answers to him.

After his ordination, however, this worthy man, considering the duties of his office as his principal and only proper business, rose into distinguished reputation and usefulness as a preacher, and was looked upon as one of the first clergymen in the west of Scotland. Humble and unambitious of public notice, he was well entitled to it, by his conscientious and exemplary piety, his learning, not only in professional, but in other branches of knowledge, his natural good sense and solid judgment, his benevolent obliging spirit to all, his warm attachment to his friends, who formed a wide circle around him, and especially his deep concern for the best interests of his people, and active exertions for their instruction and improvement. His weekly sermons were all distinctly written out in long hand, and even his lectures in short-hand. Accustomed to regular composition, he had acquired an uncommon facility in it. His countenance and appearance in the pulpit was manly and dignified; his voice clear and commanding, his manner serious and animated: these things, joined with the general prejudice in his favour, added to the impression of the plain edifying discourses he delivered, without papers, to his hearers; and living in the near neighbourhood of Glasgow his little church was often crowded, especially when he dispensed the Lord's Supper, considered in Scotland as the principal religious solemnity.

Yet these talents, and this merited popularity which followed them, made little impression on his own modest conscientious mind; for he chose to continue in the obscure country parish with which he was first connected, resisting all the attempts made by his friends or by strangers to get him translated into several other more honourable and opulent parishes, who were desirous of the benefit of his ministry, however convenient the change might have proved for the education of his family. In the year 1712, the magistrates of Glasgow invited him to be one of the ministers of that city; and in January 1717, a deputation from the town of Stirling did the same. On the other hand, the patron, heritors, and elders of his own parish, strenuously opposed the translation. The presbytery, who had it in their power to have appointed it, found great difficulties in both cases on the plea of the *majus bonum ecclesiæ*; referred the decision in the first case to the synod, and in the last to the commission of the General Assembly, and these courts thought proper to put no restraint on the minister's judgment or inclination, as he himself was certainly the best judge of his comparative usefulness in two different situations. Wodrow.

Mr Wodrow was equally conscientious and assiduous in the business of the ecclesiastical courts, as in his parochial duty. Notwithstanding his studious turn, he punctually attended the meetings of Presbytery, Synod, and General Assembly, when elected, as he often was, a member of that court; and also the commissions in November and March, which regularly met during that period of the church. His connexion with Lord Pollock made his journeys to Edinburgh easy: and after he began to collect materials for his voluminous history, his personal inspection of the public records and of the various MSS. accumulated in the Edinburgh libraries, made his visits to that capital frequent and necessary.

In common with the great body of the Presbyterians, he had strongly imbibed what are called Whig principles; in other words, he was warmly attached to the constitutional liberties of the people, as established by the revolution settlement. No wonder! The dreadful persecution and oppression they had suffered during the two preceding reigns were still fresh and galling to their minds: they considered the elevation of King William to the throne and the Hanover succession, as the two chief bulwarks raised up by Providence, for the security both of their religion and liberty. They trembled at every dark appearance threatening to this security, such as the death of King William. That cloud, however, was soon dissipated by the perseverance of the queen's ministers in his views and measures, and the splendid victories of Marlborough and his allies over the armies of Louis XIV. But the elevation of the Tory ministry in the latter part of the queen's reign was a severe trial to the Scottish Presbyterians, and involved the conscientious part of the clergy in very serious difficulties and dangers. The oath of abjuration required at that time from clergymen, and enforced by civil penalties, and even the royal proclamation for a national thanksgiving, after the peace of Utrecht, pressed hard upon the scrupulous consciences of many of the clergy. The very language of the *oath* seemed to them dubious and jesuitical, hostile to the elector of Hanover's newly acquired right to the crown, conferred on him by the parliament and the people; and, as to the other point, they had not freedom to lead their people, in a solemn thanksgiving to Heaven for a peace, termed safe and honourable, which they and the generality of their hearers considered as dangerous and disgraceful. Mr Wodrow, as might be expected, was one of the recusants of the oath: for nothing could move him to shuffle with his conscience. At the same time the liberality and equity of his mind led him to judge candidly of the consciences of others. Accordingly, he made every effort in his power to reconcile his clerical brethren, and his own people, to such of the clergy as had the freedom to take it, and by so doing, had rendered themselves obnoxious to popular prejudice and odium. With such, this good man still continued to live, not only in Christian, but ministerial communion; endeavouring to soften and remove the prejudices against them, and, in as far as his influence reached, to revive and cherish a spirit of mutual forbearance. Many proposals he made, and private

Wodrow. meetings and conferences he held with his brethren, to prevent their differences from riſing, as they threatened to do, into a ſchiſm; to prevent them eſpecially from entering at all into the church courts; juſtly afraid of the ſparks of animoſity too apt to be kindled there. His endeavours and thoſe of his friends were ſeconded by the prudence of the ſuperior courts, eſpecially the commiſſion of the General Aſſembly. Whatever paſſed there in the way of admonition to the reſt of the church, breathed the ſpirit of mutual forbearance and love. How he managed the other difficult and delicate point, *the Thankſgiving*, in a conſiſtency with his duty, does not appear in his letters; nor is it now worth while to inveſtigate this as a trait of his character, which might be done, perhaps, from his MS. ſermons preached at the time. Only it is pleaſing to remark from the letters, that the ſame ſpirit of wiſdom and mild forbearance, which animated the majority of the clergy in the weſt, ſeems alſo to have pervaded the officers of the crown, juſtices of the peace, and other civil magiſtrates in Scotland at the time. The oath was not preſſed on the recuſants, and the execution of the legal penalties incurred by the neglect of it avoided; for their general loyalty was undoubted.

A more ſevere ſtroke was inflicted on their adverſaries by the Tory miniſtry in the year 1710, by an act of the Britiſh parliament which reſtored patronage to its former full force. An act of the Scotch parliament paſſed after the Revolution had extracted the chief ſting of that grievance, by placing the election of the miniſter of every pariſh in the hands of the landed proprietors, called heritors, in conjunction with the elders, or members of the kirk-ſeſſion. A majority of that joint body, at a meeting appointed for the purpoſe, drew up a *call* or written invitation, which they ſubſcribed, to a particular candidate to be their miniſter. This was preſented to the preſbytery of the bounds, the proper judges of his learning and moral character; and if theſe were found unexceptionable, he was ordained, or ſolemnly conſecrated and inſtalled into the office. This Scotch act having continued in force for twenty years, and being conceived to have become perpetual by the articles of the Union, was now repealed; and the choice of a miniſter to every pariſh was in effect placed in the power of a ſingle perſon, a patron, becauſe he had in fact the ſole power of nominating the only candidate who could enjoy the benefice.

Mr Wodrow was exceedingly averſe from the revival of the power of patronage; and in this he was influenced both by his political and religious principles. In his letters, he ſeems to have looked upon a patron of a pariſh, as a kind of hereditary deſpot; or at leaſt like a prince, who had no reſtraints laid on his prerogative, to prevent or check the abuſe of it. The paramount power or truſt committed to a patron, this conſcientious miniſter could not reconcile with the apoſtolical counſels, *to commit the keeping of religious truth to faithful men, able alſo to inſtruct others*. He thought it very improper to leave the choice of a religious inſtructor, in the firſt inſtance, to any ſingle perſon whatever, eſpecially to one generally a ſtranger to the circumſtances of the pariſhioners; one who had little knowledge, and therefore little ſympathy with them in their religious ſentiments and feelings. He was perſuaded that the purpoſes of edification, and the peace of the country, circumſtanced as Scotland then was, were Wodrow much better ſecured by the reſtraints laid on a patron in the act 1690, that is, by admitting the two principal bodies of the pariſh to a participation with him in his choice, than by truſting it wholly to himſelf; and he threw out many judicious hints in his letters, and even ſchemes or propoſals to his brethren, on this difficult and important ſubject.

On the other hand, he wiſhed nothing to be attempted but in a conſtitutional way, in harmony with the civil power. Few men were ſo ſenſible as he was of the abuſes incident to popular government, either in church or ſtate, and of the danger of reſiſting, even unjuſt and oppreſſive laws, in a tumultuous or diſorderly manner. The Preſbyterian church, in the outward order or form of it, he viewed as a well regulated republic. He did not conſider the people in their individual capacity, as qualified to vote even on the choice of their own miniſter. The elders of the pariſh he looked upon as the repreſentatives of the people in the eccleſiaſtical courts; and their number, in his own congregation, he reſtricted to a very few, four or five at moſt, fit to aſſiſt him in the exerciſe of church diſcipline within the pariſh. The reſt of his ſeſſion were deacons, whoſe juriſdiction was confined to the care of the poor, viſiting the ſick, and diſtributing the bread and wine at the communion, but could not, like the former, be choſen to repreſent the pariſh in the preſbytery and ſuperior courts. In this ſenſe of the neceſſity of order and ſubordination, he perſevered to the end of his life. When, contrary to *his* judgment or vote, an unpopular brother was to be ordained in a pariſh within twelve or fifteen miles diſtant from Eaſtwood, in conſequence of a ſentence of the General Aſſembly, to be executed, perhaps with military aſſiſtance; this aged miniſter thought it his duty, regardleſs of perſonal danger or odium, to countenance the young brother, by joining with the reſt of the clergy in laying their hands on him, inviting him afterwards to his pulpit, and exerting any influence he had to conciliate the irritated minds of that pariſh.

The only publication for which the world is indebted to Mr Wodrow, is The Hiſtory of the Singular Sufferings of the Church of Scotland during the twenty-eight years immediately preceding the Revolution. It was written at a proper diſtance of time from the events it records; and printed at Edinburgh in the year 1721, in two large folio volumes, with two appendixes conſiſting of copies of the public records, and of many private, family, and perſonal papers, letters, &c. inſerted as vouchers of the hiſtorical facts. In collecting this great body of information, the author was aſſiſted by his friends, who cheerfully ſeconded his own almoſt incredible induſtry and patience of reſearch. In conſequence of this, the book has more the appearance of a biographical, than of a hiſtorical work. It has, however, the form, and all the eſſentials of a regular hiſtory, divided into books, chapters, and ſections, with proper margins and indexes; written in a plain, rather too familiar ſtile, unavoidably interſperſed with Scoticiſms, yet theſe ſufficiently intelligible to an Engliſh reader. It exhibits a diſtinct ſketch of the characters both of the principal ſufferers, and of their perſecutors; of the ſprings of the perſecution, in the unjuſtifiable plans and meaſures of an arbitrary government; with the motives of the adviſers and executors of them. The unfortunate and innocent

innocent ſufferers, our author viewed in the light, not of a ſet of wild fanatics, as they were called by their contemporaries, and frequently too by later hiſtorians; many of them were moſt reſpectable for their rank in their country, as well as for their talents and virtues; but even thoſe in the lower ranks of ſociety, our author thought worthy of ſome public notice, as confeſſors and martyrs in the noble cauſe which they had eſpouſed, the ſupport of the rights of conſcience, and of national liberty.

The ſubject of the hiſtory is the moſt melancholy that could be choſen; a long and ſevere perſecution of a people, who had been guilty of nothing undutiful to their civil or eccleſiaſtical rulers; a ſeries of open acts of injuſtice and tyranny, perpetrated under the colour of law, and this with ſuch an increaſing and mercileſs violence, as to ſink the uſual ſpirit of a free people, and eaſily quaſh one or two feeble ill-timed attempts to reſiſt their oppreſſors. No wonder that the continued view of ſuch a wretched and melancholy ſcene, without any thing joyful to interrupt it, ſhould give a melancholy tinge to the mind of the writer, eaſily communicated to his readers. On the other hand, ſome things have happily an oppoſite tendency. The maſs of biographical intelligence, though it muſt be confeſſed it is much too voluminous, and too minute for the management of any hiſtorian whatſoever, yet furniſhes a variety of anecdotes, which give ſome needful relaxation or relief to the ſympathy of the reader. Theſe indeed are in part the *ſimple annals of the poor*, without the varniſh or eaſy elegance of poliſhed life; but even in this ſhape they are not deſtitute, both of entertainment and inſtruction; and then the minuteneſs in the detail of names, of perſons, places, and other particular circumſtances, adds to the impreſſion of the facts, by placing their certainty beyond all reaſonable doubt.

If faithfully to record paſt facts, and tranſmit the knowledge of them to poſterity, be the principal duty of a hiſtorian, this Wodrow has certainly aimed at; and alſo to repreſs any feelings hoſtile to his fidelity and impartiality; in ſhort, to come as near as he was able to the motto prefixed to his volumes, *Nec ſtudio, nec odio*. Doubtleſs, like all other men, he had ſome political, and many theological prejudices, the laſt chiefly imbibed from education, and confirmed by too high a veneration for the characters of our firſt reformers;—prejudices which warped his perſonal opinions and feelings on both ſubjects. But he ſeems to have made a conſiderable effort to prevent his party prejudices from warping or perverting his judgment of the truth or falſehood of ſtubborn hiſtorical facts. Nothing almoſt oratorial enters into his narratives, though there is room for admiration, and much ſcope for juſt indignation; no exaggerated encomiums on his friends, or ſtrong opprobrious language in ſpeaking of his and their enemies, the unprovoked perſecutors of his church. He allows the facts which he has recorded to ſpeak for both, and tranſmit to poſterity a memorial to their honour or their infamy.

The chief fault of this hiſtorical collection already hinted at, is its minuteneſs, and exceſſive copiouſneſs. The prodigious multitude of facts it embraces, though different from one another in their circumſtances, are in other reſpects ſomewhat ſimilar. This muſt neceſſarily occaſion ſome repetition and ſatiety, eſpecially to a faſtidious reader, who has it, however, in his power to gratify his taſte by ſelecting what is moſt agreeable to it. Nevertheleſs a candid and patient reader can be at no loſs to form a proper judgment of the principal tranſactions of the period, from the authentic accounts of them before him, to appreciate the true characters of the actors, or of the motives and views from which they acted. And an inquiſitive and penetrating reader will be gratified by ſeeing not a little of the peculiar principles, opinions, ſentiments, habits, and manners of that age, as diſtinguiſhed from the preſent; and may thus eſtimate the gradual progreſs towards much noble and uſeful improvement; and on the other hand, the progreſs towards a very hurtful corruption and degeneracy of manners, which have both taken place during the laſt hundred and twenty years.

At the time of its firſt publication, the book met with leſs general attention than might have been expected in Scotland, and ſcarcely any attention in England, except from profeſſed readers. As it came to be more ſtudied, it was the more valued, except where there was an evident bias on the oppoſite ſide. Few can be at a loſs to ſee why ſuch hiſtorians as Hume, Macpherſon, and Dalrymple ſhould neglect or undervalue ſuch a book. Our later Scotch hiſtorians, Somerville and Laing, have done it more juſtice. In truth, there is a very near coincidence in their eſtimates of the characters they draw, and their accounts of the facts they relate, in common with Wodrow. But eſpecially our late illuſtrious patriot Charles Fox, whoſe high abilities, uncommon candour, and ſweetneſs of diſpoſition, almoſt remove the ſuſpected bias of his party ſpirit—Mr Fox has, in the hiſtorical fragment publiſhed ſince his death, given a very honourable teſtimony to the fidelity and accuracy of our hiſtorian. After mentioning the execution of three females, he adds, page 131. "To relate all the inſtances of cruelty which occurred would be endleſs. But it may be neceſſary to remark, that no hiſtorical facts are better aſcertained, than the accounts of them which are to be found in Wodrow. In every inſtance, where there has been an opportunity of comparing theſe accounts with the records, and other authentic monuments, they appear to be quite correct."

The collection of the materials for writing the church hiſtory from the public records, and many other authentic ſources, muſt have coſt the author a prodigious labour and time. The pecuniary expence incurred was conſiderable, and ſcarcely refunded from the ſale of the book. The only neat profit, he has been heard to ſay, which accrued from it, was one or two hundred pounds that he received from the king, to whom it was dedicated.

The laſt twelve years of Mr Wodrow's life were chiefly occupied in drawing up a biography of the principal perſons concerned in introducing the reformation of religion into Scotland, and ſettling the different forms or modes of eccleſiaſtical government attempted to be eſtabliſhed there from the beginning to the end of that period, namely from about the year 1560 to 1660, when the printed hiſtory of the ſufferings commences. Had it pleaſed God to continue his uſeful life till this larger work was finiſhed, public curioſity would have been much gratified; for it contains the lives, not only of John Knox, George Buchanan, and others already well known, but the lives of a great number more, very learned, ingenious, reſpectable, and worthy men, ſcarce-

Wodrow. ly at all known to the literary world; beſides a variety of anecdotes naturally entering into ſuch a work, illuſtrative of the hiſtory and the living manners of that age. Happily theſe manuſcript lives are ſtill preſerved, all written with his own pen, and ſome of the longeſt of them copied, probably during his laſt long illneſs, in a more legible hand. Whatever important or curious information they may contain, they are not fit for the preſs in their preſent ſtate. They are now depoſited in the library of the univerſity of Glaſgow.

Beſides writing the hiſtory and the biography, both extended by himſelf for publication, and two days every week regularly appropriated to his preparation for the pulpit, much of his time muſt have been occaſionally ſpent in writing letters, ſome of them like diſſertations, on theological and other literary ſubjects; for he correſponded with a very wide circle of acquaintances and friends in Scotland, England, and Ireland, and with a few on the continent and in North America.

His conſtitution in the firſt part of life was robuſt and ſtrong, his health in general good; but his ſtudious habits or conſtant reading, and eſpecially inceſſant writing, it is ſuppoſed, may have brought on the bodily complaint which occaſioned his death. In the latter end of the year 1731, a ſwelling about the ſize of a ſmall cheſnut appeared on his breaſt, near the collar bone. It was on the ſame place where a ſpark of fire had fallen when he was a child, and had then left a little lump and hardneſs like a large pea. About a month after the ſwelling began, it had increaſed to the ſize of a plumb, and in April 1732 was as large as a man's fiſt. It was attempted to be removed by cauſtic; the attempt failed. His body became greatly emaciated, and he gradually declined till his death, which happened on the 21ſt of March 1734. Supported by the teſtimony of a good conſcience, joined with the ſtrong conſolation and well-founded hope of the goſpel, he bore this long-continued ſevere diſtreſs with admirable fortitude, unabated piety and reſignation; never uttering a murmur, but behaving to his friends who came to ſee him, and to all about him, with much eaſe and affection; thus leaving, both in the active exertions of a uſeful life, and in his patient ſufferings at the cloſe of it, a very edifying example to his family and his flock. The day before his death, he gathered his children around his bed, gave each of them his dying bleſſing, with counſels ſuitable to their ages and circumſtances; laſt of all two boys, neither of them four years old, too young to underſtand and feel theſe marks of his affection, yet, after the example of the venerable patriarch, Gen. xlviii. 15. even them he drew to him, laid his hands upon their heads, and devoutly prayed, *that the God of his fathers, the angel who had redeemed him from all evil, would bleſs the lads.*

Mr Wodrow was married in the end of 1708, to Margaret Warner, grand-daughter of the reverend Mr William Guthrie of Fenwick, well known in Scotland by his writings, and daughter of the reverend Patrick Warner, then living on his eſtate of Ardeer in Ayrſhire. Mr Warner, in the early part of his life, had been chaplain to the Eaſt India Company at Madras. After his return home, he was driven from his miniſtry and from the kingdom, by the perſecution of the privy council; but returned in conſequence of King James's indulgence, and became miniſter of Irvine. He had a perſonal interview on his laſt return with the prince of Orange at the Hague, a ſhort time before the Revolution, an account of which appears in the hiſtory, vol. ii. p. 604. Mr Wodrow had a family of 16 children, nine of whom, with his widow, ſurvived him in decent circumſtances, without any breach among them for above 25 years. Three of his ſons were clergymen of the church of Scotland; one was miniſter of the pariſh of Cumbray, another of Tarbolton; and the third, the late Dr James Wodrow, author of the life of Dr Leechman of Glaſgow, was miniſter of Stevenſton in Ayrſhire. Wodrow || Wolfe.

Beſides his collection of foſſils, and a few Roman and Britiſh medals, Mr Wodrow left a valuable library of books, many volumes of pamphlets and alſo of manuſcripts written by others, ſent to him in preſents, or copied by his orders. The moſt valuable part of them is now in the advocates library, and in the repoſitories of the church at Edinburgh. His own manuſcript biography, as has been already ſaid, is in the library of the univerſity of Glaſgow.

WOLAW, a town in Germany, in Sileſia, and capital of a duchy of the ſame name. It is ſurrounded with ſtrong walls and a moraſs, and one part of the houſes are built with ſtone. The caſtle is alſo encompaſſed with deep ditches, and the greateſt part of the inhabitants are employed in a woollen manufactory. In 1709 a Proteſtant church was allowed to be built here. It is ſeated on the river Oder, 20 miles north-weſt of Breſlau, and 32 ſouth-eaſt of Glogau. E. Long. 16. 54. N. Lat. 51. 18.

WOLD, WELD, *DYERS Weed.* See RESEDA, BOTANY *Index*, and DYEING.

WOLF. See CANIS, MAMMALIA *Index*.

WOLF-Fiſh, or *Sea-WOLF*. See ANARRHICAS, ICHTHYOLOGY *Index*.

WOLF or *Woolf Poiſon*. See POISON.

WOLFE, MAJOR-GENERAL JAMES, was born at Weſterham in the county of Kent, about the beginning of the year 1726. His father was Lieutenant-general Edward Wolfe. He went into the army when very young; and applying himſelf with unwearied aſſiduity to the ſtudy of his profeſſion, ſoon became remarkable for his knowledge and his genius. He diſtinguiſhed himſelf at the battle of Lafelt when little more than 20, and received the higheſt encomiums from the commander in chief. After the peace he ſtill continued to cultivate the art of war. He contrived to introduce the greateſt regularity and the exacteſt diſcipline into his corps, and at the ſame time to preſerve the affection of every ſoldier. In 1758 he was preſent as a brigadier-general at the ſiege of Louiſbourg. He landed firſt on the iſland at the head of diviſion; and in ſpite of the violence of the ſurf, and the force and well directed fire of the enemy, drove them from their poſt with great precipitation. The ſurrender of the town, which happened ſoon after, was in a great meaſure owing to his activity, bravery, and ſkill. The fame which he acquired during this ſiege pointed him out to Mr Pitt, who was then miniſter, as the propereſt perſon to command the army deſtined to attack Quebec. This was the moſt difficult and the moſt arduous undertaking of the whole war. Quebec was the capital of the French dominions in North America; it was well fortified, ſituated in the midſt of a hoſtile country, and defended by an army of 20,000 men, regulars and militia, beſides a conſiderable number of Indian allies. The troops deſtined for this expedition conſiſted of ten battalions, making up altogether about 7000 men. Such was the army

Wolfe. army deſtined to oppoſe three times their own number, defended by fortifications, in a country altogether unknown, and in a late ſeaſon in that climate for military operations. But this little army, ſays an officer who was preſent at that expedition, and who has been ſo obliging as to communicate all the information we deſired, was always ſanguine of ſucceſs; for they were commanded by General Wolfe, who, by a very uncommon magnanimity and nobleneſs of behaviour, had attached the troops ſo much to his perſon, and inſpired them with ſuch reſolution and ſteadineſs in the execution of their duty, that nothing ſeemed too difficult for them to accompliſh. The admirable ſkill with which his meaſures were planned, and the prudence and vigour with which they were executed, are well known. He landed his army on the northern ſhore of the river St Lawrence in ſpite of the enemy, and forced them to a battle, in which they were completely defeated. The conſequence of this battle was the reduction of Quebec, and the conqueſt of Canada. In the beginning of the battle General Wolfe was wounded in the wriſt by a muſket-ball: he wrapt his handkerchief round it, continued to give his orders with his uſual calmneſs and perſpicuity, and informed the ſoldiers that the advanced parties on the front had his orders to retire, and that they need not be ſurpriſed when it happened. Towards the end of the battle he received a new wound in the breaſt; he immediately retired behind the rear-rank ſupported by a grenadier, and laid himſelf down on the ground. Soon after a ſhout was heard; and one of the officers who ſtood by him exclaimed, "See how they run!" The dying hero aſked with ſome emotion, "Who run?" "The enemy (replied the officer); they give way every where." The general then ſaid, "Pray, do one of you run to Colonel Burton, and tell him to march Webb's regiment with all ſpeed down to Charles river, to cut off the retreat of the fugitives from the bridge. Now, God be praiſed, I ſhall die happy!" He then turned on his ſide, cloſed his eyes, and expired.

The death of General Wolfe was a national loſs univerſally lamented. He inherited from nature an animating fervour of ſentiment, an intuitive perception, an extenſive capacity, and a paſſion for glory, which ſtimulated him to acquire every ſpecies of military knowledge that ſtudy could comprehend, that actual ſervice could illuſtrate and confirm. This noble warmth of diſpoſition ſeldom fails to call forth and unfold all the liberal virtues of the ſoul. Brave above all eſtimation of danger; generous, gentle, complacent, and humane; the pattern of the officer, the darling of the ſoldier. There was a ſublimity in his genius which ſoared above the pitch of ordinary minds; and had his faculties been exerciſed to their full extent by opportunity and action, had his judgment been fully matured by age and experience, he would, without doubt, have rivalled in reputation the moſt celebrated captains of antiquity. His body was brought to England, and buried with military honours in Weſtminſter abbey, where a magnificent monument is erected to his memory.

WOLFE, *Chriſtian*, a celebrated German philoſopher, was born at Breſlau in 1679. After having been well inſtructed in the rudiments of learning and ſcience in his own country, Wolfe proſecuted his ſtudies ſucceſſively in the univerſities of Jena, Hamburgh, and Leipſic. At the age of 26 he had acquired ſo much diſtinction, that he was appointed profeſſor of mathematics, and ſoon afterwards of philoſophy in general, in the univerſity of Hall. After Leibnitz had publiſhed his *Theodicea*, Wolfe, ſtruck with the novelty of the edifice which that philoſopher had raiſed, aſſiduouſly laboured in the inveſtigation of new metaphyſical truths. He alſo digeſted the Elements of Mathematics in a new method, and attempted an improvement of the art of reaſoning, in a treatiſe On the Powers of the Human Underſtanding. Upon the foundation of Leibnitz's doctrine of Monads, he formed a new ſyſtem of Coſmology and Pneumatology, digeſted and demonſtrated in a mathematical method. This work, entitled Thoughts on God, the World, and the Human Soul, was publiſhed in the year 1719; to which were added, in a ſubſequent edition, Heads of Ethics and Policy.

Wolfe, Wolfenbuttle.

Wolfe was now riſing towards the ſummit of philoſophical reputation, when the opinion which he entertained on the doctrine of neceſſity being deemed by his colleagues inimical to religion, and an oration which he delivered in praiſe of the morality of the Chineſe having given much offence, an accuſation of hereſy was publicly brought againſt him; and, though he attempted to juſtify himſelf in a treatiſe which he wrote on the ſubject of fatality, a royal mandate was iſſued in November 1723, requiring him to leave the Pruſſian dominions. Having been formerly invited by the landgrave of Heſſe-Caſſel to fill a profeſſor's chair in the univerſity of Caſſel, Wolfe now put himſelf under the patronage of that prince, who had the liberality to afford him a ſecure aſylum, and appointed him profeſſor of mathematics and philoſophy. The queſtion concerning the grounds of the cenſure which had been paſſed upon Wolfe was now every where freely canvaſſed; almoſt every German univerſity was inflamed with diſputes on the ſubject of liberty and neceſſity; and the names of Wolfians and Anti-Wolfians were every where heard. After an interval of nine years, the king of Pruſſia reverſed his ſentence of exile, and appointed him vice-chancellor of the univerſity of Hall; where his return was welcomed with every expreſſion of triumph. From this time he was employed in completing his Inſtitutes of Philoſophy, which he lived to accompliſh in every branch except policy. In 1745 he was created a baron by the elector of Bavaria, and ſucceeded Ludowig in the office of chancellor of the univerſity. He continued to enjoy theſe honours till the year 1754, when he expired. He poſſeſſed a clear and methodical underſtanding; which, by long exerciſe in mathematical inveſtigations, was particularly fitted for the employment of digeſting the ſeveral branches of knowledge into regular ſyſtems; and his fertile powers of invention enabled him to enrich almoſt every field of ſcience in which he laboured, with ſome valuable additions. The lucid order which appears in all his writings enables his reader to follow his conceptions with eaſe and certainty, through the longeſt trains of reaſoning.

Enfield's Hiſtory of Philoſophy, vol. ii.

WOLFENBUTTLE, a conſiderable town of Germany, in the circle of Lower Saxony, and duchy of Brunſwick, with a caſtle where the duke of Brunſwick Wolfenbuttle reſides. It is one of the ſtrongeſt places in Germany, though the fortifications want repairing in ſeveral places. There is an excellent library, kept in a building lately erected for that purpoſe, conſiſting of 116,000 printed books, and 2000 uncommon books, with

Wolfenbuttle || Wolfey.

with a cabinet of curioſities, relating to natural hiſtory. It is ſeated on the river Ocker, five miles ſouth of Brunſwick, and 30 weſt of Halberſtadt. E. Long. 10. 42. N. Lat. 52. 18.

WOLFRAM, or TUNGSTEN. See TUNGSTEN, CHEMISTRY and MINERALOGY *Index*.

WOLFSPERG, a town of Germany, in Lower Carinthia, with a caſtle, on which the diſtrict about it depends, which is 20 miles in length, and 10 in breadth. It is ſeated on the river Lavand, at the foot of a mountain covered with wood, and full of wolves, from whence the town took its name. It is 36 miles eaſt of Clagenfurt. E. Long. 15. 0. N. Lat. 46. 56.

WOLGAST, a conſiderable town of Germany, in the circle of Upper Saxony, and in Pomerania, capital of a territory of the ſame name, with a caſtle, and one of the beſt and largeſt harbours on the Baltic ſea. It is a well built place, ſubject to Sweden, and ſeated on the river Pſin. E. Long. 14. 4. N. Lat. 54. 1.

WOLLASTON, WILLIAM, deſcended of an ancient family in Staffordſhire, was born in 1659. He was in 1674 admitted a penſioner in Sidney college, Cambridge, where, notwithſtanding ſeveral diſadvantages, he acquired a great degree of reputation. In 1682, ſeeing no proſpect of preferment, he became aſſiſtant to the head maſter of Birmingham ſchool. Some time after, he got a ſmall lecture about two miles diſtant, but did the duty the whole Sunday; which, together with the buſineſs of a great frec-ſchool for about four years, began to break his conſtitution. During this ſpace he likewiſe underwent a great deal of trouble and uneaſineſs, in order to extricate two of his brothers from ſome inconveniences, to which their own imprudence had ſubjected them. In 1688 affairs took a new turn. He found himſelf by a couſin's will entitled to a very ample eſtate: and came to London that ſame year, where he ſettled; chooſing a private, retired, and ſtudious life. Not long before his death, he publiſhed his treatiſe, entitled The Religion of Nature Delineated; a work for which ſo great a demand was made, that more than 10,000 were ſold in a very few years. He had ſcarcely completed the publication of it, when he unfortunately broke an arm; and this adding ſtrength to diſtempers that had been growing upon him for ſome time, accelerated his death; which happened upon the 29th of October 1724. He was a tender, humane, and in all reſpects worthy man; but is repreſented to have had ſomething of the iraſcible in his conſtitution and temperament. His Religion of Nature Delineated expoſed him to ſome cenſure, as if he had put a ſlight upon Chriſtianity, by laying ſo much ſtreſs, as he does in this work, upon the obligations of truth, reaſon, and virtue; and by making no mention of revealed religion. But this cenſure muſt have been the offſpring of ignorance or envy, ſince it appears from the introduction to his work, that he intended to treat of revealed religion in a ſecond part, which he lived not to finiſh.

WOLSEY, THOMAS, a famous cardinal and archbiſhop of York, is ſaid to have been the ſon of a butcher at Ipſwich. He ſtudied at Magdalen college, Oxford, where he became acquainted with the learned Eraſmus; and in the year 1500 became rector of Lymington in Somerſetſhire: he was afterwards made chaplain to King Henry VIII. and obtained ſeveral preferments. Having gradually acquired an entire aſcendency over the mind of Henry VIII. he ſucceſſively obtained ſeveral biſhoprics, and at length was made archbiſhop of York, lord high-chancellor of England, and prime miniſter; and was for ſeveral years the arbiter of Europe. Pope Leo X. created him cardinal in 1515, and made him *legate à latere*; and the emperor Charles V. and the French king Francis I. loaded him with favours, in order to gain him over to their intereſt; but after having firſt ſided with the emperor, he deſerted him to eſpouſe the intereſt of France. As his revenues were immenſe, his pride and oſtentation were carried to the greateſt height. He had 500 ſervants; among whom were 9 or 10 lords, 15 knights, and 40 eſquires. His ambition to be pope, his pride, his exactions, and his political delay of Henry's divorce, occaſioned his diſgrace. In the earlier part of his life he ſeems to have been licentious in his manners; it was reported, that ſoon after his preferment to the living of Lymington in Somerſetſhire, he was put into the ſtocks by Sir Amias Paulet, a neighbouring juſtice of the peace, for getting drunk and making a riot at a fair. This treatment Wolſey did not forget when he arrived at the high ſtation of lord-chancellor of England; but ſummoned his corrector up to London, and, after a ſevere reprimand, enjoined him ſix years cloſe confinement in the Temple. Whatever may have been his faults, there can be no doubt of their having been aggravated both by the zealous reformers and by the creatures of Henry VIII. who was himſelf neither Papiſt nor Proteſtant; for there is every reaſon to believe that the cardinal was ſincere in his religion; and ſincerity, or at leaſt conſiſtency, was then a crime. Wolſey was the patron of learned men; a judge and munificent encourager of the polite arts; and ought to be conſidered as the founder of Chriſt-church college, Oxford; where, as well as in other places, many remains of his magnificent ideas in architecture ſtill exiſt. He died in 1530.

Wolſey || Wood.

WOLVERENE. See URSUS, MAMMALIA *Index*.

WOLVES-TEETH, of a horſe. See FARRIERY.

WOMAN, the female of the human ſpecies. See HOMO.

WOMB, or UTERUS. See ANATOMY, N° 108.

WOMBAT, an animal lately diſcovered in New South Wales. See DASYURUS, MAMMALIA *Index*.

WOOD, ANTHONY, an eminent biographer and antiquarian, was the ſon of Thomas Wood, bachelor of arts and of the civil law, and was born at Oxford in 1632. He ſtudied at Merton college, and in 1655 took the degree of maſter of arts. He wrote, 1. The Hiſtory and Antiquities of the Univerſity of Oxford; which was afterwards tranſlated into Latin by Mr Waſe and Mr Peers, under the title of *Hiſtoria et Antiquitates Univerſitatis Oxonienſis*, 2 vols folio. 2. *Athenæ Oxonienſes*; or an exact Account of all the Writers and Biſhops who have had their education in the Univerſity of Oxford, from the Year 1500 to 1600, 2 vols folio; which was greatly enlarged in a ſecond edition publiſhed in 1721 by Biſhop Tanner. Upon the firſt publication of this work the author was attacked by the univerſity, in defence of Edward earl of Clarendon, lord high chancellor of England, and chancellor of the univerſity, and was likewiſe animadverted upon by Biſhop Burnet; upon which he publiſhed a Vindication of the Hiſtoriographer of the Univerſity of Oxford. He died at Oxford in 1695.

Wood. WOOD, a ſubſtance whereof the trunks and branches of trees conſiſts. It is compoſed of a number of concentric circles or zones, one of which is formed every year; conſequently their number correſponds to the age of the tree. Theſe zones vary in thickneſs according to the degree of vegetation that took place the year of their formation. They are alſo of different degrees of thickneſs in different parts, that part of the tree which is moſt expoſed to the ſun and beſt ſheltered growing faſteſt; hence in this country that part of the zone which looked towards the ſouth while the tree was growing is generally thickeſt. The innermoſt circle or zone is the one which was firſt formed, the outermoſt was formed the year before the tree was cut down. Theſe zones are at firſt very ſoft and tender, and harden by degrees as the tree becomes older: this is the reaſon that the middle of a tree is ſo often much better wood than the outſide of it.

The proper ligneous part of the wood conſiſts of longitudinal fibres, diſpoſed in faſciculi, and poſſeſſed of conſiderable hardneſs. It is this longitudinal direction of the fibres that renders it ſo much eaſier to cleave wood lengthwiſe, than acroſs the tree, or in any other direction. See PLANT and VEGETABLE PHYSIOLOGY.

For an account of the ingredients which enter into the compoſition of wood, ſee CHEMISTRY *Index*.

For the *Method of Staining or Dyeing Wood*, ſee TURNING.

For more complete information concerning wood, ſee alſo TREE, and *STRENGTH of Materials*.

Foſſil WOOD. Foſſil wood, or whole trees, or parts of them, are very frequently found buried in the earth, and that in different ſtrata; ſometimes in ſtone, but more uſually in earth; and ſometimes in ſmall pieces looſe among the gravel. Theſe, according to the time they have lain in the earth, or the matter they have lain among, are found differently altered from their original ſtate; ſome of them having ſuffered very little change; and others being ſo highly impregnated with cryſtalline, ſparry, pyritical, or other extraneous matter, as to appear mere maſſes of ſtone, or lumps of the common matter of the pyrites, &c. of the dimenſions, and, more or leſs, of the internal figure, of the vegetable bodies into the pores of which they have made their way.

The foſſil woods have been arranged by Dr Hill into three kinds: 1. The leſs altered; 2. The pyritical; and, 3. The petrified.

Of the trees, or parts of them, leſs altered from their original ſtate, the greateſt ſtore is found in digging to ſmall depths in bogs, and among what is called *peat* or *turf earth*, a ſubſtance uſed in many parts of the kingdom for fuel. In digging among this, uſually very near the ſurface, immenſe quantities of vegetable matter of various kinds are found buried; in ſome places there are whole trees ſcarce altered, except in colour; the oaks in particular being uſually turned to a jetty black; the pines and firs, which are alſo very frequent, are leſs altered, and are as inflammable as ever, and often contain between the bark and wood a black reſin. Large parts of trees have alſo been not unfrequently met with unaltered in beds of another kind, and at much greater depths, as in ſtrata of clay and loam, among gravel, and ſometimes even in ſolid ſtone.

Beſides theſe harder parts of trees, there are frequently found alſo in the peat earth vaſt quantities of the leaves and fruit and catkins of the hazel and ſimilar trees; theſe are uſually mixed with ſedge and roots of graſs, and are ſcarce at all altered from their uſual texture. The moſt common of theſe are hazel nuts; but there are frequently found alſo the twigs and leaves of the white poplar; and a little deeper uſually there lies a cracked and ſhattered wood, the crevices of which are full of a bituminous black matter: and among this the ſtones of plums and other ſtone-fruits are ſometimes found, but more rarely. Wood.

In this ſtate the fruits and larger parts of trees are uſually found: what we find of them more altered, are ſometimes large and long, ſometimes ſmaller and ſhorter branches of trees; ſometimes ſmall fragments of branches, and more frequently ſmall ſhapeleſs pieces of wood. The larger and longer branches are uſually found bedded in the ſtrata of ſtone, and are more or leſs altered into the nature of the ſtratum they lie in. The ſhorter and ſmaller branches are found in vaſt variety in the ſtrata of blue clay uſed for making tiles in the neighbourhood of London. Theſe are prodigiouſly plentiful in all the clay-pits of this kind, and uſually carry the whole external reſemblance of what they once were, but nothing of the inner ſtructure; their pores being wholly filled, and undiſtinguiſhably cloſed, by the matter of the common pyrites, ſo as to appear mere ſimple maſſes of that matter. Theſe fall to pieces on being long expoſed to moiſture; and are ſo impregnated with vitriol that they are what is principally uſed for making the green vitriol or copperas at Deptford and other places.

The irregular maſſes or fragments of petrified wood are principally of oak, and are moſt uſually found among gravel; though ſometimes in other ſtrata. Theſe are variouſly altered by the inſinuation of cryſtalline and ſtony particles; and make a very beautiful figure when cut and poliſhed, as they uſually keep the regular grain of the wood, and ſhow exactly the ſeveral circles which mark the different years growth. Theſe, according to the different matter which has filled their pores, aſſume various colours, and the appearance of the various foſſils that have impregnated them; ſome are perfectly white, and but moderately hard; others of a browniſh black, or perfectly black, and much harder; others of a reddiſh black, others yellowiſh, and others grayiſh, and ſome of a ferruginous colour. They are of different weights alſo and hardneſſes, according to the nature and quantity of the ſtoney particles they contain: of theſe ſome pieces have been found with every pore filled with pure pellucid cryſtal; and others in large maſſes, part of which is wholly petrified and ſeems mere ſtone, while the reſt is crumbly and is unaltered wood. That this alteration is made in wood, even at this time, is alſo abundantly proved by the inſtances of wood being put into the hollows of mines, as props and ſupports to the roofs, which is found after a number of years as truly petrified as that which is dug up from the natural ſtrata of the earth. In the pieces of petrified wood found in Germany, there are frequently veins of ſpar or of pure cryſtal, ſometimes of earthy ſubſtances, and often of the matter of the common pebbles: theſe fragments of wood ſometimes have the appearance of parts of the branches of trees in their natural ſtate, but more frequently they reſemble pieces of broken boards; theſe are uſually capable of a high and elegant poliſh.

Many

Wood. Many ſubſtances, it is certain, have been preſerved in the cabinets of collectors, under the title of *petrified wood*, which have very little right to that name. But where the whole outer figure of the wood, the exact lineaments of the bark, or the fibrous and fiſtular texture of the ſtriæ, and the veſtiges of the utriculi and tracheæ or air-veſſels, are yet remaining, and the ſeveral circles yet viſible which denoted the ſeveral years growth of the tree, none can deny theſe ſubſtances to be real foſſil wood. See PETRIFACTION.

Dr Parry of Bath has recently inveſtigated the cauſes of the decay of wood, and the means of preventing it. For this purpoſe he recommends the application of a preparation of the reſinous kind, mixed with a certain portion of bees-wax. The proportion of the ingredients and the mode of mixing them are as follows: Take 12 ounces of roſin and 8 ounces of roll brimſtone, each coarſely powdered, and 3 gallons of train oil; heat them ſlowly, gradually adding 4 ounces of bees-wax, cut into ſmall bits. Frequently ſtir the liquor, which, as ſoon as the ſolid ingredients are diſſolved, will be fit for uſe. It is recommended to dreſs every part of the wood-work with this compoſition twice over before the parts are put together, and once afterwards; and a higher ſtate of preſervation is promiſed from its uſe than has yet been attained. It ſhould be obſerved, that in preparing this varniſh, it is adviſable, in order to prevent accidents, to uſe an earthen veſſel, and to make the fire in the open air.

WOOD (*ſylva*), in *Ancient Geography*, a multitude of trees extended over a large continued tract of land, and propagated without culture. The generality of woods only conſiſt of trees of one kind.—The ancient Saxons had ſuch a veneration for woods, that they made them ſanctuaries.—It is ordained, that none ſhall deſtroy any wood, by turning it into tillage or paſture, &c. where there are two acres or more in quantity, on pain of forfeiting 40s. an acre, by 35 Henry VIII. c. 17. All woods that are felled at 14 years growth, are to be preſerved from deſtruction for eight years; and no cattle put into the ground till five years after the felling thereof, &c. 13 Eliz. c. 25. The burning of woods or underwood is declared to be felony; alſo thoſe perſons that maliciouſly cut or ſpoil timber-trees, or any fruit-trees, &c. ſhall be ſent to the houſe of correction, there to be kept three months, and whipt once a month.

WOOD, *Engraving on*, is commonly executed on box; and in many caſes, engravings of this kind are uſed with advantage inſtead of copperplates. The art of cutting or engraving on wood is of very high antiquity; for Chineſe printing is a ſpecimen of it. Even in Europe, if credit be due to Papillon, this art was practiſed at a very remote period; for he mentions eight engravings on wood, entitled, "A repreſentation of the warlike actions of the great and magnanimous Macedonian king, the bold and valiant Alexander; dedicated, preſented, and humbly offered, to the moſt holy father, Pope Honorius IV. by us Alexander Arberic Cunio Chevalier, and Iſabella Cunio, &c." This anecdote, if true, carries the art of cutting in wood back to 1284 or 1285; for Honorius occupied the papal throne only during theſe two years. But this is not the remoteſt period to which ſome have carried the art in Europe: for the uſe of ſeals or ſignets being of very high antiquity, they imagine that the invention of wood-cuts muſt be coeval with them. The ſuppoſition is certainly plauſible, but it is not ſupported by proof. The earlieſt impreſſion of a wooden-cut, of which there is any certain account, is that of St Chriſtopher carrying an infant Jeſus through the ſea, in which a hermit is ſeen holding up a lanthorn to ſhew him the way; and a peaſant, with a ſack on his back, climbing a hill, is exhibited in the back ground. The date of this impreſſion is 1423. In the year 1430 was printed at Haerlem, "The hiſtory of St John the evangeliſt and his revelation, repreſented in 48 figures in wood, by Lowrent Janſon Coſter;" and, in 1438, Jorg Schappf of Augſburg cut in wood the hiſtory of the Apocalypſe, and what was called *The poor man's bible*.

A folio chronicle, publiſhed 1493 by Schedal, was adorned with a great number of wooden-cuts by William Plydenwurff and Michael Wolgemut, whoſe engravings were greatly ſuperior to any thing of the kind which had appeared before them. The latter was the preceptor of Albert Durer, whoſe admirable performances in this department of art are juſtly held in the higheſt eſteem even at the preſent day.

About this period it became the practice of almoſt all the German engravers on copper to engrave likewiſe on wood; and many of their wood cuts ſurpaſs in beauty the impreſſions of their copperplates. Such are the wood-cuts of Albert Aldtorfer, Hiſbel Pen, Virgil Soles, Lucas Van Cranach, and Lucas Van Leyden, the friend and imitator of Albert Durer, with ſeveral others.

The Germans carried this art to a great degree of perfection. Hans or John Holbein, who flouriſhed in 1500, engraved the *Dance of Death*, in a ſeries of wooden-cuts, which, for the freedom and delicacy of execution, have ſcarcely been equalled, and never ſurpaſſed. Italy, France, and Holland, have produced capital artiſts of this kind. Joan. Tornæſium printed a bible at Leyden, in 1554, with wooden-cuts of excellent workmanſhip. Chriſtopher Jegher of Antwerp, from his eminence in the art, was employed by Rubens to work under his inſpection, and he executed ſeveral pieces which are held in much eſtimation; they are particularly diſtinguiſhed for boldneſs and ſpirit.

The next attempt at improvement in this art was by Hugo da Carpi, to whom is attributed the invention of the *chiaro ſcuro*. Carpia was an Italian, and of the 16th century; but the Germans claim the invention alſo, and produce in evidence ſeveral engravings by Mair, a diſciple of Martin Schoen, of date 1499. His mode of performing this was very ſimple. He firſt engraved the ſubject upon copper, and finiſhed it as much as the artiſts of his time uſually did. He then prepared a block of wood, upon which he cut out the extreme lights, and then impreſſed it upon the print; by which means a faint tint was added to all the reſt of the piece, excepting only in thoſe parts where the lights were meant to predominate, which appear on the ſpecimens extant to be coloured with white paint. The drawings for this ſpecies of engraving were made on tinted paper with a pen, and the lights were drawn upon the paper with white paint.

But there is a material difference between the chiaro ſcuro of the old German maſters and that of the Italians. Mair and Cranach engraved the outlines and deep

Wood. deep ſhadows upon copper. The impreſſion taken in this ſtate was tinted over by means of a ſingle block of wood, with thoſe parts hollowed out which were deſigned to be left white upon the print. On the contrary, the mode of engraving by Hugo da Carpi was, to cut the outline on one block of wood, the dark ſhadows upon a ſecond, and the light ſhadows, or half-tint, upon a third. The firſt being impreſſed upon the paper, the outlines only appeared: this block being taken away, the ſecond was put in its place, and being alſo impreſſed on the paper, the dark ſhadows were added to the outlines; and the third block being put in the ſame place upon the removal of the ſecond, and alſo impreſſed upon the paper, made the dim tints, when the print was completed. In ſome inſtances, the number of blocks was increaſed, but the operation was ſtill the ſame, the print receiving an impreſſion from every block.

In 1698, John Baptiſt Michel Papillon practiſed engraving on wood with much ſucceſs, particularly in ornamental foliage and flowers, ſhells, &c. In the opinion, however, of ſome of the moſt eminent artiſts, his performances are ſtiff and cramped. From that period the art of engraving on wood gradually degenerated, and may be ſaid to have been wholly loſt, when it was lately re-invented by Mr Bewick of Newcaſtle. This eminent artiſt was apprentice to Mr Bielby, a reſpectable engraver on metal. Mr Bielby, who was accuſtomed to employ his apprentices in engraving on wood, was much gratified with the performance of Thomas Bewick, and therefore adviſed him to proſecute engraving in that line. The advice was followed; and young Bewick inventing tools, even making them with his own hands, and ſawing the wood on which he was to work into the requiſite thickneſs, proceeded to improve upon his own diſcoveries, without aſſiſtance or inſtruction of any kind. When his apprenticeſhip expired, he went to London, where the obſcure wood-engravers of the time wiſhed to avail themſelves of his abilities, while they were determined to give him no inſight into their art. During his apprenticeſhip, he received from the Society for the Encouragement of Arts, &c. a premium of conſiderable value for the beſt engraving on wood. The cut which obtained the premium was one of a ſeries for an edition of Gay's Fables. Having remained ſome years in London, he returned to Newcaſtle, and entered into copartnerſhip with his old maſter; and eſtabliſhed his reputation as an artiſt by the publication of his admirable Hiſtory of Quadrupeds. This was followed by his Hiſtory of Birds, in 2 vols. The greater part of the volume on Quadrupeds, and the whole of the firſt volume of the work on Birds, was compoſed by Mr Bielby.

John Bewick, brother to Thomas, learned the art of him, and practiſed it for ſeveral years in London with great applauſe. His abilities, however, though reſpectable, were not, by the beſt judges, deemed ſo brilliant as his brother's; and owing to bad health, and the nature of his connection with the bookſellers and others, he ſeems not to have advanced the art beyond the ſtage at which he received it. He died, ſome years ago, at Newcaſtle.

Mr Neſbit, who executed the admirable cuts from deſigns by Thornton, for an edition of Hudibras, as well as the cuts for editions of Shakeſpeare and Thomſon's Seaſons, and Mr Anderſon, whoſe beautiful cuts adorn the poem entitled *Grove Hill*, have been the moſt ſucceſsful of Thomas Bewick's pupils, who have appeared before the public as artiſts. It appears, that the method practiſed by the ancient engravers on wood, whoſe works are ſtill admired, muſt have been different from that of Bewick and his pupils. What that method was ſeems to be altogether unknown. Papillon, who writes the beſt hiſtory extant of the art, gueſſes indeed in what manner the old engravers proceeded, ſo as to give to their works the ſpirit and freedom for which they are famed; but that his gueſſes are erroneous ſeems evident from the ſtiffneſs of his own works. The principal characteriſtic in the mechanical department of the productions of the ancient maſters is the croſſing of the black lines, which Papillon has attempted with the greateſt awkwardneſs, though it ſeems to have been accompliſhed by them with ſo much eaſe, that they introduced it at random, even where it could add nothing to the beauty of the piece. In Bewick's method of working, this croſs hatching is ſo difficult and unnatural, that it may be conſidered as impracticable. Mr Neſbit has indeed introduced ſomething of it into two or three of his pieces; but ſo great was the labour, and ſo little the advantage of this improvement, if ſuch it can be called, that probably it will not be attempted again. Wood.

The engravers of Bewick's ſchool work on the end of the wood, which is cut acroſs the trunk of the tree, in pieces of the proper thickneſs. As wood cuts are generally employed in the printer's preſs amidſt a form of types, this thickneſs muſt be regulated by the height of the types with which they are to be uſed. The tools employed are nearly the ſame with thoſe uſed in copperplate engraving, being only a little more deep, or lozenge, as engravers call it. They muſt have points of various degrees of fineneſs for the different purpoſes to which they are applied, ſome of them being ſo much rounded off at the bottom as to approach to the nature of a goodge, whilſt others are in fact little chiſſels of various ſizes. Theſe chiſſels and goodges, to which every artiſt gives the ſhape which he deems moſt convenient, are held in the hand in a manner ſomewhat different from the tool of the engraver on copper, it being neceſſary to have the power of lifting the chips upwards with eaſe. To attempt a deſcription of this in writing would be in vain; but it is eaſily acquired, we are told, by practice.

The pupils of the ſchool of Bewick conſider it as quite improper to ſpeak of his invention as a revival of the ancient art. Some old prints, it is true, have the appearance of being executed in the ſame way with his; but others have certainly been done by a method very different. It is therefore not fair to appreciate the preſent art by what has been done, but by what may be done; and that remains yet to be ſhewn. The art is in its infancy; and thoſe who are diſpoſed to compare it with the art of engraving on copper, ought to look back to the period when copperplate engraving was of as recent invention as Bewick's method of engraving on wood. Marc Antonio, who engraved under the direction of the great painter Raphael, thought it no mean proof of his proficiency in his art, that he was able to imitate on copperplates the wood-cuts of Albert Durer; and Papillon is highly indignant that there ſhould have been perſons ſo very blind as to miſtake the copies for the originals. If copper has its ad-

Wood. vantages over wood in point of delicacy and minuteneſs, wood has, in its turn, advantages not inferior in regard to ſtrength and richneſs. Thoſe prints which were executed under the auſpices of Titian and Rubens, will always remain a monument of the ſpirit and vigour natural to wood-engraving; and if there be not found in them all the attention to chiaro ſcuro, which the preſent age demands, it muſt not be attributed either to defect in the art, or to want of abilities in the artiſts, but to the taſte of the times, when chiaro ſcuro was little underſtood. It remains for ſome enterpriſing artiſt to ſhew that the vigour of the ancient art may be attained by the preſent one, and at the ſame time to add to that vigour thoſe gradations of ſhade which are ſo much admired in good copperplates. As there ſeems to be a more perfect, or at leaſt a more pleaſant black produced by wood than by copperplate printing, and certainly a more perfect white (A), who will ſay that any intermediate ſhade whatever may not be produced by wood cuts? To attempt this on a ſmall ſcale would indeed be vain, becauſe the ſlighteſt variation, produced by a little more or leſs ink, or a harder preſſure in printing, bears ſuch a proportion to a very ſhort line, as muſt neceſſarily render the attempt abortive.

Wood-engraving, therefore, muſt always appear to diſadvantage while it is confined to ſmall ſubjects, and will never reach its ſtation *as a fine art*, till thoſe who are engaged in its cultivation improve upon the diſcoveries of one another, and apply to ſubjects to which it is properly adapted. As an *economical art* for illuſtrating mechanics, various branches of natural hiſtory, and other ſubjects of ſcience, it is too little employed even in its preſent ſtate.

The works of Bewick and his pupils, which have hitherto been publiſhed, are not numerous. Beſides his quadrupeds and birds, the Hudibras, and the cuts for ſome editions of Shakeſpeare and Thomſon's Seaſons, by Neſbit, and the Grove Hill by Anderſon, already noticed, there are alſo ſome others of leſs note.—Goldſmith's Traveller and Deſerted Village with elegant plates, are all executed by Thomas Bewick, except one or two which were executed by John; Somerville's Chace by the ſame artiſts, executed in a ſtyle of elegance which perhaps has never been ſurpaſſed; a View of St Nicholas's Church, Newcaſtle, 15 inches long, by Mr Neſbit, who received for it a ſilver medal from the Society for the Encouragement of Arts.

Wood, Rotten, Illumination of. This is a ſubject which has often been diſcuſſed by naturaliſts. Spallanzani maintained, that there is a perfect analogy between the illumination of rotten wood, and artificial phoſphorus; and he imagines, that in the putrid fermentation, the hydrogen and the carbone of the wood come more eaſily in contact with the oxygen of the atmoſphere, by which combination a ſlow combuſtion, and the illumination of the wood, is produced; and he thinks that this proceſs cannot proceed in the irreſpirable kinds of gaſes. Rotten wood alſo, in which the neceſſary quantity of hydrogen and carbone is not at the ſame time diſengaged, does not obtain the property of illuminating. Mr Corradori, however, objects to this theory, that the ſlow combuſtion does not take place according to the above theory, as the wood, at the time when it begins to illuminate, is moſtly deprived of its reſinous particles, and conſequently contains but very little hydrogen and carbone; and it appears to him more probable, that the more it loſes of combuſtible matter, the more it obtains the property of illuminating. There is, he thinks, a very great difference between this natural and the artificial phoſphorus. Mr Humboldt concludes, from his experiments, that the illumination of rotten wood takes place only when it gets into contact with oxygen; and when it has loſt the property of emitting light in irreſpirable gaſes, it recovers it again by expoſing it to oxygen gas. Dr Gartner, however, is of opinion, that, according to his experiments, a certain degree of humidity is always requiſite, and he thinks that oxygen gas is not quite neceſſary though the illumination be increaſed by it. This phenomenon, however, being ſo very different from all known proceſſes of combuſtion, where light is diſengaged, Dr Gartner aſks, whether it be not more agreeing with the animal proceſs of reſpiration, than with a true combuſtion, or whether the illumination of the wood be produced by phoſphorus and carbone in a proportion hitherto unknown. Dr Gartner is, on the whole, inclined to think, that it is at preſent impoſſible to give a ſatisfactory explanation of all the phenomena that occur in this proceſs. Beckmann has made numerous experiments on the illumination of rotten wood, in different gaſes and fluids, in order to throw ſome light on the ideas of the above naturaliſts. The reſults of theſe experiments differ in ſome points from what the experiments of thoſe gentlemen have ſhewn, which, however, Beckmann aſcribes to the nature of rotten wood, as a ſubſtance that is not always of the ſame kind, and has not always an equal degree of putrefaction and humidity. It ſeems alſo to differ materially from the artificial phoſphorus in the following particulars. 1. It ſhines in oxygen gas at a very low temperature. 2. It emits light in all irreſpirable gaſes, at leaſt for a ſhort time. 3. In muriatic acid gas its light is ſuddenly extinguiſhed. 4. It ſhines in a leſs degree in air rarefied by the air-pump. 5. According to Mr Corradori, it even ſhines in the torricellian vacuum. 6. Its illumination is extinguiſhed in oxygen gas, as well as in other kinds of gaſes, when they are heated. 7. By its illumination in oxygen gas, carbonic acid gas is produced. 8. One may ſuffer the rotten wood to be extinguiſhed ſeveral times, one after another, in irreſpirable gaſes, without depriving them of the property of making new pieces of rotten wood ſhine again. 9. Humidity greatly promotes the illumination, and even ſeems to be neceſſary in producing it. 10. The rotten wood continues to ſhine under water, oil, and other fluids, and in ſome of them its light is even increaſed. All this ſeems to ſhew, that the extinction of rotten wood, in different media, does not immediately depend on a want of oxygen, but rather on a particular change, to which the wood itſelf has been expoſed.

Wood || Wood-louſe.

Wood-Cock. See Scolopax, Ornithology *Index.*

Wood-Goat. See Capra, Mammalia *Index.*

Wood-Louſe. See Oniscus, Entomology *Index.*

Wood-

(A) The parts of the print intended to be white are not even touched by the wood block.

Wood-pecker || Wool.

WOOD-Pecker. See PICUS, ORNITHOLOGY *Index.*

WOODMOTE. See *FOREST Courts.*

WOODSTOCK, a town of Oxfordſhire, in England, pleaſantly ſeated on a riſing ground, and on a rivulet; a well compacted borough-town, and ſends two members to parliament; but is chiefly noted for Blenheim-houſe, a fine palace, built in memory of the victory obtained by the duke of Marlborough over the French and Bavarians in Auguſt 1704. It was erected at the public expence, and is one of the nobleſt ſeats in Europe. One of the paſſages to it is over a bridge with one arch, 190 feet in diameter, reſembling the Rialto at Venice. The gardens take up 100 acres of ground; and the offices, which are very grand, have room enough to accommodate 300 people. The apartments of the palace are magnificently furniſhed; and the ſtaircaſes, ſtatues, paintings, and tapeſtry, ſurpriſingly fine. The town is about half a mile from the palace, having ſeveral good inns; and a manufacture of ſteel chains for watches, and excellent gloves. A ſteel chain has been made at this place which ſold for 170l.—The population is eſtimated at 1300 perſons. It is eight miles north of Oxford, and 60 weſt-north-weſt of London. W. Long. 1. 15. N. Lat. 51. 52.

WOODWARD, DR JOHN, was born in 1665, and educated at a country ſchool, where he learned the Latin and Greek languages, and was afterwards ſent to London, where he is ſaid to have been put apprentice to a linen-draper. He was not long in that ſtation, till he became acquainted with Dr Peter Barwick, an eminent phyſician, who took him under his tuition and into his family. Here he proſecuted with great vigour and ſucceſs the ſtudy of philoſophy, anatomy, and phyſic. In 1692, Dr Stillingfleet quitting the place of profeſſor of phyſic in Greſham college, our author was choſen to ſucceed him, and the year following was elected F. R. S. In 1695 he obtained the degree of M. D. by patent from Archbiſhop Tenniſon; and the ſame year he publiſhed his Eſſay towards a Natural Hiſtory of the Earth. He afterwards wrote many other pieces, which have been well received by the learned world. He founded a lecture in the univerſity of Cambridge, to be read there upon his Eſſay, &c. and handſomely endowed it. He died in 1728.

WOOF, among manufacturers, the threads which the weavers ſhoot acroſs with an inſtrument called the *ſhuttle.* See CLOTH.

WOOKEY or *OKEY Hole*, a remarkable cavern two miles from the city of Wells in Somerſetſhire; for an account of which, ſee the article GROTTO.

WOOL, the covering of ſheep. See OVIS and SHEEP.

Wool reſembles hair in a great many particulars; but beſides its fineneſs, which conſtitutes an obvious difference, there are other particulars which may ſerve alſo to diſtinguiſh them from one another. Wool, like the hair of horſes, cattle, and moſt other animals, completes its growth in a year, and then falls off as hair does, and is ſucceeded by a freſh crop. It differs from hair, however, in the uniformity of its growth, and the regularity of its ſhedding. Every filament of wool ſeems to keep exact pace with another in the ſame part of the body of the animal; the whole crop ſprings up at once; the whole advances uniformly together; the whole looſens from the ſkin nearly at the ſame period, and thus falls off, if not previouſly ſhorn, leaving the animal covered with a ſhort coat of young wool, which in its turn undergoes the ſame regular mutations. Wool.

, vol. i. p. 57.

Hairs are commonly of the ſame thickneſs in every part; but wool conſtantly varies in thickneſs in different parts, being generally thicker at the points than at the roots. That part of the fleece of ſheep which grows during the winter is finer than what grows in ſummer. This was firſt obſerved by Dr Anderſon, the editor of the Bee, and publiſhed in his *Obſervations on the Means of exciting a Spirit of National Induſtry.*

While the wool remains in the ſtate it was firſt ſhorn off the ſheep's back, and not ſorted into its different kinds, it is called *fleece.* Each fleece conſiſts of wool of divers qualities and degrees of fineneſs, which the dealers therein take care to ſeparate. The French and Engliſh uſually ſeparate each fleece into three ſorts, viz. 1. Mother-wool, which is that of the back and neck. 2. The wool of the tails and legs. 3. That of the breaſt and under the belly. The Spaniards make the like diviſion into three ſorts, which they call *prime, ſecond* and *third;* and for the greater eaſe, mark each bale or pack with a capital letter, denoting the ſort. If the triage or ſeparation be well made, in 15 bales there will be 12 marked R, that is, refine, or prime; two marked F, for fine, or ſecond; and one S, for thirds.

The wools moſt eſteemed are the Engliſh, chiefly thoſe about Leominſter, Cotſwold, and the iſle of Wight; the Spaniſh, principally thoſe about Segovia; and the French, about Berry: which laſt are ſaid to have this peculiar property, that they will knot or bind with any other ſort; whereas the reſt will only knot with their own kind.

Among the ancients, the wools of Attica, Megara, Laodicea, Apulia, and eſpecially thoſe of Tarentum, Parma, and Altino, were the moſt valued. Varro aſſures us, that the people there uſed to clothe their ſheep with ſkins, to ſecure the wool from being damaged.

Of late a great deal of attention has been paid to wool in this country, as well as ſeveral others. Several very ſpirited attempts have been made to improve it, by introducing ſuperior breeds of ſheep, and better methods of managing them. For this purpoſe has been formed the

Britiſh WOOL Society, an aſſociation formed for the purpoſe of obtaining the beſt breeds of fine-woolled ſheep, with a view of aſcertaining, by actual experiments, how far each ſpecies or variety is calculated for the climate of Great Britain; the qualities of their wool reſpectively; the uſes to which each kind of wool could be moſt profitably employed in different manufactures; and the comparative value of each ſpecies of ſheep, ſo far as the ſame can be determined.

Attention had for ſome time been paid by the Highland Society to a famous breed of fine-woolled ſheep in Shetland; but it occurred to Sir John Sinclair of Ulbſter, baronet, and to Dr James Anderſon, well known as the author of many uſeful publications, that the improvement of Britiſh wool was a matter of too much importance to be entruſted to a ſociety which is obliged to devote its attention to ſuch a variety of objects as the general improvement of the Highlands of Scotland. The latter of theſe gentlemen, therefore, in an Appendix to the Report of the Committee of the Highland

Wool. Society of Scotland, for the year 1790, propoſed *the plan of a patriotic aſſociation for the improvement of Britiſh wool;* and the former, who was convener of the committee to whom the ſubject of Shetland wool had been referred, wrote circular letters, recommending the plan. The conſequence of which was, that on the 31ſt of January 1791, ſeveral noblemen and gentlemen of the higheſt reſpectability met in Edinburgh, and conſtituted themſelves into a *Society for the Improvement of Britiſh Wool.* Of this ſociety Sir John Sinclair was elected preſident; after which, in an excellent ſpeech, he pointed out to the members the objects of the inſtitution, the means by which thoſe objects could be attained, and the advantages which would reſult from their united labours. This addreſs was afterwards printed by order of the ſociety.

The particular breeds of ſheep to which the ſociety propoſed to direct its attention, were ſheep for the hilly parts of Scotland; ſheep for the plains, or the Lowland breed; and ſheep for the iſlands. They were to try experiments alſo with ſheep from foreign countries, diſtinguiſhed by any particular property.

The principal objects which the members had in view, during the firſt year of their aſſociation, were, 1. To collect ſpecimens of the beſt breeds which Great Britain at that period afforded, in order to aſcertain the degree of perfection to which ſheep had already been brought in this kingdom. 2. To procure from every country, diſtinguiſhed for the quality of its ſheep and wool, ſpecimens of the different breeds it poſſeſſed, in order to aſcertain how far the original breed, or a mixed breed from it and the native ſheep of the country, could thrive in Scotland. 3. To diſperſe as much as poſſible all theſe breeds, both foreign and domeſtic, over the whole kingdom, wherever proper perſons could be found to take charge of them, in order to try experiments on a more extenſive ſcale than the ſociety itſelf could do; to ſpread information, and to excite a ſpirit for the improvement of ſheep and wool in every part of the country.

Sir John Sinclair had previouſly collected a flock, conſiſting of ſheep of the Spaniſh, Herefordſhire, Southdown, Cheviot, Lomond hills, and Shetland breeds, and of a mixed breed from theſe different ſheep. This flock amounted to 110 rams, ewes, and lambs. M. d'Aubenton, in conſequence of a correſpondence with Sir John Sinclair, ſent over to the ſociety ten rams and five ewes, of real Spaniſh breed, which had been originally entruſted to his care by the late king of France: theſe, after encountering a number of obſtacles, and after being ſtopped and threatened to be ſlaughtered at the cuſtomhouſe of Brighthelmſtone for the uſe of the poor, arrived ſafe at Leith. Lord Sheffield, at the ſame time, ſent to the ſociety four rams and ſix ewes of the Southdown and Spaniſh breeds. Mr Biſhton of Kilſall, in Shropſhire, preſented them with three Hereford rams, reckoned by many the beſt breed in England; the ſociety at the ſame time ordered 150 ewes of the ſame breed, and two ewes of the Long Mountain breed, reckoned the beſt in Wales, to be ſent along with them. They purchaſed 57 rams and 173 ewes of the Cheviot breed, reckoned the beſt in Scotland, for the hilly parts of the country. Lord Daer ſent them 20 ewes of an excellent breed, which exiſted at Mochrum in Galloway. The late earl of Oxford ſent them in a preſent three rams of the Norfolk croſſed by the Cape of Good Hope breed. Mr Iſaac Grant junior of Leghorn, in conjunction with Mr Sibbald, merchant at Leith, preſented them an Apulian ram and ewe; the ram arrived in ſafety, but the ewe unfortunately died on the paſſage. Mr Baron Seton of Preſton, in Linlithgowſhire, ſent them a ram and two ewes of a Spaniſh breed, which had been for ſome time kept in Sweden unmixed with any other. They purchaſed 100 ewes of a ſmall breed exiſting in the pariſh of Leuchars in Fife, much reſembling the Shetland. The Right Honourable William Conynghame of Ireland ſent them 11 Spaniſh rams, ſeven Spaniſh ewes, 15 three-fourth breed and 16 one-half breed Spaniſh and Iriſh ewes. Lord Sheffield ſent them eight rams and 18 ewes; and his majeſty made them a preſent of two rams. Wool.

Thus, in the courſe of one year, the ſociety acquired by donation or purchaſe about 800 ſheep of different ſorts and ages, and many of them from foreign countries: about 500 of theſe were diſtributed over different parts of Scotland, the greater number of which were ſold to gentlemen anxious to promote the views of the ſociety, and well qualified to make experiments on the different breeds which they had obtained. The greateſt part of the remainder were taken by different gentlemen, who kept them for the ſociety, and according to their directions, without any expence.

It is impoſſible to produce an inſtance of ſo much having been accompliſhed by a ſociety of private individuals in ſo ſhort a time. Nor was this all; the ſame year Mr Andrew Kerr, a very intelligent ſheep-farmer on the borders of England, was ſent, at the expence of the ſociety, to examine the ſtate of ſheep-farming along the eaſt coaſt of Scotland and the interior parts of the Highlands. His tour was printed by order of the ſociety, and contains the firſt intimation of the poſſibility of the Cheviot breed thriving in the north of Scotland.

In the year 1792, Meſſrs Redhead, Laing, and Marſhall were ſent by the ſociety, to make a ſurvey of the ſtate of ſheep-farming through ſome of the principal counties of England; the reſult of which was alſo publiſhed by the ſociety, and contains more information on the ſubject of the different breeds of England than any work hitherto publiſhed; and in 1794, Mr John Naiſmyth was ſent on a tour through the ſouthern diſtricts of Scotland, which completed the circuit of almoſt the whole kingdom.

Thus a few private individuals, unaided by the public purſe, had boldneſs enough to undertake aſcertaining the comparative value of the different kinds of ſheep in their own country, and to introduce ſome of the moſt celebrated breeds of other countries, and ſucceeded in the ſpirited attempt. It is impoſſible in this place to ſtate more minutely the various other tranſactions of the ſociety; to enter into any detail of the premiums given by this reſpectable inſtitution for the improvement of the celebrated Shetland breed; or to explain how, as if it were by magic, in a country where the manufacture of wool was little known, articles manufactured of that material were made, rivalling, and in ſome caſes ſurpaſſing, the moſt celebrated fabrics of other countries. A war having unfortunately ariſen, it became impoſſible to pay the ſame attention, or to carry on with the ſame ſucceſs, novel enterpriſes; even

old

Wool, Woolcombing.

old eſtabliſhments often fall a ſacrifice amidſt the horrors of war. The utmoſt that the Britiſh Wool Society could expect to do, was to preſerve the inſtitution in ſuch a ſtate, that when peace ſhall be happily reſtored it may revive with double energy and ſpirit.

It is a curious fact that the Romans, during their reſidence in Britain, eſtabliſhed a manufactory of woollen cloth at Winchcſter, which was ſo extenſive as to ſupply their army; and there is reaſon to believe that the trade which they introduced into Britain, was not neglected by the native inhabitants, for the firſt 900 years of the Chriſtian era. The long Spaniſh wool was imported into this country ſo early as the 12th century, and we find that ſince the days of Edward III. Britiſh fleeces were admirably adapted to the kind of cloth which was in greateſt requeſt, though now they are generally unequal to the production of that which is fought after.

Wool-Combing, a well known operation, which, when performed by the hand, is laborious, tedious, and expenſive. The expence of it through all England has been calculated at no leſs a ſum than 800,000l.; and to leſſen this expence, the Rev. Edmund Cartwright of Doncaſter in Yorkſhire bethought himſelf, ſome years ago, of carding wool by machinery. After repeated attempts and improvements, for which he took out three patents, he found that wool can be combed in perfection by machinery, of which he gives the following deſcription.

Plate CXXVIII. Fig. 1. is the crank laſher. A is a tube through which the material, being formed into a ſliver, and ſlightly twiſted, is drawn forward by the delivering rollers; B, a wheel faſt upon the croſs bar of the crank; C, a wheel, on the oppoſite end of whoſe axis is a pinion working in a wheel upon the axis of one of the delivering rollers.

Note. When two or more ſlivers are required, the cans or baſkets, in which they are contained, are placed upon a table under the laſher (as repreſented at D), which, by having a ſlow motion, twiſts them together as they go up.

Fig. 2. 3. Fig. 2. is the circular clearing comb, for giving work in the head, carried in a frame by two cranks. Fig. 3. the comb-table, having the teeth pointing towards the centre, moved by cogs upon the rim, and carried round upon trucks like the head of a windmill. *a*, *b*, The drawing rollers. *c*, *d*, Callendar, or conducting rollers.

Note. Underneath the table is another pair of rollers, for drawing out the backings.

In the above ſpecification, we have omitted the frame in which the machine ſtands, the wheels, ſhafts, &c. Had theſe been introduced, the drawing would have been crowded and confuſed; beſides, as matters of information, they would have been unneceſſary, every mechanic, when he knows the principles of a machine, being competent to apply the movements to it.

The wool, if for particularly nice work, goes through three operations, otherwiſe two are ſufficient: the firſt operation opens the wool, and makes it connect together into a rough ſliver, but does not clear it. The clearing is performed by the ſecond, and, if neceſſary, a third operation. A ſet of machinery, conſiſting of three machines, will require the attendance of an overlooker and ten children, and will comb a pack, or 240lb. in twelve hours. As neither fire nor oil is neceſſary for machine-combing, the ſaving of thoſe articles, even the fire alone, will, in general, pay the wages of the overlooker and children; ſo that the actual ſaving to the manufacturer is the *whole* of what the combing coſts, by the old imperfect mode of hand-combing. Machine-combed wool is better, eſpecially for machine-ſpinning, by at leaſt 12 per cent. being all equally mixed, and the ſlivers uniform, and of any required length.

Wool-combing || Worceſter.

WOOLSTON, Thomas, an Engliſh divine, was born at Northampton in 1669, and educated at Cambridge. His firſt appearance in the learned world was in 1705, in a work entitled, The Old Apology for the Truth of the Chriſtian Religion, againſt the Jews and Gentiles, revived. He afterwards wrote many pieces: but what made the moſt noiſe, were his ſix Diſcourſes on the Miracles of Chriſt; which occaſioned a great number of books and pamphlets upon the ſubject, and raiſed a proſecution againſt him. At his trial in Guildhall, before the lord chief-juſtice Raymond, he ſpoke ſeveral times himſelf; and urged, that "he thought it very hard that he ſhould be tried by a ſet of men who, though otherwiſe very learned and worthy perſons, were no more judges of the ſubjects on which he wrote, than himſelf was a judge of the moſt crabbed points of the law." He was ſentenced to a year's impriſonment, and to pay a fine of 100l. He purchaſed the liberty of the rules of the King's bench, where he continued after the expiration of the year, being unable to pay the fine. The greateſt obſtruction to his deliverance from confinement was, the obligation of giving ſecurity not to offend by any future writings, he being reſolved to write again as freely as before. Whilſt ſome ſuppoſed that this author wrote with the ſettled intention of ſubverting Chriſtianity under the pretence of defending it, others believed him diſordered in his mind; and many circumſtances concurred which gave countenance to this opinion. He died, January 27. 1732-3, after an illneſs of four days; and, a few minutes before his death, uttered theſe words: "This is a ſtruggle which all men muſt go through, and which I bear not only patiently, but with willingneſs." His body was interred in St George's church-yard, Southwark.

WOOLWICH, a town in Kent, with a market on Fridays. It is ſeated on the river Thames, and of great note for its fine docks and yards, where men of war are built; as alſo for its vaſt magazines of great guns, mortars, bombs, cannon-balls, powder, and other warlike ſtores. It has likewiſe an academy, where young officers are inſtructed in the military art; the population in 1801 exceeded 9000. It is nine miles eaſt of London. E. Long. 0. 10. N. Lat. 51. 30.

WORCESTER, in Latin *Wigornia*, the capital of a county of England of the ſame name, ſtands on the river Severn, but ſo low that it can hardly be ſeen till one is cloſe upon it. It is ſuppoſed to be the Branonium of Antoninus, the Branogenium of Ptolemy, and to have been built by the Romans to awe the Britons on the other ſide of the Severn. It was made an epiſcopal ſee about the year 680 by Sexulphus biſhop of the Mercians; but the preſent cathedral was begun by Wulſton in the year 1084. The town hath been ſeveral times burnt down; firſt, in 1041, by Hardicanute, who alſo maſſacred the citizens; ſecondly, not long after William Rufus's time; and a third time, when King Stephen beſieged and took it. Here, in latter times,

Worceſter. was fought that battle, in which Charles II. with his Scots army, was defeated by Cromwell. In a garden near the ſouth gate of the city, where the action was hotteſt, the bones of the ſlain are often dug up. It had formerly ſtrong walls and a caſtle; but theſe have been demoliſhed long ago. It is now a large city, the ſtreets broad and well paved, and ſome of them very regular and well built, particularly Foregate-ſtreet; ſo that in general it is a very agreeable place. The cathedral is a ſtately edifice, and among other monuments in it are thoſe of King John, of Arthur, elder brother to Henry VIII. and of the counteſs of Saliſbury, who gave occaſion to the inſtitution of the order of the Garter. There are ſeven or eight hoſpitals in and about the city; of which that built and endowed by Robert Berkley of Spetchley, Eſq. is a very noble one. There is a ſchool founded by Henry VIII. three other ſchools, and ſix charity-ſchools. The churches, St Nicholas and All-Saints, have been lately rebuilt, and are handſome edifices. The city carries on a great trade; for which it is chiefly indebted to its ſituation upon the Severn. The population in 1801 was eſtimated at 11,000, a large proportion of which is employed in the manufacture of broad cloth and gloves. The Welch inhabit a part of it, and ſpeak their own language. Its market is well ſupplied with proviſions and cattle, and its quay is much frequented by ſhips. By a charter from James I. it is governed by a mayor, ſix aldermen, who are juſtices of the peace, and choſen out of 24 capital citizens; a ſheriff, the city being a county of itſelf; a common council, conſiſting of 48 other citizens, out of which two chamberlains are yearly choſen; a recorder, town-clerk, two coroners, a ſword-bearer, 13 conſtables, and four ſerjeants at mace. Of the biſhops of this ſee, there have been, it is ſaid, one pope, four ſaints, ſeven lord high-chancellors, 11 archbiſhops, two lord treaſurers, one chancellor to the queen, one lord preſident of Wales, and one vice-preſident. The city at preſent gives title of earl and marquis to the duke of Beaufort. W. Long. 1. 55. N. Lat. 52. 10.

WORCESTER, *Edward Somerſet, Marquis of*, was a diſtinguiſhed political character in the time of Charles I. by whom he was created earl of Glamorgan, while heir-apparent to the marquis of Worceſter. This nobleman flouriſhed chiefly in the reign of Charles I. and ſeems to have been a moſt zealous adherent to the cauſe of that unfortunate monarch, on whoſe account it is ſaid that he and his father waſted an immenſe ſum. Of this the king was ſo ſenſible, that he granted to the earl a moſt extraordinary patent, the chief powers of which were, to make him generaliſſimo of three armies, and admiral with nomination of his officers; to enable him to raiſe money by ſelling his majeſty's woods, wardſhips, cuſtoms, and prerogatives; and to create by blank patents, to be filled up at Glamorgan's pleaſure, from the rank of marquis to baronet. If any thing, ſays Lord Orford, could juſtify the delegation of ſuch authority, beſides his majeſty having loſt all authority, when he conferred it, it was the promiſe with which the king concluded of beſtowing the princeſs Elizabeth on Glamorgan's ſon. This patent was given up by the marquis to the houſe of peers after the reſtoration. He died not long after that era, in 1667, after he had publiſhed what Lord Orford calls the following amazing piece of folly.

Worceſter. "A century of the names and ſcantlings of ſuch inventions, as at preſent I can call to mind to have tried and perfected, which (my former notes being loſt) I have, at the inſtance of a powerful friend, endeavoured now in the year 1655, to ſet theſe down in ſuch a way as may ſufficiently inſtruct me to put any of them in practice."

Some of the inventions referred to in this work are the following. A ſhip-deſtroying engine, a coach-ſtopping engine, a balance water-work, a bucket fountain, an ebbing and flowing caſtle clock, a tinder-box piſtol, a pocket ladder, a moſt admirable way to raiſe weights, a ſtupendous water-work. For the laſt contrivance the marquis procured an act of parliament in 1663, for the ſole benefit ariſing from it, one-tenth of it being appropriated to Charles II. and his ſucceſſors.

In a manuſcript addition to a copy of the Century of Inventions, the ſtupendous or water-commanding engine is deſcribed as boundleſs for height or quantity, requiring no external, or even additional help or force to be ſet or continued in motion, but what intrinſically is afforded from its own operation, nor yet the twentieth part thereof, and the engine conſiſteth of the following particulars. 1. A perfect counterpoiſe for what quantity ſoever of water. 2. A perfect countervail for what height ſoever it is to be brought unto. 3. A primum mobile, commanding both height and quantity, regulator-wiſe. 4. A vicegerent or countervail, ſupplying the place, and performing the full force of man, wind, beaſt, or mill. 5. A helm or ſtern, with bit and reins, wherewith any child may guide, order, and controul the whole operation. 6. A particular magazine for water, according to the intended quantity or height of water. 7. A place for the original fountain, or even river to run into, and naturally of its own accord incorporate itſelf with the riſing water, and at the very bottom of the ſame aqueduct, though never ſo big or high.

Various and very oppoſite opinions have been held with regard to the title of this nobleman to be conſidered as a mechanical genius. Lord Orford has pronounced his work an amazing piece of folly; and Mr Hume, ſpeaking of his political conduct, ſays, "that the king judged aright of this nobleman's character, appears from his Century of Arts, or Scantling of Inventions, which is a ridiculous compound of lies, chimeras, and impoſſibilities, and ſhows what might be expected from ſuch a man." *Hiſt. of England.* It may be fairly preſumed from the quotations now made, that neither Lord Orford nor Mr Hume was qualified to judge of the marquis's work, otherwiſe a more temperate or a more modified opinion would have been given. By others, the author of the inventions has been regarded as one of the greateſt mechanical geniuſes, and is to be conſidered as the inventor of the ſteam-engine, which he denominates a ſtupendous water-work. There ſeems to be no reaſon to ſuppoſe that any ſteam-engine was erected by the marquis himſelf; but it is ſaid that Captain Savary, after reading the marquis's books, tried many experiments upon the power and force of ſteam, and at laſt fell upon a method of applying it to raiſe water; and having bought up and deſtroyed all the marquis's books that could be got, claimed the honour of the invention to himſelf, and obtained a patent for it.

The

Worceſter || Word.

The marquis of Worceſter is ſometimes confounded with John Tiptoft, earl of Worceſter, a very accompliſhed literary character, who lived in the times of Henry VI. and Edward IV. Being attached to Edward, he abſconded during the ſhort reſtoration of Henry, and being taken concealed in a tree in Waybridge foreſt in Huntingdonſhire, he was brought to London, accuſed of cruelty in his adminiſtration of Ireland, and condemned and beheaded at the Tower in the year 1470. This nobleman tranſlated Cicero de Amicitia, ſome parts of Cæſar's Commentaries, and was the author of ſeveral other works.

WORCESTERSHIRE, a county of England, bounded by Warwickſhire on the eaſt, by Glouceſterſhire on the ſouth, by the counties of Hereford and Salop on the weſt, and on the north by Staffordſhire. According to Templeman, it is 36 miles in length, 28 in breadth, and about 130 in circumference, within which it contains ſeven hundreds, and a part of two others, 11 market towns, of which three are boroughs, one city, namely *Worceſter*, 152 pariſhes, about 540,000 acres, and 139,518 inhabitants.

This being an inland county, well cultivated, and free from lakes, marſhes, or ſtagnant waters, the air is very ſweet and wholeſome all over it. The ſoil in general is very rich, producing corn, fruit, eſpecially pears, of which they make a great deal of perry; hops and paſture. The hills are covered with ſheep, and the meadows with cattle. Hence they have wool, cloth, ſtuffs, butter, and cheeſe in abundance. They are alſo well ſupplied with fuel, either wood or coal, and ſalt from their brine pits and ſalt ſprings. Of the laſt they have not only enough for themſelves, but export large quantities by the Severn; which noble river, to the great convenience and emolument of the inhabitants, runs from north to ſouth through the very middle of the county, enriching the ſoil, and yielding it plenty of fiſh, and an eaſy expeditious conveyance of goods to and from it. The other rivers by which it is watered are the Stour, Avon, Teme, &c. It ſends nine members to parliament, viz. two for the county, two for the city of Worceſter, two for Droitwich, two for Eveſham, and one for Bewdley; and lies in the dioceſe of Worceſter, and Oxford circuit.

WORD, in language, an articulate ſound deſigned to repreſent ſome idea or notion. See GRAMMAR and LANGUAGE. See alſo LOGIC, Part I. chap. i.

WORD, or *Watch-word*, in military affairs, is ſome peculiar word or ſentence, by which the ſoldiers know and diſtinguiſh one another in the night, &c. and by which ſpies and deſigning perſons are diſcovered. It is uſed alſo to prevent ſurpriſes. The word is given out in an army every night to the lieutenant or major-general of the day, who gives it to the majors of the brigades, and they to the adjutants; who give it firſt to the field-officers, and afterwards to a ſerjeant of each company, who carry it to the ſubalterns. In garriſons it is given after the gate is ſhut to the town-major, who gives it to the adjutants, and they to the ſerjeants.

WORDS of Command. See EXERCISE and MANUAL.

Signals by the Drum, made uſe of in exerciſing of the Army, inſtead of the WORD of Command, viz.

Signals by the drum.	*Operations.*
A ſhort roll,	To caution.
A flam,	To perform any diſtinct thing.
To arms,	To form the line or battalion.
The march,	To advance, except when intended for a ſalute.
The quick march,	To advance quick.
The point of war,	To march and charge.
The retreat,	To retreat.
Drum ceaſing,	To halt.
Two ſhort rolls,	To perform the flank firing.
The dragoon march,	To open the battalion.
The grenadier march,	To form the column.
The troop,	To double diviſions.
The long roll,	To form the ſquare.
The grenadier march,	To reduce the ſquare to the column.
The preparative,	To make ready and fire.
The general,	To ceaſe firing.
Two long rolls,	To bring or lodge the colours.

Word || Work-houſe.

WORK, in the manege. To work a horſe, is to exerciſe him at pace, trot, or gallop, and ride him at the manege. To work a horſe upon volts, or head and haunches in or between two heels, is to paſſage him, or make him go ſideways upon parallel lines.

To WORK, in ſea language, is to direct the movements of a ſhip, by adapting the ſails to the force and direction of the wind. See SEAMANSHIP.

WORK, Carpenters, Clock, Crown, Field, Fire, Fret, Groteſque, Horn, Moſaic. See the ſeveral articles, together with FORTIFICATION and PYROTECHNY.

WORK-Houſe, a place where indigent, vagrant, and idle people, are ſet to work, and ſupplied with food and clothing.

Work-houſes are of two kinds, or at leaſt are employed for two different purpoſes. Some are uſed as priſons for vagrants or ſturdy beggars, who are there confined and compelled to labour for the benefit of the ſociety which maintains them; whilſt others, ſometimes called *poor-houſes*, are charitable aſylums for ſuch indigent perſons as through age or infirmity are unable to ſupport themſelves by their own labour. The former kind of work-houſe, when under proper management, may be made to ſerve the beſt of purpoſes; of the latter we are acquainted with none which entirely commands our approbation.

To make confinement in a work-houſe operate to the correction of vagrants and diſorderly perſons (and if it produce not this effect it can hardly be conſidered as a beneficial inſtitution), the priſoners ſhould be ſhut up in ſeparate cells, and compelled to labour for their own ſubſiſtence. A crew of thieves and vagabonds aſſociating with each other is a hell upon earth, in which every individual is hardened in his crimes by the countenance and converſation of his companions; and wretches who, when at liberty, chooſe to beg or ſteal rather than to earn a comfortable livelihood by honeſt induſtry, will ſubmit to any puniſhment which a humane overſeer can inflict rather than work for the benefit of others. No puniſhment indeed will compel a vagrant to labour. He may aſſume the appearance of it, but he will make no progreſs; and the pretext of ſickneſs or weakneſs is ever at hand for an excuſe. Hence it is that thieves and ſtrumpets

Work-houſe. ſtrumpets are too often diſmiſſed from work-houſes and bridewells ten times more the children of the devil than when they entered them.

To remedy theſe evils, we can think of no better method than to confine each priſoner in a cell by himſelf, and to furniſh him daily with ſuch an allowance of bread and water as may preſerve him from *immediate* death; for the only compulſion to make ſuch men work ſeriouſly is the fear of want, and the only way to reform them is to leave them to their own meditations on the conſequences of their paſt conduct. There are ſurely very few perſons, if any, whoſe averſion from labour would not be conquered by the pinchings of hunger and the certain proſpect of periſhing by famine; and it is to be hoped that there are not many ſo totally diveſted of every latent principle of virtue, as not to be brought by ſuch ſolitude to a due ſenſe of their former wickedneſs. Should one or two, however, be occaſionally found ſo very obdurate as to ſuffer themſelves to periſh rather than work, their deaths would prove a ſalutary beacon to others, and their blood would be on their own heads; for we have the expreſs command of St Paul himſelf, that "if any will not work, neither ſhould he eat."

No doubt it would be proper that the meditations of vagabonds confined in a work-houſe ſhould be directed by the private admonitions of a pious and intelligent clergyman; but it is not every clergyman who is qualified to diſcharge ſuch a duty. If he be actuated by a zeal not according to knowledge, or if he have not with equal care ſtudied human nature and the word of God, his admonitions will be more likely to provoke the profane ridicule of his auditor, and harden him in his wickedneſs, than to excite in his breaſt ſuch ſorrow for his ſins as ſhall "bring forth fruits meet for repentance." To render the inſtruction of thieves and vagrants of any uſe, it muſt be accurately adapted to the caſe of each individual; and however excellent it may be in itſelf, it will not be liſtened to unleſs offered at ſeaſons of uncommon ſerioufneſs, which the inſtructor ſhould therefore carefully obſerve.

That ſuch wholeſome ſeverity as this would often reform the inhabitants of work-houſes, appears extremely probable from the effects of a ſimilar treament of common proſtitutes mentioned by Lord Kames in his Sketches of the Hiſtory of Man: "A number of thoſe wretches were in Edinburgh confined in a houſe of correction, on a daily allowance of threepence, of which part was embezzled by the ſervants of the houſe. Pinching hunger did not reform their manners; for being abſolutely idle, they encouraged each other in vice, waiting impatiently for the hour of deliverance. Mr Stirling the ſuperintendant, with the conſent of the magiſtrates, removed them to a clean houſe; and, inſtead of money, appointed for each a pound of oatmeal daily, with ſalt, water, and fire for cooking. Relieved now from diſtreſs, they longed for comfort. What would they not give for milk or ale? Work (ſays he) will procure you plenty. To ſome who offered to ſpin, he gave flax and wheels, engaging to pay them half the price of their yarn, retaining the other half for the materials furniſhed. The ſpinners earned about ninepence weekly; a comfortable addition to what they had before. The reſt undertook to ſpin, one after another; and before the end of the firſt quarter they were all of them intent upon work. It was a branch of his plan to ſet free ſuch as merited that favour; and ſome of them appeared to be ſo thoroughly reformed as to be in no danger of a relapſe." Work-houſe.

Work-houſes erected as charitable aſylums appear to us, in every view that we can take of them, as inſtitutions which can ſerve no good purpoſe. Economy is the great motive which inclines people to this mode of providing for the poor. There is comparatively but a very ſmall number of mankind in any country ſo aged and infirm as not to be able to contribute, in ſome degree, to their ſubſiſtence by their own labour; and in ſuch houſes it is thought that proper work may be provided for them, ſo that the public ſhall have nothing to give in charity but what the poor are abſolutely unable to procure for themſelves. It is imagined likewiſe, that numbers collected at a common table, can be maintained at leſs expence than in ſeparate houſes; and foot ſoldiers are given for an example, who could not live on their pay if they did not meſs together. But the caſes are not parallel. "Soldiers having the management of their pay, can club for a bit of meat; but as the inhabitants of a poor-houſe are maintained by the public, the ſame quantity of proviſions muſt be allotted to each. The conſequence is what might be expected: the bulk of them reſerve part of their victuals for purchaſing ale or ſpirits. It is vain to expect work from them: poor wretches void of ſhame will never work ſeriouſly, where the profit accrues to the public, not to themſelves. Hunger is the only effectual means for compelling ſuch perſons to work *." ** Kames's Sketches.*

The poor, therefore, ſhould be ſupported in their own houſes; and to ſupport them properly, the firſt thing to be done is, to eſtimate what each can earn by his own labour; for as far only as that falls ſhort of maintenance, is there room for charity. In repairing thoſe evils which ſociety did not or could not prevent, it ought to be careful not to counteract the wiſe purpoſes of nature, nor to do more than to give the poor a fair chance to work for themſelves. The preſent diſtreſs muſt be relieved, the ſick and the aged provided for; but the children muſt be inſtructed; and labour, not alms, offered to thoſe who have ſome ability to work, however ſmall that ability may be. They will be as induſtrious as poſſible, becauſe they work for themſelves; and a weekly ſum of charity under their own management will turn to better account than in a poor-houſe under the direction of mercenaries. Not a penny of it will be laid out on fermented liquors, unleſs perhaps as a medicine in ſickneſs. Nor does ſuch low fare call for pity to thoſe who can afford no better. Ale makes no part of the maintenance of thoſe who, in many parts of Scotland, live by the ſweat of their brows; and yet the perſon who ſhould baniſh ale from a charity work-houſe, would be exclaimed againſt as hard-hearted, and even void of humanity.

That ſuch a mode of ſupporting the poor in their own houſes is practicable, will hardly admit of a diſpute; for it has been actually put in practice in the city of Hamburgh ever ſince the year 1788. At that period ſuch revenues as had till then been expended in alms by the ſeveral church-wardens, and thoſe of which the adminiſtration had been connected with the work-houſe, were united under one adminiſtration with ſuch ſums as were collected from private benevolence. The city was divided into ſixty diſtricts, containing each an

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Work-houſe. equal number of poor; and over theſe 180 overſeers were appointed. Actual relief was the firſt object; but at the very moment that this proviſion was ſecured, meaſures were taken to prevent any man from receiving a ſhilling which he could have been able to earn for himſelf. By theſe methods, which our limits will not permit us to ſtate, the overſeers were able to make a calculation tolerably exact of what each pauper wanted for bare ſubſiſtence, in addition to the fruits of his own labour. A flax-yarn-ſpinning manufacture was eſtabliſhed, in which the yarn is paid for, not by its weight, but by its meaſure. The clean flax is ſold to the poor at a low price, and a certain meaſure of yarn again bought from them at 30 per cent. above the uſual price; ſo that the overſeers are ſure that all the yarn ſpun by the poor will be brought into their office. Every pauper brings with him a book in which the quantity delivered is carefully noted down, which furniſhes the overſeers with a continual average of the ſtate of induſtry among their poor.

As ſoon as this inſtitution was eſtabliſhed, the overſeers went through their diſtricts, and aſked, in all ſuch manſions as could be ſuppoſed to harbour want, if the inhabitants ſtood in need of ſupport? The queſtion to all ſuch poor as wiſhed for relief, and were able to ſpin, was, Whether they did earn by their work 1s. 6d. a-week? for experience had taught the inhabitants of Hamburgh, that many poor live upon that ſum; and they knew enough of their poor to ſuppoſe, that 1s. 6d. avowed earning was equal to ſomething more. If the anſwer was affirmative, the pauper ſtood not in need of weekly aſſiſtance. If it was negative, work was given him, which, by being paid 30 per cent. above its value, afforded him 1s. 6d. a-week eaſily, if he was even an indifferent hand. The far more frequent caſes were partial inability by age, or weakneſs, or want of ſkill. For poor of the latter deſcription a ſchool was opened, and in three months time the buſineſs was eaſily learnt. During that time, the pauper got firſt 2s. a-week, and every week afterwards 2d. leſs, till in the twelfth week he got nothing at all but his earnings, and was diſmiſſed, with a wheel and a pound of flax gratis.

The quantity of work which diſabled poor were capable of doing in a week was eaſily and accurately aſcertained by a week's trial in the ſpinning-ſchool. The reſult was produced weekly before appointed members of the committee, and the ſum which the poor could earn was noted down in their ſmall books. The overſeer was directed to pay them weekly what their earnings fell ſhort of 1s. 6d. in every ſuch week, when it appeared from their books that they had earned to the known extent of their abilities. From that moment applications became leſs frequent; and the committee had an infallible ſtandard for diſtinguiſhing real want: for whenever the pauper, if in health (if not, he was peculiarly provided for), had not earned what he could, then he had either been lazy, or had found more lucrative work; in either caſe, he was not entitled to a relief for that week, whatever he might be for the following.

This mode of providing for the poor, which attracted the notice and obtained the eulogium of the miniſter and the Britiſh houſe of commons, has for ſix years been in Hamburgh attended with the happieſt conſequences. In the ſtreets of that city a beggar is rarely to be ſeen, whilſt thoſe who ſtand in need of the charitable contributions of the rich, are much more comfortably, as well as at much leſs expence, maintained at home, with their children about them, than they could be in work-houſes, under the management of mercenary overſeers. For a fuller account of this judicious inſtitution, we muſt refer the readers to Voght's Account of the Management of the Poor in Hamburgh, ſince the year 1788, in a Letter to ſome Friends of the Poor in Great Britain. Work-houſe || Worming.

WORLD, the aſſemblage of parts which compoſe the globe of the earth. See GEOGRAPHY and ASTRONOMY.

WORM, in *Gunnery*, a ſcrew of iron, to be fixed on the end of a rammer, to pull out the wad of a firelock, carabine, or piſtol, being the ſame with the wad-hook, only the one is more proper for ſmall arms, and the other for cannon.

WORM, in *Chemiſtry*, is a long winding pipe, placed in a tub of water, to cool and condenſe the vapours in the diſtillation of ſpirits.

Blind-WORM, or *Slow-WORM*. See ANGUIS, ERPETOLOGY *Index*.

Earth-WORM. See LUMBRICUS, HELMINTHOLOGY *Index*.

Glow-WORM. See LAMPYRIS, ENTOMOLOGY *Index*.

Silk WORM. See SILK, N° 5.

WORMS, VERMES. See HELMINTHOLOGY and CONCHOLOGY.

WORMS, in the human body. See MEDICINE, N° 407.

WORMS, in horſes. } See FARRIERY.
WORMS, in dogs. }

WORMS for bait. See FISHING.

WORMS, an ancient, large, and famous city of Germany, in the palatinate of the Rhine, with a biſhop's ſee, whoſe biſhop is a ſovereign and prince of the empire. It is a free and imperial city, and the inhabitants are Proteſtants. In the war of 1689 it was taken by the French, who almoſt reduced it to aſhes. The biſhop afterwards built a new palace in it; and it is famous for a diet held here in 1521, at which Luther aſſiſted in perſon. The Proteſtants have lately built a handſome church, where Luther is repreſented as appearing at the diet. It is noted for the excellent wine that grows in the neighbourhood, which they call *our Lady's milk*. In the campaign of 1743, King Geo. II. took up his quarters in this city, and lodged at the biſhop's palace after the battle of Dettingen. It is ſeated on the weſtern bank of the Rhine, 14 miles north-weſt of Heidelberg, 20 ſouth-eaſt of Mentz, and 32 ſouth-weſt of Franckfort. E. Long. 8. 29. N. Lat. 49. 32.

WORMING OF DOGS. All dogs have certain ſtrings under their tongues, by moſt called *a worm*; this muſt be taken out when they are about two months old, with the help of a ſharp knife to ſlit it, and a ſhoemaker's awl to raiſe it up; you muſt be careful to take all out, or elſe your pains is to little purpoſe; for till then he will be hardly ever fat and right, in regard the worm or ſtring will grow foul and troubleſome, and hinder his reſt and eating. This cruel operation is generally recommended as a preventive of madneſs in dogs, or at leaſt as diſabling them, if mad, from biting in that condition.

In this operation, of which the vulgar account is gi-

Worming ‖ Worſhip.

ven above, which we have juſtly denominated a cruel one, it is not a ſtring that is removed, but the duct by which the ſaliva is conveyed from the gland in which it is ſecreted to the mouth for the purpoſe of mixing with the food and promoting its deglutition and digeſtion. Now this operation by no means prevents the animal from biting, nor can it, in our opinion, obſtruct the flow of the ſaliva by which the dreadful diſeaſe hydrophobia is communicated.

WORMIUS, Olaus, a learned Daniſh phyſician, born in 1588 at Arhuſen in Jutland. After beginning his ſtudies at home, he ſtudied at ſeveral foreign univerſities, and travelled to various parts of Europe for improvement. He returned to his native country in 1613, and was made profeſſor of the belles lettres in the univerſity of Copenhagen. In 1615, he was tranſlated to the chair of the Greek profeſſor; and in 1624 to the profeſſorſhip of phyſic, which he held to his death. Theſe occupations did not hinder him from practiſing in his profeſſion, and from being the faſhionable phyſician: the king and court of Denmark always employed him; and Chriſtian IV. as a recompenſe for his ſervices, conferred on him a canonry of Lunden. He publiſhed ſome pieces on ſubjects relating to his profeſſion, ſeveral works in defence of Ariſtotle's philoſophy, and ſeveral concerning the antiquities of Denmark and Norway; for which latter he is principally regarded, as they are very learned, and contain many curious particulars. He died in 1654.

WORMWOOD. See Artemisia, Botany *Index*.

WORSHIP of God (*cultus Dei*), amounts to the ſame with what we otherwiſe call *religion*. This worſhip conſiſts in paying a due reſpect, veneration, and homage to the Deity, under a certain expectation of reward. And this internal reſpect, &c. is to be ſhown and teſtified by external acts; as prayers, ſacrifices, thankſgivings, &c.

The Quietiſts, and ſome other myſtic divines, ſet aſide not only all uſe of external worſhip, but even the conſideration of rewards and puniſhments. Yet even the heathens had a notion that God did not require us to ſerve him for nought: "Dii quamobrem colendi ſint (ſays Cicero), non intelligo, nullo nec accepto ab illis nec ſperato bono."

The ſchool-divines divide worſhip into divers kinds, viz. *latria*, that rendered to God; and *idololatria*, that rendered to idols or images. To which the Romaniſts add, *dulia*, that rendered to ſaints; and *hyperdulia*, that to the Virgin. Some theological writers have obſerved, that the Greek word, προσκυνεω, *to worſhip*, is not deſcriptive only of the honour which is appropriated to God, but is indifferently uſed to ſignify the honour and reſpect which are paid to ſuperiors of all kinds in heaven or on earth. Accordingly, they have diſtinguiſhed between civil and religious worſhip.

That it is the duty of man to worſhip his Maker, has been ſufficiently proved under other articles (ſee Prayer; and Theology, N° 40—45.). It is not indeed eaſily to be conceived how any one who has tolerably juſt notions of the attributes and providence of God, can poſſibly neglect the duty of *private* worſhip; and though we have admitted in the laſt of the two articles referred to, that *public* worſhip does not ſeem to be enjoined in that ſyſtem which is called the religion of *nature*, yet it is moſt expreſsly commanded by the religion of Christ, and will be regularly performed by every one who reflects on its great utility. Worſhip.

As the illiterate vulgar cannot form to themſelves correct notions of the divine providence and attributes, it is obvious, that without the inſtitution of public worſhip, they would never think of worſhipping God at all, unleſs perhaps occaſionally, when under the preſſure of ſome ſevere calamity; but occaſional worſhip, the offſpring of compulſion, could have little of the reſigned ſpirit of true devotion. Ignorant, however, as the loweſt of the vulgar are, and neceſſarily muſt be, it cannot be denied, that in moſt Chriſtian countries, perhaps in all, they are more accurately acquainted with the firſt principles of religion, and the laws of morality, than even the leaders of barbarous nations. This ſuperiority is doubtleſs owing in ſome meaſure to their acceſs to the Sacred Scriptures, but much more, we are perſuaded, to the inſtruction which they receive in the aſſemblies which they frequent for public worſhip. If this be admitted, public worſhip may be eaſily proved to be the duty of every individual of the community: For were thoſe, who may be ſuppoſed to ſtand in no need either of the contagion of ſociety to kindle their own devotion, or of the preaching of a clergyman to inſtruct them in the doctrines and precepts of the goſpel, "to forſake, on theſe accounts, the aſſembling themſelves together, as the manner of ſome is," religious aſſemblies and public worſhip would very quickly fall into univerſal diſuſe. Man is an animal prone to imitation; and every order in ſociety is ambitious of treading in the footſteps of the order immediately above it. Were the wiſe and the good, therefore, permitted to abſent themſelves from the aſſemblies inſtituted for the public worſhip of the Creator and Redeemer of the world, others would quickly follow their example; impelled to it not only by this univerſal propenſity, but by the additional motive of wiſhing to appear both to the world and to themſelves as wiſe and as good as their privileged neighbours. The conſequence is obvious: one man would ſtay from church with the ſerious intention perhaps of employing the Lord's day in private devotion and religious ſtudy; another, following his example, would abſent himſelf upon the ſame pretence, but would in reality waſte the day in dozing indolence or in ſecret ſenſuality. For theſe and other reaſons which might be eaſily aſſigned, no ſincere Chriſtian will think himſelf at liberty to diſpute a practice enjoined by the inſpired preachers of his religion, coeval with the inſtitution, and retained by every ſect into which it has ſince been unhappily divided.

As Chriſtian worſhip conſiſts of prayers and praiſes, it has been a matter of ſome debate whether it is moſt properly performed by preconcerted forms or liturgies, or by extemporaneous addreſſes to the Almighty. Both theſe modes have their advantages and diſadvantages; and by the ſacred writers neither of them is preſcribed in oppoſition to the other.

The advantages of a liturgy are, that it prevents abſurd, extravagant, or impious addreſſes to God, which the folly or enthuſiaſm of individuals muſt always be in danger of producing; it gives the congregation an opportunity of *joining* in the prayers which are put up for them, which they cannot poſſibly do in a ſeries of extemporaneous petitions, ſince before they can aſſent to

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orſhip, Fort. any one of theſe and make it their own, their attention is neceſſarily called away to that which ſucceeds it; and it relieves the clergyman from the labour of compoſition, which ſeems incompatible with that fervour which conſtitutes the ſpirit of devotion.

The diſadvantages of a fixed liturgy, which are the recommendations of extemporary prayer, are principally two. The forms compoſed in one age muſt, by the unavoidable change of language, circumſtances, and opinions, become in ſome degree unfit for another; and the perpetual repetition of the ſame form of words is very apt to produce inattentive laſſitude in the congregation. Would the clergy of the church of England take that liberty which is allowed them in the bidding prayer before ſermon, perhaps the ſervice of that church would unite in itſelf all the advantages both of liturgic and extemporary worſhip. We have only to add on this ſubject, that public prayers, whether precompoſed or not, ought to be compendious; that they ought to expreſs juſt conceptions of the Divine attributes; recite ſuch wants as the congregation are likely to feel, and no other; that they ought to contain as few controverted propoſitions as poſſible; and that, if it can be done without offence, the pompous ſtyle of *the ſtate* ſhould be laid aſide in our prayers for the king, and all that are in authority; becauſe in every act which carries the mind to God, human greatneſs muſt be annihilated.

WORT, the infuſion of malt, of which beer is made. See BREWING. The uſes of this infuſion in common affairs are well known. By Dr M'Bride it has lately been found to have a ſtrong antiſeptic virtue, and to be uſeful in preventing the ſcurvy and other diſeaſes to which ſailors are liable; this was confirmed by Captain Cook in his voyages. See *Means of Preſerving the Health of* SEAMEN.

It is of great importance to the manufacturer to be able to aſcertain with facility and preciſion the real ſtrength of worts, or the quantity of ſaccharine matter contained in the infuſion. This is accompliſhed by determining the ſpecific gravity by means of inſtruments, which, from the purpoſe to which they are applied, have obtained the name of *ſaccharometers*. But as theſe inſtruments, from the very nature of the material of which they are conſtructed, are liable to conſiderable change, the reſults which they afford cannot always be depended on. With the view of obviating theſe inconveniences, the patent areometrical beads have been invented by Mrs Lovi of Edinburgh. We have already noticed theſe beads on account of their accuracy, ſimplicity, and facility of application for aſcertaining the ſpecific gravity, or the real ſtrength and value, of ſpirituous liquors. See vol. xix. p. 599.; and we now recommend them with greater confidence, from having had opportunities of knowing that they are capable of a more extended application, as in the manufacture of acids, and ſalts of different kinds; to aſcertain the ſtrength of acids, or that of ſaline ſolutions in bleaching; to determine the ſtrength of liquids employed in the different proceſſes of calico printing and dyeing, and not only for the purpoſe of examining the ſtrength of the acids employed, but alſo particularly to aſcertain the denſity or ſpecific gravity of the colouring matters which are uſed in theſe arts, ſo that the ſame degree of ſhade required may be always obtained. It has been ſuggeſted, that theſe beads might be conveniently employed in determining the ſtrength of mineral waters, which, it is well known, vary conſiderably at different ſeaſons of the year. Wort, Wotton.

As the patent beads are conſtructed on the ſame principle from 800, the ſpecific gravity of alcohol, to 2000, which is double the ſpecific gravity of water; and as they are divided into different ſeries, each of which includes a range of ſpecific gravities applicable to the particular fluids, the denſity or ſtrength of which is required, we have no heſitation in aſſerting that they will be found extremely convenient and uſeful to all manufacturers and dealers, who wiſh to aſcertain with accuracy the real ſtrength and value of liquids.

It has been objected to the uſe of theſe beads, that they require a longer time than other inſtruments in uſing them. The ſame objection has been made to the introduction of other new inſtruments, the application of which frequent uſe has afterwards rendered familiar and eaſy. We have had opportunities of knowing that this objection is completely obviated, by thoſe who have been accuſtomed to uſe the beads. They find that they can determine the ſpecific gravity of a liquid by means of the beads with the ſame facility, and in as ſhort a time, as with any other inſtrument.

WOTTON, SIR HENRY, an eminent writer, was the ſon of Thomas Wotton, Eſq. and was born in 1568. He ſtudied for ſome time at New-college, Oxford, whence he removed to Queen's college, where he made a great progreſs in logic and philoſophy; wrote a tragedy for the uſe of that college, called *Tancredo;* and afterwards received the degree of maſter of arts. After this, leaving the univerſity, he travelled into France, Germany, and Italy; and having ſpent about nine years abroad, he returned to England, and became ſecretary to Robert earl of Eſſex, with whom he continued till that earl was apprehended for high treaſon. He then retired to Florence, where he became known to the the grand duke of Tuſcany, who ſent him privately with letters to James VI. king of Scotland, under the name of *Octavio Baldi*, to inform that king of a deſign againſt his life. Some months after he went back to Florence; but King James coming to the poſſeſſion of the crown of England, Mr Wotton returned home, was knighted by his majeſty, and ſent ambaſſador to the republic of Venice; and afterwards was employed in many other embaſſies to that and other courts; but the only reward he obtained for theſe ſervices was his having the provoſtſhip of Eton conferred upon him about the year 1623, which he kept till his death, which happened in 1639. After his deceaſe ſome of his manuſcripts and printed tracts were publiſhed together in a volume, intitled, *Reliquiæ Wottonianæ*.

WOTTON, *Dr William*, a learned divine and writer, was the ſon of Mr Henry Wotton, B. D. rector of Wrentham in Suffolk, where he was born in 1666. He was educated by his father, a gentleman well ſkilled in the learned languages; under whom he made ſuch amazing proficiency, that at five years of age it is ſaid he could render ſeveral chapters of the goſpels out of Latin and Greek, and many pſalms in Hebrew, into his mother tongue. When he was very young, he remembered the whole of almoſt every diſcourſe he had heard; and often ſurpriſed a preacher by repeating his ſermon to him. He was admitted into Catharine-hall in Cambridge ſome months before he was ten years old; when the progreſs he made in learning in that univerſity en-

Wotton, Wounds.

gaged Dr Duport, then master of Magdalen college, and dean of Peterborough, to write an elegant copy of Latin verses in his praise. In 1679 he took the degree of bachelor of arts when he was but twelve years and five months old; and the winter following he was invited to London by Dr Gilbert Burnet, then preacher at the Rolls, who introduced him to most of the learned men in that city, and particularly to Dr William Lloyd, bishop of St Asaph; to whom he recommended himself by repeating to him one of his sermons, as Dr Burnet had engaged he should. In 1691 he commenced bachelor of divinity. The same year Bishop Lloyd gave him the sinecure of Llandrillo, in Denbighshire. He was afterwards made chaplain to the earl of Nottingham, then secretary of state, who presented him to the rectory of Middleton Keynes, in Bucks, and to whom he dedicated his Reflections upon Ancient and Modern Learning. In 1705, Bishop Burnet gave him a prebend in the church of Salisbury; and in 1707, Archbishop Tenison presented him with the degree of doctor of divinity: but in 1714, the difficulties he laboured under with respect to his private fortune, obliged him to retire into South Wales, where he was treated with great kindness and humanity by the gentlemen of that country; and wrote there the "Memoirs of the Cathedral Churches of St David's and Landaff," and his "Miscellaneous Discourses relating to the Traditions and Usages of the Scribes and Pharisees;" which were afterwards printed. He died in 1726. This great man was remarkable for his humanity and friendliness of temper; the narrowness of a party spirit never broke in upon any of his friendships; and his time and abilities were at the service of any person who was making advances in real learning. He wrote, besides the above works, 1. A History of Rome. 2. A Defence of his Reflections upon Ancient and Modern Learning. 3. A Discourse concerning the Languages of Babel. 4. Advice to a young Student, with a Method of Study for the first four Years; and other learned pieces.

WOUNDS, in *Surgery*, have been divided into *simple*, *contused* or *lacerated*, and *gun-shot*.

Of Simple Wounds.—The first thing to be considered in the inspection of a wound is, whether it be likely to prove mortal or not. This knowledge can only be had from anatomy, by which the surgeon will be able to determine what parts are injured; and, from the offices which these parts are calculated to perform, whether the human frame can subsist under such injuries. It is not, however, easy for the most expert anatomist always to prognosticate the event with certainty; but this rule he ought always to lay down to himself, to draw the most favourable prognosis the case will bear, or even more than the rules of his art will allow. This is particularly incumbent on him in sea-engagements, where the sentence of death is executed as soon as pronounced, and the miserable patient is thrown alive into the sea, upon the surgeon's declaring his wound to be mortal. There are, besides, many instances on record, where wounds have healed, which the most skilful surgeons have deemed mortal. The following wounds may be reckoned mortal.

1. Wounds which are necessarily mortal.

1. Those which penetrate the cavities of the heart, and all those wounds of the viscera where the large blood-vessels are opened; because their situation will not admit of proper applications to restrain the flux of blood. Wounds.

2. Those which entirely cut off the passage of the nervous influence through the body. Such are wounds of the brain, cerebellum, medulla oblongata, and spinal marrow. Wounds likewise of the small blood-vessels within the brain are attended with great danger, from the effused fluids pressing upon the brain. Nor is there less danger where the nerves which tend to the heart are wounded, or entirely divided; for, after this, it is impossible for the heart to continue its motion.

3. All wounds which entirely deprive the animal of the faculty of breathing.

4. Those wounds which interrupt the course of the chyle to the heart; such are wounds of the receptacle of the chyle, thoracic duct, and larger lacteals, &c.

5. There are other wounds which prove fatal if neglected and left to nature: such are wounds of the larger external blood-vessels, which might be remedied by ligature. Wounds of such parts generally prove fatal; and though a few instances may have occurred where people have recovered after them, yet they are always to be considered as extremely dangerous. Portions of the brain have been destroyed, and wounds have been made into it, and the patients have lived. It is possible, too, that the thoracic duct might be wounded and the patient live; Mr A. Cooper having shown, in a very ingenious paper in the Medical Records and Researches, that it may become obstructed, and the chyle conveyed into the system by anastomosing lymphatics.

2. Symptoms of wounds in different parts of the body.

In examining wounds, the next consideration is, whether the parts injured are such as may be supposed to induce dangerous symptoms, either immediately or at some period during the course of the cure. In order to proceed with any degree of certainty, it is necessary to be well acquainted with those symptoms which attend injuries of the different parts of the body. If the skin and part of the cellular substance are only divided, the first effects are an effusion of blood; the lips of the wound retract, become tumefied, red and inflamed, leaving a gap of considerable wideness according to the length and deepness of the wound. If a very considerable portion of skin and cellular substance is divided, a slight fever seizes the patient; the effusion of blood in the mean time stops, and the wound is partly filled up with a cake of coagulated blood. Below this cake, the small vessels pour forth a clear liquor, which in a short time is converted into pus (see the articles Pus and Mucus). Below this pus granulations of new flesh arise, the cake of coagulated blood loosens, a new skin covers the place where the wound was, and the whole is healed up; and there only remains a mark, called a *cicatrix* or *scar*, showing where the injury had been received.

3. Of wounds of the skin and cellular substance.

All wounds are accompanied with a considerable degree of pain, especially when the inflammation comes on, though the division reaches no farther than the skin and cellular substance. If the muscular fibres are divided, the pain is much greater, because the sound part of the muscle is stretched by the contraction of the divided part and the action of the antagonist muscle, which it is now less fitted to bear. The wound also gapes much more than where the cellular substance is alone

4. Of the muscles.

Wounds. alone divided, inſomuch that, if left to itſelf, the ſkin will cover the muſcular fibres, without any intervention of cellular ſubſtance; and not only a very unſightly cicatrix remains, but the uſe of the muſcle is in ſome meaſure loſt.—If the muſcle happens to be totally divided, its fibres retract to a very conſiderable diſtance; and unleſs proper methods be taken to bring them into contact, the uſe of it is ever afterwards loſt.

5 the arries. If by a wound any conſiderable artery happens to be divided, the blood flows out with great velocity, and by ſtarts; the patient ſoon becomes faint with loſs of blood; nor does the hæmorrhagy ſtop until he faints away altogether; and if as much *vis vitæ* ſtill remains as is ſufficient to renew the operations of life, he recovers after ſome time, and the wound heals up as uſual. The part of the artery which is below the wound in the mean time becomes uſeleſs, ſo that all the inferior part of the limb would be deprived of blood, were it not that the ſmall branches ſent off from the artery above the wounded place become enlarged, and capable of carrying on the circulation. Nature alſo, after a wonderful manner, often produces new veſſels from the ſuperior extremity of the divided artery, by which the circulation is carried on as formerly. The conſequences of ſuch a profuſe hæmorrhagy may be, however, very dangerous to the patient, by inducing extreme debility, or an univerſal dropſy. This great hæmorrhagy happens eſpecially where the artery is partially divided; becauſe then the veſſel cannot contract in ſuch a manner as to cloſe the orifice: however, if the wound is but ſmall, the blood gets into the cellular ſubſtance, ſwelling up the member to an extreme degree, forming what is called a *diffuſed aneuriſm*. Thus the hæmorrhagy ſoon ſtops externally, but great miſchief is apt to flow from the confinement of the extravaſated blood, from bringing on exterior ſuppuration among the muſcles and bones; and thus not only the uſe of the limb is entirely loſt, but the patient is brought into great danger of his life.

6 of the ligaments, nerves, and tendons. Wounds of the ligaments, nerves, and tendons, are likewiſe attended with bad conſequences. When a nerve is entirely divided, the pain is but trifling, though the conſequences are often dangerous. If the nerve is large, all the parts to which it is diſtributed below the wound immediately loſe the power of motion and ſenſation. This, however, takes place only when all or the greateſt part of the nerves belonging to a particular part are divided. If the ſpinal marrow, for inſtance, be divided near the head, the parts below ſoon loſe their ſenſation irrecoverably; or if the bundle of nerves paſſing out of the axilla be divided or tied, ſenſation in the greateſt part of the arm below will be loſt. But though a nerve ſhould be divided, and a temporary palſy be produced, it may reunite, and perform its former functions. If a nerve be wounded only, inſtead of being divided, the worſt ſymptoms frequently enſue.

7 Of the thorax, and the viſcera which it contains. Wounds which penetrate the cavities of the thorax are always exceedingly dangerous, becauſe there is ſcarce a poſſibility of all the viſcera eſcaping unhurt. A wound is known to have penetrated the cavity of the thorax principally by the diſcharge of air from it at each inſpiration, by an extreme difficulty of breathing, and by coughing up blood. Such wounds, however, are not always mortal; the lungs have frequently been wounded, and yet the patient has recovered.—Wounds of the diaphragm are almoſt always mortal, either by Wounds. inducing fatal convulſions immediately, or by the aſcent of the ſtomach, which the preſſure of the abdominal muſcles forces up through the wound into the cavity of the thorax; of this Van Swieten gives ſeveral inſtances. —Even though the wound do not penetrate into the cavity of the thorax, the very worſt ſymptoms may follow. For if the wound deſcends deeply among the external muſcles, and its orifice lies higher, the extravaſated blood will be therein collected, ſtagnate, and form various ſinuſes; which after having eroded the pleura, may at length paſs into the cavity of the thorax. The matter having once found a vent into this cavity, will be continually augmenting from the diſcharge of the ſinuous ulcer, and the lungs will at laſt ſuffer by the ſurrounding matter. If, in caſes of wounds in the thorax, the ribs or ſternum happen to become carious, the cure will be extremely tedious and difficult. Galen relates the caſe of a lad who received a blow upon his ſternum in the field of exerciſe: it was firſt neglected, and afterwards badly healed; but, four months afterwards, matter appeared at the place which had received the blow. A phyſician made an inciſion into the part, and it was ſoon after cicatrized: but in a ſhort time a new collection made its appearance, and upon a ſecond inciſion the wound refuſed to heal. Galen found the ſternum carious; and having cut off the diſeaſed part, the pericardium itſelf was obſerved to be corroded, ſo that the heart could be ſeen quite naked; notwithſtanding which, the wound was cured in no very long time.

There is ſometimes difficulty in determining whether the wound has really penetrated into the thorax or into the abdomen; for the former deſcends much farther towards the ſides than at the middle. But as the lungs are almoſt always wounded when the cavity of the thorax is penetrated, the ſymptoms ariſing from thence can ſcarcely be miſtaken.—Another ſymptom which frequently, though not always, attends wounds of the thorax, is an emphyſema. This is occaſioned by the air eſcaping from the wounded lungs, and inſinuating itſelf into the cellular ſubſtance; which being pervious to it over the whole body, the tumor paſſes from one part to another, till at laſt every part is inflated to a ſurpriſing degree. An inſtance is given in the Memoirs of the Royal Academy, of a tumour of this kind, which on the thorax was eleven inches thick, on the abdomen nine, on the neck ſix, and on the reſt of the body four; the eyes were in a great meaſure thruſt out of their orbits by the inflation of the cellular ſubſtance; and the patient died the fifth day. This was occaſioned by a ſtab with a ſword.

8 Of the abdomen and its viſcera. Wounds of the abdomen are not leſs dangerous than thoſe of the thorax, on account of the importance of the viſcera which it contains. When the wound does not penetrate the cavity, there is ſome danger of a hernia being formed by the protruſion of the peritonæum through the weakened integuments, and the danger is greater the larger the wound is. Thoſe wounds which run obliquely betwixt the interſtices of the muſcles often produce ſinuous ulcers of a bad kind. For as there is a large quantity of fat interpoſed everywhere betwixt the muſcles of the abdomen, if a wound happens to run between them, the matter there collected, not meeting with free egreſs through the mouth of the wound, often makes its way in a ſurpriſing manner through the cellular

lar

Wounds. lar ſubſtance, and forms deep ſinuoſities between the muſcles; in which caſe the cure is always difficult, and ſometimes impoſſible.

If a large wound penetrate the cavity of the abdomen, ſome of the viſcera will certainly be protruded through it; or if the wound is but ſmall, and cloſed up with fat ſo that none of the inteſtines can be protruded, we may know that the cavity of the abdomen is pierced, and probably ſome of the viſcera wounded, by the acute pain and fever, paleneſs, anxiety, faintings, hiccough, cold ſweats, and weakened pulſe, all of which accompany injuries of the internal parts. The miſchiefs which attend wounds of this kind proceed not only from the injury done to the viſcera themſelves, but from the extravaſation of blood and the diſcharge of the contents of the inteſtines into the cavity of the abdomen; which, being of a very putreſcent nature, ſoon bring on the moſt violent diſorders. Hence wounds of the abdominal viſcera are very often mortal. This, however, is not always the caſe, for the ſmall inteſtines have been totally divided, and yet the patient has recovered. Wounds both of the ſmall and large inteſtines have healed ſpontaneouſly, even when they were of ſuch magnitude that the contents of the inteſtine were freely diſcharged through the wound into the abdomen, and after part of the inteſtine itſelf has been protruded through the wound of the integuments.

When the meſentery is injured, the danger is extreme, on account of its numerous veſſels and nerves. Wounds of the liver, ſpleen, and pancreas, are alſo exceedingly dangerous, although there are ſome inſtances of the ſpleen being cut out of living animals without any conſiderable injury.

From the preceding account of the ſymptoms attending wounds in the different parts of the body, the ſurgeon may be enabled to judge in ſome meaſure of the event; though it muſt always be remembered, that wounds, even thoſe which ſeemed at firſt to be of the ſlighteſt nature, have, contrary to all expectation, proved mortal, chiefly by inducing convulſions, or a locked jaw; ſo that no certain prognoſtic can be drawn on ſight of recent wounds. We ſhall now, however, proceed to conſider their treatment.

9 Treatment of wounds. For the cure of wounds, it has been already obſerved, that the ancients imagined balſams, the juice of herbs, &c. to be ſpecifics. In after-ages, and in countries where balſams are not eaſily to be procured, ſalves were ſubſtituted in their place; and even at this day there are many who reckon a ſalve or ointment eſſentially neceſſary for healing the ſlighteſt cut. It is certain, however, that the cure of wounds cannot be effected, nay, not even forwarded in the leaſt, by ointments, unleſs in particular caſes. That power which the human frame has of repairing the injuries done to itſelf, which by phyſicians is called *vis medicatrix naturæ*, is the ſole agent in curing external injuries; and without this the moſt celebrated balſams would prove ineffectual. When a wound has been made with a ſharp inſtrument, and is not extenſive, if it be immediately cleaned and all the extravaſated blood ſucked (A) out or waſhed away, it will almoſt always heal by *adheſion*. When a wound does not heal by this proceſs, there are three ſtages to be obſerved in its cure; the firſt, called ſuppuration, which takes place when the ends of the wounded veſſels contract themſelves, and pour out the liquor which is converted into pus. As ſoon as this appears, the ſecond, or granulating ſtage, in which the fleſh begins to grow up, takes place; and as this proceeds, the edges of the wound acquire a fine bluiſh or pearl colour, which is that of the new ſkin beginning to cover the wound as far as the granulations have filled it up. This proceſs continues, and the ſkin advances from all ſides towards the centre, which is called the *cicatrizing* of the wound. For the promoting of each of theſe proceſſes, ſeveral ointments were formerly much in vogue. But it is now found, that no ointment whatever is capable of promoting them; and that it is only neceſſary to keep the wound clean, and to prevent the air from having acceſs to it. This, indeed, nature takes care to do, by covering the wound with a cake of coagulated blood; but if a wound of any conſiderable magnitude ſhould be left entirely to nature, the pus would form below the cruſt of coagulated blood in ſuch quantity, that it would moſt probably corrupt, and the wound degenerate into a corroding ulcer. It is neceſſary, therefore, to cleanſe the wound frequently; for this purpoſe it will be proper to apply a little ointment ſpread on ſoft ſcraped lint. And, in a healthy body, the wound will heal without farther trouble. As to the ointment employed, it is almoſt indifferent what it be, provided it has no acrid or ſtimulating ingredient in its compoſition; hogs lard or the ſimple ointment of the Pharmacopeia will anſwer perfectly. Wounds.

But though, in general, wounds thus eaſily admit of a cure, there are ſeveral circumſtances which require a different treatment, even in ſimple diviſions of the fleſhy parts, when neither the membranous nor tendinous parts are injured. Theſe are, 1. Where the wound is large, and gapes very much, ſo that, if allowed to heal in the natural way, the patient might be greatly diſfigured by the ſcar. It is proper to bring the lips of the wound near to each other, and to join them either by adheſive plaſter or by ſuture, according as the wound is ſuperficial, or deep. 2. When foreign bodies are lodged in the wound, as when a cut is given by glaſs, &c. it is neceſſary to extract them, before the wound is dreſſed: for it will never heal until they are diſcharged. When theſe bodies are ſituated in ſuch a manner as not to be capable of being extracted without lacerating the adjacent parts, which would occaſion violent pain and other bad ſymptoms, it is neceſſary to enlarge the wound, ſo that theſe offending bodies may be eaſily removed. This treatment, however, is chiefly neceſſary in gunſhot wounds, of which we ſhall afterwards ſpeak. 3. When the wound is made in ſuch a manner that it runs for ſome length below the ſkin, and the bottom is much lower than the orifice, the matter collected from all parts of the wound will be lodged in the bottom of it, where, corrupting by the heat, it will degenerate into a fiſtulous ulcer. To prevent this, we muſt

(A) See an account of the method of ſucking wounds, in Mr John Bell's *Diſcourſes on Wounds*, Part I. diſcourſe v. p. 215.

Wounds. must use compresses, applied so that the bottom of the wound may suffer a more considerable pressure than the upper part of it. Thus the matter formed at the bottom will be gradually forced upwards, and that formed at the upper part will be incapable of descending by its weight; the divided parts, in the mean time, easily uniting when brought close together. Indeed, the power which nature has of uniting different parts of the human body is very surprising; for, according to authors of credit, even if a piece of flesh be totally cut out, and applied in a short time afterwards to the place from whence it was cut, it will unite. That a part cut out of a living body does not entirely lose its vital power for some time, is evident from the modern practice of transplanting teeth; and from an experiment of Mr John Hunter's, where he put the testicle of a cock into the belly of a living hen, and the testicle adhered to the liver, and became connected to it by means of blood-vessels*. We have therefore the greatest reason to hope, that the divided parts of the human body, when closely applied to each other, will cohere without leaving any sinus or cavity between them. However, if this method should fail, and matter be collected in the depending part of the wound, it will be necessary to make an opening in that part in order to let it out; after which the wound may be cured in the common way. 4. During the course of the cure, it sometimes happens that the wound, instead of filling up with granulations of a florid colour, shoots up into a glassy-like substance which rises above the level of the surrounding skin, while, at the same time, instead of laudable pus, a thin ill-coloured and fetid ichor is discharged. In this case the lips of the wound lose their beautiful pearl colour, and become callous and white, nor does the cicatrizing of the wound at all advance. When this happens in a healthy patient, it generally proceeds from some improper management, especially the making use of too many emollient and relaxing medicines, an immoderate use of balsams and ointments. Frequently nothing more is requisite for taking down this fungus than dressing with dry lint; at other times deiccative powders, such as calamine, tutty, calcined alum, &c. will be necessary; and sometimes red precipitate mercury must be used. This last, however, is apt to give great pain, if sprinkled in its dry state upon the wound; it is therefore most proper to grind it with some yellow basilicon ointment, which makes a much more gentle, though at the same time an efficacious escharotic. Touching the overgrown parts with blue vitriol is also found very effectual.

See *lood*, ° 19.

10 f the re- men of tients in ounds.

Hitherto we have considered the wounded patient as otherwise in a state of perfect health; but it must be observed, that a large wound is capable of disordering the system to a great degree. If the patient is strong and vigorous, and the pain and inflammation of the wound great, considerable degree of fever may arise, which it will be necessary to check by bleeding, low diet, and other parts of the antiphlogistic regimen, at the same time the inflamed lips of the wound and parts adjacent are to be treated with emollient fomentations or cataplasms till the pain and swelling abate. On the other hand, it may happen, when the patient is of a weak and lax habit, that the *vis vitæ* may not be sufficient to excite such an inflammation in the wound as is absolutely necessary for its cure. In this case, the edges of the wound look pale and soft; the wound itself ichorous and bloody, without any signs of granulations; or if any granulations shoot up, they are of the fungous glassy kind above mentioned. To such wounds all external applications are vain; it is necessary to strengthen the patient by proper internal remedies, among which the bark has a principal place, until the wound begins to alter its appearance. In such persons, too, there is some danger of a hectic fever by the absorption of matter; and this will take place during the course of the cure, even when the appearances have been at first as favourable as could be wished. This happens generally when the wound is large, and a great quantity of matter formed; for by this discharge the patient is weakened; so that the pus is no sooner formed, than it is reconveyed into the body by the absorbent vessels, and immediately affects the patient with feverish heat. When this takes place, the best remedy is to exhibit the bark copiously, at the same time to support the patient by proper cordials and nourishing diet. Indeed, in general, it will be found, that, in the case of wounds of any considerable magnitude, a more full and nourishing regimen is required than the patient, even in health, has been accustomed to; for the discharge of pus alone, where the quantity is considerable, proves very debilitating. And it is constantly found, that the cure of such sores goes on much more easily when the patient is kept in his usual habit of body, than when his system is much emaciated by a very low allowance; and, for the same reason, purgatives, taken more freely than what is necessary to keep the bowels open, and whatever else tends to weaken the constitution, are improper in the cure of wounds. Wounds.

11 Of hæmorrhagies from wounds.

Hæmorrhagies very frequently happen in wounds, either from a division of a large artery, or of a number of small ones. In this case, the first step to be taken by the surgeon is to effect a temporary stoppage of the blood by means of compression, and he is then to tie up all the larger vessels according to the methods usually directed.

When the principal arteries of a wound have been tied, and a little blood continues to be discharged, which appears to come from sundry small vessels only, an experienced surgeon is induced to think, that the compression of the bandages will in all probability effect a total stoppage of the hæmorrhagy. In a general oozing from the whole surface of a sore, and when no particular vessel can be distinguished, there is a necessity for trusting to the bandage or compression; but whenever an artery can be discovered, of whatever size it may be, it ought to be secured by a ligature. But it frequently happens, that considerable quantities of blood are discharged, not from any particular vessel, but from all the small arteries over the surface of the wound; and in wounds of great extent, particularly after the extirpation of cancerous breasts, and in other operations where extensive sores are left, this species of hæmorrhagy often proves very troublesome by being exceedingly difficult to suppress.

In constitutions perfectly healthy, on the occurrence of wounds even of the most extensive nature, as soon as the larger arteries are secured, all the small vessels which have been divided are diminished, not only in their diameters, but also in their length; in consequence of which, they recede considerably within the surface of the

Wounds. the ſurrounding parts. This cauſe of itſelf would probably, in the greateſt number of inſtances, prove ſufficient for reſtraining all loſs of blood from the ſmaller arteries. Another very powerful agent however is provided by nature for producing the ſame effect. From the extremities of the divided veſſels which at firſt diſcharged red blood, there now, in their contracted ſtate, oozes out a more thin, though viſcid fluid, containing a great proportion of the coagulable parts of the blood; and this being equally diſtributed over the ſurface of the wound, by its agglutinating powers has a very conſiderable influence in reſtraining all ſuch hæmorrhagies.

When a tedious oozing occurs in a patient young and vigorous, and where the tone of the muſcular fibres is evidently great, the moſt effectual means of putting a ſtop to the diſcharge is to relax the vaſcular ſyſtem, either by opening a vein in ſome other part, or, what gives ſtill more immediate relief, by untying the ligature on one of the principal arteries of the part, ſo as to allow it to bleed freely: thoſe violent ſpaſmodic twitchings too, ſo frequent after operations on any of the extremities, when they do not depend on a nerve being included in the ligature with the artery, are in this manner more effectually relieved than by any other means.

By the ſame means the patient, from being in a febrile heat and much confuſed, ſoon becomes very tranquil: the violent pulſation of the heart and larger arteries abates, and the blood not being propelled with ſuch impetuoſity into the ſmaller veſſels of the part, they are left at more liberty to retract.

The patient ought to be kept exceedingly cool; wine and other cordials ſhould be rigidly avoided; cold water, acidulated either with the mineral or vegetable acids, ought to be the only drink; motion of every kind, particularly of the part affected, ſhould be guarded againſt; and the lip of the wound being drawn together by adheſive plaſter, and gently covered with ſoft charpie, it ought to be tied up with a bandage ſo applied as to produce a moderate degree of preſſure on the extremities of the divided parts.

As ſoon as a ſufficient quantity of blood has been diſcharged, the wound dreſſed, and the patient laid to reſt, a doſe of opium proportioned to the violence of the ſymptoms ought to be immediately exhibited. It ought to be remarked, however, that in all ſuch circumſtances, much larger doſes of this medicine are neceſſary than in ordinary caſes requiring the uſe of opiates. Small doſes, inſtead of anſwering any good purpoſe, ſeem frequently rather to aggravate the various ſymptoms; ſo that whenever they are had recourſe to in ſuch caſes, they ought always to be given in quantities ſufficient for the intended effect.

But hæmorrhagies of this nature happen much more frequently in relaxed enfeebled habits, where the ſolids have loſt part of their natural firmneſs, and the fluids have acquired a morbid tenuity. In this caſe a moderate uſe of generous wine ought to be immediately preſcribed; for nothing tends ſo much, in ſuch circumſtances, to reſtrain hæmorrhagies, as a well directed uſe of proper cordials. By tending to invigorate and brace the ſolids, they enable the arterial ſyſtem to give a due reſiſtance to the contained fluids; and have alſo a conſiderable influence in reſtoring to the fluids that viſcidity of texture, of which in all ſuch inſtances we ſuppoſe them to be deprived. Wounds.

A nouriſhing diet alſo becomes proper; the patient ought to be kept cool; and the mineral acids, from their known utility in every ſpecies of hæmorrhagy, ought alſo to be preſcribed. Reſt of body is here alſo proper; and opiates, when indicated either by pain or ſpaſmodic affections of the muſcles, ought never to be omitted.

Together with theſe remedies adapted to the general ſyſtem, particular dreſſings, appropriated to the ſtate of the parts to which they are to be applied, have been found very beneficial. In healthy conſtitutions, ſoon after the diſcharge of blood is over, the parts are covered with a viſcid coagulable effuſion from the mouths of the now retracted arteries; but in conſtitutions of an oppoſite nature, where the ſolids are much relaxed, the blood in general is found in ſuch an attenuated ſtate as to afford no ſecretion of this nature.

To ſupply as much as poſſible the deficiency of this natural balſam, different artificial applications have been invented. Duſting the part with ſtarch or wheat-flour has ſometimes been found of uſe, and gum arabic in fine powder has been known to anſwer when theſe failed.

Applications of this kind, indeed, have been uſed with ſucceſs in all ſuch hæmorrhagies, with whatever habit of body they happen to be connected; but they have always proved more particularly ſerviceable in relaxed conſtitutions, attended with an attenuated ſtate of the blood and an enfeebled muſcular ſyſtem. Alcohol, or any other ardent ſpirits, impregnated with as great a quantity as they can diſſolve of myrrh, or any other of the heating viſcid gums, may be here uſed with freedom, though in conſtitutions of an oppoſite nature they ought never to be employed. The *balſamum traumaticum* of the ſhops, a remedy of this nature, has long been famous for its influence in ſuch caſes: but that indiſcriminate uſe of this and ſimilar applications which has long prevailed with ſome practitioners, has undoubtedly done much harm; for as they are all poſſeſſed of very ſtimulating powers, they of courſe tend to aggravate every ſymptom in wounds connected with a tenſe ſtate of fibres, or much pain, eſpecially when ſpaſmodic muſcular affections prevail.

By a due perſeverance in one or other of the plans here pointed out, it will ſeldom happen that hæmorrhagies are not at laſt put a ſtop to: but when the contrary does occur, when, notwithſtanding the uſe of the remedies recommended, a diſcharge of blood ſtill continues; in addition to the means already adviſed, an equal moderate preſſure ought to be applied over the whole ſurface of the ſore, to be continued as long as the neceſſity of the caſe ſeems to indicate.

In finiſhing the dreſſings of ſuch wounds, after the adheſive plaſter and compreſſes have been applied, a bandage properly adapted to the part ought to be employed, and in ſuch a manner as to produce as equal a degree of preſſure over the ſurface of the wound as poſſible. But it now and then happens that no bandage can be applied ſo as to produce the deſired effect; and in ſuch caſes the hand of an aſſiſtant is the only reſource; which being firmly preſſed over the dreſſings, will commonly ſucceed when no other means is found to have much influence.

Wounds.

Wounds of the nerves, tendons, and ligaments, are attended with much more violent ſymptoms than thoſe where even conſiderable arteries are divided, and they frequently reſiſt every method of cure propoſed by the moſt ſkilful practitioners. In the ſimple proceſs of blood-letting, it frequently happens that the tendinous expanſion called the *aponeuroſis* of the biceps muſcle is wounded, or even the tendon of that muſcle itſelf is puncture, by the point of the lancet; or ſometimes a nerve which happens to lie in the neighbourhood is partially divided. Any one of theſe wounds, though they are the ſmalleſt we can well ſuppoſe to be given, are frequently very dangerous and difficult of cure. It ſometimes immediately happens on the introduction of the lancet, that the patient complains of a moſt exquiſite degree of pain; and when this occurs, we may reſt aſſured that either a tendon or a nerve has been wounded. On ſome occaſions, by proper management, ſuch as evacuating a conſiderable quantity of blood at the orifice newly made, by keeping the part at perfect reſt, and preſerving the patient in as cool a ſtate as poſſible, the pain at firſt complained of will gradually abate, and at laſt go off entirely without any bad conſequence. At other times, however, this pain which occurs inſtantaneouſly on the introduction of the lancet, inſtead of abating, begins ſoon to increaſe; a fullneſs, or ſmall degree of ſwelling, takes place in the parts contiguous to the wound; the lips of the ſore become ſomewhat hard and inflamed; and, in the courſe of about 24 hours from the operation, a thin watery ſerum begins to be diſcharged at the orifice.

12 Symptoms which ſometimes ſucceed blood-letting.

If, by the means employed, relief is not ſoon obtained, theſe ſymptoms generally continue in nearly the ſame ſtate for two or perhaps three days longer. At this time the violent pain which at firſt took place becomes ſtill more diſtreſſing; but inſtead of being ſharp and acute as before, it is now attended with the ſenſation of a burning heat, which goes on to increaſe, and proves, during the whole courſe of the ailment, a ſource of conſtant diſtreſs to the patient. The fullneſs and hardneſs in the lips of the wound begin to increaſe, and the ſwelling in the neighbouring parts gradually extends over the whole members. The parts at laſt become exceedingly tenſe and hard; an eryſipelatous inflammatory colour frequently appears over the whole member; the pulſe by this time is generally very hard and quick; the pain is now intenſe, the patient exceedingly reſtleſs; twitchings of the tendons occur to a greater or leſs degree; on ſome occaſions, a locked jaw and other convulſive affections ſupervene; and all theſe ſymptoms continuing to increaſe, it moſt frequently happens that the torture under which the patient has been groaning is at laſt terminated by death.

13 Opinions about the cauſes of theſe ſymptoms.

Different opinions have prevailed reſpecting the cauſe of theſe ſymptoms. By ſome they have been imputed to wounds of the tendons. By others the tendons are ſuppoſed to be ſo entirely deſtitute of ſenſibility, as to be quite incapable of producing ſo much diſtreſs; ſo that wounds of the nerves they conſider, on all ſuch occaſions, as the true cauſe of the various ſymptoms we have mentioned.

One or other of theſe ideas continued to be the only ſource for explaining the various phenomena found to occur in this malady, till a different opinion was ſuggeſted by the late ingenious Mr John Hunter of London. Mr Hunter ſuppoſed, that all the dreadful ſymptoms found now and then to be induced by the operation of blood-letting, might be more readily accounted for from an inflamed ſtate of the internal ſurface of the vein, than from any other cauſe. Such a ſtate of the vein he has often traced in horſes that have died of ſuch ſymptoms from veneſection, and the ſame appearances have ſometimes occurred alſo in the human body. And on other occaſions, inflammation having in this manner been once excited, has been known to terminate in ſuppuration; and the matter thus produced being in the courſe of circulation carried to the heart, Mr Hunter ſuppoſes that in ſuch caſes death may have been induced by that cauſe alone.

Wounds.

14 Mr John Hunter's opinion

There can be no reaſon to doubt the fact held forth by Mr Hunter, that in ſuch inſtances the vein in which the orifice has been made, has frequently after death been found greatly inflamed: but however ingenious his arguments may be for concluding that the ſtate of the vein is the original cauſe of all the bad ſymptoms enumerated, and although we muſt allow that ſuch an inflammatory affection of a vein muſt have a conſiderable influence in aggravating the various ſymptoms previouſly induced by other cauſes; yet we may very fairly conclude, that it could not probably in any one inſtance be able to account with ſatisfaction for their firſt production.

In many caſes the patient, at the very inſtant of the operation, feels a very unuſual degree of pain. In ſome caſes, the violence of the pain is almoſt unſupportable. Now this we can never ſuppoſe to have been produced by the mere puncture of a vein; for although the coats of veins are not perhaps entirely deſtitute of feeling, yet we know well that they are not endowed with ſuch a degree of ſenſibility as to render it probable that ſuch intenſe pain could ever be induced by their being punctured in any way whatever. This inflamed ſtate of the veins therefore, as detected by Mr Hunter after death, muſt be conſidered rather as being produced by, than as being productive of, ſuch affections; and that ſuch ailments ſhould frequently produce an inflammation of the contiguous veins, is a very probable conjecture. In the courſe of 48 hours from the operation, when the febrile ſymptoms are juſt commencing, ſuch a degree of hardneſs and evident inflammation is induced over all the parts contiguous to the orifice, that it would be ſurpriſing indeed if the vein, which is thus perhaps entirely ſurrounded with parts highly inflamed, ſhould eſcape altogether. We ſhall therefore proceed upon the ſuppoſition of this inflamed ſtate of the veins being a conſequence rather than the cauſe of ſuch ailments; and of courſe we now revert to one or other of the opinions long ago adopted on this ſubject, that all the train of bad ſymptoms found on ſome occaſions to ſucceed veneſection, proceeds either from the wound of a nerve or of a tendon.

15 not juſt.

16 Really owing to the wounding of a nerve or tendon.

That a partial wound of a nerve will now and then produce very diſtreſſing ſymptoms, no practitioner will deny: but it has been attempted to be ſhown, that tendons are almoſt totally deſtitute of ſenſibility; and it has therefore been ſuppoſed, that their being wounded can never account for the various ſymptoms known to occur in ſuch caſes. There is great reaſon however to think, that in different inſtances the ſame train of ſymptoms have been induced by different cauſes; that in one

Wounds.

inſtance a wounded nerve, and in others pricks of the tendons, have given riſe to them, as we have already ſuppoſed.

17 Method of obviating theſe ſymptoms, and curing the wound.

In order to prevent as much as poſſible the conſequent inflammation and other ſymptoms which uſually enſue, a conſiderable quantity of blood ſhould be immediately diſcharged at the orifice juſt made: the limb, for ſeveral days at leaſt, ought to be kept in a ſtate of perfect reſt, care being at the ſame time taken to keep the muſcles of the part in as relaxed a ſtate as poſſible: the patient ſhould be alſo kept cool, on a low diet; and, if neceſſary, gentle laxatives ought to be adminiſtered.

When, notwithſtanding theſe means, the ſymptoms, inſtead of diminiſhing, rather become more violent; if the lips of the orifice turn hard and more inflamed, if the pain become more conſiderable, and eſpecially if the ſwelling begin to ſpread, other remedies come to be indicated. In this ſtate of the complaint, topical bloodletting, by means of leeches applied as near as poſſible to the lips of the wound, frequently affords much relief; and when the pulſe is full and quick, it even becomes neceſſary to evacuate large quantities of blood by opening a vein in ſome other part.

The external applications uſually employed in this ſtate of the complaint are warm emollient fomentations and poultices. In ſimilar affections of other parts no remedies with which we are acquainted would probably be found more ſucceſsful; but in the complaint now under conſideration, all ſuch applications, inſtead of being productive of any advantage, rather do harm. The heat of the part is here one of the moſt diſtreſſing ſymptoms; and warm emollient applications rather tend to augment this ſource of uneaſineſs. The lips of the wound alſo are rendered ſtill more hard, ſwelled, and of courſe more painful; and the ſwelling of the contiguous parts is increaſed. The beſt external remedies are cooling aſtringents, eſpecially the ſaturnine applications. The parts chiefly affected being alternately covered over with cloths wet with a ſolution of ſaccharum ſaturni, and pledgets ſpread with Goulard's cerate, are kept more cool and eaſy than by any other remedy hitherto uſed. The febrile ſymptoms which occur muſt at the ſame time be attended to, by keeping the patient cool, on a low diet, preſerving a lax ſtate of the bowels; and, if neceſſary, farther quantities of blood ought to be evacuated.

On account of the violence of the pain, which is ſometimes ſo exceſſive as to deſtroy entirely the patient's reſt, opiates ought to be freely exhibited; and when twitchings of the tendons and other convulſive ſymptoms ſupervene, medicines of this kind become ſtill more neceſſary. In order, however, to have a proper influence in this ſtate of the complaint, opiates ought to be given in very full doſes; otherwiſe, inſtead of anſwering any good purpoſe, they conſtantly tend to aggravate the different ſymptoms, not only by increaſing the heat and reſtleſſneſs, but by having an evident influence in rendering the ſyſtem more ſuſceptible than it was before of the pain and other diſtreſſing effects produced upon it by the wound.

It often happens, however, either from neglecting the wound or from improper treament, that all theſe remedies are had recourſe to without any advantage whatever: the fever, pain, and ſwelling of the parts continue, and convulſive affections of the muſcles at laſt occur, all tending to indicate the moſt imminent danger. In this ſituation of matters, if we have not immediate recourſe to ſome effectual means, the patient will ſoon fall a victim to the diſorder; and the only remedy from which much real advantage is to be expected, is a free and extenſive diviſion of the parts in which the orifice producing all the miſchief was at firſt made. We know well, from the experience of ages, that much more pain and diſtreſs of every kind are commonly produced by the partial diviſion either of a nerve or of a tendon, than from any of theſe parts being at once cut entirely acroſs. Now the intention of the operation here recommended, is to produce a complete diviſion of the nerve or tendon we ſuppoſe to have been wounded by the point of the lancet, and which we conſider as the ſole cauſe of all the ſubſequent diſtreſs. Wounds.

This operation being attended with a good deal of pain, and being put in practice for the removal of ſymptoms from which it is perhaps difficult to perſuade the patient that much danger can occur, all the remedies we have mentioned ſhould be made trial of before it is propoſed: but at the ſame time, care ought to be taken that the diſorder is not allowed to proceed too far before we have recourſe to it; for if the patient ſhould be previouſly much weakened by the feveriſh ſymptoms having continued violent for any length of time, neither this remedy nor any other with which we are acquainted would probably have much influence. As ſoon, therefore, as the courſe already preſcribed has been fairly tried, and is found to be inadequate to the effects expected from it, we ought immediately to have recourſe to a free diviſion of the parts affected.

18 Treatment of wounded or ruptured tendons.

Wherever a wounded or ruptured tendon may be ſituated, the limb ſhould be placed in ſuch a manner as will moſt readily admit of the retracted ends of the tendon being brought together; and when in this ſituation, the muſcles of the whole limb in which the injury has happened muſt be tied down with a roller, ſo as to prevent them from all kinds of exertion during the cure, endeavouring at the ſame time to keep the parts eaſy and relaxed. Thus, in a wound or rupture of the tendon of the rectus muſcle of the thigh, the patient's *leg* ſhould be kept as much as poſſible ſtretched out during the cure, while the thigh ſhould be in ſome degree bent, to relax the muſcle itſelf as far as poſſible.

In ſimilar affections of the tendo Achillis, the *knee* ſhould be kept conſtantly bent to relax the muſcles of the leg, and the foot ſhould be ſtretched out to admit of the ends of the ruptured tendon being brought into contact. A roller ſhould be applied with a firmneſs quite ſufficient for ſecuring the muſcles and tendons in this ſituation; but care muſt be taken to prevent it from impeding the circulation. With this view, ſoft fine flannel ſhould be preferred either to linen or cotton; for being more elaſtic, it more readily yields to any ſwelling with which the limb may be attacked.

The late Dr Monro was the firſt who gave any accurate directions for the treatment of rupture in the large tendons; and it is perhaps given with more preciſion, from his having himſelf experienced the effects of this misfortune in the tendo achillis.

He uſed a foot-ſock or ſlipper, made of double quilted ticking, and left open at the toe; from the heel of which a ſtrap went up above the calf of the leg. A

ſtrong

Wounds. strong piece of the same materials went round the calf, and was fastened with a lace. On the back part of this was a buckle, through which the strap of the foot-sock was passed, by which the calf could be brought down, and the foot extended at pleasure. Besides there was a piece of tin applied to the fore part of the leg, to prevent the foot from getting into any improper posture during sleep. After proposing to walk, he put on a shoe with a heel two inches deep; and it was not till the expiration of five months that he ventured to lay aside the tin-plate; and he continued the use of the high-heeled shoe for two years.

From this treatment a knowledge may be formed of the treatment necessary to be followed in the laceration of tendons of other parts of the body.

19 Wounds of the thorax. In wounds of the thorax, even though none of the viscera should be wounded, we may yet reasonably expect that a considerable quantity of blood will be extravasated; and this, if very large, must be evacuated if possible. However, it ought to be particularly observed, that this extravasated blood should not be discharged before we are assured that the wounded vessels have done bleeding. When the pulse appears sufficiently strong and equal, the extremities warm, no hickup or convulsion, and the patient's strength continues, we may then know that the internal hæmorrhagy has ceased, and that the means for discharging the blood may now be safely used. Matter, water, and blood have sometimes vanished from the cavities of the thorax, and been afterwards discharged by sweat, urine, &c. Yet this but seldom happens; and if we were to trust to nature alone in these cases, it is certain that many would perish from a destruction of the vital viscera by the extravasated blood, who by an artificial extraction of the same blood might have been saved.

20 Wounds of the abdomen. Wounds of the abdomen must be closed as soon as possible, and then treated as simple wounds; only they ought to be dressed as seldom and expeditiously as possible. Copious bleeding and a spare diet, with other parts of the antiphlogistic regimen, are here absolutely necessary.

It sometimes happens, that, through a large wound of the abdominal integuments, the intestine comes out without being injured. The most certain method, in all such cases, is to return the protruded part as soon as possible; for although writers in general formerly recommended warm fomentations, &c. to be previously applied, the latest authors upon this subject consider the most natural and proper fomentation to be that which is produced by the heat and moisture of the patient's belly, and that therefore the intestines, if no mortification has taken place, are to be cleared from extraneous matter, and immediately returned.

When the wound of the abdomen is large, the intestines easily prolapse, and they are as easily returned. But when part of an intestine has been forced through a narrow wound, it is much more dangerous. For the prolapsed intestine being distended by flatus, or the ingested aliments driven thither by the peristaltic motion, it will become inflamed, tumefied, and incapable of being returned through the stricture of the wound; whence gangrene will soon follow. In this case the utmost care is to be taken to reduce the intestine to its natural size. When this cannot be accomplished by other means, some practitioners of great eminence have even advised the puncturing of the intestine in different places in order to discharge the flatus. This practice has also been recommended in an incarcerated hernia, but is exceedingly disapproved of by Mr Pott and later writers; and it seems to be very dubious whether any good can possibly arise from it. To puncture any part that is already inflamed, must undoubtedly add to the inflammation; and it is very improbable that the discharge of flatus procured by the punctures would be at all a recompense for the bad consequences produced by the increased inflamniation. The method of Celsus is much more eligible: It is to dilate the wound so as to reduce the intestine with ease. Wounds.

Sometimes part of the intestine is lost either by suppuration or gangrene. In this case, all that can be done is to put a single stitch through the wounded bowel, and to fix it to the external wound by passing the future also through the sides of the wound. The ends of the intestine may perhaps adhere; or at any rate the wound will continue to perform the office of an anus, out of which the fæces will continue to be discharged during life. The directions given by some surgeons about inserting the upper end of the gut into the lower, and stitching them together, are perfectly impracticable; and even if they were practicable, would certainly produce new mortification, which could not but be fatal.

When the omentum appears prolapsed, the same general treatment is to be observed; only that, when it is mortified, the dead part may be safely extirpated.—We shall conclude the article of abdominal wounds with a case from the memoirs of the academy of sciences for the year 1705, which shows that we ought not to despair, even though the most desperate symptoms should take place. A madman wounded himself in 18 different places of the abdomen. Eight of these penetrated the cavity, and injured the contained viscera; he had a diarrhœa, nausea, and vomiting, tension of the abdomen, with difficult respiration and violent fever, so that his life was despaired of. During the first four days he was blooded seven times; and during the greatest part of the cure his diet consisted almost entirely of flesh-broths, with the addition of some mild vegetables. By these means he was not only cured of his wounds, but restored to his right senses. Seventeen months after, he went mad again, and threw himself over a precipice, by which he was instantly killed. On opening the body, the wounds were found to have penetrated the middle lobe of the liver, the intestinum jejunum, and the colon.

Such extraordinary cures are to be imputed, according to the satisfactory explanation of Mr J. Bell, to the abdomen being perfectly full, and constantly subjected to strong pressure between the diaphragm and abdominal muscles; which keeps the parts contiguous to a wound closely applied to it, also in some measure prevents the discharge of fæces or even of blood, and gives an opportunity for a very speedy adhesion between the parts.

21 Wounds of the head. In wounds of the head, where the cellular membrane only is affected, and the aponeurosis and pericranium are untouched, phlebotomy, lenient purges, and the use of the common febrifuge medicines, particularly those of the neutral kind, generally remove all the threatening symptoms. When the inflammation is gone off, it leaves on the skin a yellowish tint and a dry scurf, which continue until perspiration takes them away; and upon the

Wounds. removal of the diſeaſe, the wound immediately recovers a healthy aſpect, and ſoon heals without further trouble. But in the worſt kind of theſe wounds, that is, where a ſmall wound paſſes through the tela celluloſa and aponeuroſis to the pericranium, the patient will admit of more free evacuations by phlebotomy than in the former. In both, the uſe of warm fomentations is required; but an emollient cataplaſm, which is generally forbid in the eryſipelatous ſwellings, may in this latter caſe be uſed to great advantage. Where the ſymptoms are not very preſſing, nor the habit very inflammable, this method will prove ſufficient; but it ſometimes happens that the ſcalp is ſo tenſe, the pain ſo great, and the ſymptomatic fever ſo high, that by waiting for the ſlow effect of ſuch means the patient runs a riſk from the continuance of the fever; or elſe the injured aponeuroſis and pericranium become ſloughy, produce an abſceſs, and render the caſe both tedious and troubleſome. A diviſion of the wounded part, by a ſimple inciſion down to the bone, about half an inch or an inch in length, will moſt commonly remove all the bad ſymptoms; and if it be done in time, will render every thing elſe unneceſſary.

22 Wounds of the joints. The wounds penetrating into the cavities of the joints do not ſeem at firſt alarming; yet, by expoſure to the air, the lining membrane of ſuch cavities acquires ſuch a degree of ſenſibility as to endanger life when they are large. As ſoon therefore as any extraneous body, puſhed into the joint, is removed, the admiſſion of the external air is to be guarded againſt as much as poſſible. If the wound be not too large, this may be done by pulling the ſkin over the wound of the joint; and, to prevent its retraction, rather adheſive plaſter, with proper bandaging, is to be uſed. But when inflammation has come on, repeated and copious blood-letting, together with fomentations, becomes neceſſary; and as the pain, in theſe caſes, is apt to be violent, opiates muſt be adminiſtered; but ſhould matter be formed in the cavity of the joint, free vent muſt be given to it.

Of contuſed and lacerated Wounds.—When the ſmall veſſels are ruptured by a blow with any hard inſtrument without penetrating the ſkin, at the ſame time that the ſolid fibres of the part are cruſhed, the injury is termed a *contuſion:* and when at the ſame time the ſkin is broken, it is termed a *contuſed and lacerated wound.*

23 Symptoms and effects of contuſions. Every contuſion therefore, whether the ſkin is broken or not, may be properly reckoned a wound; where the injury is ſo ſlight that none of the contents of the ſmall veſſels are extravaſated, it ſcarcely deſerves to be mentioned. The immediate conſequence of a contuſion, therefore, is a ſwelling, by reaſon of the extravaſation juſt mentioned; and the ſkin becomes diſcoloured by the blood ſtagnating under it; but as this fluid, even though covered by the ſkin, cannot long remain in the natural ſtate, it thence happens, that the contuſed part ſoon loſes its florid red colour, and becomes blue or black; the thinner parts being in the mean time gradually taken up by the abſorbent veſſels. This at laſt happens to the blood itſelf; the blue diſappears, and is ſucceeded by a yellowiſh colour, ſhowing that the blood is now diſſolved; after which, the part recovers its former appearance, and the ruptured veſſels appear to have united as if no injury had happened.

Theſe are the ſymptoms which attend the ſlighteſt kind of contuſions; but it is evident, that where the blow is ſo violent as to rupture the blood-veſſels or cruſh Wounds. ſome of the large nerves, all the bad conſequences which attend ſimple wounds of thoſe parts will enſue, and they will not be at all alleviated by the circumſtance of the ſkin remaining whole. Hence it is eaſy to ſee how a contuſion may produce ulcers of the worſt kind, gangrene, ſphacelus, carious bones, &c.; and if it happen to be on a glandular part, a ſchirrus or cancer is very frequently found to enſue. Even the viſcera themſelves, eſpecially of the abdomen, may be injured by contuſions to ſuch a degree as to produce an inflammation, gangrene, or ſchirrus, nay inſtant death, without rupturing the ſkin.

Of Gun-ſhot Wounds.—Gun-ſhot wounds can be conſidered in no other light than contuſed wounds. In thoſe made by a muſket or piſtol ball, the firſt things to be done are, to extract the ball, or any other extraneous body which may have lodged in the wounded part; and to ſtop the hemorrhagy, if there be an effuſion of blood from the rupture of ſome conſiderable artery.

24 Extraction of the ball or other foreign bodies. It is frequently neceſſary to enlarge the wound in order to extract the ball; and if it has gone quite through (provided the ſituation of the part wounded will admit of its being done with ſafety), the wound is to be laid freely open through its whole length; by which means any extraneous body will be more readily removed, and the cure facilitated.

In order to get at the ball, or any foreign matter, the probe is to be uſed as ſparingly as poſſible: and this muſt appear evident to any one who will only conſider the nature of the ſymptoms attendant on penetrating wounds of the breaſt or belly, either from a bullet or ſharp inſtrument; the thruſting in a probe to parts under ſuch circumſtances being unavoidably a freſh ſtab on every repetition. Wherever probing is neceſſary, the finger is to be preferred as the beſt and trueſt probe, where it can be uſed.

If a ball, or any other foreign body, happen to be lodged near the orifice, or can be perceived by the finger to lie under the ſkin, though at ſome diſtance from the mouth of the wound, we ſhould cut upon it and take it out: but when it is ſunk deep, and lies abſolutely beyond the reach of the finger, it muſt appear evident upon the leaſt reflection, that thruſting, firſt a long probe in queſt of the bullet, and then, as has been likewiſe practiſed, a long pair of forceps, either with or without teeth, into a wound of that kind, though with ſome certainty to extract it, muſt either contuſe, or irritate and inflame the parts to a great degree; and conſequently do as much, or more, miſchief as the ball did at firſt in forcing its paſſage to ſuch a length. And ſhould they at the ſame time lay hold of any conſiderable artery or nerve along with the ball (which can ſcarce ever fail of being the caſe), what ſhocking conſequences would attend ſuch a proceeding! Nor would attempts of this ſort be leſs injurious, if a bullet ſhould happen to be lodged in the cavity of the belly or breaſt. Such attempts are the leſs neceſſary, becauſe a great number of inſtances have occurred, where balls have been quietly lodged in ſeveral parts of the body, till after many years they have worked themſelves a paſſage towards the ſurface, and were very eaſily extracted; and many caſes alſo where balls have been entirely left behind.

In caſe the wound be occaſioned by a muſket or piſtol

Wounds.

ſtol ſhot, and of courſe be ſmall, it will be neceſſary to dilate the wound without delay, provided the nature of the part will permit of this with ſafety: for in wounds near a joint, or in very membranous or tendinous parts, the knife, as well as forceps, ſhould be put under ſome reſtraint; nor ſhould any more opening be made than what is abſolutely requiſite for the free diſcharge of the matter lodged within.

25 Dilatation of the wound.

Where the wounded perſon has not ſuffered any great loſs of blood, and this is generally the caſe, it will be adviſable to open a vein immediately, and take from the arm a large quantity; and to repeat bleeding as circumſtances may require, the ſecond, and even the third day.

26 Advantage of bleeding.

Repeated bleedings in the beginning are followed by many advantages. They prevent pain and a good deal of inflammation, leſſen any feveriſh aſſaults, and ſeldom fail to obviate impoſthumations, and a long train of complicated ſymptoms which are wont otherwiſe to interrupt the cure, miſerably haraſs the poor patient, and too often endanger his life. Even where the feveriſh ſymptoms run high, and there is almoſt a certainty that matter is forming, bleeding, in ſuch a ſtate, is very frequently of great advantage.

27 Regimen.

For the firſt twelve days after the wound has been received, it will be proper to obſerve a cooling regimen, both in reſpect of the medicines that may be preſcribed, and the diet requiſite for the ſupport of the patient. It is likewiſe abſolutely neceſſary that the body be conſtantly kept open. Unleſs, therefore, nature does this office of herſelf, a ſtool ſhould be every day procured, either by emollient clyſters, or ſome gentle laxative taken at the mouth; and whenever there is much pain in the wounded parts, immediate recourſe muſt be had to opium.

28 External application.

As to external applications, whatever is of a hot ſpirituous nature is remarkably injurious on theſe occaſions, and what no wounded part can in any degree bear. The wound may be dreſſed with pledgits of any emollient ointment; the whole being covered with a common poultice, or, in ſome caſes, the preparations of lead may be uſed. An opiate ſhould now be adminiſtered; and the part affected being placed in the eaſieſt and moſt convenient poſture, the patient ſhould be laid to reſt. The formation of matter, in every contuſed wound, is an object of the firſt importance; for, till this takes place, there is often reaſon to ſuſpect that gangrene may happen. With a view to haſten ſuppuration, the warm poultices ſhould be frequently renewed, and they ſhould be continued till the tenſion and ſwelling, with which wounds of this kind are uſually attended, be removed; and till the ſore has acquired a red, healthy, granulating appearance, and then it is to be treated like a common ulcer.

Gun-ſhot wounds are commonly covered from the beginning with deep ſloughs, and various remedies are recommended for removing theſe. Every appearance, however, of this kind with which they are attended proceeds entirely from contuſion; and, excepting the injury be extenſive, the ſlough is not often perceptible, or it is ſo thin as to come away along with the matter at the firſt or ſecond dreſſing. Although emollient poultices be extremely uſeful, they ought to be no longer continued than till the effects already mentioned are produced; otherwiſe they will not only relax the parts, but alſo produce too copious a diſcharge of matter, which is ſometimes attended with great danger. A too copious flow of matter may proceed from different cauſes; but in whatever way it may have been produced, the practice to be adopted muſt be nearly the ſame. Every collection which appears muſt have a free outlet, and the limb laid in that poſture which will moſt readily admit of its running off. In ſuch circumſtances, nouriſhing diet and Peruvian bark in conſiderable quantities are highly uſeful. When the diſcharge continues copious, in ſpite of every effort to check it, detached pieces of bone or ſome extraneous matter are probably the cauſe. In ſuch a ſituation nothing will leſſen the quantity of matter till ſuch ſubſtances be removed. The wound ought therefore again to be examined, and any looſe bodies taken away. Pieces of cloth have been known to be removed by ſetons, when that method was practicable, after every other method had failed. Opium is frequently uſed in checking an exceſſive diſcharge, when it happens to be kept up by irritation.

Wounds.

Although no conſiderable hemorrhagy may happen on firſt receiving a gun-ſhot wound; yet after the ſloughs commonly produced upon ſuch occaſions have come off, ſome conſiderable arteries may be expoſed, and then a dangerous hemorrhagy may enſue. The hemorrhagy is often preceded by a great heat in the injured parts, and with a throbbing pulſatory pain. At this period it may frequently be prevented by plentiful blood-letting, particularly local. But if the hemorrhagy has fairly taken place, and from arteries of conſiderable ſize, nothing will reſtrain it but the proper application of ligatures. As the diſcharge in theſe caſes would often prove dangerous before the ſurgeon could be procured, the attendants ſhould be furniſhed with a tourniquet, with directions to apply it, upon the firſt appearance of blood.

29 Scarifying improper.

Till of late years the ſcarifying of gun-ſhot wounds was a practice which prevailed very univerſally among ſurgeons; and it was expected by this, that the ſloughs with which wounds are ſometimes covered would ſooner ſeparate, and that the cure would thereby be more readily performed. It is now, however, known, that this practice, inſtead of being uſeful, very generally does harm by increaſing the inflammation. It ſhould therefore be laid entirely aſide.

When a gun-ſhot wound cannot eaſily or ſafely be laid open from one end to the other, perhaps it may be proper to introduce a cord through the ſinus. This, however, ſhould not be attempted till the firſt or inflammatory ſtate of the wound is over: but when a cord cannot be properly introduced, on account of the ſituation or direction of the wound, compreſſion may prove equally uſeful here as in caſes of punctured wounds.

30 Mortification.

Mortification happening after gun-ſhot wounds, is to be treated in the ſame manner as if it had ariſen from any other cauſe, only bark is not to be promiſcuouſly uſed; as, in plethoric habits, it may prove hurtful, though in debilitated relaxed habits it will be extremely uſeful; but even in ſuch it ſhould never be given while much pain and tenſion continue.

31 Symptoms of compreſſion of the brain.

Of Wounds and Injuries of the Head producing Fractures and Depreſſions.—When the brain is compreſſed, a ſet of ſymptoms enſue, extremely dangerous, though ſometimes they do not make their appearance till after a conſiderable interval. But at whatever time they appear, they are uniformly of the ſame kind, and

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Wounds. are in general as follows: drowſineſs, giddineſs, and ſtupefaction, dimneſs of ſight, dilatation of the pupil; and, where the injury done to the head is great, there is commonly a diſcharge of blood from the eyes, noſe, or ears. Sometimes the fractured bone can be diſcovered through the integuments, at other times it cannot. There is an irregular and oppreſſed pulſe, and ſnoring or apoplectic ſtertor in breathing. There is likewiſe nauſea and vomiting, with an involuntary diſcharge of fæces and urine. Among the muſcles of the extremities and other parts, there is loſs of voluntary motion, convulſive tremors in ſome parts of the body, and palſy in others, eſpecially in that ſide of the body which is oppoſite to the injured part of the head.

Some of the milder of theſe ſymptoms, as vertigo, ſtupefaction, and a temporary loſs of ſenſibility, are frequently induced by ſlight blows upon the head, but commonly ſoon diſappear, either by reſt alone, or by the means to be afterwards pointed out. But when any other ſymptoms enſue, ſuch as dilatation of the pupils, and eſpecially when much blood is diſcharged from the eyes, noſe, and ears, and that there is an involuntary diſcharge of fæces and urine, it may be reaſonably concluded that compreſſion of the brain is induced.

The cavity of the cranium, in the healthy and natural ſtate, is everywhere completely filled by the brain; whatever therefore diminiſhes that cavity, will produce a compreſſion of the brain.

32 Cauſes of theſe. The cauſes producing ſuch a diminution may be of various kinds, as fracture and depreſſion of the bones of the cranium; the forcible introduction of any extraneous body into the cavity of the cranium; effuſion of blood, ſerum, pus, or any other fluid; the thickneſs and irregularity of the bones of the cranium in certain diſeaſes, as in lues venerea, rickets, or ſpina ventoſa; or water collected in hydrocephalous caſes. The firſt ſet of cauſes ſhall be conſidered in their order. The four laſt mentioned belong to the province of the phyſician, and have been conſidered in a former part of this work.

Fractures of the cranium have been differently diſtinguiſhed by different authors; but it ſeems ſufficient to divide them into thoſe attended with depreſſion, and thoſe which are not.

In fracture and depreſſion of the cranium, the treatment ought to be,—to diſcover the ſituation and extent of the fracture; and to obviate the effects of the injury done to the brain, by raiſing or removing all the depreſſed parts of the bone.

33 Method of diſcovering the ſituation of fractures of the cranium. When the teguments correſponding to the injury done to the bone are cut or lacerated, and, as is ſometimes the caſe, entirely removed, the ſtate of the fracture is immediately diſcovered; but when the integuments of the ſkull remain entire, even though the general ſymptoms of fracture be preſent, there is ſometimes much difficulty in aſcertaining it. When, however, any external injury appears, particularly a tumor from a recent contuſion, attended by the ſymptoms already deſcribed, there can be no doubt of the exiſtence of a fracture. But it ſometimes happens that compreſſion exiſts without the ſmalleſt appearance of tumor. In ſuch caſes, the whole head ought to be ſhaved, when an inflammatory ſpot may frequently be obſerved. Sometimes the place of the fracture has been diſcovered by the patient applying the hand frequently on or near ſome particular part of the head. Wounds.

When the ſymptoms of a compreſſed brain are evidently marked, no time ought to be loſt in ſetting about an examination of the ſtate of the cranium, wherever appearances point out, or even lead us to conjecture, in what part a fracture may be ſituated. For this purpoſe an inciſion is to be made upon the ſpot through the integuments to the ſurface of the bone, which muſt be ſufficiently expoſed to admit of a free examination.

Some authors have recommended a crucial inciſion; others one in form of the letter T; while many adviſe a conſiderable part of the integuments to be entirely removed. But as it is more agreeable to the preſent mode of practice to ſave as much of the ſkin as poſſible, a ſimple inciſion is generally preferred, unleſs the fracture run in different directions, and then the inciſion muſt vary accordingly. It will frequently happen, that a conſiderable part of the integuments muſt be ſeparated from the ſkull, in order to obtain a diſtinct view of the full extent of the fracture; but no part of the integuments is to be entirely removed.

When blood-veſſels of any conſiderable ſize are divided, either before or in time of the examination, they ought to be allowed to bleed freely, as in no caſe whatever is the loſs of blood attended with more advantage than the preſent. When, however, it appears that the patient has loſt a ſufficient quantity, the veſſels ought to be ſecured.

After the integuments have been divided, if the ſkull be found to be fractured and depreſſed, the nature of the caſe is rendered evident; but even where there is no external appearance of fracture, tumor, diſcoloration, or other injury, if the patient continue to labour under ſymptoms of a compreſſed brain, if the pericranium has been ſeparated from the bone, and eſpecially if the bone has loſt its natural appearance, and has acquired a pale white or duſky yellow hue, the trepan ought to be applied without heſitation at the place where theſe appearances mark the principal ſeat of the injury.

Again, although no mark either of fracture or of any diſeaſes underneath ſhould appear on the outer table of the bone, yet there is a poſſibility that the inner table may be fractured and depreſſed. This indeed is not a common occurrence, but it happens probably more frequently than ſurgeons have been aware of; and where it does happen, the injury done to the brain is as great, and attended with as much danger, as where the whole thickneſs of the bone is beat in. The application of the trepan is therefore neceſſary.

But if, after the application of the trepan, it happens that no mark of injury appears either in the outer or inner table in that part, or in the dura mater below it, and that the ſymptoms of a compreſſed brain ſtill continue, a fracture in ſome other part is to be ſuſpected; or that kind of fracture termed by practitioners *counter fiſſure*, where the ſkull is fractured and ſometimes depreſſed on the oppoſite ſide to, or at a diſtance from, the part where the injury was received. This is fortunately not a very frequent occurrence, and has even been doubted by ſome; but different inſtances of it have, beyond all queſtion, been found. If therefore the operation of the trepan has been performed, and no fracture

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Wounds.

is discovered, no extravasation appears on the surface of the brain; and if blood-letting and other means usually employed do not remove the symptoms of compression, the operator is to search for a fracture on some other part. The whole head should again be examined with much accuracy; and, by pressing deliberately but firmly over every part of it, if the smallest degree of sensibility remains, the patient will show signs of pain, either by moans or by raising his hands, when pressure is made over the fractured part. In this way fractures have been frequently detected, which might otherwise have been concealed.

34 Method of removing and elevating depressed portions of the cranium.

Having now considered every thing preparatory to the operation of the trepan, we shall next point out the means best adapted for the removal or elevation of a depressed portion of the bone.

The first thing to be done is, after shaving the head, to make an incision as deep as the bone, and directly upon the course of the fracture.

The patient ought to be laid on a table, with a mattress under him, while his head is placed upon a pillow, and secured by an assistant. When the extent of the fracture has been determined, and the bleeding from the incision stopped, the depressed bone is now to be elevated; but previous to this it is necessary to search for detached pieces. Should any be found, they ought to be removed by a pair of forceps adapted to this purpose. By the same instrument any splinters of bone which may have been beaten in may be removed; but when a part of the bone is beaten in beyond the level of the rest of the cranium, as much of the pericranium is then to be removed by a raspatory, as will allow the trephine to be applied; or, if the operator incline, for the sake of dispatch, he may use the trepan; or the operation may be begun and finished with the trephine, while the trepan may perform the middle and principal part of the work. This part of the work is begun by making a hole with the perforator, deep enough to fix the central pin of the trephine, in order to prevent the saw from slipping out of its central course, till it has formed a groove sufficiently deep to be worked steadily in; and then the pin is to be removed. If the bone be thick, the teeth of the saw must be cleaned now and then by the brush during the perforation, and dipped in oil as often as it is cleaned, which will considerably facilitate the motion, and render it more expeditious; making it at the same time much less disagreeable to the patient, if he possess his senses. That no time may be lost, the operator ought to be provided with two instruments of the same size, or at least to have two heads which can be readily fitted to the same handle.

After having made some progress in the operation, the groove ought to be frequently examined with a pick-tooth, or some such instrument, in order to discover its depth; and if one side happen to be deeper than the other, the operator ought to press more on that side which is shalloweſt. Precautions are more particularly necessary when the operation is performed upon a part of the skull which is of an unequal thickness, especially after the instrument has passed the diploe. And though it be said by writers in general that the instrument may be worked boldly till it comes at the diploe (which is generally known by the appearance of blood), yet the operator should be upon his guard in this point, examining from time to time if the piece be loose, lest through inadvertence the dura mater be wounded; for in some parts of the skull there is naturally very little diploe, and in old subjects scarcely any. It ought likewise to be remembered, that the skulls of children are very thin. When the piece begins to vacillate, it ought to be snapped off with the forceps or levator; for the sawing ought by no means to be continued till the bone be cut quite through, otherwise the instrument may plunge in upon the brain, or at least injure the dura mater (B). If the inner edge of the perforation be left ragged, it is to be smoothed with the lenticular, to prevent it from irritating the dura mater. Particular care is to be taken in using the instrument, lest it should press too much upon the brain.

Wounds.

The next step is to raise the depressed part of the bone with the levator, or to extract the fragments of the bone, grumous blood, or any extraneous body. After this, if there appear reason to apprehend that blood, lymph, or matter, is contained under the dura mater, it ought to be cautiously opened with a lancet, endeavouring to avoid the blood-vessels running upon it, or lying immediately under it.

When the trepan is to be used on account of a fissure in which the bone will not yield, the instrument should be applied so as to include part of it, if not directly over it, as it is most probable that the extravasated fluid will be found directly under it. And when the fissure is of great extent, it may be proper to make a perforation at each end, if the whole can be conveniently brought into view; and in some cases several perforations may become necessary.

When it is proposed to make several perforations to remove depressed fragments of the bone which are firmly fixed, and having the internal surface larger than the external, or to raise them sufficiently, it is necessary to apply the trepan as near the fractured parts as possible; making the perforations join each other, to prevent the trouble of cutting the intermediate spaces.

When the skull is injured over a suture, and it is not thought advisable to use the trepan, a perforation ought to be made on each side of the suture, especially in young subjects, in which the dura mater adheres more strongly than in adults; because there cannot be a free communication between the one side and the other, on account of the attachment of that membrane to the suture.

35 Treatment of the patient after the operation.

After the elevation of the depressed pieces, or the removal of those which are quite loose, the extraction of extraneous bodies, and the evacuation of extravasated fluids, &c. the sore is to be dressed in the lightest and easiest manner; all that is necessary being to apply a pledget of fine scraped lint, covered with simple ointment, to that part of the dura mater which is laid bare by

(B) A trepanning instrument has been invented by Mr Rodman, surgeon, Paisley, which has no central pin, and it is so contrived that any given thickness of bone may be cut, so that the danger from other instruments is by the use of this entirely avoided. See a more detailed account of this instrument under ABAPTISTON.

Wounds. by the trepan, or otherwiſe; after which the edges of the ſcalp are to be brought together or nearly ſo, and another pledget laid along the whole courſe of the wound; a piece of fine ſoft linen is to be laid over all, and the dreſſings may be retained in their place by a common night-cap applied cloſe to the head, and properly fixed.

The patient is to be placed in as eaſy a poſition in bed as poſſible, with his head and ſhoulders elevated a little more than ordinary. If the operation be attended with ſucceſs, the patient will ſoon begin to ſhow favourable ſymptoms; he will ſoon ſhow ſigns of increaſing ſenſibility, and the original bad ſymptoms will gradually diſappear. After this he ought to be kept as quiet as poſſible; proper laxatives are to be adminiſtered, and ſuch as may be leaſt of a naufeating nature. His food ought to be ſimple and eaſy of digeſtion, and his drink of the moſt diluent kind. If he complain of the wound being uneaſy, an emollient poultice ſhould be immediately applied, and renewed three or four times in the twenty-four hours. By theſe means there will commonly be a free ſuppuration from the whole ſurface of the ſore.

Every time the wound is dreſſed, the purulent matter ought to be wiped off from it with a fine warm ſponge; and if any degree of ſloughineſs take place on the dura mater or parts adjacent, it will then be completely ſeparated. Granulations will begin to form, which will continue to increaſe till the whole ariſe to a level with the ſurface of the cranium. The edges of the ſore are now to be dreſſed with cerate ſtraps, and the reſt of it covered with fine ſoft lint, kept gently preſſed on by the nightcap properly tied. In this way the cure will go on favourably; luxuriance of granulations will commonly be prevented; the parts will cicatrize kindly; and as the ſkin has been preſerved in making the firſt inciſion, the cicatrix will be but little obſerved.

But things do not always proceed in this favourable manner. Sometimes in a few hours after the operation the patient is ſeized with a kind of reſtleſſneſs, toſſing his arms, and endeavouring to move himſelf in bed, while the ſymptoms of a compreſſed brain remain nearly the ſame as formerly. In this caſe, eſpecially if the pulſe be quick and ſtrong, the patient ought to be bled freely, as there will be reaſon to ſuſpect ſome tendency to inflammation in the brain. Sometimes, though the trepan has been properly applied, the ſymptoms are not relieved, on account of extravaſated fluids collected internally under the dura mater, or between the pia mater and brain, or in the cavity of the ventricles. The danger in theſe caſes will be in proportion to the depth of the collection. Particular attention therefore ought always to be paid to the ſtate of the dura mater after the perforation has been made. If blood be collected below the dura mater, this membrane will be found tenſe, dark coloured, elaſtic, and even livid; in which caſe, an opening becomes abſolutely neceſſary to diſcharge the extravaſated fluid. Gentle ſcratches are to be made with a ſcalpel, till a probe or directory can be introduced; upon which the membrane is to be ſufficiently divided in a longitudinal, and ſometimes even in a crucial direction, till an outlet to the fluid be given.

After the dura mater has been cut in this manner, there is ſome danger of the brain protruding at the opening; but the danger from this is not equal to the bad effects ariſing from effuſed fluids compreſſing the brain. Wounds || Wreck.

A troubleſome and an alarming appearance now and then follows the operation of the trepan; namely, the excreſcences called *fungi*, formerly ſuppoſed to grow immediately from the ſurface of the brain, but which, in general, originate from the ſurface of the dura mater or cut edge of the bone granulating too luxuriantly. 36 Of fungi.

It often happens that they poſſeſs little ſenſibility; and then the beſt method to prevent their riſing to any great height is to touch them frequently with lunar cauſtic: but ſome caſes occur where their ſenſibility is ſo great that they cannot be touched, unleſs they hang by a ſmall neck; and then a ligature may be put round them, and tightened from time to time till they drop off, which will commonly be in the courſe of a few days. It ſeldom happens, however, that there is any occaſion for applying ſuch means for the removal of theſe tumors, for they generally fall off as the perforations of the bone fill up.

If they do not, as the connection between them and the brain will be then in a great meaſure intercepted, they may be with more ſafety removed, either by exciſion, by cauſtic, or by ligature.

The cure being thus far completed, only a ſmall cicatrix will remain, and in general the parts will be nearly as firm as at firſt: but when much of the integuments have been ſeparated or deſtroyed, as they are never regenerated, the bone will be left covered only by a thin cuticle, with ſome ſmall quantity of cellular ſubſtance. When this is the caſe, the perſon ought to wear a piece of lead or tin, properly fitted and lined with flannel, to protect it from the cold and other external injuries.

This is the method now commonly practiſed in caſes of compreſſion; but it frequently happens, that inſtead of compreſſion, ſuch a degree of concuſſion takes place that no aſſiſtance from the trepan can be attended with any advantage; for the effects of concuſſion are totally different from thoſe of compreſſion, and therefore to be removed in a different manner.

WOUNDS, in *Farriery*. See FARRIERY *Index*.

WRASSE, or OLD WIFE. See LABRUS, ICHTHYOLOGY *Index*.

WREATH, in *Heraldry*, a roll of fine linen or ſilk (like that of a Turkiſh turban), conſiſting of the colours borne in the eſcutcheon, placed in an achievement between the helmet and the creſt, and immediately ſupporting the creſt.

WRECK, or SHIPWRECK, the deſtruction of a ſhip by rocks or ſhallows at ſea.

By the ancient common law, where any ſhip was loſt at ſea, and the goods or cargo were thrown upon the land, theſe goods, ſo wrecked, were judged to belong to the king: for it was held, that, by the loſs of the ſhip, all property was gone out of the original owner. But this was undoubtedly adding ſorrow to ſorrow, and was conſonant neither to reaſon nor humanity. Wherefore it was firſt ordained by King Henry I. that if any perſon eſcaped alive out of the ſhip, it ſhould be no wreck; and afterwards King Henry II. by his charter, declared, that if on the coaſts of either England, Poictou, Oleron, or Gaſcony, any ſhip ſhould be diſtreſſed, and

Wreck. and either man or beaſt ſhould eſcape or be found therein alive, the goods ſhould remain to the owners, if they claimed them within three months; but otherwiſe ſhould be eſteemed a wreck, and ſhould belong to the king, or other lord of the franchiſe. This was again confirmed with improvements by King Richard I.; who, in the ſecond year of his reign, not only eſtabliſhed theſe conceſſions, by ordaining that the owner, if he was ſhipwrecked and eſcaped, *omnes res ſuas liberas et quietas haberet*, but alſo, that if he periſhed, his children, or, in default of them, his brethren and ſiſters, ſhould retain the property; and in default of brother or ſiſter, then the goods ſhould remain to the king (A). And the law, as laid down by Bracton in the reign of Henry III. ſeems ſtill to have improved in its equity. For then, if not only a dog (for inſtance) eſcaped, by which the owner might be diſcovered, but if any certain mark were ſet on the goods, by which they might be known again, it was held to be no wreck. And this is certainly moſt agreeable to reaſon; the rational claim of the king being only founded upon this, that the true owner cannot be aſcertained. Afterwards, in the firſt ſtatute of Weſtminſter, the time of limitation of claims, given by the charter of Hnnry II. is extended to a year and a day, according to the uſage of Normandy: and it enacts, that if any man, a dog, or a cat, eſcape alive, the veſſel ſhall not be adjudged a wreck. Theſe animals, as in Bracton, are only put for examples; for it is now held, that not only if any live thing eſcape, but if proof can be made of the property of any of the goods or lading which come to ſhore, they ſhall not be forfeited as wreck. The ſtatute further ordains, that the ſheriff of the county ſhall be bound to keep the goods a year and a day (as in France for one year, agreeable to the maritime laws of Oleron, and in Holland for a year and a half), that if any man can prove a property in them, either in his own right or by right of repreſentation, they ſhall be reſtored to him without delay; but if no ſuch property be proved within that time, they then ſhall be the king's. If the goods are of a periſhable nature, the ſheriff may ſell them, and the money ſhall be liable in their ſtead. This revenue of wrecks is frequently granted out to lords of manors as a royal franchiſe; and if any one be thus intitled to wrecks in his own land, and the king's goods are wrecked thereon, the king may claim them at any time, even after the year and day.

It is to be obſerved, that, in order to conſtitute a legal wreck, the goods muſt come to land. If they continue at ſea, the law diſtinguiſhes them by the barbarous and uncouth appellations of *jetſam*, *flotſam*, and *ligan*. Jetſam is where goods are caſt into the ſea, and there ſink and remain under water: flotſam is where they continue ſwimming on the ſurface of the waves: ligan is where they are ſunk in the ſea, but tied to a cork or buoy, in order to be found again. Theſe are alſo the king's, if no owner appears to claim them; but if any owner appears, he is intitled to recover the poſſeſſion. For even if they be caſt overboard, without any mark or buoy, in order to lighten the ſhip, the owner is not by this act of neceſſity conſtrued to have renounced his property: much leſs can things ligan be ſuppoſed to be abandoned, ſince the owner has done all in his power to aſſert and retain his property. Theſe three are therefore accounted ſo far a diſtinct thing from the former, that by the king's grant to a man of wrecks, things jetſam, flotſam, and ligan, will not paſs. Wreck.

Wrecks, in their legal acceptation, are at preſent not very frequent: for if any goods come to land, it rarely happens, ſince the improvement of commerce, navigation, and correſpondence, that the owner is not able to aſſert his property within the year and day limited by law. And in order to preſerve this property entire for him, and if poſſible to prevent wrecks at all, our laws have made many very humane regulations; in a ſpirit quite oppoſite to thoſe ſavage laws which formerly prevailed in all the northern regions of Europe, and a few years ago were ſtill ſaid to ſubſiſt on the coaſts of the Baltic ſea, permitting the inhabitants to ſeize on whatever they could get as lawful prize; or, as an author of their own expreſſes it, "*in naufragorum miſeria et calamitate tanquam vultures ad prædam currere.*" For by the ſtatute 27 Edw. III. c. 13. if any ſhip be loſt on the ſhore, and the goods come to land (which cannot, ſays the ſtatute, be called *wreck*), they ſhall be preſently delivered to the merchants, paying only a reaſonable reward to thoſe that ſaved and preſerved them, which is intitled *ſalvage*. Alſo by the common law, if any perſons (other than the ſheriff) take any goods ſo caſt on ſhore, which are not legal wreck, the owners might have a commiſſion to inquire and find them out, and compel them to make reſtitution. And by 12 Ann. ſtat. 2. c. 18. confirmed by 4 Geo. I. c. 12. in order to aſſiſt the diſtreſſed, and prevent the ſcandalous illegal practices on ſome of our ſea-coaſts (too ſimilar to thoſe on the Baltic), it is enacted, that all head-officers and others of towns near the ſea, ſhall, upon application made to them, ſummon as many hands as are neceſſary, and ſend them to the relief of any ſhip in diſtreſs, on forfeiture of 100l.; and in caſe of aſſiſtance given, ſalvage ſhall be paid by the owners, to be aſſeſſed by three neighbouring juſtices. All perſons that ſecrete any goods ſhall forfeit their treble value; and if they wilfully do any act whereby the ſhip is loſt or deſtroyed, by making holes in her, ſcaling her pumps, or otherwiſe, they are guilty of felony without benefit of clergy. Laſtly, by the ſtatute of 26 Geo. II. c. 19. plundering any veſſel, either in diſtreſs or wrecked, and whether any living creature be on board or not (for whether wreck or otherwiſe, it is clearly not the property of the populace), ſuch plundering or preventing the eſcape of any perſon that endeavours to ſave his life, or wounding him with intent to deſtroy him, or putting out falſe lights in order to bring any veſſel into danger, are all declared to be capital felonies; in like manner as the deſtroying of trees, ſteeples, or other ſtated ſea-marks,

(A) In like manner Conſtantine the Great, finding that by the imperial law the revenue of wrecks was given to the prince's treaſury or fiſcus, reſtrained it by an edict (Cod. 11. 5. 1.) and ordered them to remain to the owners; adding this humane expoſtulation: "Quod enim jus habet fiſcus in aliena calamitate, ut de re tam luctuoſa compendium ſectetur."

Wreck || Wreſtling.

is puniſhed by the ſtatute 8 Eliz. c. 13. with a forfeiture of 100l. or outlawry. Moreover, by the ſtatute of Geo. II. pilfering any goods caſt aſhore is declared to be petty larceny; and many other ſalutary regulations are made, for the more effectually preſerving ſhips of any nation in diſtreſs.

By the civil law, to deſtroy perſons ſhipwreeked, or prevent their ſaving the ſhip, is capital. And to ſteal even a plank from a veſſel in diſtreſs or wrecked, makes the party liable to anſwer for the whole ſhip and cargo. The laws alſo of the Wiſigoths, and the moſt early Neapolitan conſtitutions, puniſhed with the utmoſt ſeverity all thoſe who neglected to aſſiſt any ſhip in diſtreſs, or plundered any goods caſt on ſhore.

WREN. See MOTACILLA, ORNITHOLOGY *Index*.

WREN, *Sir Chriſtopher*, a great philoſopher, and one of the moſt learned and moſt eminent architects of his age, was the ſon of Chriſtopher Wren dean of Windſor, and was born in 1632. He ſtudied at Wadham college in Oxford; where he took the degree of maſter of arts in 1653, and was choſen fellow of All Souls college. When very young he diſcovered a ſurpriſing genius for the mathematics; in which ſcience he made great advances before he was ſixteen years old. In 1657, he was made profeſſor of aſtronomy at Greſham college, London; which he reſigned in 1660, on his being choſen to the Savilian profeſſorſhip of aſtronomy in Oxford: he was next year created doctor of laws, and in 1663 was elected fellow of the Royal Society. He was one of the commiſſioners for the reparation of St Paul's; and in 1665 travelled into France, to examine the moſt beautiful edifices there, when he made many curious obſervations. At his return to England, he drew a noble plan for rebuilding the city of London after the fire, which he preſented to parliament; and upon the deceaſe of Sir John Denham in 1668, was made ſurveyor-general of his majeſty's works; and from that time had the direction of a great number of public edifices, by which he acquired the higheſt reputation. He built the magnificent theatre at Oxford, St Paul's cathedral, the churches of St Stephen Walbrook, and St Mary-le-Bow, the Monument, the modern part of the palace of Hampton Court, Chelſea college, one of the wings of Greenwich hoſpital, and many other beautiful edifices. He was preſident of the Royal Society, one of the commiſſioners of Chelſea college, and twice member of parliament; firſt for Plymouth in Devonſhire, and then for Melcomb Regis in the ſame county; but in 1718 was removed from his place of ſurveyor-general. He died in 1723, and was interred in the vault under St Paul's.

This great man alſo diſtinguiſhed himſelf by many curious inventions and diſcoveries in natural philoſophy; and, among many others, contrived an inſtrument for meaſuring the quantity of rain that falls on any ſpace of land for a year; he invented many ways of making aſtronomical obſervations more accurate and eaſy; and was the firſt author of the anatomieal experiment of injecting liquors into the veins of animals, &c. He tranſlated into Latin Mr Oughtred's *Horologiographica Geometrica;* and wrote a Survey of the cathedral church of Saliſbury, and other pieces. After his death his poſthumous works and draughts were publiſhed by his ſon.

WRESTLING, a kind of combat or engagement between two perſons unarmed, body to body, to prove their ſtrength and dexterity, and try which can throw his opponent to the ground. Wreſtling || Writ.

Wreſtling is an exerciſe of very great antiquity and fame. It was in uſe in the heroic age; witneſs Hercules, who wreſtled with Antæus.

It continued a long time in the higheſt repute, and had conſiderable rewards and honours aſſigned to it at the Olympic games. It was the cuſtom for the athletæ to anoint their bodies with oil, to give the leſs hold to their antagoniſts.

Lycurgus ordered the Spartan maids to wreſtle in public quite naked, in order, as it is obſerved, to break them of their too much delicacy and niceneſs, to make them appear more robuſt, and to familiarize the people, &c. to ſuch nudities.

WRIST, in *Anatomy*. See there, N° 53.

WRIT, in *Law*, ſignifies, in general, the king's precept in writing under ſeal, iſſuing out of ſome court, directed to the ſheriff or other officer, and commanding ſomething to be done in relation to a ſuit or action, or giving commiſſion to have the ſame done. And, according to Fitzherbert, a writ is ſaid to be a formal letter of the king in parchment, ſealed with his ſeal, and directed to ſome judge, officer, or miniſter, &c. at the ſuit of a ſubject, for the cauſe briefly expreſſed, which is to be determined in the proper court according to law.

WRITS, in civil actions, are either original or judicial: original, are ſuch as are iſſued out of the court of chancery for the ſummoning of a defendant to appear, and are granted before the ſuit is commenced, in order to begin the ſame; and judicial writs iſſue out of the court where the original is returned, after the ſuit is begun. See PROCESS.

The original writ is the foundation of the ſuit. See SUIT.

When a perſon hath received an injury, and thinks it worth his while to demand a ſatisfaction for it, he is to conſider with himſelf, or take advice, what redreſs the law has given for that injury; and thereupon is to make application or ſuit to the crown, the fountain of all juſtice, for that particular ſpecific remedy which he is determined or adviſed to purſue. As for money due on bond, an action of debt; for goods detained without force, an action of *detenue* or *trover;* or, if taken with force, an action of *treſpaſs vi et armis;* or, to try the title of lands, a writ of entry or action of treſpaſs in ejectment; or for any conſequential injury received, a ſpecial action on the caſe. To this end he is to ſue out, or purchaſe by paying the ſtated fees, an *original* or original writ from the court of chancery, which is the *officina juſtitiæ*, the ſhop or mint of juſtice, wherein all the king's writs are framed. It is a mandatory letter from the king in parchment, ſealed with his great ſeal, and directed to the ſheriff of the county wherein the injury is committed, or ſuppoſed ſo to be, requiring him to command the wrong-doer, or party accuſed, either to do juſtice to the complainant, or elſe to appear in court, and anſwer the accuſation againſt him. Whatever the ſheriff does in purſuance of this writ, he muſt return or certify to the court of common pleas, together with the writ itſelf: which is the foundation of the juriſdiction of that court, being the king's warrant for the judges to proceed to the determination of the cauſe. For it was a maxim introduced by the Normans, that there ſhould

be

Writs. be no proceedings in common-pleas before the king's juſtices without his original writ; becauſe they held it unfit that thoſe juſtices, being only the ſubſtitutes of the crown, ſhould take cognizance of any thing but what was thus expreſsly referred to their judgment. However, in ſmall actions, below the value of forty ſhillings, which are brought in the court-baron or county-court, no royal writ is neceſſary; but the foundation of ſuch ſuits continue to be (as in the times of the Saxons), not by original writ, but by plaint; that is, by a private memorial tendered in open court to the judge, wherein the party injured ſets forth his cauſe of action: and the judge is bound of common right to adminiſter juſtice therein, without any ſpecial mandate from the king. Now indeed even the royal writs are held to be demandable of common right, on paying the uſual fees: for any delay in the granting them, or ſetting an unuſual or exorbitant price upon them, would be a breach of magna charta, c. 29. "nulli vendemus, nulli negabimus, aut differemus juſtitiam vel rectum."

Original writs are either optional or peremptory; or, in the language of our law, they are either a *præcipe* or a *ſi te fecerit ſecurum*. The *præcipe* is in the alternative, commanding the defendant to do the thing required, or ſhow the reaſon wherefore he hath not done it. The uſe of this writ is where ſomething certain is demanded by the plaintiff, which is in the power of the defendant himſelf to perform; as, to reſtore the poſſeſſion of land, to pay a certain liquidated debt, to perform a ſpecific covenant, to render an account, and the like; in all which caſes the writ is drawn up in the form of a *præcipe* or command, to do thus, or ſhow cauſe to the contrary; giving the defendant his choice to redreſs the injury or ſtand the ſuit. The other ſpecies of original writs is called a *ſi fecerit te ſecurum*, from the words of the writ; which directs the ſheriff to cauſe the defendant to appear in court, without any option given him, provided the plaintiff gives the ſheriff ſecurity effectually to proſecute his claim. This writ is in uſe where nothing is ſpecifically demanded, but only a ſatisfaction in general; to obtain which, and miniſter complete redreſs, the intervention of ſome judicature is neceſſary. Such are writs of treſpaſs, or on the caſe, wherein no debt or other ſpecific thing is ſued for in certain, but only damages to be aſſeſſed by a jury. For this end the defendant is immediately called upon to appear in court, provided the plaintiff gives good ſecurity of proſecuting his claim. Both ſpecies of writs are teſted, or witneſſed, in the king's own name; "witneſs ourſelf at Weſtminſter," or wherever the chancery may be held.

The ſecurity here ſpoken of, to be given by the plaintiff for proſecuting his claim, is common to both writs, though it gives denomination only to the latter. The whole of it is at preſent become a mere matter of form; and John Doe and Richard Roe are always returned as the ſtanding pledges for this purpoſe.—The ancient uſe of them was to anſwer for the plaintiff, who in caſe he brought an action without cauſe, or failed in the proſecution of it when brought, was liable to an amercement from the crown for raiſing a falſe accuſation; and ſo the form of the judgment ſtill is. In like manner, as by the Gothic conſtitutions no perſon was permitted to lay a complaint againſt another *niſi ſub ſcripturæ aut ſpecificatione trium teſtium, quod actionem vellet perſequi:* and, as by the laws of Sancho I. king of Portugal, damages were given againſt a plaintiff who proſecuted a groundleſs action. Writs, Writing.

The day on which the defendant is ordered to appear in court, and on which the ſheriff is to bring in the writ, and report how far he has obeyed it, is called the *return of the writ;* it being then returned by him to the king's juſtices at Weſtminſter. And it is always made returnable at the diſtance of at leaſt 15 days from the date or teſt, that the defendant may have time to come up to Weſtminſter, even from the moſt remote parts of the kingdom; and upon ſome day in one of the four terms, in which the court ſits for the diſpatch of buſineſs.

WRITING, the art or act of ſignifying and conveying our ideas to others, by letters or characters viſible to the eye. See COMPOSITION, GRAMMAR, and LANGUAGE.

The moſt ancient remains of writing, which have been tranſmitted to us, are upon hard ſubſtances, ſuch as ſtones and metals, which were uſed by the ancients for edicts and matters of public notoriety; the decalogue was written on two tables of ſtone; but this practice was not peculiar to the Jews, for it was uſed by moſt of the eaſtern nations, as well as by the Greeks and Romans; and therefore the ridicule which Voltaire attempts to caſt upon that part of the book of Geneſis, where the people are commanded to write the law on ſtones, is abſurd; for what is there ſaid by no means implies, that other materials might not be uſed on common occaſions. The laws penal, civil, and ceremonial, among the Greeks, were engraven on tables of braſs which were called *cyrbes*.

We find that wood was alſo uſed for writing on in different countries. In the Sloanian library (N° 4852.) are ſix ſpecimens of Kufic writing, on boards about two feet in length, and ſix inches in depth. The Chineſe, before the invention of paper, wrote or engraved with an iron tool upon thin boards or on bamboo. Pliny ſays, that table books of wood were in uſe before the time of Homer. Theſe table books were called by the Romans *pugillares*. The wood was cut into thin ſlices, and finely plained and poliſhed. The writing was at firſt upon the bare wood, with an iron inſtrument called a *ſtyle*. In later times theſe tables were uſually waxed over, and written upon with that inſtrument. The matter written upon the tables which were thus waxed over was eaſily effaced, and by ſmoothing the wax new matter might be ſubſtituted in the place of what had been written before. The Greeks and Romans continued the uſe of waxed table-books long after the uſe of papyrus, leaves, and ſkins, became common, becauſe they were ſo convenient for correcting extemporary compoſitions.

Table books of ivory are ſtill uſed for memorandums, but they are commonly written upon with black lead pencils. The practice of writing on table-books covered with wax was not entirely laid aſide till the commencement of the 14th century.

The bark of trees was alſo uſed for writing by the ancients, and is ſo ſtill in ſeveral parts of Aſia. The ſame thing may be ſaid of the leaves of trees. It is needleſs to obſerve the uſe of parchment and vellum, papyrus and paper, for writing; it is too well known.

Writing. The method of fabricating theſe ſubſtances has been already deſcribed as they occurred in the order of the alphabet.

It is obvious, that when men wrote, or rather engraved, on hard ſubſtances, inſtruments of metal were neceſſary, ſuch as the chiſel and the ſtylus; but the latter was chiefly uſed for writing upon boards, waxed tablets, or on bark.

When the ancients wrote on ſofter materials than wood or metal, other inſtruments were uſed for writing with, of which reeds and canes ſeem to have been the firſt. Reeds and canes are ſtill uſed as inſtruments for writing with by the Tartars, the Indians, the Perſians, the Turks, and the Greeks. Pencils made of hair are uſed by the Chineſe for their writing: they firſt liquefy their ink, and dip their pencils into it. Hair-pencils have likewiſe been uſed for writing in Europe. Large capital letters were made with them from the time of the Roman emperors till the 16th century. After the invention of printing they were drawn by the illuminators. Quills of geeſe, ſwans, peacocks, crows, and other birds, have been uſed in theſe weſtern parts for writing with, but how long is not eaſy to aſcertain. St Iſidore of Seville, who lived about the middle of the 7th century, deſcribes a pen made of a quill as uſed in his time.

Method of reſtoring decayed WRITINGS. In the 77th volume of the Phil. Tranſ. there is a paper on this ſubject by Sir Charles Blagden. One of the beſt methods he found upon experiment to be, covering the letters with phlogiſticated or pruſſic alkali, with the addition of a diluted mineral acid; upon the application of which, the letters changed very ſpeedily to a deep blue colour, of great beauty and intenſity. To prevent the ſpreading of the colour, which, by blotting the parchment, detracts greatly from the legibility, the alkali ſhould be put on firſt, and the diluted acid added upon it. The method found to anſwer beſt has been, to ſpread the alkali thin with a feather over the traces of the letters, and then to touch it gently, as nearly upon or over the letters as can be done with the diluted acid, by means of a feather or a bit of ſtick cut to a blunt point. Though the alkali ſhould occaſion no ſenſible change of colour, yet the moment the acid comes upon it, every trace of a letter turns at once to a fine blue, which ſoon acquires its full intenſity, and is beyond compariſon ſtronger than the colour of the original trace had been. If, then, the corner of a bit of blotting paper be carefully and dexterouſly applied near the letters, ſo as to imbibe the ſuperfluous liquor, the ſtaining of the parchment may be in a great meaſure avoided; for it is this ſuperfluous liquor which, abſorbing part of the colouring matter from the letters, becomes a dye to whatever it touches. Care muſt be taken not to bring the blotting paper in contact with the letters, becauſe the colouring matter is ſoft whilſt wet, and may eaſily be rubbed off. The acid chiefly employed was the marine; but both the vitriolic and nitrous ſucceed very well. They ſhould be ſo far diluted as not to be in danger of corroding the parchment, after which the degree of ſtrength does not ſeem to be a matter of much nicety.

Method of copying WRITINGS. The ingenious Mr Watt, ſome years ago, invented a method of copying writings very ſpeedily, and without the poſſibility of committing miſtakes. A piece of thin unſized paper is to be taken exactly of the ſize of the paper to be copied; it is to be moiſtened with water, or, what is better, with the following liquid: Take of diſtilled vinegar two pounds weight, diſſolve it in one ounce of boracic acid; then take four ounces of oyſter-ſhells calcined to whiteneſs, and carefully freed from their brown cruſt; put them into the vinegar, ſhake the mixture frequently for 24 hours, then let it ſtand until it depoſits its ſediment; filter the clear part through unſized paper into a glaſs veſſel; then add two ounces of the beſt blue Aleppo galls bruiſed, and place the liquor in a warm place, ſhaking it frequently for 24 hours; then filter the liquor again through unſized paper, and add to it after filtration one quart, ale meaſure, of pure water. It muſt then ſtand 24 hours, and be filtered again if it ſhows a diſpoſition to depoſit any ſediment, which it generally does. When the paper has been wet with this liquid, put it between two thick unſized papers to abſorb the ſuperfluous moiſture; then lay it over the writing to be copied, and put a piece of clean writing paper above it. Put the whole on the board of a rolling-preſs, and preſs them through the rolls, as is done in printing copperplates, and a copy of the writing ſhall appear on both ſides of the thin moiſtened paper; on one ſide in a reverſed order and direction, but on the other ſide in the natural order and direction of the lines. Writing || Wurtzburg.

WRITTEN MOUNTAINS. See MOUNTAINS.

WRY-NECK. See JYNX, ORNITHOLOGY *Index*.

WURTEMBURG, or WIRTENBERG, a ſovereign duchy of Germany, in Suabia; bounded on the north by Franconia, the archbiſhopric of Mentz, and the palatinate of the Rhine; on the eaſt by the county of Oeting, the marquiſate of Burgau, and the territory of Ulm; on the ſouth by the principality of Hoen-Zollern, Furſtenburg, and the marquiſate of Hohenburg; and on the weſt by the palatinate of the Rhine, the marquiſate of Baden, and the Black Foreſt. It is 65 miles in length, and as much in breadth, and the river Neckar runs almoſt through the middle of it from ſouth to north. Though there are many mountains and woods, yet it is one of the moſt populous and fertile countries in Germany, producing plenty of graſs, corn, fruits, and a great deal of wine towards the confines of the palatinate. There are alſo mines, and ſalt ſprings, with plenty of game and fiſh. It contains 645 villages, 88 towns, and 26 cities, of which Stutgard is the capital.

WURTSBURG, a large biſhopric in Germany comprehending the principal part of Franconia. It is bounded by the county of Henneburg, the duchy of Coburg, the abbey of Fuld, the archbiſhopric of Mentz, the marquiſate of Anſpach, the biſhopric of Bamberg, and the county of Wertheim; being about 65 miles in length, and 50 in breadth, and divided into 50 bailiwicks. The ſoil is very fertile, and produces more corn and wine than the inhabitants conſume. The territories of the biſhop comprehend above 400 towns and villages, of which he is ſovereign, being one of the greateſt eccleſiaſtical princes of the empire.

WURTZBURG, a large and handſome city of Germany, and one of the principal in the circle of Franconia. It is defended with good fortifications, and has a magnificent palace. There is a handſome hoſpital, in which

Wurtzburg, Wycherley.

which are generally 400 poor men and women. The caſtle is at a ſmall diſtance from the city, and commands it, as it ſtands upon an eminence. It communicates with the city by a ſtone bridge, on which are 12 ſtatues, repreſenting as many ſaints. The arſenal and the cellars of the biſhop deſerve the attention of the curious. There is alſo an univerſity, founded in 1403. It is ſeated on the river Maine, in E. Long. 10. 2. N. Lat. 49. 40.

WYCHERLEY, William, an eminent Engliſh comic poet, was born about 1640. A little before the reſtoration of King Charles II. he became a gentleman commoner of Queen's college Oxford, where he was reconciled by Dr Barlow to the Proteſtant religion, which he had a little before abandoned in his travels. He afterwards entered himſelf in the Middle-temple, but ſoon quitted the ſtudy of the law for purſuits more agreeable to his own genius, as well as to the taſte of the age. Upon writing his firſt play, entitled, Love in a Wood, or St James's Park, which was acted in 1672, he became acquainted with ſeveral of the celebrated wits both of the court and town, and likewiſe with the ducheſs of Cleveland. Some time after appeared his comedies, called The Gentleman Dancing Maſter, the Plain Dealer, and the Country Wife; all which were acted with applauſe. George duke of Buckingham had a very high eſteem for him, and beſtowed on him ſeveral advantageous poſts. King Charles alſo ſhowed him ſignal marks of favour; and once gave him a proof of his eſteem, which perhaps never any ſovereign prince before had given to a private gentleman. Mr Wycherley being ill of a fever, at his lodgings in Bow-ſtreet, the king did him the honour of a viſit. Finding him extremely weakened, he commanded him to take a journey to the ſouth of France, and aſſured him, at the ſame time, that he would order him 500l. to defray the charges of the journey. Mr Wycherley accordingly went into France; and having ſpent the winter there, returned to England entirely reſtored to his former vigour. The king, ſhortly after his arrival, told him, that he had a ſon, who he was reſolved ſhould be educated like the ſon of a king, and that he could not chooſe a more proper man for his governor than Mr Wycherley; for which ſervice 1500l. *per annum* ſhould be ſettled upon him.

Immediately after this offer he went to Tunbridge, where walking one day upon the Well's walk with his friend Mr Fairbeard of Gray's Inn, juſt as he came up to the bookſeller's ſhop, the counteſs of Drogheda, a young widow, rich, noble, and beautiful, came there to inquire for the Plain Dealer; "Madam," ſays Mr Fairbeard, "ſince you are for the Plain Dealer, there he is for you;" puſhing Mr Wycherley towards her. "Yes," ſays Mr Wycherley, "this lady can bear plain dealing; for ſhe appears to be ſo accompliſhed, that what would be a compliment to others, would be plain dealing to her." "No, truly, Sir," ſaid the counteſs, "I am not without my faults, any more than the reſt of my ſex; and yet notwithſtanding, I love plain dealing, and am never more fond of it than when it tells me of them." "Then, madam," ſays Mr Fairbeard, "you and the Plain Dealer ſeem deſigned by Heaven for each other." —In ſhort, Mr Wycherley walked a turn or two with the counteſs, waited upon her home, viſited her daily while ſhe ſtaid at Tunbridge, and married her ſoon after without acquainting the king. By this ſtep, which was looked upon as a contempt of his majeſty's orders, he forfeited the royal favour. The counteſs of Drogheda ſettled her whole fortune upon him; but his title being diſputed after her death, he was ſo reduced by the expences of the law and other incumbrances, as to be unable to ſatisfy the impatience of his creditors, who threw him into priſon; and the bookſeller who printed his Plain Dealer, by which he got almoſt as much money as the other gained reputation, was ſo ungrateful as to refuſe to lend him 20l. in his extreme neceſſity. In that confinement he languiſhed ſeven years; but at length King James going to ſee the above play, was ſo charmed with it, that he gave immediate orders for the payment of his debts, and even granted him a penſion of 200l. *per annum*. But the prince's bountiful intentions were in a great meaſure defeated merely through Mr Wycherley's modeſty; he being aſhamed to tell the earl of Mulgrave, whom the king had ſent to demand it, a true ſtate of his debts. He laboured under the weight of theſe difficulties till his father died, who left him 600l. a-year. But this eſtate was under limitations, he being only a tenant for life, and not being allowed to raiſe any money for the payment of his debts. However, he took a method of doing it which few ſuſpected to be his choice; and this was making a jointure. He had often declared, that he was reſolved to die married, though he could not bear the thoughts of living in that ſtate again: accordingly, juſt at the eve of his death, he married a young gentlewoman with 1500l. fortune, part of which he applied to the uſes he wanted it for. Eleven days after the celebration of theſe nuptials, in December 1715, he died, and was interred in the vault of Covent-garden church.

Wycherley || Wye.

Beſides his plays above mentioned, he publiſhed a volume of poems in folio. In 1728 his poſthumous works in proſe and verſe were publiſhed by Mr Theobald.

WYNDHAM, Sir William, deſcended of an ancient family, was born about the year 1687, and ſucceeded young to the title and eſtate of his father. On his return from his travels, he was choſen member for the county of Somerſet; in which ſtation he ſerved in the three laſt parliaments of Queen Anne, and as long as he lived: after the change of the miniſtry in 1710, he was appointed ſecretary at war; and in 1713 was raiſed to be chancellor of the exchequer. Upon the breach between the earl of Oxford and Lord Bolingbroke, he adhered to the intereſts of the latter. He was removed from his employment on the acceſſion of George I. and falling under ſuſpicion on the breaking out of the rebellion in 1715, was apprehended. He made his eſcape; a reward was publiſhed for apprehending him; he ſurrendered, was committed to the Tower, but never brought to a trial. After he regained his liberty, he continued in oppoſition to the ſeveral adminiſtrations under which he lived; and died in 1740.

WYE, a river of South Wales, which iſſuing out of Plinlymmon Hill, very near the ſource of the Severn, croſſes the north-eaſt corner of Radnorſhire, giving name to the town of Rhyadergowy (Fall of the Wye), where it is precipitated in a cataract: then flowing between this county and Brecknockſhire, it croſſes Herefordſhire, and dividing the counties of Glouceſter and Monmouth, falls into the mouth of the Severn, below Chepſtow. The romantic beauties of the Wye, which flows in a deep-

Wye. deep bed, between lofty rocks clothed with hanging woods, and here and there crowned by ruined caſtles, have employed the deſcriptive powers of the pen and pencil.

WYE is alſo the name of a river in Derbyſhire, which riſes in the north-weſt part, above Buxton; and, flowing ſouth-eaſt, falls into the Derwent, below Bakewell.

Wye. WYE, the name of a town in Kent, with a market on Thurſday, ſeated on the Stour, 10 miles ſouth of Canterbury, and 59 ſouth-eaſt of London. E. Long. 1. 4. N. Lat. 51. 10.

WYE, a town of Switzerland, in a territory of the abbey of St Gallen, with a palace. It is built on an eminence, 16 miles ſouth-ſouth-weſt of Conſtance. E. Long. 9. 4. N. Lat. 47. 34.

X.

X || Xebec. X, or x, is the 22d letter of our alphabet, and a double conſonant. It was not uſed by the Hebrews or ancient Greeks; for, as it is a compound letter, the ancients, who uſed great ſimplicity in their writings, expreſſed this letter by its component letters *c s*. Neither have the Italians this letter, but expreſs it by *ſſ*. X begins no word in our language but ſuch as are of Greek original; and is in few others but what are of Latin derivation; as *perplex*, *reflexion*, *defluxion*, &c. We often expreſs this ſound by ſingle letters, as *cks*, in *backs*, *necks;* by *ks*, in *books*, *breaks;* by *cc*, in *acceſs*, *accident;* by *ct*, in *action*, *unction*, &c. The Engliſh and French pronounce it like *cs* or *ks;* the Spaniards like *c* before *a*, viz. *Alexandro*, as it were *Alecandro*. In numerals it expreſſeth 10, whence in old Roman manuſcripts it is uſed for *denarius;* and as ſuch ſeems to be made of two V's placed one over the other. When a daſh is added over it, thus $\bar{X}$, it ſignifies 10,000.

XANTHIUM, a genus of plants of the claſs *monœcia*, and arranged in the natural claſſification under the 49th order, *Compoſitæ*. See BOTANY *Index*.

XANTHOXYLUM. See ZANTHOXYLUM.

XEBEC, or ZEBEC, a ſmall three-maſted veſſel, navigated in the Mediterranean ſea, and on the coaſts of Spain, Portugal, and Barbary. See Plate fig. 10.

The ſails of the xebec are in general ſimilar to thoſe of the poleacre, but the hull is extremely different from that and almoſt every other veſſel. It is furniſhed with a ſtrong prow: and the extremity of the ſtern, which is nothing more than a ſort of railed platform or galley, projects farther behind the counter and buttock than that of any European ſhip.

Being generally equipped as a corſair, the xebec is conſtructed with a narrow floor, to be more ſwift in purſuit of the enemy; and of a great breadth, to enable her to carry a greater force of ſail for this purpoſe without danger of overturning. As theſe veſſels are uſually very low built, their decks are formed with a great convexity from the middle of their breadth towards the ſides, in order to carry off the water which falls aboard more readily by their ſcuppers. But as this extreme convexity would render it very difficult to walk thereon at ſea, particularly when the veſſel rocks by the agitation of the waves, there is a platform of grating extending along the deck from the ſides of the veſſel towards the middle, whereon the crew may walk dry-footed whilſt the water is conveyed through the grating to the ſcuppers. Xebec, Xenocrates.

The xebecs, which are generally armed as veſſels of war by the Algerines, mount from 16 to 24 cannon, and carry from 300 to 450 men, two-thirds of whom are generally ſoldiers.

By the very complicated and inconvenient method of working theſe veſſels, what one of their captains of Algiers told Mr Falconer will be readily believed, viz. that every xebec requires at leaſt the labour of three ſquare-rigged ſhips, wherein the ſtanding ſails are calculated to anſwer every ſituation of the wind.

XENOCRATES, a celebrated ancient Grecian philoſopher, was born at Chalcedon in the 95th Olympiad. At firſt he attached himſelf to Æſchines, but afterwards became a diſciple of Plato, who took much pains in cultivating his genius, which was naturally heavy. His temper was gloomy, his aſpect ſevere, and his manners little tinctured with urbanity. Theſe material defects his maſter took great pains to correct; frequently adviſing him to ſacrifice to the Graces: and the pupil was patient of inſtruction, and knew how to value the kindneſs of his preceptor. As long as Plato lived, Xenocrates was one of his moſt eſteemed diſciples; after his death he cloſely adhered to his doctrine; and in the ſecond year of the 110th Olympiad, he took the chair in the academy, as the ſucceſſor of Speuſippus.

Xenocrates was celebrated among the Athenians, not only for his wiſdom, but for his virtues. So eminent was his reputation for integrity, that when he was called upon to give evidence in a judicial tranſaction, in which an oath was uſually required, the judges unanimouſly agreed, that his ſimple aſſeveration ſhould be taken, as a public teſtimony to his merit. Even Philip of Macedon found it impoſſible to corrupt him. So abſtemious was he with reſpect to food, that his proviſion was frequently ſpoiled before it was conſumed. His chaſtity was invincible. Phryne, a celebrated Athenian courtezan, attempted without ſucceſs to ſeduce him. Of his humanity the followed pathetic incident is a ſufficient proof: A ſparrow, which was purſued by a hawk, flew into his boſom; he afforded it protection till its enemy was out of ſight, and then let it go, ſaying, that he would never betray a ſuppliant. He was fond of retirement, and was ſeldom ſeen in the city. He was diſcreet in the uſe of his time, and carefully allotted a certain portion of each day

Enfield's Hiſt. of Philoſophy, vol. ii.

Xenocrates || Xenophon.

day to its proper buſineſs. One of theſe he employed in ſilent meditation. He was an admirer of the mathematical ſciences; and was ſo fully convinced of their utility, that when a young man, who was unacquainted with geometry and aſtronomy, deſired admiſſion into the academy, he refuſed his requeſt, ſaying, that he was not yet poſſeſſed of the handles of philoſophy. In fine, Xenocrates was eminent both for the purity of his morals and for his acquaintance with ſcience, and ſupported the credit of the Platonic ſchool, by his lectures, his writings, and his conduct. He lived to the firſt year of the 116th Olympiad, or the 82d of his age, when he loſt his life by accidentally falling, in the dark, into a reſervoir of water.

XENOPHANES, the founder of the Eleaic ſect of philoſophy among the Greeks, was born at Colophon probably about the 65th Olympiad. From ſome cauſe or other he left his country early, and took refuge in Sicily, where he ſupported himſelf by reciting, in the court of Hiero, elegiac and iambic verſes, which he had written in reprehenſion of the theogonies of Heſiod and Homer. From Sicily he paſſed over into Magna Græcia, where he took up the profeſſion of philoſophy, and became a celebrated preceptor in the Pythagorean ſchool. Indulging, however, a greater freedom of thought than was uſual among the diſciples of Pythagoras, he ventured to introduce new opinions of his own, and in many particulars to oppoſe the doctrines of Epimenides, Thales, and Pythagoras. Xenophanes poſſeſſed the Pythagorean chair of philoſophy about ſeventy years, and lived to the extreme age of an hundred years, that is, according to Euſebius, till the 81ſt Olympiad. The doctrine of Xenophanes concerning nature is ſo imperfectly preſerved, and obſcurely expreſſed, that it is no wonder that it has been differently repreſented by different writers. Perhaps the truth is, that he held the univerſe to be one in nature and ſubſtance, but diſtinguiſhed in his conception between the matter of which all things conſiſt, and that latent divine force which, though not a diſtinct ſubſtance but an attribute, is neceſſarily inherent in the univerſe, and is the cauſe of all its perfection.

XENOPHON, an illuſtrious philoſopher, general, and hiſtorian, was born at Athens in the 3d year of the 82d Olympiad. When he was a youth, Socrates, ſtruck with his external appearance, determined to admit him into the number of his pupils. Meeting him by accident in a narrow paſſage, the philoſopher put his ſtaff acroſs the path, and ſtopping him, aſked, where thoſe things were to be purchaſed which are neceſſary to human life? Xenophon appearing at a loſs for a reply to this unexpected ſalutation, Socrates proceeded to aſk him, where honeſt and good men were to be found? Xenophon ſtill heſitating, Socrates ſaid to him, "Follow me, and learn." From that time Xenophon became a diſciple of Socrates, and made a rapid progreſs in that moral wiſdom for which his maſter was ſo eminent. Xenophon accompanied Socrates in the Peloponneſian war, and fought courageouſly in defence of his country. He afterwards entered into the army of Cyrus as a private volunteer in his expedition againſt his brother. This enterpriſe proving unfortunate, Xenophon, after the death of Cyrus, adviſed his fellow ſoldiers to attempt a retreat into their own country. They liſtened to his advice; and having had many proofs of his wiſdom as well as courage, they gave him the command of the army, in the room of Proxenus who had fallen in battle. In this command he acquired great glory by the prudence and firmneſs with which he conducted them back, through the midſt of innumerable dangers, into their own country. The particulars of this memorable adventure are related by Xenophon himſelf in his Retreat of the Ten Thouſand. After his return into Greece, he joined Ageſilaus, king of Sparta, and fought with him againſt the Thebans in the celebrated battle of Chæronea. The Athenians, diſpleaſed at this alliance, brought a public accuſation againſt him for his former conduct in engaging in the ſervice of Cyrus, and condemned him to exile. The Spartans, upon this, took Xenophon, as an injured man, under their protection, and provided him a comfortable retreat at Scilluntes in Elea. Here, with his wife and two children, he remained ſeveral years, and paſſed his time in the ſociety of his friends, and in writing thoſe hiſtorical works which have rendered his name immortal. A war at length aroſe between the Spartans and Eleans; and Xenophon was obliged to retire to Lepreus, where his eldeſt ſon had ſettled. He afterwards removed, with his whole family, to Corinth, where, in the firſt year of the hundred and fifth Olympiad, he finiſhed his days.

Xenophon || Ximenes.

XENOPHON the *Younger*, a Greek writer, ſo called to diſtinguiſh him from the celebrated Xenophon, was born at Epheſus, and lived, according to ſome authors, before Heliodorus, that is, about the beginning of the 4th century. He is only known by his *Epheſiaca*, a Greek romance in five books, which is eſteemed, and contains the amours or adventures of Abracomes and Anthia. This romance was printed at London, in Greek and Latin, in 1724, 4to.

XERXES I. the fifth king of Perſia, memorable for the vaſt army he is ſaid to have carried into the field againſt Leonidas king of Sparta; conſiſting, according to ſome hiſtorians, of 800,000 men, while others make it amount to 3,000,000, excluſive of attendants. The fleet that attended this prodigious land force is likewiſe made to conſiſt of 2000 ſail; and all the ſucceſs they met with was the taking and burning the city of Athens; for the army was ſhamefully repulſed near the ſtraits of Thermopylæ by Leonidas, and the fleet was diſperſed and partly deſtroyed by Themiſtocles at the ſtraits of Salamis, who had only 380 ſail under his command. Xerxes was aſſaſſinated by Artabanes, chief captain of his guards, and his diſtinguiſhed favourite. See SPARTA.

XIMENES, FRANCIS, a juſtly celebrated cardinal, biſhop of Toledo, and prime miniſter of Spain, was born at Torrelaguna, in Old Caſtile, in 1437, and ſtudied at Alcala and Salamanca. He then went to Rome; and being robbed on the road, brought nothing back but a bull for obtaining the firſt vacant prebend: but the archbiſhop of Toledo refuſed it him, and threw him into priſon. Being at length reſtored to liberty, he obtained a benefice in the dioceſe of Siguença, where Cardinal Gonzales de Mendoza, who was the biſhop, made him his grand vicar. Ximenes ſome time after entered among the Franciſcans of Toledo; but being there troubled with viſits, he retired to a ſolitude named *Caſtanel*, and applied himſelf to the ſtudy of divinity and the oriental tongues. At his return to Toledo, Queen Iſabella of Caſtile choſe him for her confeſſor, and afterwards nominated him archbiſhop of Toledo; which, next to the papacy, is the richeſt dignity in the church of Rome. "This honour (ſays Dr Robertſon) he declined with a firmneſs

Ximenes. firmneſs which nothing but the authoritative injunction of the pope was able to overcome. Nor did this height of promotion change his manners. Though obliged to diſplay in public that magnificence which became his ſtation, he himſelf retained his monaſtic ſeverity. Under his pontifical robes he conſtantly wore the coarſe frock of St Francis, the rents of which he uſed to patch with his own hands. He at no time uſed linen, but was commonly clad in hair-cloth. He ſlept always in his habit; moſt frequently on the floor or on boards, and rarely in a bed. He did not taſte any of the delicacies which appeared at his table, but ſatisfied himſelf with that ſimple diet which the rule of his order preſcribed. Notwithſtanding theſe peculiarities, ſo oppoſite to the manners of the world, he poſſeſſed a thorough knowledge of its affairs, and diſcovered talents for buſineſs which rendered the fame of his wiſdom equal to that of his ſanctity." His firſt care was to provide for the neceſſities of the poor; to viſit the churches and hoſpitals; to purge his dioceſe of uſurers and places of debauchery; to degrade corrupt judges, and place in their room perſons whom he knew to be diſtinguiſhed by their probity and diſintereſtedneſs. He erected a famous univerſity at Alcala; and in 1499 founded the college of St Ildephonſo. Three years after he undertook the Polyglot Bible; and for that purpoſe ſent for many learned men to come to him at Toledo, purchaſed ſeven copies in Hebrew for 4000 crowns, and gave a great price for Latin and Greek manuſcripts. At this Bible they laboured above 12 years. It contains the Hebrew text of the Bible; the verſion of the Septuagint, with a literal tranſlation; that of St Jerom, and the Chaldee paraphraſes of Onkelos; and Ximenes added to it a dictionary of the Hebrew and Chaldee words contained in the Bible. This work is called *Ximenes's Polyglot*. In 1507 Pope Julius II. gave him the cardinal's hat, and King Ferdinand the Catholic entruſted him with the adminiſtration of affairs. Cardinal Ximenes was from this moment the ſoul of every thing that paſſed in Spain. He diſtinguiſhed himſelf at the beginning of his miniſtry by diſcharging the people from the burdenſome tax called *acavale*, which had been continued on account of the war againſt Granada; and laboured with ſuch zeal and ſucceſs in the converſion of the Mahometans, that he made 3000 converts, among whom was a prince of the blood of the kings of Granada. In 1509 Cardinal Ximenes extended the dominions of Ferdinand, by taking the city of Oran in the kingdom of Algiers. He undertook this conqueſt at his own expence, and marched in perſon at the head of the Spaniſh army clothed in his pontifical ornaments, and accompanied by a great number of eccleſiaſtics and monks. Some time after, foreſeeing an extraordinary ſcarcity, he erected public granaries at Toledo, Alcala, and Torrelaguna, and had them filled with corn at his own expence; which gained the people's hearts to ſuch a degree, that to preſerve the memory of this noble action they had an eulogium upon it cut on marble, in the hall of the ſenate-houſe at Toledo, and in the market-place. King Ferdinand dying in 1516, left Cardinal Ximenes regent of his dominions; and the archduke Charles, who was afterwards the emperor Charles V. confirmed that nomination. The cardinal immediately made a reform of the officers of the ſupreme council and of the court, and put a ſtop to the oppreſſion of the grandees. He vindicated the rights of the people againſt the Ximenes. nobility; and as by the feudal conſtitution the military power was lodged in the hands of the nobles, and men of inferior condition were called into the field only as their vaſſals, a king with ſcanty revenues depended on them in all his operations. From this ſtate Ximenes reſolved to deliver the crown; and iſſued a proclamation, commanding every city in Caſtile to inrol a certain number of its burgeſſes, and teach them military diſcipline; he himſelf engaging to provide officers to command them at the public expence. This was vigorouſly oppoſed by the nobles; but by his intrepidity and ſuperior addreſs he carried his point. He then endeavoured to diminiſh the poſſeſſions of the nobility, by reclaiming all the crown-lands, and putting a ſtop to the penſions granted by the late king Ferdinand. This addition made to the revenues enabled him to diſcharge all the debts of Ferdinand, and to eſtabliſh magazines of warlike ſtores. The nobles, alarmed at theſe repeated attacks, uttered loud complaints; but before they proceeded to extremities, appointed ſome grandees of the firſt rank to examine the powers in conſequence of which he exerciſed acts of ſuch high authority. Ximenes received them with cold civility; produced the teſtament of Ferdinand, by which he was appointed regent, together with the ratification of that deed by Charles. To both theſe they objected; and he endeavoured to eſtabliſh their validity. As the converſation grew warm, he led them inſenſibly to a balcony, from which they had a view of a large body of troops under arms, and of a formidable train of artillery. "Behold (ſays he, pointing to theſe, and raiſing his voice) the powers which I have received from his Catholic majeſty! With theſe I govern Caſtile; and with theſe I will govern it, till the king, your maſter and mine, takes poſſeſſion of his kingdom!" A declaration ſo bold and haughty ſilenced them, and aſtoniſhed their aſſociates. They ſaw that he was prepared for his defence, and laid aſide all thoughts of a general confederacy againſt his adminiſtration. At length, from the repeated intreaties of Ximenes, and the impatient murmurs of the Spaniſh miniſtry, Charles V. embarked, and landed in Spain, accompanied by his favourites. Ximenes was advancing to the coaſt to meet him, but at Bos Equillos was ſeized with a violent diſorder, which his followers conſidered as the effects of poiſon. This accident obliging Ximenes to ſtop, he wrote to the king, and with his uſual boldneſs adviſed him to diſmiſs all the ſtrangers in his train, whoſe number and credit already gave offence to the Spaniards, and earneſtly deſired to have an interview with him, that he might inform him of the ſtate of the nation, and the temper of his ſubjects. To prevent this, not only the Flemings, but the Spaniſh grandees, employed all their addreſs to keep Charles at a diſtance from Aranda, the place to which the cardinal had removed. His advice was now ſlighted and deſpiſed. Ximenes, conſcious of his own integrity and merit, expected a more grateful return from a prince to whom he delivered a kingdom more flouriſhing than it had been in any former age, and a more extenſive authority than the moſt illuſtrious of his anceſtors had ever poſſeſſed; and lamented the fate of his country, about to be ruined by the rapaciouſneſs and inſolence of foreign favourites. While his mind was agitated by theſe paſſions, he received a letter from the king; in which, after a few

cold

Ximenes || Xylo-aloes.

cold and formal expreſſions of regard, he was allowed to retire to his dioceſe; and he expired a few hours after reading it in 1517, in the 81ſt year of his age.

This famous cardinal ought not to be confounded with *Roderic* XIMENES, archbiſhop of Toledo, in the 13th century, who wrote a Hiſtory of Spain in nine books; nor with ſeveral other Spaniſh writers of the name of *Ximenes*.

XIPHIAS, the SWORD-FISH; a genus of fiſhes belonging to the order of *apodes*. See ICHTHYOLOGY *Index*. This fiſh is common in the Mediterranean ſea, eſpecially in that part which ſeparates Italy from Sicily, and which has been long celebrated for it: the promontory Pelorus, now Capo di Faro, was a place noted for the reſort of the xiphias, and poſſibly the ſtation of the ſpeculatores, or the perſons who watched and gave notice of the approach of the fiſh.

The ancient method of taking them is particularly deſcribed by Strabo, and agrees exactly with that practiſed by the moderns. A man aſcends one of the cliffs that overhangs the ſea: as ſoon as he ſpies the fiſh, he gives notice, either by his voice or by ſigns, of the courſe it takes. Another that is ſtationed in a boat, climbs up the maſt, and on ſeeing the ſword-fiſh, directs the rowers towards it. As ſoon as he thinks they are got within reach, he deſcends, and taking a ſpear in his hand, ſtrikes it into the fiſh; which, after wearying itſelf with its agitation, is ſeized and drawn into the boat. It is much eſteemed by the Sicilians, who buy it up eagerly, and at its firſt coming into ſeaſon give for it about ſixpence Engliſh per pound. The ſeaſon laſts from May till Auguſt. The ancients uſed to cut this fiſh into pieces and ſalt it; whence it was called *Tomus Thurianus*, from Thurii, a town in the bay of Tarentum, where it was taken and cured.

The ſword-fiſh is ſaid to be very voracious, and that it is a great enemy to the tunny, which (according to Belon) are as much terrified at it as ſheep are at the ſight of a wolf. It is a great enemy to whales, and frequently deſtroys them.

XYLO-ALOES, or ALOE WOOD, in the *Materia Medica*, is the product of a tree growing in China and ſome of the Indian iſlands. See EXCÆCARIA.

This drug is diſtinguiſhed into three ſorts; the calambac or tambac, the common lignum aloes, and calambour.

The calambac, or fineſt aloes wood, called by authors *lignum aloes præſtantiſſimum*, and by the Chineſe *ſukhiang*, is the moſt reſinous of all the woods we are acquainted with: it is of a light ſpongy texture, very porous, and its pores ſo filled up with a ſoft and fragrant reſin, that the whole may be preſſed and dented by the fingers like wax, or moulded about by chewing in the mouth, in the manner of maſtich. This kind, laid on the fire, melts in great part like reſin, and burns away in a few moments with a bright flame and perfumed ſmell. Its ſcent, while in the maſs, is very fragrant and agreeable; and its taſte acrid and bitteriſh, but very aromatic and agreeable. It is ſo variable in its colour, that ſome have divided it into three kinds; the one variegated with black and purple; the ſecond, with the ſame black, but with yellowiſh inſtead of purple; and the third, yellow alone like the yolk of an egg: this laſt is the leaſt ſcented of the three. The variation, however, is owing to the trunk of the tree being itſelf of three different colours; and the heart of it is the valuable ſort firſt deſcribed. The two following are ſuppoſed to be the outer parts of the trunk; though this ſeems doubtful, eſpecially in regard to the laſt ſort, from the circumſtance mentioned of its being found in large logs entire, and ſometimes only the *heart*, which, as above noticed, conſtitutes the calambac. Xylo-aloes || Xyſtus.

The lignum aloes vulgare is the ſecond in value. This is of a more denſe and compact texture, and conſequently leſs reſinous than the other; there is ſome of it, however, that is ſpongy, and has the holes filled up with the right reſinous matter; and all of it, when good, has veins of the ſame reſin in it. We meet with it in ſmall fragments, which have been cut and ſplit from larger: theſe are of a tolerably denſe texture in the more ſolid pieces, and of a duſky brown colour, variegated with reſinous black veins. It is in this ſtate very heavy, and leſs fragrant than in thoſe pieces which ſhow a multitude of little holes, filled up with the ſame blackiſh matter that forms the veins in others. The woody part of theſe laſt pieces is ſomewhat darker than the other, and is not unfrequently purpliſh, or even blackiſh. The ſmell of the common aloe wood is very agreeable, but not ſo ſtrongly perfumed as the former. Its taſte is ſomewhat bitter and acrid, but very aromatic.

The calambour, called alſo *agallochum ſylveſtre*, and *lignum aloes mexicanum*, is light and friable, of a duſky and often mottled colour, between a duſky green black and a deep brown. Its ſmell is fragrant and agreeable, but much leſs ſweet than that of either of the others; and its taſte bitteriſh, but not ſo much acrid or aromatic as either of the two former. This is ſaid to be met with very frequently, and in large logs; and theſe ſometimes entire, ſometimes only the heart of the tree. This is the aloe wood uſed by the cabinet-makers and inlayers.

This drug is eſteemed a cordial taken inwardly; and is ſometimes given in diſorders of the ſtomach and bowels, and to deſtroy the worms. A very fragrant oil may be procured from it by diſtillation; which is recommended in paralytic caſes from five to fifteen drops. It is at preſent, however, but little uſed; and would ſcarce be met with anywhere in the ſhops, but that it is an ingredient in ſome of the old compoſitions.

XYNOECIA, in Grecian antiquity, an anniverſary feaſt obſerved by the Athenians in honour of Minerva, upon the ſixteenth of Hecatombæon, to commemorate their leaving, by the perſuaſion of Theſeus, their country ſeats, in which they lay diſperſed here and there in Attica, and uniting together in one body.

XYSTARCHA, in antiquity, the maſter or director of the xyſtus. In the Greek gymnaſium the xyſtarcha was the ſecond officer, and the gymnaſiarcha the firſt; the former was his lieutenant, and preſided over the two xyſti, and all exerciſes of the athletæ therein.

XYSTUS, among the Greeks, was a long portico, open or covered at the top, where the athletæ practiſed wreſtling and running: the gladiators, who practiſed therein, were called *xyſtici*. Among the Romans, the xyſtus was only an alley, or double row of trees, meeting like an arbour, and forming a ſhade to walk under.

Y.

Y Yard.

Y or y, the 23d letter of our alphabet: its ſound is formed by expreſſing the breath with a ſudden expanſion of the lips from that configuration by which we expreſs the vowel *u*. It is one of the ambigenial letters, being a conſonant in the beginning of words, and placed before all vowels, as in *yard*, *yield*, *young*, &c. but before no conſonant. At the end of words it is a vowel, and is ſubſtituted for the ſound of *i*, as in *try*, *deſcry*, &c. In the middle of words it is not uſed ſo frequently as *i* is, unleſs in words derived from the Greek, as in *chyle*, *empyreal*, &c. though it is admitted into the middle of ſome pure Engliſh words, as in *dying*, *flying*, &c. The Romans had no capital of this letter, but uſed the ſmall one in the middle and laſt ſyllables of words, as in *coryambus*, *onyx*, *martyr*. Y is alſo a numeral, ſignifying 150, or, according to Baronius, 159; and with a daſh a-top, as $\bar{Y}$, it ſignified 150,000.

YACHT, or YATCH, a veſſel of ſtate, uſually employed to convey princes, ambaſſadors, or other great perſonages, from one kingdom to another.

As the principal deſign of a yacht is to accommodate the paſſengers, it is uſually fitted with a variety of convenient apartments, with ſuitable furniture, according to the quality or number of the perſons contained therein.

The royal yachts are commonly rigged as ketches, except the principal one reſerved for the ſovereign, which is equipped with three maſts like a ſhip. They are in general elegantly furniſhed, and richly ornamented with ſculpture; and always commanded by captains in his majeſty's navy.

Beſides theſe, there are many other yachts of a ſmaller kind, employed by the commiſſioners of the exciſe, navy, and cuſtoms; or uſed as pleaſure-boats by private gentlemen.

YAMS. See DIOSCOREA, } BOTANY *Index*.
YAMBOO. See EUGENIA, }

YARD *of a* SHIP, a long piece of timber ſuſpended upon the maſts of a ſhip, to extend the ſails to the wind. See MAST and SAIL.

All yards are either ſquare or lateen; the former of which are ſuſpended acroſs the maſts at right angles, and the latter obliquely.

The ſquare yards are nearly of a cylindrical ſurface. They taper from the middle, which is called the *ſlings*, towards the extremities, which are termed the *yard-arms*; and the diſtance between the ſlings and the yard-arms on each ſide is by the artificers divided into quarters, which are diſtinguiſhed into the firſt, ſecond, third quarters, and yard-arms. The middle quarters are formed into eight ſquares, and each of the end parts is figured like the fruſtum of a cone. All the yards of a ſhip are ſquare except that of the mizen.

The proportions for the length of yards, according to the different claſſes of ſhips in the Britiſh navy, are as follows:

			Guns.
1000 : gun-deck : :	560 : 559 : 570 : 576 : 575 : 561 :	main-yard, fig. 1. Pl. CCCCLXVIII. *Note*, the figure repreſents the yard and ſails of a ſhip of 74 guns.	100 / 90 80 / 70 / 60 / 50 / 44
1000 : main-yard : :	880 : 874 :	fore-yard.	100 90 80 / all the reſt.

Yard.

To apply this rule to practice, ſuppoſe the gun-deck 144 feet. The proportion for this length is, as 1000 is to 575, ſo is 144 to 83; which will be the length of the main-yard in feet, and ſo of all the reſt.

			Guns.
1000 : main-yard : :	820 : 847 : 840 :	mizen-yard	100 90 80 60 44 / 70 / 24
1000 : main-yard : :	726 : 720 :	main topſail-yard	24 / all the reſt.
1000 : fore-yard : :	719 : 726 : 715 :	fore topſail-yard	70 / 24 / all the reſt.
1000 : main topſail-yard : :	main top gallant-yard all the rates.		
1000 fore-topſail yard : :	696 : 690 :	fore top gallant-yard	70 / all the reſt.
1000 : fore-topſail yard : :	768 : 750 :	mizentopſailyard	70 / all the reſt.

Croſs-jack and ſprit-ſail yards equal to the fore top-ſail-yard.

Sprit-topſail-yard equal to the fore top-gallant-yard.

The diameters of yards are in the following proportions to their length.

The main and fore yards five-ſevenths of an inch to one yard. The topſail, croſs-jack, and ſprit-ſail yards, nine-fourteenths of an inch to one yard. The top-gallant, mizen topſail, and ſprit-ſail topſail yards, eight-thirteenths of an inch to one yard.

The mizen-yard five ninths of an inch to one yard.

All ſtudding-ſail booms and yards half an inch to one yard in length.

The lifts of the main-yard are exhibited in the above figure by *gg*; the horſes and their ſtirrups by *h i*; the reef-tackles and their pendents by *k*, *l*; and the braces and brace-pendents by *m*, *n*.

The lateen-yards evidently derive their names from having been peculiar to the ancient Romans. They are uſually compoſed of ſeveral pieces faſtened together by wooldings, which alſo ſerve as ſteps whereby the ſailors climb to the peek or upper extremity, in order to furl or caſt looſe the ſail.

The mizen-yard of a ſhip, and the main-yard of a bilander, are hung obliquely on the maſt, almoſt in the ſame manner as the lateen-yard of a xebec, ſettee, or polacre.

YARD, a meaſure of length uſed in Britain and Spain, conſiſting of three feet, chiefly to meaſure cloth, ſtuffs, &c.

Yard-arm || Yawning.

YARD-*Arm* is that half of the yard that is on either ſide of the maſt, when it lies athwart the ſhip.

YARDS alſo denotes places belonging to the navy, where the ſhips of war, &c. are laid up in harbour.—There are belonging to his majeſty's navy ſix great yards, viz. Chatham, Deptford, Woolwich, Portſmouth, Sheerneſs, and Plymouth; theſe yards are fitted with ſeveral docks, wharfs, launches, and graving places, for the building, repairing, and cleaning of his majeſty's ſhips; and therein are lodged great quantities of timber, maſts, planks, anchors, and other materials: there are alſo convenient ſtore-houſes in each yard, in which are laid up vaſt quantities of cables, rigging, ſails, blocks, and all other ſorts of ſtores needful for the royal navy.

YARE, among ſailors, implies ready or quick: as, be yare at the helm; that is, be quick, ready, and expeditious at the helm. It is ſometimes alſo uſed for bright by ſeamen: as, to keep his arms yare; that is, to keep them clean and bright.

YARE, a river of Norfolk, which runs from weſt to eaſt through that county, paſſing by Norwich, and falling into the German ſea at Yarmouth.

YARMOUTH, a ſea-port town of Norfolk, with a market on Wedneſdays and Saturdays, and a fair on Friday and Saturday in Eaſter-week for petty chapmen. It is ſeated on the river Yare, where it falls into the ſea; and is a place of great ſtrength, both by art and nature, being almoſt ſurrounded with water; and there is a drawbridge over the river. It is eſteemed the key of this coaſt, and is a clean handſome place, whoſe houſes are well built, it being a conſiderable town for trade. It has one large church, and a neat chapel, and the ſteeple of St Nicholas is ſo high that it ſerves for a ſea-mark. It is governed by a mayor. The harbour is a very fine one, though it is very dangerous for ſtrangers in windy weather; and it has for its ſecurity a pretty ſtrong fort. The inhabitants in 1801 amounted to nearly 15,000. It is 27 miles eaſt of Norwich, and 112 north-eaſt of London. E. Long. 1. 55. N. Lat. 52. 45.

YARMOUTH, a town of the iſle of Wight, in Hampſhire, with a market on Fridays, and one fair on July 25th for toys. It is ſeated on the weſtern part of the iſland, on the ſea ſhore, and is encompaſſed with water; for, not many years ago a channel was cut through the peninſula, over which there is a drawbridge, and it is defended by a ſtrong caſtle on the quay. It is a handſome place, whoſe houſes are chiefly built with ſtone, and covered with ſlate; and it ſends two members to parliament. The market is now diſuſed. W. Long. 1. 28. N. Lat. 50. 40.

YARN, wool or flax ſpun into thread, of which they weave cloth. See CLOTH.

YARROW. See ACHILLÆA, BOTANY *Index*.

YAWNING, an involuntary opening of the mouth, generally produced by wearineſs or an inclination to ſleep. Yawning, according to Boerhaave, is performed by expanding at one and the ſame time all the muſcles capable of ſpontaneous motion; by greatly extending the lungs; by drawing in gradually and ſlowly a large quantity of air; and gradually and ſlowly breathing it out, after it has been retained for ſome time and rarefied; and then reſtoring the muſcles to their natural ſtate. Hence the effect of yawning is to move, accelerate, and equally diſtribute all the humours through all the veſſels of the body, and conſequently to qualify the muſcles and organs of ſenſation for their various functions. Yawning, Year.

Sanctorius obſerves, that a great deal is inſenſibly diſcharged, when nature endeavours to get rid of the retained perſpirable matter, by yawning and ſtretching of the limbs. To theſe a perſon is moſt inclined juſt after ſleep, becauſe a greater quantity going off by the pores of the ſkin than at other times, whenſoever a perſon wakes, the increaſing contraction that then happens cloſes a great deal of the perſpirable matter in the cutaneous paſſages, which will continually give ſuch irritations as excite yawning and ſtretching; and ſuch motions, by ſhaking the membranes of the whole body, and ſhifting the contacts of their fibres, and the incloſed matter, by degrees throw it off. Hence we ſee the reaſon why healthful ſtrong people are moſt inclined to ſuch motions, becauſe they perſpire moſt in time of ſleep, and therefore have more of the perſpirable matter to lodge in the pores, and greater irritations thereunto. The advantages of ſome little exerciſe juſt after waking in a morning are conſiderable, as it throws off all the perſpirable matter that is ready for its exit out of the body. When yawning is troubleſome, Hippocrates ſays that long deep reſpiration or drawing in the air at long intervals cures it.

YEAR, in *Aſtronomy* and *Chronology*. See ASTRONOMY and KALENDAR.

The ancient Roman year was the lunar year, which, as firſt ſettled by Romulus, conſiſted of only 10 months; viz. 1. March, containing 31 days. 2. April, 30. 3. May, 31. 4. June, 30. 5. Quintilis, 31. 6. Sextilis, 30. 7. September, 30. 8. October, 31. 9. November, 30. 10. December, 30.—In all 304 days; which came ſhort of the true lunar year by 50 days, and of the ſolar, by 61 days. Numa Pompilius corrected this irregular conſtitution of the year, and compoſed two new months, January and February, of the days that were uſed to be added to the former year.

The ancient Egyptian year, called alſo the *year of Nabonaſſar*, on account of the epoch of Nabonaſſar, is the ſolar year of 365 days, divided into 12 months, of 30 days each, beſides five intercalary days added at the end. The names, &c. of the months are as follows: 1. Thoth. 2. Paophi. 3. Athyr. 4. Chojac. 5. Tybi. 6. Mecheir. 7. Phamenoth. 8. Pharmuthi. 9. Pachon. 10. Pauni. 11. Epiphi. 12. Meſori; beſide the ἡμέραι ἐπαγόμεναι.

The ancient Greek year was lunar; conſiſting of 12 months, which at firſt had 30 days a-piece, then alternately 30 and 29 days, computed from the firſt appearance of the new moon; with the addition of an emboliſmic month of 30 days, every 3d, 5th, 8th, 11th, 14th, 16th, and 19th year of a cycle of 19 years; in order to keep the new and full moons to the ſame terms or ſeaſons of the year. Their year commenced with that new moon, the full moon of which comes next after the ſummer ſolſtice. The order, &c. of their months was thus: 1. Ἑκατομβαιών, containing 29 days. 2. Μεταγειτνιών, 30. 3. Βοηδρομιών, 29. 4. Μαιμακτηριών, 30. 5. Πυανεψιών, 29. 6. Ποσειδεών, 30. 7. Γαμηλιών, 29. 8. Ανθεστηριών, 30. 9. Ελαφηβολιών, 30. 10. Μουνιχιών, 30. 11. Θαργηλιών, 29. 12. Σκιροφοριών, 30.

The ancient Jewiſh year is a lunar year, conſiſting

Year. commonly of 11 months, which alternately contain 30 and 29 days. It was made to agree with the ſolar year, either by the adding of 11, and ſometimes 12 days, at the end of the year, or by an emboliſmic month. The names and quantities of the months ſtand thus: 1. Niſan, or Abib, 30 days. 2. Jiar, or Zius, 29. 3. Siban, or Siwan, 30. 4. Thammuz, or Tammuz, 29. 5. Ab, 30. 6. Elul, 29. 7. Tiſri, or Ethanim, 30. 8. Marcheſvam, or Bul, 29. 9. Ciſleu, 30. 10. Tebeth, 29. 11. Sabat, or Schebeth, 30. 12. Adar, in the emboliſmic year, 30. Adar, in the common year, was but 29. Note, in the defective year, Ciſleu was only 29 days; and in the redundant year, Marcheſvam was 30.

The Perſian year is a ſolar year of about 365 days; conſiſting of 12 months of 30 days each, with five intercalary days added at the end.

The Arabic, Mahometan, and Turkiſh years, called alſo the *year of the Hegira*, is a lunar year, equal to 354 days eight hours and 48 minutes, and conſiſts of 12 months, which contain alternately 30 and 29 days.

The Hindoo year differs from all theſe, and is indeed different in different provinces of India. The beſt account that we have of it is by Mr Cavendiſh, in the Phil. Tranſ. of the Royal Society of London for the year 1792. "Before I ſpeak of the civil year of the Hindoos (ſays this eminent philoſopher), it will be proper to ſay a few words of the aſtronomical year, by which it is regulated.

"The aſtronomical year begins at the inſtant when the ſun comes to the firſt point of the Hindoo zodiac. In the year 1792, it began on April 9th, at 22h. 14′ after midnight of their firſt meridian, which is about 41′ of time weſt of Calcutta; but, according to Mr Gentil's account of the Indian aſtronomy, it began 3h. 24′ earlier. As this year, however, is longer than ours, its commencement falls continually later, in reſpect of the Julian year, by 50′ 26″ in four years. This year is divided into 12 months, each of which correſponds to the time of the ſun's ſtay in ſome ſign; ſo that they are of different lengths, and ſeldom begin at the beginning of a day.

"The civil day in all parts of India begins at ſunriſe, and is divided into 60 parts called *dandas*, which are again divided into 60 palas. In thoſe parts of India in which the Benares almanac, or as it is there called *patras*, is uſed, the civil year is luniſolar, conſiſting of 12 lunar months, with an intercalary month inſerted between them occaſionally. It begins at the day after the new moon next before the beginning of the ſolar year. The lunar month is divided into 30 parts called *teethees*; theſe are not ſtrictly of the ſame length, but are equal to the time in which the moon's true motion from the ſun is 12°. From the new moon till the moon arrives at 12° diſtance from the ſun is called the firſt *teethee*; from thence till it comes to 24°, is called the ſecond *teethee*; and ſo on till the full moon, after which the teethees return in the ſame order as before.

"The civil day is conſtantly called by the number of that teethee which expires during the courſe of the day; and as the teethee is ſometimes longer than one day, a day ſometimes occurs in which no teethee ends. When this is the caſe, the day is called by the ſame number as the following day; ſo that two ſucceſſive days go by the ſame name. It oftener happens, however, that two teethees end on the ſame day; in which caſe the number of the firſt of them gives name to the day, and there is no day called by the number of the laſt, ſo that a gap is made in the order of the days. In the latter part of the month the days are counted from the full moon, in the ſame manner as in the former part they are counted from the new moon; only the laſt day, or that on which the new moon happens, is called the 30th, inſtead of the 15th. It appears, therefore, that each half of the month conſtantly begins on the day after that on which the new or full moon falls; only ſometimes the half month begins with the ſecond day, the firſt being wanting. Year, Yeaſt.

"This manner of counting the days is ſufficiently intricate; but that of counting the months is ſtill more ſo.

"The civil year, as was before ſaid, begins at the day after the new moon; and, moreover, in the years which have an intercalary month, this month begins at the day after the new moon; but notwithſtanding this, the ordinary civil month begins at the day after the full moon. To make their method more intelligible, we will call the time from new moon to new moon the natural month. The civil month Viſākha, the firſt in the Hindoo kalender, which extends from the 9th of our April to the 10th of May, begins at the day after that full moon which is neareſt to the inſtant at which the ſun enters Meſha, the firſt in order of the Indian ſigns, whether before or after; however, it is not always accurately the neareſt.

"A conſequence of this way of counting the months is, that the firſt half of Chitra, the laſt month in the Indian kalender, extending from March the 10th to April the 9th, falls in one year, and the latter half in the following year; and whenever the ſun enters no ſign during a natural month, this month is intercalary. The number of days in the month varies from 29 to 32. Indeed the Hindoo months, both ſolar and lunar, conſiſt neither of a determinate number of days, nor are regulated by any cycle, but depend ſolely on the motions of the ſun and moon; ſo that a Hindoo has no way of knowing what day of the month it is but by conſulting his almanac; and what is more, the month ought ſometimes to begin on different days, in different places, on account of the difference in latitude and longitude, not to mention the difference which may ariſe from errors in computation. This mode of computing time muſt be attended with many inconveniences; but in the tranſactions of civil life the Hindoos do not much regard it. A diſagreement, however, in the computation of the teethee, which ſometimes alſo happens, occaſions no ſmall perplexity; becauſe by the teethees or lunar days are regulated moſt of their religious feſtivals. Every Brahmin in charge of a temple, or whoſe duty it is to announce the times for the obſervance of religious ceremonies, is therefore furniſhed with one of their almanacs; and if he be an aſtronomer, he makes ſuch corrections in it as the difference of latitude and longitude renders neceſſary."

New YEAR's Gift. See GIFT.

YEAST, or YEST, a head or ſcum riſing upon beer or ale while working or fermenting in the vat. See BREWING.

It is uſed for a leaven or ferment in the baking of bread, as ſerving to ſwell or puff it up very conſiderably

in

Yeaſt. in a little time, and to make it much lighter, ſofter, and more delicate. See BAKING, BARM, and BREAD.

Mr Henry has publiſhed a method of preparing *artificial yeaſt*, by which good bread may be made without the aſſiſtance of any other ferment. The method is this: Boil flour and water together to the conſiſtence of treacle, and when the mixture is cold ſaturate it with fixed air. Pour the mixture thus ſaturated into one or more large bottles or narrow-mouthed jars; cover it over looſely with paper, and upon that lay a ſlate or board with a weight to keep it ſteady. Place the veſſel in a ſituation where the thermometer will ſtand from 70° to 80°, and ſtir up the mixture two or three times in 24 hours. In about two days ſuch a degree of fermentation will have taken place, as to give the mixture the appearance of yeaſt. With the yeaſt in this ſtate, and before it has acquired a thoroughly vinous ſmell, mix the quantity of flour intended for bread, in the proportion of ſix pounds of flour to a quart of the yeaſt, and a ſufficient portion of warm water. Knead them well together in a proper veſſel, and covering it with a cloth, let the dough ſtand for 12 hours, or till it appears to be ſufficiently fermented in the fore-mentioned degree of warmth. It is then to be formed into loaves and baked. Mr Henry adds, that perhaps the yeaſt would be more perfect, if a decoction of malt were uſed inſtead of ſimple water.

It has lately been diſcovered, that a decoction of malt alone, without any addition, will produce a yeaſt proper enough for the purpoſe of brewing. This diſcovery was made by Joſeph Senyor, ſervant of the reverend Mr Maſon of Aſton near Rotheram; and he received for it a reward of 20l. from the Society for promoting Arts, Manufactures, and Commerce. The proceſs is as follows: Procure three earthen or wooden veſſels of different ſizes and apertures, one capable of holding two quarts, the other three or four, and the third five or ſix: boil a quarter of a peck of malt for about eight or ten minutes in three pints of water; and when a quart is poured off from the grains, let it ſtand in the firſt or ſmaller veſſel in a cool place till not quite cold, but retaining that degree of heat which the brewers uſually find to be proper when they begin to work their liquor. Then remove the veſſel into ſome warm ſituation near a fire, where the thermometer ſtands between 70 and 80 degrees Fahrenheit, and there let it remain till the fermentation begins, which will be plainly perceived within 30 hours: add then two quarts more of a like decoction of malt, when cool, as the firſt was; and mix the whole in the ſecond or larger veſſel, and ſtir it well in, which muſt be repeated in the uſual way, as it riſes in a common vat: then add a ſtill greater quantity of the ſame decoction, to be worked in the largeſt veſſel, which will produce yeaſt enough for a brewing of 40 gallons.

Common ale yeaſt may be kept freſh and fit for uſe ſeveral months by the following method: Put a quantity of it into a cloſe canvas bag, and gently ſqueeze out the moiſture in a ſcrew-preſs till the remaining matter be as firm and ſtiff as clay. In this ſtate it may be cloſe packed up in a tight caſk for ſecuring it from the air; and will keep freſh, ſound, and fit for uſe, for a long time. This is a ſecret that might be of great uſe to the brewers and diſtillers, who, though they employ very large quantities of yeaſt, ſeem to know no method of preſerving it, or raiſing nurſeries of it; for want of which they ſuſtain a very conſiderable loſs; whereas the brewers in Flanders make a very great advantage of ſupplying the malt diſtillers of Holland with yeaſt, which is rendered laſting and fit for carriage by this eaſy expedient.

Yell ‖ Yew.

YELL, one of the ſlands of Shetland, lying north-eaſt from the Mainland, and divided from it by an arm of the ſea, called *Yell-Sound*. By ſome it is thought to have been the *Thule* of the ancients. In the old deſcriptions it is ſaid to be 20 miles long and 8 broad. It is very mountainous and full of moſs; but there are pretty conſiderable paſtures in which they feed a great many ſheep; and it alſo affords plenty of peat. It has eight large harbours, which would not be thought deſpicable in other countries. Anciently it ſeems to have been pretty populous, ſince there are in it three churches, twenty chapels, and many brughs or Pictiſh forts.

YELLOW, one of the original colours of light.

YELLOW-Colour for Houſe-painting. See *COLOUR-Making*.

Naples YELLOW, a beautiful colour much uſed by painters, formerly thought to be prepared from arſenic, but now diſcovered to have lead for its baſis.

YELLOW-Hammer. See FRINGILLA, ORNITHOLOGY *Index*.

YELLOW-Fever. See MEDICINE, N° 168.

YEMEN, a province of Arabia ſtretching along the Red ſea and Indian ocean, and forming a part of the country once known by the name of Arabia Felix.

YEOMAN, the firſt or higheſt degree among the plebeians of England, next in order to the gentry.

The yeomen are properly freeholders, who having land of their own, live on good huſbandry.

YEOMAN is alſo a title of office in the king's houſehold, of a middle place or rank between an uſher and a groom.

YEOMEN of the Guard were anciently 250 men of the beſt rank under gentry, and of larger ſtature than ordinary, each being required to be ſix feet high. At preſent there are but 100 yeomen in conſtant duty, and 70 more not in duty; and as any of the 100 dies, his place is ſupplied out of the 70. They go dreſſed after the manner of King Henry VIII.'s time. They formerly had diet as well as wages when in waiting; but this was taken off in the reign of Queen Anne.

YEST, or YEAST, See YEAST.

YEW. See TAXUS, BOTANY *Index*.

Yew trees are remarkable for their duration. There are now growing within 300 yards of the old Gothic ruins of Fountain's abbey, near Rippon, in Yorkſhire, ſeven very large yew trees, commonly called the Seven Siſters, whoſe exact ages cannot be accurately aſcertained, though tradition ſays that they were ſtanding in the year 1088. It is ſaid alſo, that when the great Fountain's abbey was building, which is 700 feet long, and was finiſhed in 1283, the maſons uſed to work their ſtones, during the hot ſummers, under the ſhade of theſe trees. The circumference of the Seven Siſters, when meaſured by a curious traveller, were of the following ſizes:—the ſmalleſt tree, round its body, 5 yards 1 foot; four others are from $5\frac{1}{2}$ to $7\frac{1}{2}$ yards; the ſixth is $9\frac{1}{2}$ yards; and the ſeventh is 11 yards 1 foot 7 inches in circumference, being 2 yards 10 inches larger than the

Yew || York.

great yew tree now growing in the churchyard at Gresford, in North Wales, which is 9 yards 9 inches. Theſe trees are the largeſt and oldeſt in the Britiſh dominions.

YNCA, an appellation anciently given to the kings of Peru, and the princes of their blood; the word literally ſignifying lord, king, emperor, and royal blood.

YOAK, or YOKE, in *Agriculture*, a frame of wood fitted over the necks of oxen, whereby they are coupled together and harneſſed to the plough.

YOAK of Land, in our ancient cuſtoms, was the ſpace which a yoke of oxen, that is, two oxen, may plough in one day.

YOLK, the yellow part in the middle of an egg (ſee EGG). It contains a lymphatic ſubſtance mixed with a certain quantity of mild oil, which, on account of this mixture, is ſoluble in water. When expoſed to heat, it aſſumes a conſiſtence not ſo hard as the white of the egg; and when bruiſed gives out the oil which it contains. This oil has been uſed externally as a liniment.

YONNE, a river in France, which riſes in Burgundy, and running north through Nivernois and Champagne, falls into the Seine at Monterau ſur Yonne.

YORK, in Latin *Eboracum*, the capital of Yorkſhire in England. This city is ſo ancient that the origin of it is uncertain. In the time of the Romans a legion was ſtationed here, it being then the capital of the Brigantes; and here died the emperor Severus, and Flavius Valerius Conſtantius Chlorus, father of Conſtantine the Great. There was then alſo a temple of Bellona here, and no leſs than three military ways went from hence. In the time of the Saxons it was erected into an archbiſhopric by Pope Honorius, to which are now ſubject the biſhoprics of Cheſter, Durham, Carliſle, and the iſle of Man; though anciently 12 biſhoprics in England, and all Scotland, were. A horn is ſtill kept in the minſter, by which Ulphius, one of the Saxon princes, beſtowed all his lands and revenues upon the church.

This city ſuffered very much during the ravages of the Danes; but, after the Conqueſt, it began to flouriſh again. The cathedral, which coſt a long time and a great deal of money in building, is a moſt ſtately Gothic pile. Its chapter-houſe is particularly admired for its painted glaſs, its fine marble ſtalls, its pillars of alabaſter, and curious contrivance. In it is the following line in gold letters:

Ut Roſa, flos florum, ſic eſt Domus iſta Domorum.

The choir is remarkable for its fine carvings, particularly the ſtatues of all the Engliſh monarchs; and the windows are exquiſitely painted with the hiſtory of the Bible. The lanthorn ſteeple is 70 feet ſquare, and 188 high, and the windows are 45. At the ſouth end is a circular light, called the *marigold window* from the colour of its glaſs; and at the north end is a very large one, whoſe painting repreſents embroidery.

This city is generally reckoned the ſecond city in England; but though it ſtands upon more ground, it is inferior in trade, wealth, and number of people, to Briſtol. The inhabitants are reckoned at 16,145. It is ſituated in a fine plain, in the middle of the ſhire, on both ſides the Ouſe, walled and divided into four wards, containing 28 pariſhes. It enjoys large privileges and immunities, conferred upon it by a ſucceſſion of kings from Henry II. and its chief magiſtrate has the title of *lord mayor*, which is an honour peculiar to it and London. Richard II. made it a county of itſelf. The conſervancy of moſt of the rivers of the county, within certain limits, belongs to the lord mayor and aldermen. The middle arch of the bridge here over the Ouſe is thought to equal the Rialto at Venice in architecture, height, and breadth, the diameter being 81 feet, and the height 51. Though this city is 60 miles diſtant from the ſea, yet ſhips of 70 tons burden come up the river to it. The town-houſe or guild-hall ſtands upon the bridge, and is ſuperior in all reſpects to that of London. In the Popiſh times there were nine abbeys here, and a vaſt number of churches; but of the latter there are only 17 now. The ſteeple of that of Allhallows is reckoned the fineſt in England. The archbiſhop has a fine palace; and the aſſembly-room, deſigned by the carl of Burlington, is very noble. Here are plays, aſſemblies, concerts, and the like entertainments, at ſome houſe or other, almoſt every night in the week. In the old caſtle, built originally by William the Conqueror, and repaired in 1701, the aſſizes are kept. It ſerves alſo for the county-gaol, which is the neateſt and pleaſanteſt in England, with an area larger than that of the king's-bench, and it has a handſome chapel in it, with a good allowance for a preacher. This city has long given the title of *duke* to ſome branch of the royal family.

The plenty and cheapneſs of proviſions induces many perſons of ſmall fortune, or that would live frugally, to take up their abode here; and the venerable remains of Roman antiquities, and thoſe of a later date, as abbeys, churches, and caſtles, procure this city a viſit from every curious traveller. Many Roman altars, urns, coins, inſcriptions, &c. have been found; and Saxon coins are ſtill extant that have been ſtruck here. The members, being two in number, for this city, have precedence of all others, except thoſe of London, in the houſe of commons. An infirmary, after the manner of thoſe of Bath, Briſtol, &c. hath been erected in it; and a cotton manufacture eſtabliſhed and brought to great perfection. Beſides four weekly markets, it has a great many fairs; one, in particular, every other Thurſday for cattle and ſheep. W. Long. 1. 1. N. Lat. 53. 59.

York, Yorkſhire.

YORKSHIRE, the largeſt county of England, bounded on the ſouth by Derbyſhire, Nottinghamſhire, and Lincolnſhire; on the north by Durham and Weſtmoreland; on the eaſt by the German ocean; and on the weſt by Lancaſhire and a part of Cheſhire.—It is upwards of 80 miles in length from eaſt to weſt, nearly as much in breadth, and about 360 in circumference, containing, in the whole, 26 hundreds or wapentakes, 49 market-towns, 563 pariſhes, 242 vicarages, with many chapels of eaſe, and 2330 villages. Its area is computed by ſome at 4684 ſquare miles, by others at 3,770,000 acres, and its inhabitants at 858,892. It is divided into three parts or ridings, viz. the Weſt, Eaſt, and North; ſo denominated from their ſituation, in reſpect of the city of York. Each of theſe is as large, if not larger, than any ordinary county. There are other diviſions, as Richmondſhire, Allertonſhire, Howdenſhire, Hallanſhire, Craven, Cleveland, Marſhland, Holderneſs, &c.

As the ſoil and face of the country vary greatly, ſo does the air. In the hilly parts the air is good, but the ſoil very indifferent; of the lower ſome are marſhy, others drier, and the ſoil of both rich; but the air of the former

York. former is more foggy and unhealthy than that of the latter. The manufactures of this county are cutlery and hard-wares, particularly knives, bits, and ſpurs; but the principal are ſtockings and woollen cloth, with which it ſupplies in a great meaſure Germany and the North. As to the produce, it abounds in corn, cattle, horſes, lead and iron, coal, wood, lime, liquorice, alum, jet, &c. It lies wholly in the northern circuit, and much the greater part of it in the dioceſe of York; that only which is called *Richmondſhire* belonging to the dioceſe of Cheſter. The members it ſends to parliament are 30; of which two are for the ſhire and 28 for the towns.

New-York, one of the United States of America, is bounded towards the ſouth-eaſt by the Atlantic ocean; eaſt by Connecticut, Maſſachuſets, and Vermont; north by the 45th degree of latitude, which divides it from Canada; north-weſtwardly by the river Iroquois or St Lawrence, and the lakes Ontario and Erie; ſouth-weſt and ſouth by Pennſylvania and New Jerſey. The whole ſtate contains about 44,000 ſquare miles, equal to 28,160,000 acres.

The ſettlements already made in this ſtate are chiefly upon two narrow oblongs, extending from the city of New-York eaſt and north. The one eaſt is Long Iſland, which is 140 miles long, and narrow, and ſurrounded by the ſea. The one extending north is about 40 miles in breadth, and biſected by Hudſon's river. And ſuch is the interſection of the whole ſtate by the branches of the Hudſon, the Delaware, the Suſquehannah, and other large rivers, that there are few places throughout its whole extent which are more than 15 or 20 miles from ſome navigable ſtream. There are few fiſh in the rivers, but in the brooks are plenty of trout; and in the lakes yellow perch, ſun-fiſh, ſalmon-trout, cat-fiſh, and a variety of others.

The ſtate, to ſpeak generally, abounds with lakes, ſome of ſalt and others of freſh water. It is interſected by ridges of mountains running in a north-eaſt and ſouth-weſt direction. Beyond the Allegany mountains, however, the country is a dead level, of a fine rich ſoil, covered, in its natural ſtate, with maple, beech, birch, cherry, black-walnut, locuſt, hickory, and ſome mulberry-trees. On the banks of lake Erie, are a few cheſnut and oak ridges. Hemlock ſwamps are interſperſed thinly through the country. All the creeks that empty into lake Erie have falls, which afford many excellent mill ſeats. Eaſt of the Allegany mountains, the country is broken into hills with rich intervening valleys. The hills are clothed thick with timber, and when cleared afford fine paſture; the valleys, when cultivated, produce wheat, hemp, flax, peaſe, graſs, oats, Indian corn. Of the commodities produced from culture, wheat is the ſtaple; of which immenſe quantities are raiſed and exported. Indian corn and peaſe are likewiſe raiſed for exportation; and rye, oats, barley, &c. for home conſumption. In ſome parts of the ſtate excellent dairies are kept, which furniſh for the market butter and cheeſe.

The ſituation of New-York, with reſpect to foreign markets, has decidedly the preference to any other of the United States. It has at all ſeaſons of the year a ſhort and eaſy acceſs to the ocean. Its exports to the Weſt Indies are, biſcuit, peaſe, Indian corn, apples, onions, boards, ſtaves, horſes, ſheep, butter, cheeſe, pickled oyſters, beef, and pork. But wheat is the ſtaple commodity of the ſtate, of which no leſs than 677,700 buſhels were exported in the year 1775, beſides 2555 tons of bread and 2828 tons of flour. Inſpectors of flour are appointed to prevent impoſition, and to ſee that none is exported but that which is deemed by them merchantable. Beſides the above-mentioned articles, are exported flax-ſeed, cotton, wool, ſarſaparilla, coffee, indigo, rice, pig-iron, bar-iron, pot-aſh, pearl-aſh, furs, deer-ſkins, logwood, fuſtick, mahogany, bees wax, oil, Madeira wine, rum, tar, pitch, turpentine, whale-fins, fiſh, ſugars, molaſſes, ſalt, tobacco, lard, &c. but moſt of theſe articles are imported for re-exportation. In the year 1774, there were employed, in the trade of this ſtate, 1075 veſſels, whoſe tonnage amounted to 40,812. York.

Since the revolution, the literature of the ſtate has engaged the attention of the legiſlature. In one of their earlieſt ſeſſions an act paſſed, conſtituting 21 gentlemen (of whom the governor and lieutenant-governor for the time being are members *ex officiis*) a body coporate and politic, by the name and ſtyle of "The regents of the univerſity of the ſtate of New-York." They are intruſted with the care of literature in general in the ſtate, and have power to grant charters of incorporation for erecting colleges and academies throughout the ſtate—are to viſit theſe inſtitutions as often as they ſhall think proper, and report their ſtate to the legiſlature once a-year. All degrees, above that of maſter of arts are to be conferred by the regents. A univerſal toleration is granted in religion.

The ſupreme legiſlative powers of the ſtate are veſted in two branches, a ſenate and aſſembly, The members of the ſenate are elected by the freeholders of the ſtate, who poſſeſs freehold eſtates to the value of 100l. clear of debts. For the purpoſe of electing ſenators, the ſtate is divided into four great diſtricts, each of which chooſes a certain number.

The aſſembly of the ſtate is compoſed of repreſentatives from the ſeveral counties, choſen annually in May. Every male inhabitant of full age, who has reſided in the ſtate ſix months preceding the day of election, and poſſeſſing a freehold to the value of 20l. in the county where he is to give his vote; or has rented a tenement therein of the yearly value of forty ſhillings, and has been rated and actually paid taxes—is entitled to vote for repreſentatives in aſſembly. The number of repreſentatives is limited to 300.

The ſupreme executive power of the ſtate is veſted in a governor choſen once in three years by the freemen of the ſtate. The lieutenant-governor is, by his office, preſident of the ſenate; and, upon an equal diviſion of voices, has a caſting vote; but has no voice on other occaſions. The governor has not a ſeat in the legiſlature; but as a member of the council of reviſion and council of appointment, he has a vaſt influence in the ſtate. The council of reviſion is compoſed of the chancellor, the judges of the ſupreme court, or any of them, and the governor. In the year 1790 the number of inhabitants in this ſtate was 340,120, of whom 21,324 were negroes; but in 1795 the whole population of the ſtate amounted to 530,177, making an increaſe of 190,057 in five years.

New-York, a city of North America, capital of the ſtate of the ſame name. It is ſituated at the ſouth-weſt

York. point of an iſland, at the confluence of Hudſon and Eaſt rivers, and is about four miles in circumference. The ſituation is both healthy and pleaſant. Surrounded on all ſides by water, it is refreſhed by cool breezes in ſummer, and the air in winter is more temperate than in other places under the ſame parallel. York iſland is 15 miles in length, and hardly one in breadth. It is joined to the main by a bridge called King's bridge. The channels between Long and Staten iſlands, and between Long and York iſlands, are ſo narrow as to occaſion an unuſual rapidity of the tides, which is increaſed by the confluence of the waters of Hudſon and Eaſt rivers. This rapidity, in general, prevents the obſtruction of the channel by ice. There is no baſon or bay for the reception of ſhips; but the road where they lie in Eaſt river is defended from the violence of the ſea by the iſlands which interlock with each other; ſo that, except that of Rhode iſland, the harbour of New-York, which admits ſhips of any burden, is the beſt of the United States. The number of the inhabitants in 1786 was 23,614.

The moſt magnificent edifice in this city is *Federal Hall*, at the head of Broad-ſtreet; in a gallery in front of which General Waſhington, attended by the ſenate and houſe of repreſentatives, took his oath of office at the commencement of the operation of the federal conſtitution, 30th April, 1789. The other public buildings in the city are, three houſes for public worſhip for the Dutch Reformed church, four for Preſbyterians, three for Epiſcopalians, two for German Lutherans and Calviniſts, two for Quakers, two for Baptiſts, two for Methodiſts, one for Moravians, one for Catholics, one for French Proteſtants, and a Jewiſh ſynagogue.

King's college was chiefly founded by the voluntary contributions of the inhabitants of the province, aſſiſted by the general aſſembly, and the corporation of Trinity Church; in the year 1754, a royal charter (and grant of money) being then obtained, incorporating a number of gentlemen therein mentioned, by the name of "The Governors of the College of the Province of New-York, in the city of New-York, in America;" granting to them the power of conferring all ſuch degrees as are uſually conferred by either of the Engliſh univerſities. The building conſiſts of an elegant ſtone edifice, three ſtories high, with four ſtair caſes, 12 apartments in each, a chapel, hall, library, muſeum, anatomical theatre, and a ſchool for experimental philoſophy. It is ſituated on a dry gravelly ſoil, about 150 yards from the bank of Hudſon's river, commanding a beautiful and extenſive proſpect. Since the revolution, the legiſlature paſſed an act conſtituting 21 gentlemen (of whom the governor and lieutenant-governor for the time being, are members *ex officiis*) a body corporate and politic by the name of "The Regents of the Univerſity of the State of New-York." They are entruſted with the care of literature in general, and have power to grant charters for erecting colleges and academies through the ſtate. It is now denominated *Columbia college*. The annual revenue ariſing from the eſtate belonging to the college amounts to 1535l. currency, excluſive of ſome bonds which are not as yet productive. It conſiſts of a faculty of arts, and one of phyſic, the firſt having a preſident and ſeven profeſſors, and the ſecond a dean, and the ſame number of profeſſors. The library and muſeum were deſtroyed during the war, after which upwards of 800l. were expended on books to enlarge the library. York, Young.

The government of this city is at preſent in the hands of a mayor, aldermen, and common council, and the city is divided into ſeven wards, in each of which an alderman and aſſiſtant are annually choſen by the people. A court of ſeſſion is held for the trial of criminal cauſes. It is eſteemed the moſt eligible ſituation for commerce in the United States; but the want of good water is a great inconveniency, there being few wells in the city, and moſt of the people are ſupplied with freſh water conveyed to their doors in caſks from the head of Queen-ſtreet. The number of inhabitants in 1796 is ſtated at more than 33,000; and according to ſome it is ſuppoſed that they amount at this time to nearly the double. The entries from foreign ports in 1795, were 178 ſhips, 309 brigs, 9 barques, 7 ſnows, 268 ſchooners, and 170 ſloops. Works of defence have been erected to a conſiderable extent, and when completed on the original plan, will afford great ſecurity to the city. New-York is 95 miles N. E. of Philadelphia, 197 N. E. of Baltimore, and 913 from Charleſton. W. Long. 74° 9′ 45″. N. Lat. 40° 42′ 8″.

YOUNG, Dr Edward, was the ſon of a clergyman of the ſame name, and was born about the year 1679. When ſufficiently qualified, he was matriculated into All-Souls college, Oxford; and deſigning to follow the civil law, he took a degree in that profeſſion. In this ſituation he wrote his poem called The Laſt Day, publiſhed in 1704; which coming from a layman gave univerſal ſatisfaction: this was ſoon after followed by another, entitled The Force of Religion, or Vanquiſhed Love. Theſe productions gained him a reſpectable acquaintance; he was intimate with Addiſon, and thus became one of the writers of the Spectator: but the turn of his mind leading him to the church, he took orders, was made one of the king's chaplains, and obtained the living of Welwyn in Hertfordſhire, worth about 500l. per annum, but he never roſe to higher preferment. For ſome years before the death of the late prince of Wales, Dr Young attended his court pretty conſtantly; but upon his deceaſe all his hopes of church preferment vaniſhed; however, upon the death of Dr Hales, he was taken into the ſervice of the princeſs-dowager of Wales, and ſucceeded him as her privy chaplain. When pretty far advanced in life, he married the lady Elizabeth Lee, daughter of the late earl of Litchfield. This lady was a widow, and had an amiable ſon and daughter, who both died young. What he felt for their loſs, as well as for that of his wife, is finely expreſſed in his Night Thoughts, in which the young lady is characteriſed under the name of Narciſſa; her brother by that of Philander; and his wife, though nameleſs, is frequently mentioned; and he thus, in an apoſtrophe to death, deplores the loſs of all the three.

Inſatiate archer, could not once ſuffice!
Thy ſhaft flew thrice, and thrice my peace was ſlain,
And thrice ere thrice yon moon renew'd her horn.

He wrote three tragedies, The Revenge, Buſiris, and The Brothers. His ſatires, called Love of Fame the univerſal Paſſion, are by many eſteemed his principal performance; though Swift ſaid the poet ſhould have been

Young. been either more angry or more merry: they have been characteriſed as a ſtring of epigrams written on one ſubject, that tire the reader before he gets through them. His Complaint, or Night Thoughts. exhibit him as a moral and melancholy poet, and are eſteemed his maſterpiece. They form a ſpecies of poetry peculiarly his own, and in which he has been unrivalled by all thoſe who attempted to write in this manner. They were written under the recent preſſure of his ſorrow for the loſs of his wife, daughter, and ſon-in-law; they are addreſſed to Lorenzo, a man of pleaſure and the world, and who, as it is inſinuated by ſome, is his own ſon, but then labouring under his father's diſpleaſure. As a proſe-writer, he arraigned the prevailing manners of his time, in a work called The Centaur not Fabulous; and when he was above 80 years of age, publiſhed Conjectures on Original Compoſition. He publiſhed ſome other pieces; and the whole of his works are collected in 4 and 5 vols 12mo. Dr Young's turn of mind was naturally ſolemn; and he uſually, when at home in the country, ſpent many hours of the day walking in his own church-yard among the tombs. His converſation, his writings, had all a reference to the life after this; and this turn of diſpoſition mixed itſelf even with his improvements in gardening. He had, for inſtance, an alcove with a bench, ſo painted, near his houſe, that at a diſtance it looked as a real one which the ſpectator was then approaching. Upon coming up near it, however, the deception was perceived, and this motto appeared, *Inviſibilia non decipiunt*, "The things unſeen do not deceive us." Yet, notwithſtanding this gloomineſs of temper, he was fond of innocent ſports and amuſement: he inſtituted an aſſembly and a bowling-green in the pariſh of which he was rector, and often promoted the gaiety of the company in perſon. His wit was generally poignant, and ever levelled at thoſe who teſtified any contempt for decency and religion. His epigram, ſpoken extempore on Voltaire, is well known; who happening in his company to ridicule Milton, and the allegorical perſonages of Death and Sin, Young thus addreſſed him:

Thou art ſo witty, profligate, and thin,
You ſeem a Milton with his Death and Sin.

Young || Yunx.

One Sunday, preaching in office at St James's, he found, that though he ſtrove to make his audience attentive, he could not prevail. Upon which his pity for their folly got the better of all decorums, and he ſat back in the pulpit and burſt into a flood of tears. Towards the latter part of life he knew his own infirmities, and ſuffered himſelf to be in pupilage to his houſe-keeper; for he conſidered that, at a certain time of life, the ſecond childhood of age demanded its wonted protection. His ſon, whoſe boyiſh follies were long obnoxious to paternal ſeverity, was at laſt forgiven in his will; and our poet died regretted by all, having performed all that man could do to fill his poſt with dignity. His death happened in 1765.

YOUTH, that ſtate of man in which he approaches towards his greateſt perfection of body.

YPRES, a handſome, large, and populous town of the Auſtrian Netherlands, with a biſhop's ſee. It has a conſiderable manufactory in cloth and ſerges, and every year in Lent there is a conſiderable fair. It is one of the barrier towns, but was beſieged and taken by the French in 1744, and alſo in 1794. It is ſeated in a fertile plain on the river Ypre, in E. Long. 2. 48. N. Lat. 50. 51.

YTTRIA, one of the lately diſcovered earths. For an account of its properties and combinations, ſee CHEMISTRY, N° 1457.

Yttrio-Tantalite, a mineral ſubſtance containing the new earth yttria, and the new metal tantalium, which latter is found by Dr Wollaſton to be identical with columbium.

YUCCA, ADAM'S NEEDLE, a genus of plants of the claſs hexandria. The ſpecies of this plant are all exceedingly curious in their growth, and are therefore much cultivated in gardens. The Indians make a kind of bread from the roots of this plant.

YULE, YOOL, or *Iul*. See IUL.

YUNX, a genus of birds of the order *picæ*. See ORNITHOLOGY *Index*.

Z.

Z. Z, or z, the 24th and laſt letter, and the 19th conſonant of our alphabet; the ſound of which is formed by a motion of the tongue from the palate downwards and upwards to it again, with a ſhutting and opening of the teeth at the ſame time. This letter has been reputed a double conſonant, having the ſound *ds*; but ſome think with very little reaſon: and, as if we thought otherwiſe, we often double it, as in *puzzle*, *muzzle*, &c. Among the ancients, Z was a numeral letter, ſignifying 2000; and with a daſh added a-top, $\bar{Z}$ ſignified 2000 times 2000, or 4,000,000.

In abbreviations this letter formerly ſtood as a mark for ſeveral ſorts of weights; ſometimes it ſignified an ounce and a half; and very frequently it ſtood for half an ounce; ſometimes for the eighth part of an ounce, or a dram troy weight; and it has in earlier times been uſed to expreſs the third part of an ounce or eight ſcruples. ZZ were uſed by ſome of the ancient phyſicians to expreſs myrrh, and at preſent they are often uſed to ſignify zinziber or ginger.

Z. Zaara.

ZAARA, ZAPARA, SAHARA, or *the Deſert*, a vaſt country of Africa, bounded on the north by Barbary, on the eaſt by Fezzan and Caſhna, on the ſouth by Tombuctoo, and on the weſt by the Atlantic ocean. Zaara contains a variety of wandering nations, all proceeding from Arabs, Moors, and fugitive Portugueſe, who took refuge there when the family of the Sherifs made themſelves maſters of the three kingdoms of Barbary.

Zaara || Zaffe.

bary. All theſe people bear indiſcriminately the names of *Nars*, *Moors*, or *Arabs*. They are ſubdivided into various nations, of which the moſt conſiderable are the Mongearts, Traſars, and Bracnars. The Mongearts lead a wandering life, and live chiefly on the milk of their flocks, with a little barley-meal, and ſome dates. The poorer ſort go naked, except the females, who commonly wrap a clout about their middle, and wear a kind of bonnet on their head; but the wealthier ſort have a kind of looſe gown, made of blue calico, with large ſleeves, that is brought them from Negroland. When they move from one place to another for freſh paſture, water, or prey, moſt of them ride on camels, which have generally a ſort of ſaddle between the bunch and the neck, with a ſtring or ſtrap run through their noſtrils, which ſerves for a bridle; and inſtead of ſpurs they uſe a ſharp bodkin. Their tents or huts are covered with a coarſe ſtuff, made of camel's hair, and a kind of wool or moſs that grows on the palm trees. Theſe Arabs live here under the government of their ſheiks or cheyks; as in Arabia, Egypt, and other places. The other two tribes are rather more civilized. They are all Mahometans.

ZABULON, in *Ancient Geography*, one of the twelve tribes; bounded on the north by the tribes of Aſher and Naphthali; on the eaſt by the ſea of Galilee; on the ſouth by the tribe of Iſſachar or the brook Ciſon, which ran between both; on the weſt by the Mediterranean; ſo that it touched two ſeas, or was bimarous.

ZABULON, in *Ancient Geography*, a very ſtrong town in the tribe of that name, on the Mediterranean, ſirnamed *of men*, near Ptolemais: its vicinity to which makes it probable that it was alſo Chabulon, unleſs either name is a faulty reading in Joſephus; diſtant about 60 ſtadia from Ptolemais.

ZACYNTHUS, in *Ancient Geography*, an iſland to the ſouth of Cephalenia 60 ſtadia, but nearer to Peloponneſus, in the Ionian ſea, formerly ſubject to Ulyſſes, in compaſs above 160 ſtadia, woody and fruitful, with a conſiderable cognominal town and a port. The iſland lies over againſt Elis, having a colony of Achæans from Peloponneſus, over againſt the Corinthian gulf. Both iſland and town are now called *Zante*.

ZAFFRE, is the oxide of cobalt, employed for painting pottery ware and porcelain of a blue colour. The method of preparing it is as follows: The cobalt taken out of the mine is broken with hammers into pieces about the ſize of a hen's egg; and the ſtony involucrum, with ſuch other heterogeneous matters as are diſtinguiſhable by the eye, are ſeparated as much as poſſible. The choſen mineral is then pounded in ſtamping mills, and ſifted through braſs wire ſieves. The lighter parts are waſhed off by water, and it is afterwards put into a large flat-bottomed arched furnace, reſembling a baking oven, where the flame of the wood reverberates upon the ore; which is occaſionally ſtirred and turned with long handled iron hooks or rakes; and the proceſs is continued till it ceaſes to emit any fumes. The oven or furnace is terminated by a long horizontal gallery, which ſerves for a chimney; in which the arſenic, naturally mixed with the ore, ſublimes. If the ore contains a little biſmuth, as this ſemimetal is very fuſible, it is collected at the bottom of the furnace. The cobalt remains in the ſtate of a dark gray oxide, and is called *zaffre*. One hundred pounds of the cobalt ore loſe 20 and even 30 per cent. during this operation, which is continued 4 or even 9 hours, according to the quality of the ore. The roaſted ore being taken out from the furnace, ſuch parts as are concreted into lumps are pounded and ſifted afreſh. Zaffre, in commerce, is never pure, being mixed with two or rather three parts of powdered flints. A proper quantity of the beſt ſort of theſe, after being ignited in a furnace, is thrown into water to render it friable, and more eaſily reduced to powder; which, being ſifted, is mixed with the zaffre, according to the before-mentioned doſe; and the mixture is put into caſks, after being moiſtened with water. This oxide, fuſed with three parts of ſand and one of potaſh, forms a blue glaſs; which, when pounded, ſifted, and afterwards ground in mills, included in large caſks, forms *ſmalt*.

Zaffre || Zama.

The blue of zaffre is the moſt ſolid and fixed of all the colours that can be employed in vitrification. It ſuffers no change from the moſt violent fire. It is ſucceſsfully employed to give ſhades of blue to enamels, and to the cryſtal-glaſſes made in imitation of ſome opaque and tranſparent precious ſtones, as the lapis lazuli, the turquois, the ſapphire, and others of this kind.

ZALEUCUS, a famous legiſlator of the Locrians, and the diſciple of Pythagoras, flouriſhed 500 years, B. C. He made a law, by which he puniſhed adulterers with the loſs of both their eyes; and his ſon offending, was not abſolved from this puniſhment: yet, to ſhow the father as well as the juſt lawgiver, he put out his own right, and his ſon's left eye. This example of juſtice and ſeverity made ſo ſtrong an impreſſion on the minds of his ſubjects, that no inſtance was found of the commiſſion of that vice during the reign of that legiſlator. It is added, that Zaleucus forbade any wine being given to the ſick on pain of death, unleſs it was preſcribed by the phyſicians; and that he was ſo jealous of his laws, that he ordered, that whoever was deſirous of changing them, ſhould be obliged, when he made the propoſal, to have a cord about his neck, in order that he might be immediately ſtrangled, if thoſe alterations were eſteemed no better than the laws already eſtabliſhed. Diodorus Siculus attributes the ſame thing to Charondas legiſlator of the Sybarites.

ZAMA, in *Ancient Geography*, a town of Chamane, a diſtrict of Cappadocia, of unknown ſituation.—Another Zama, of Meſopotamia, on the Saocoras, to the ſouth of Niſibis.—A third, of Numidia, diſtant five days journey to the weſt of Carthage: it was the other royal reſidence of the kings of Numidia, hence called *Zama Regia*. It ſtood in a plain; was ſtronger by art than nature; richly ſupplied with every neceſſary; and abounding in men, and every weapon both of defence and annoyance.

The laſt of theſe is remarkable for the deciſive battle fought between the two greateſt commanders in the world, Hannibal the Carthaginian and Scipio Africanus. Of this engagement, the moſt important perhaps that ever was fought, Mr Hooke gives the following account.

"Scipio drew up his army after the Roman manner, except that he placed the cohorts of the Principes directly behind thoſe of the Haſtati, ſo as to leave ſufficient ſpace for the enemy's elephants to paſs through from

Zama. from front to rear. C. Lælius was poſted on the left wing with the Italian horſe, and Maſiniſſa with his Numidians on the right. The intervals of the firſt line Scipio filled up with his Velites, or light-armed troops, ordering them, upon a ſignal given, to begin the battle; and, in caſe they were repulſed, or broke by the elephants, to run back through the lanes before mentioned, and continue on their flight till they were got behind the Triarii. Thoſe that were wounded, or in danger of being overtaken, were to turn off to the right and left through the ſpaces between the lines, and that way eſcape to the rear.

"The army thus drawn up, Scipio went from rank to rank, urging his ſoldiers to conſider the conſequences of a defeat and the rewards of victory: on the one hand, certain death or ſlavery (for they had no town in Africa ſtrong enough to protect them); on the other, not only a laſting ſuperiority over Carthage, but the empire of the reſt of the world.

"Hannibal ranged all his elephants, to the number of above 80, in one front. Behind theſe he placed his mercenaries, conſiſting of 12,000 men, Ligurians, Gauls, Balcares, and Mauritanians.

"The new levies of Carthaginians and other Africans, together with 4000 Macedonians, under a general named *Sopater*, compoſed the ſecond line. And in the rear of all, at the diſtance of about a furlong, he poſted his Italian troops, in whom he chiefly confided. The Carthaginian horſe formed his right wing, the Numidians his left.

"He ordered their ſeveral leaders to exhort their troops not to be diſcouraged by their own weakneſs, but to place the hope of victory in him and his Italian army; and particularly directed the captains of the Carthaginians to repreſent to them what would be the fate of their wives and children if the event of this battle ſhould not prove ſucceſsful. The general himſelf, walking through the ranks of his Italian troops, called upon them to be mindful of the 17 campaigns in which they had been fellow-ſoldiers with him; and of that conſtant ſeries of victories by which they had extinguiſhed in the Romans all hope of ever being conquerors. He urged them to remember, above all, the battles of Trebia, Thraſymenus, and Cannæ; with any of which the approaching battle was in no wiſe to be compared, either with reſpect to the bravery or the number of the enemy. 'The Romans were yet unfoiled, and in the height of their ſtrength, when you firſt met them in the field; nevertheleſs you vanquiſhed them. The ſoldiers now before us are either the children of the vanquiſhed, or the remains of thoſe whom you have often put to flight in Italy. Maintain therefore your general's glory and your own, and eſtabliſh to yourſelves the name of invincible, by which you are become famous throughout the world.'

"When the Numidians of the two armies had ſkirmiſhed a while, Hannibal ordered the managers of the elephants to drive them upon the enemy. Some of the beaſts, frightened at the noiſe of the trumpets and other inſtruments of war which ſounded on all ſides, immediately ran back amongſt the Numidians of the Carthaginian left wing, and put them into confuſion; which Maſiniſſa taking advantage of, entirely routed them. Great deſtruction was made of the Velites by the reſt of the elephants, till theſe alſo being terrified, ſome of them ran through the void ſpaces of the Roman army which Scipio had left for that purpoſe; others falling in among the cavalry of the enemy's right wing, gave Lælius the ſame opportunity againſt the Carthaginian horſe as had been given to Maſiniſſa againſt the Numidian, and of which the Roman did not fail to make the ſame uſe. After this the infantry of the foremoſt lines joined battle. Hannibal's mercenaries had the advantage in the beginning of the conflict; but the Roman Haſtati, followed and encouraged by the Principes, who exhorted them to fight manfully, and ſhowed themſelves ready to aſſiſt them, bravely ſuſtained the attack, and at length gained ground upon the enemy. The mercenaries not being ſeaſonably ſupported by their ſecond line, and therefore thinking themſelves betrayed, they in their retreat fell furiouſly upon the Africans; ſo that theſe, the Haſtati coming up, were obliged to fight for ſome time both againſt their own mercenaries and the enemy. When the two Carthaginian lines had ceaſed their mutual rage, they joined their ſtrength; and though now but a mere throng of men, broke the Haſtati: but then the Principes advancing to the aſſiſtance of the latter, reſtored the battle; and moſt of the Africans and mercenaries were here cut off. Hannibal did not advance to their relief, the Roman Triarii not having yet engaged, and the Principes being ſtill in good order; and left the routed Africans and mercenaries ſhould break the ranks of his Italian ſoldiers, he commanded theſe to preſent their ſpears at thoſe who fled to them for protection, which obliged the runaways to move off to the right and left.

"The ground over which the Romans muſt march before they could attack Hannibal being ſtrewed with heaps of dead bodies and weapons, and being ſlippery with blood, Scipio feared that the order of his battalions would be broke, ſhould he paſs it haſtily. To avoid this miſchief, he commanded the Haſtati to give over the purſuit, and halt where they were, oppoſite to the enemy's centre: after which, having ſent all his wounded to the rear, he advanced leiſurely with the Principes and Triarii, and placed them on the wings of the Haſtati. Then followed a ſharp engagement, in which victory was long and eagerly diſputed. It would ſeem that the Romans, though ſuperior in number, were once upon the point of loſing the day; for Polybius tells us, that Maſiniſſa and Lælius came very ſeaſonably, and as if ſent from heaven, to their aſſiſtance. Theſe generals being returned from the purſuit of the cavalry, fell ſuddenly upon the rear of Hannibal's men, moſt of whom were cut off in their ranks; and of thoſe that fled, very few eſcaped the horſe, the country all around being a plain.

"There died of the Carthaginians in the fight above 20,000, and almoſt the like number were taken priſoners. The loſs on the ſide of the Romans amounted to about 2000 men. Hannibal eſcaped with a few horſe to Adrumetum, having performed every thing in the engagement which could be expected from a great general. His army (ſays Polybius) could not have been more ſkilfully drawn up. For as the order of the Roman battalions makes it extremely difficult to break them, the Carthaginian wiſely placed his elephants in the front, that they might put the enemy in confuſion before the armies ſhould engage. In his firſt line he placed the mercenaries; men bold and active, but not

Zama ‖ Zapata.

well disciplined, that by their impetuosity he might give a check to the ardour of the Romans. The Africans and Carthaginians, whose courage he doubted, he posted in the middle between the mercenaries and his Italian soldiers, that they might be forced to fight, or at least that the Romans, by slaughtering them, might fatigue themselves and blunt their weapons. Last of all, he drew up the troops he had disciplined himself, and in whom he chiefly confided, at a good distance from the second line, that they might not be broken by the route of the Africans and mercenaries, and kept them in reserve for a vigorous attack upon a tired and weakened enemy."

ZANGUEBAR, a country in Africa, lying on the eastern coast, between three degrees of north latitude, and 18 south. It includes several petty kingdoms, in which the Portuguese have various settlements. The inhabitants, except those converted by the Portuguese, are all Mahometans or idolaters; and the latter much the more numerous. The names of the principal territories are *Mombaza*, *Lamon*, *Melinda*, *Quiola*, and *Mosambique*. The Portuguese have built several forts in Mombaza and Mosambique, and have settled several colonies there. They trade with the negroes for slaves, ivory, gold, ostrich-feathers, wax and drugs. The productions are much the same as in other parts of Africa between the tropics.

ZANONIA, a genus of plants of the class pentandria. See BOTANY *Index*.

ZANTE, an island of the Mediterranean, near the coast of the Morea, 19 miles south-east of the island of Cephalonia, belonging to the Venetians. It is about 24 miles in length and 12 in breadth, and very pleasant and fertile; but its principal riches consist in currants, with which it greatly abounds. They are cultivated in a very large plain, under the shelter of mountains on the shore of this island; for which reason the sun has greater power to bring them to perfect maturity. The town called *Zante* may contain near 20,000 inhabitants; the whole island contains about 40,000. The houses are low, on account of the frequent earthquakes, for scarce a year passes without one; however, they do no great damage. The natives speak both Greek and Italian. There are very few Roman Catholics among them; but they have a bishop as well as the Greeks. This place has no fortifications, but there is a fortress upon an eminence planted with cannon. In one part of this island is a place which shakes when trod upon like a quagmire; and a spring which throws out a great deal of bitumen, especially at the time of an earthquake. It serves instead of pitch to pay the bottoms of the ships, and about 100 barrels in a year are used for this purpose. There are about 50 villages in the island; but no other large town beside Zante. It is seated on the eastern side of the island, and has a good harbour. The English and Dutch have each a factory and consul here. E. Long. 21. 3. N. Lat. 37. 53.

ZANTHOXYLUM, the TOOTHACHE-TREE, a genus of plants of the class of dioecia; and in the natural system arranged under the 46th order, *Hederaceæ*. See BOTANY *Index*.

ZAPATA, a kind of feast or ceremony held in Italy in the courts of certain princes, on St Nicholas's day; wherein people hide presents in the shoes or slippers of those they would do honour to, in such a manner as may surprise them on the morrow when they come to dress; being done in imitation of the practice of St Nicholas, who used in the night-time to throw purses of money in at the windows to marry poor maids withal.

Zapata, Zea.

ZEA, INDIAN CORN; a genus of plants of the class monoecia. See BOTANY *Index*.—There is only one species, the *Mays*, maize. The Indians in New England, and many other parts of America, had no other vegetable but maize or Indian corn for making their bread. They call it *weachin*; and in the United States of America there is much of the bread of the country made of this grain, not of the European corn. In Italy and Germany also there is a species of maize which is the food of the poor inhabitants.

The ear of the maize yields a much greater quantity of grain than any of our corn ears. There are commonly about eight rows of grain in the ear, often more, if the ground be good. Each of these rows contains at least 30 grains, and each of these gives much more flour than a grain of any of our corn. The grains are usually either white or yellowish; but sometimes they are red, bluish, greenish, or olive-coloured, and sometimes striped and variegated. This sort of grain, though so essentially necessary to the natives of the place, is yet liable to many accidents. It does not ripen till the end of September; so that the rains often fall heavy upon it while on the stalk, and the birds in general peck it when it is soft and unripe. Nature has, to defend it from these accidents, covered it with a thick husk, which keeps off slight rains very well: but the birds, if not frighted away, often eat through it, and devour a great quantity of the grain.

There are three or four varieties of maize in different parts of America. That of Virginia is very tall and robust, growing to seven or eight feet high; that of New England is shorter and lower. And the Indians farther up in the country have a yet smaller kind in common use. The stalk of the maize is jointed like the sugar-cane; it is very soft and juicy, and the juice is so sweet and saccharine, that a syrup, as sweet as that of sugar, has been often made of it; and things sweetened with it have been found not distinguishable from those done with sugar. It has not been tried yet whether it will crystallize into sugar; but in all probability it will.

The Americans plant this corn any time from the beginning of March to the beginning of June; but the best season is the middle of April. The savage Indians, who knew nothing of our account of months, used to guide themselves in the seed-time of this useful plant by the budding of some particular trees of that country, and by the coming up of a sort of fish into their rivers which they call the *aloose*. These things were both so regular, that they were in no danger of mistaking the time.

The manner of planting maize is in rows, at equal distances, every way about five or six feet. They open the earth with a hoe, taking away the surface to three or four inches deep, and of the breadth of the hoe; they then throw in a little of the finer earth, so as to leave the hoe four inches deep or thereabouts, and in each of these holes they place four or five grains at a little distance from one another. If two or three of these grow up, it is very well; some of them are usually destroyed either by the birds or other animals.

When

Zea || Zealand.

When the young plants appear, they hoe up the weeds from time to time; and when the ſtalk gathers ſome ſtrength, they raiſe the earth a little about it, and continue this at every hoeing till it begins to put forth the ears; then they enlarge the hill of earth, round the root, to the ſize of a hop-hill, and after this they leave it till the time of harveſt, without any farther care. When they gather the ears, they either immediately ſtrip off the corn, or elſe hang up the ears, tied in traces at diſtances from one another; for if they are laid near together, they will heat and rot, or elſe ſprout and grow; but kept cool and ſeparate, they will remain good all the winter. The beſt method is to thraſh out the corn as ſoon as the harveſt is over, to dry it well on mats in the ſun, and then lay it up in holes of the ground, well lined with mats, graſs, or the like, and afterwards covered at top with more earth. The moſt careful among the Indians uſe this method, and this ſort of ſubterranean granary always proves good.

The uſes of this plant among the Indians are very many. The great article is the making their bread of it; but beſides this, the ſtalks, when cut up before they are too much dried, are an excellent winter food for cattle; but they uſually leave them on the ground for the cattle to feed on. The huſks about the ear are uſually ſeparated from the reſt, and make a particular ſort of fodder, not inferior to our hay. The Indian women have a way of ſlitting them into narrow parts, and they then weave them artificially into baſkets and many other toys. The original way of eating the grain among the Indians was this: they boiled it whole in water till it ſwelled and became tender, and then they fed on it either alone, or ate it with their fiſh and veniſon inſtead of bread. After this, they found the way of boiling it into a ſort of pudding, after bruiſing it in a mortar; but the way of reducing it to flour is the beſt of all. They do this by parching it carefully in the fire, without burning, and then beating it in mortars and ſifting it. This flour they lay up in bags as their conſtant proviſion, and take it out with them when they go to war, eating it either dry or with water. The Engliſh have contrived, by mixing it into a ſtiff paſte, either by itſelf or with rye or wheat-meal, fermenting it with leaven or yeaſt, and baking it in a hot oven, to make good bread of it. They have likewiſe found out a method of making good beer, either of the bread or by malting the grain.

ZEAL, paſſionate ardour for any perſon or cauſe. It is moſt frequently uſed to denote a ſtrong and warm attachment to the diſtinguiſhing doctrines or worſhip of ſome particular ſect of Chriſtians. Thus we ſay, a zealous *Calviniſt*, *Arminian*, or *Papiſt*; though we may likewiſe with the greateſt propriety ſay of an upright and benevolent man, that he is zealous of *good works*.

ZEALAND, the chief of the Daniſh iſlands, is ſituated at the entrance of the Baltic ſea, bounded by the Schaggerrac ſea on the north; by the Sound, which ſeparates it from Schonen, on the eaſt; by the Baltic ſea on the ſouth; and by the ſtrait called the *Great Belt*, which ſeparates it from the iſland of Funen, on the weſt; being of a round figure, near 200 miles in circumference: the chief town is Copenhagen.

ZEALAND, is alſo a province of the United Netherlands, conſiſting of eight iſlands, which lie in the mouth of the river Scheldt, bounded by the province of Holland, from which they are ſeparated by a narrow channel, on the north; by Brabant on the eaſt; by Flanders, from which they are ſeparated by one of the branches of the Scheldt, on the ſouth; and by the German ocean on the weſt.

Zealand || Zembla.

New ZEALAND, a country of Aſia, in the South Pacific ocean, firſt diſcovered by Taſman, the Dutch navigator, in the year 1642, who gave it the name of *Staten Land*, though it has been generally diſtinguiſhed in our maps and charts by the name of *New Zealand*, and was ſuppoſed to be part of a ſouthern continent: but it is now known, from the late diſcoveries of Captain Cook who ſailed round it, to conſiſt of two large iſlands, divided from each other by a ſtrait four or five leagues broad. They are ſituated between the latitudes of 34 and 48 degrees ſouth, and between the longitudes of 166 and 180 degrees eaſt from Greenwich. One of theſe iſlands is for the moſt part mountainous, rather barren, and but thinly inhabited; but the other is much more fertile, and of a better appearance. In the opinion of Sir Joſeph Banks and Dr Solander, every kind of European fruits, grain, and plants, would flouriſh here in the utmoſt luxuriance. From the vegetables found here, it is ſuppoſed that the winters are milder than thoſe in England, and the ſummers not hotter, though more equally warm; ſo that it is imagined, that if this country were ſettled by people from Europe, they would, with moderate induſtry, be ſoon ſupplied, not only with the neceſſaries, but the luxuries of life, in great abundance. Here are foreſts of vaſt extent, filled with very large timber trees; and near 400 plants were found here that had not been deſcribed by the naturaliſts. The inhabitants of New Zealand are ſtout and robuſt, and equal in ſtature to the largeſt Europeans. Their colour in general is brown, but in few deeper than that of the Spaniard who has been expoſed to the ſun, and in many not ſo deep; and both ſexes have good features. Their dreſs is very uncouth, and they mark their bodies in a manner ſimilar to the inhabitants of Otaheite, and which is called *tattowing*. Their principal weapons are lances, darts, and a kind of battle-axes; and they have generally ſhown themſelves very hoſtile to the Europeans who have viſited them.

ZEALOTS, an ancient ſect of the Jews, ſo called from their pretended zeal for God's law and the honour of religion.

ZEBRA. See EQUUS, MAMMALIA *Index*.

ZEBU, a name given by M. de Buffon to the bos indicus of Linnæus. See MAMMALIA *Index*.

ZECHARIAH, a canonical book of the Old Teſtament. See SCRIPTURE, N° 80.

ZECHIN, or ZECCHINO. See SEQUIN.

ZEDOARY, in the *Materia Medica*. See KÆMPFERIA.

ZELL, a city of Germany in the circle of Lower Saxony, capital of the duchies of Zell and Lunenburg, ſituated at the confluence of the rivers Aller and Fuhſe, 30 miles north of Hanover, and 40 ſouth of Lunenburg. E. Long. 10. 12. N. Lat. 52. 49.

ZEMBLA, NOVA, a very large iſland lying in the Northern ocean, to the north of Ruſſia, from which it is ſeparated by the ſtrait of Waigate. It has no inhabitants except wild beaſts, particularly white foxes and bears. In 1595 a Dutch veſſel was caſt away on the coaſt, and the ſhip's company were obliged to winter here;

Zembla, Zemindar.

here; but they did not ſee the ſun from the fourth of November to the beginning of February, and had great difficulty to keep themſelves from being frozen to death.

ZEMINDAR, in its original meaning, ſignifies a great landholder of Bengal; but it is now more ſtrictly applicable to thoſe who have their title conſtituted or confirmed by a patent or charter from government, by which they hold their lands or zemindaries upon certain conditions. It appears from hiſtory, that, in times prior to the irruption of the Mahomedans, the rajahs who held their reſidence at Delhy, and poſſeſſed the ſovereignty of Hindoſtan, deputed officers to collect their revenues. The word *zemindar* is Perſian, and that language can have had no currency in the countries of India, until it was introduced by the people of Perſia. When the emperor Shehab-ul-Dien Ghory conquered the empire of Hindoſtan at the end of the 12th century, he left Sultan Cutub-ul-Dien to be his viceroy at Delhy, and adminiſter the government of Hindoſtan. From that time the cuſtoms and practices of the Mahomedans began gradually to be eſtabliſhed in India: their armies were ſent into the countries of the reduced rajahs, under the command of omrahs, in order to preſerve the conqueſt; and lands were allotted to them to defray the expence. From hence aroſe the ſyſtem of Jaghiredarry in Hindoſtan. But when theſe Omrah Jaghiredars had eſtabliſhed their own ſtrength, ſeveral of them rebelled againſt the imperial authority, and aſpired at the crown. Thus circumſtanced, the emperors, in order to obviate theſe miſchiefs, thought it would be more politic to commit the management of the country to the native Hindoos, who had moſt diſtinguiſhed themſelves by the readineſs and conſtancy of their obedience to the ſovereign power.

In purſuance of this plan, diſtricts were allotted to numbers of them under a reaſonable revenue (Jummah Monâſib), which they were required to pay in money to the governors of the provinces, deputed from the emperor. And in caſe any one of the omrahs or provincial governors ſhould ſwerve from his allegiance, the zemindars of that country were to exert themſelves in ſuch a manner as ſhould check rebellion, and reſtore good government. For this purpoſe, grants of zemindary were ſeverally conferred upon ſuch of the Hindoos as were obedient; deſcribing their apportionment of the country; and every perſon who had received a grant under the authority of the crown was thereby fully inveſted with the functions of zemindar.

The functions of a zemindar are, 1ſt, The preſervation and defence of their reſpective boundaries from traitors and inſurgents. 2dly, The tranquillity of the ſubjects, the abundance of cultivators, and increaſe of his revenue. 3dly, The puniſhment of thieves and robbers, the prevention of crimes, and the deſtruction of highwaymen. The accompliſhment of theſe objects is conſidered in the royal grant as the diſcharge of office to the ſovereign; and on that account the word *office* (khidmut) is employed in the Dewanny Sunnud for a zemindary.

It was a rule in the times of the ancient emperors, that when any of the zemindars died, their effects and property were ſequeſtrated by the government. After which, in conſideration of the rights of long ſervice, which is incumbent on ſovereigns, and elevates the dignity of the employer, ſunnuds for the office of zemindary were granted to the children of the deceaſed zemindar; and no other perſon was accepted, becauſe the inhabitants could never feel for any ſtranger the attachment and affection which they naturally entertain for the family of their zemindar, and would have been afflicted if any other had been put over them. For this reaſon, the emperors, conſidering it as a means of conciliating the minds of the people, graciouſly fixed and confirmed the children of the deceaſed zemindar in the office of their fathers and grandfathers, by iſſuing new ſunnuds to transfer the poſſeſſion to them. By degrees zemindaries became truly heritable property, which, however, could be transferred by gift or ſale from one family to another. They could likewiſe be forfeited to the ſovereign, by the zemindar's deviating from his allegiance, neglecting to pay his tribute, or to diſcharge the duties of his ſtation. Zemindar, Zend.

It is univerſally known, ſays Sir Charles Rouſe Boughton, that, when the three provinces of Bengal, Bahar, and Oriſſa, were ceded to the Britiſh Eaſt India Company, the country was diſtributed among the zemindars and talookdars or holders of land, who paid a ſtipulated revenue, by twelve inſtalments, to the ſovereign power or its delegates. They aſſembled at the capital in the beginning of every Bengal year (commencing in April), in order to complete their final payments, and make up their annual accounts; to ſettle the diſcount to be charged upon their ſeveral remittances in various coins for the purpoſe of reducing them to one ſtandard, or adjuſt their concerns with their bankers; to petition for remiſſions on account of ſtorms, drought, inundation, diſturbances, and ſuch like; to make their repreſentations of the ſtate and occurrences of their diſtricts: after all which they entered upon the collections of the new year; of which, however, they were not permitted to begin receiving the rents from their own farmers, till they had completely cloſed the accounts of the preceding year, ſo that they might not encroach upon the new rents, to make up the deficiency of the paſt. Our author proves, we think completely, the right of the zemindars to transfer their poſſeſſions, either by inheritance to their children, or, with the conſent of the ſovereign, to other families; and he argues ſtrenuouſly and ſucceſsfully againſt the bad policy, as well as injuſtice, of interfering with thoſe rights, as long as the zemindars diſcharge the duties of their ſeveral ſtations.

ZEND, or ZENDAVESTA, a book aſcribed to Zoroaſter, and containing his pretended revelations; which the ancient Magicians and modern Perſees, called alſo *Gaurs*, obſerve and reverence in the ſame manner as the Chriſtians do the Bible, and the Mahometans the Koran, making it the ſole rule both of their faith and manners. The word, it is ſaid, originally ſignifies any inſtrument for kindling fire, and is applied to this book to denote its aptitude for kindling the flame of religion in the hearts of thoſe who read it.

The Zend contains a reformed ſyſtem of Magianiſm; teaching that there is a Supreme Being, eternal, ſelf-exiſtent, and independent, who created both light and darkneſs, out of which he made all other things; that theſe are in a ſtate of conflict, which will continue till the end of the world; that then there ſhall be a general reſurrection and judgment; and that juſt retribution

ſhall

Zend ‖ Zeno.

shall be rendered unto men according to their works; that the angel of darkness with his followers shall be consigned to a place of everlasting darkness and punishment, and the angel of light with his disciples introduced into a state of everlasting light and happiness; after which light and darkness shall no more interfere with each other. The Zend also enjoins the constant maintenance of sacred fires and fire temples for religious worship; the distinction of clean and unclean beasts; the payment of tithes to priests, which are to be of one family or tribe; a multitude of washings and purifications, resembling those of the Jewish law; and a variety of rules and exhortations for the exercise of benevolence and charity.

In this book there are many passages evidently taken out of the Scriptures of the Old Testament, particularly out of the Psalms of David: The author represents Adam and Eve as the first parents of all mankind, gives in substance the same account of the creation and deluge with Moses, differing indeed with regard to the former, by converting the six days of the Mosaic account into six times, comprehending in the whole 365 days; and speaks also of Abraham, Joseph, Moses, and Solomon. Moreover, Dr Baumgarten asserts, that this work contains doctrines, opinions, and facts, actually borrowed from the Jews, Christians, and Mahometans; whence, and from other circumstances, he concludes that both the history and writings of this prophet were probably invented in the later ages, when the fire-worshippers under the Mahometan government thought fit to vindicate their religion from the suspicion of idolatry.

At whatever period the Zend may have been written, we are assured by Dr Hyde, that it is in the pure old Persian language, and in the character called *Peplavi*. Some parts of it contain the original text, and others Zoroaster's second thoughts subjoined, for explaining more fully his doctrine. These were occasioned by the opposition of adversaries, and unforeseen circumstances which occurred during the fabrication of the imposture. About 300 years ago, when the old Persian language had become antiquated and little understood, one of the destours or high-priests among the Persees composed the *Sadda*, which is a compendium in the vulgar or modern Persic tongue, of those parts of the Zend that relate to religion, or a kind of code of canons and precepts, drawn from the theological writings of Zoroaster, serving as an authoritative rule of faith and practice for his followers. This Sadda is written in a low kind of Persic verse, and as Dr Hyde informs us, it is *bonorum et malorum farrago*, having many good and pious things, and others very superstitious and trifling. See PERSEES and ZOROASTER.

ZENITH, in *Astronomy*, the vertical point, or a point in the heavens directly over our heads.

ZENO ELEATES, an eminent Grecian philosopher, was born at Elea about 504 years before Christ. He was a zealous friend of civil liberty, and is celebrated for his courageous and successful opposition to tyrants; but the inconsistency of the stories related by different writers concerning him in a great measure destroys their credit. He chose to reside in his small native city of Elea rather than at Athens, because it afforded freer scope to his independent and generous spirit, which could not easily submit to the restraints of authority. It is related, that he vindicated the warmth with which he resented reproach, by saying, "If I were indifferent to censure, I should also be indifferent to praise." The invention of the dialectic art has been improperly ascribed to Zeno; but there can be no doubt that this philosopher, and other metaphysical disputants in the Eleatic sect, employed much ingenuity and subtlety in exhibiting examples of most of the logical arts, which were afterwards reduced to rule by Aristotle and others.

Enfield's History of Philosophy.

According to Aristotle, he taught, that nothing can be produced either from that which is similar or dissimilar; that there is only one being, God; who is eternal, homogeneous, and spherical, neither finite nor infinite, neither quiescent nor moveable; that there are many worlds; that there is in nature no vacuum; that all bodies are composed of four elements, heat and moisture, cold and dryness; and that the body of man is from the earth, and his soul an equal mixture of these four elements. He argued with great subtlety against the possibility of motion. If Seneca's account of this philosopher deserves credit, he reached the highest point of scepticism, and denied the real existence of external objects. The truth is, that after all that has been advanced by different writers, it is impossible to determine whether Zeno understood the term *one*, metaphysically, logically, or physically; or whether he admitted or denied a nature properly divine.

Zeno.

ZENO, the founder of the sect of the Stoics, was born about 300 years before Christ at Citium, in the island of Cyprus. This place having been originally peopled by a colony of Phœnicians, Zeno is sometimes called a Phœnician. His father was by profession a merchant, but discovering in the youth a strong propensity towards learning, he early devoted him to philosophy. In his mercantile capacity he had frequent occasion to visit Athens, where he purchased for his son several of the writings of the most eminent Socratic philosophers. These he read with great avidity; and when he was about 30 years of age, he determined to take a voyage to a city which was so celebrated both as a mart of trade and of science. If it be true, as some writers relate, that he brought with him a valuable cargo of Phœnician purple, which was lost by shipwreck upon the coast of Piræus, this circumstance will account for the facility with which he at first attached himself to a sect whose leading principle was the contempt of riches. Upon his first arrival in Athens, going accidentally into the shop of a bookseller, he took up a volume of the Commentaries of Xenophon; and after reading a few passages, was so much delighted with the work, and formed so high an idea of the author, that he asked the bookseller where he might meet with such men. Crates the Cynic philosopher happening at that instant to be passing by, the bookseller pointed to him, and said, "Follow that man." Zeno attended upon the instructions of Crates, and was so well pleased with his doctrine that he became one of his disciples. But though he admired the general principles of the Cynic school, he could not easily reconcile himself to their peculiar manners. Besides, his inquisitive turn of mind would not allow him to adopt that indifference to every scientific inquiry which was one of the characteristic distinctions of the sect. He therefore attended upon other masters, who professed to instruct their disciples in the nature and causes of things. When Crates, displeased at his following other philosophers, attempted to drag him by force out of the school of Stilpo, Zeno

said

Zeno. Zenobia.

said to him, "You may seize my body, but Stilpo has laid hold of my mind." After continuing to attend upon the lectures of Stilpo several years, he passed over to other schools, particularly to those of Xenocrates and Diodorus Cronus. By the latter he was instructed in dialectics. He was so much delighted with this branch of study, that he presented to his master a large pecuniary gratuity, in return for his free communication of some of his ingenious subtleties. At last, after attending almost every other master, he offered himself as a disciple of Polemo. This philosopher appears to have been aware, that Zeno's intention in thus removing from one school to another, was to collect materials from various quarters for a new system of his own; for, when he came into Polemo's school, he said to him, "I am no stranger, Zeno, to your Phœnician arts; I perceive that your design is to creep slyly into my garden, and steal away my fruit." Polemo was not mistaken in his opinion. Having made himself master of the tenets of others, Zeno determined to become the founder of a new sect. The place which he made choice of for his school was a public portico, adorned with the pictures of Polygnotus, and other eminent painters. It was the most famous portico in Athens, and called, by way of eminence, Στοα, "the Porch." It was from this circumstance that the followers of Zeno were called *Stoics*.

In his person Zeno was tall and slender; his aspect was severe, and his brow contracted. His constitution was feeble, but he preserved his health by great abstemiousness. The supplies of his table consisted of figs, bread, and honey; notwithstanding which, he was frequently honoured with the company of great men. In public company, to avoid every appearance of an assuming temper, he commonly took the lowest place. Indeed so great was his modesty, that he seldom chose to mingle with a crowd, or wished for the company of more than two or three friends at once. He paid more attention to neatness and decorum in external appearance than the Cynic philosophers. In his dress indeed he was plain, and in all his expences frugal; but this is not to be imputed to avarice, but a contempt of external magnificence. He showed as much respect to the poor as to the rich; and conversed freely with persons of the meanest occupations. He had only one servant, or, according to Seneca, none.

Zeno lived to the extreme age of 98; and at last, in consequence of an accident, voluntarily put an end to his life. As he was walking out of his school he fell down, and in the fall broke one of his fingers; upon which he was so affected with a consciousness of infirmity, that, striking the earth, he said, "Why am I thus importuned? I obey thy summons;" and immediately went home and strangled himself. He died in the first year of the 129th Olympiad. The Athenians, at the request of Antigonus, erected a monument to his memory in the Ceramicum.

We ought not to confound the two Zenos already mentioned with

ZENO, a celebrated Epicurean philosopher, born at Sidon, who had Cicero and Pomponius Atticus for his disciples, and who wrote a book against the mathematics, which, as well as that of Possidonius's refutation of it, is lost; nor with several other Zenos mentioned in history.

ZENOBIA, queen of Palmyra. See PALMYRA.

ZEOLITE, a mineral substance. See MINERALOGY *Index*.

Zeolite ‖ Zeuxis.

ZEPHANIAH, a canonical book of the Old Testament. See SCRIPTURE, N° 79.

ZEPHYR, the *WEST-Wind*, or that which blows from the cardinal point of the horizon opposite to the east.

ZEPHYRUS, one of the Pagan deities, was represented as the son of Aurora, and the lover of the nymph Chloris, according to the Greeks, or of Flora according to the Romans; and as presiding over the growth of fruits and flowers. He is described as giving a refreshing coolness to the air by his soft and agreeable breath, and as moderating the heat of summer by fanning the air with his silken wings. He is depictured under the form of a youth, with a very tender air, with wings resembling those of the butterfly, and with his head crowned with a variety of flowers. As the poets of Greece and Rome lived in a warm climate, they are lavish in in their praise of this beneficent deity, and under his name describe the pleasure and advantage they received from the western breezes.

ZERDA. See CANIS, MAMMALIA *Index*.

ZERTA, the ZERTE, a fish caught in the rivers of Italy and some other places, of the figure of the chub, and called by authors *capito anodromus*, and the *blike*. It seldom grows to more than two pounds weight, and at times lives in rivers, at times in the sea; and is esteemed a very well tasted fish, especially a little before the season of its spawning. The zerte is that species of cyprinus described by Gesner and others under the name of *capito anodromus*.

ZEST, the woody thick skin quartering the kernel of a walnut; prescribed by some physicians, when dried and taken with white wine, as a remedy against the gravel.

ZEST is also used for a chip of orange or lemon peel; such as is usually squeezed into ale, wine, &c, to give it a flavour; or the fine oil which spurts out of that peel on squeezing it.

ZEUGMA, a figure in *Grammar*, whereby an adjective or verb which agrees with a nearer word, is also, by way of supplement, referred to another more remote.

ZEUS, a genus of fishes of the order of *thoracici*. See ICHTHYOLOGY *Index*.

ZEUXIS, a celebrated painter of antiquity, flourished about 400 years before Christ. He was born at Heraclea; but as there have been many cities of that name, it cannot be certainly determined which of them had the honour of his birth. Some learned men, however, conjecture, that it was the Heraclea near Crotona in Italy. He carried painting to a much higher degree of perfection than Apollodorus had left it; discovered the art of properly disposing of lights and shades, and particularly excelled in colouring. He amassed immense riches; and then resolved to sell no more of his pictures, but gave them away; saying very frankly, "That he could not set a price on them equal to their value." Before this time he made people pay for seeing them; and nobody was admitted to see his Helena without ready money, which occasioned the wags calling his picture *Helen the Courtezan*. It is not known whether this Helen of Zeuxis was the same with that which was at Rome in Pliny's time, or that which he painted for the inhabitants

Zeuxis || Zimentwater.

inhabitants of Crotona to be hung up in the temple of Juno: this laſt he painted from five beautiful girls of that city, copying from each her greateſt excellencies. Pliny obſerves, that this admirable painter, diſputing for the prize of painting with Parrhaſius, painted ſome grapes ſo naturally, that the birds flew down to peck them. Parrhaſius, on the other hand, painted a curtain ſo very artfully, that Zeuxis, miſtaking it for a real one that hid his rival's work, ordered the curtain to be drawn aſide, to ſhow what Parrhaſius had done; but having found his miſtake, he ingenuouſly confeſſed himſelf vanquiſhed, ſince he had only impoſed upon birds, while Parrhaſius had deceived even a maſter of the art. Another time he painted a boy loaded with grapes; when the birds alſo flew to this picture, at which he was vexed; and confeſſed, that this work was not ſufficiently finiſhed, ſince, had he painted the boy as perfectly as the grapes, the birds would have been afraid of him. Archelaus, king of Macedon, made uſe of Zeuxis's pencil for the embelliſhment of his palace. One of this painter's fineſt pieces was a Hercules ſtrangling ſome ſerpents in his cradle, in the preſence of his affrighted mother: but he himſelf chiefly eſteemed his Athleta, or Champion, under which he placed a Greek verſe that afterwards became very famous, and in which he ſays, "That it was eaſier to criticiſe than to imitate the picture." He made a preſent of his Alcmena to the Agrigentines. Zeuxis did not value himſelf on ſpeedily finiſhing his pictures; but knowing that Agatharchus gloried in his being able to paint with eaſe and in a little time, he ſaid, "That for his part he, on the contrary, gloried in his ſlowneſs; and, if he was long in painting, it was becauſe he painted for eternity." Verrius Flaccus ſays, that Zeuxis having painted an old woman, he laughed ſo very heartily at the ſight of this picture, that he died: but as no other of the ancients has mentioned this particular, there is the greateſt reaſon to believe it fabulous. Carlo Dati has compoſed in Italian the Life of Zeuxis, with thoſe of Parrhaſius, Apelles, and Protogenes. This work was printed at Florence in 1667.

ZICLAG, or ZIKLAG, in *Ancient Geography*, a town of the tribe of Simeon, on the borders of the Philiſtines (Joſhua xv. and xix.), but in the hands of the Philiſtines till David's time (1 Sam. xxvii. and xxx.).

ZIMENT-WATER, COPPER-WATER, the name by which ſome have called water found in places where there are copper-mines, which is impregnated with particles of that metal.

The moſt famous ſpring of this kind is about a mile diſtant from Newſohl in Hungary, in the great copper-mine called by the Germans *herrngrundt*. The water in this mine is found at different depths, and is received into baſons, for the purpoſe of ſeparating the copper from it: in ſome of theſe it is much more ſated with this metal than in others, and will make the ſuppoſed change of iron into that metal much ſooner. The moſt common pieces of iron uſed in the experiments are horſe-ſhoes, nails, and the like; and they are found very little altered in ſhape, after the operation, except that their ſurfaces are more raiſed. The water appears greeniſh in the baſon, where it ſtands; but if a glaſs of it be taken up, it looks clear as cryſtal: it has no ſmell, but a ſtrong vitriolic aſtringent taſte, inſomuch that the lips and tongue are bliſtered and ſcorched upon taſting it.

Zimentwater || Zinc.

ZIN, in *Ancient Geography*, a wilderneſs encompaſſing Idumea, at leaſt on the ſouth and weſt, as far as Paleſtine or Canaan; but according to Wells, on the eaſt of Edom, to the north of Ezion-gaber.

ZINC, a metallic ſubſtance, formerly conſidered as one of the brittle metals; or, according to the diſtinction of the older chemiſts, a *ſemi-metal* or an imperfect metal, becauſe it was found to be deſtitute of ſome of the properties of other metals which were conſidered as perfect. For an account of the properties and combinations of zinc, as they were then known, ſee CHEMISTRY *Index*; and for the hiſtory of its ores, ſee MINERALOGY *Index*.

But in the progreſs of chemical diſcovery it has been found that zinc is not a leſs perfect metal than others; for in the year 1805, it was announced that a patent was granted to Meſſrs Hobſon and Sylveſter of Sheffield for a method of manufacturing zinc. From their diſcovery it appears, that zinc raiſed to a temperature of between 210° and 300° of Fahrenheit, is not only very malleable, but may be paſſed through rollers, or drawn into wire. After the metal has been treated in this manner, it does not return to its former brittleneſs, but continues ſoft, flexible, and extenſible, and may be applied to many uſes for which this metal was before thought unfit *.

* *Phil. Mag.* xxiii. 92.

We muſt, however, notice, that a prior claim to the diſcovery of rendering zinc ductile and malleable, has been made by Mr Lowry, in favour of a Mr Sheffield of Somerſtown. Twenty years before the time of Meſſrs Hobſon and Sylveſter's patent being announced, Mr Sheffield, in making an aſſay of ſome blende, was impatient to examine the metal, ſtruck an ingot for the purpoſe of breaking it while it was yet hot, but was much ſurpriſed to find that inſtead of being brittle, and breaking with the uſual fracture of zinc, it was extremely tough, and when he ſucceeded in breaking it, after many bendings backward and forward, it exhibited a ſteel-grained fibrous texture. At firſt he doubted of the metal being zinc, but he repeated the experiment on what he knew to be pure metal, and obtained the ſame reſult; and from this he concluded that zinc at a certain temperature is equally malleable and ductile with other metals. This he found to be the caſe by drawing it into wire, and laminating it between rollers, by which he produced plates not exceeding the $\frac{1}{100}$th of an inch, and poſſeſſing the ſtrength and tenacity of ſilver †.

† *Phil. Mag.* xxiii. 282.

Since the time that our article CHEMISTRY was printed, the decompoſition of potaſh, ſoda, the alkaline earths, and ſome other bodies which were formerly conſidered as ſimple, or were only conjectured from analogy to be compound, has been effected by Mr Davy; and as we were diſpoſed to entertain hopes that ſomething new might be added to the unexpected and brilliant diſcoveries of that celebrated chemiſt, we have deferred, till near the cloſe of our work, giving any account of them. This is the reaſon that the fact was merely announced under the words POTASH and SODA, and a reference made to *Galvanic* TROUGH, under which it was intended to give a ſhort deſcription of the apparatus employed in the experiments which led to the diſcoveries alluded to. For the ſame reaſon we were induced to make a farther reference to this place, becauſe zinc is

Zinc. one of the metallic ſubſtances uſually employed in the conſtruction of galvanic apparatus. We ſhall therefore here employ a few pages, 1ſt, In a deſcription of the improvements which have been made in the conſtruction of galvanic apparatus; and, 2d, We ſhall lay before our readers a view of the diſcoveries in galvanic electricity ſince the treatiſes on CHEMISTRY and GALVANISM in this work were printed.

Galvanic Apparatus.—A very conſiderable improvement has been made on the conſtruction of galvanic batteries, by which they are rendered, not only more convenient and manageable, but far more powerful. Under the article GALVANISM, we have deſcribed particularly the conſtruction of the galvanic trough, and we have noticed that the ſoldering of the plates of zinc and copper employed for this purpoſe was attended with conſiderable difficulty. In the new method of conſtruction the plates are not ſoldered together, but are merely connected by means of a metallic arc. In this way each pair of plates can be removed from the trough at pleaſure, for the purpoſe of examining and cleaning them. The new apparatus is conſtructed preciſely on the ſame principle as the *couronne de Taſſes*, propoſed by Volta, and deſcribed at p. 333 of GALVANISM. The trough employed in this apparatus is prepared in the ſame way as when the plates of zinc and copper ſoldered together were fixed in it by means of cement; but in place of the metallic plates, plates of glaſs, or ſome other non-conducting ſubſtance, are introduced and ſecured by cement, ſo that there ſhall be no communication between the different cells into which the liquid is introduced. The plates of zinc and copper connected by means of the metallic arc, at the diſtance of about half an inch, are placed in different cells, having a plate of glaſs between each pair of plates. Each cell then contains a plate of each of the metals, which are unconnected, excepting through the medium of the liquid which is to be the conductor of the electricity. It is ſcarcely neceſſary to mention, that the proper order of arrangement ſhall be obſerved, ſo that throughout the whole trough or battery there ſhall be a ſeries of zinc, copper, and liquid.

Beſide the conveniency and ſimplicity of this mode of conſtructing galvanic troughs, it poſſeſſes this farther advantage of being more powerful, becauſe inſtead of one ſurface of the plates, as in the former conſtruction of this apparatus, both ſurfaces are expoſed to the action of electricity, and therefore the power is greatly increaſed. A farther improvement, it is ſaid, has been made in conſtructing batteries of this kind, which conſiſts in employing troughs of Wedgwood's ware, with partitions of the ſame material, inſtead of wooden troughs with partitions of glaſs. This improvement was firſt ſuggeſted by Dr Babington.

The following is the account of the conſtruction of galvanic apparatus, with the view of aſcertaining in what way the greateſt effect might be produced, with the leaſt waſte of power and expence. The experiments which we are now to mention were made by Mr Children *. For this purpoſe a battery was conſtructed on the new method, with plates of copper and zinc, connected by leaden ſtraps, ſoldered on the top of each pair of plates. Twenty pairs of plates were employed, and each plate was four feet high by two feet wide. The whole extent of ſurface expoſed amounted to 92,160 ſquare inches; the trough was made of wood, with wooden partitions, covered with cement, to reſiſt the action of the acid employed. The battery was charged with a mixture of three parts of fuming nitrous, and one of ſulphuric acid, diluted with thirty of water; the quantity employed was 120 gallons. With this apparatus the following experiments were made. Zinc.

* *Phil. Tranſ.* 1809, p. 32.

Exper. 1. Eighteen inches of platina wire, of one-thirtieth of an inch diameter were completely fuſed in about twenty ſeconds. *Exper.* 2. Three feet of the ſame wire were heated to a bright red, viſible by ſtrong day-light. *Exper.* 3. Four feet of the ſame wire were rendered very hot, but not perceptibly red by day-light. *Exper.* 4. Charcoal burnt with intenſe brilliancy. *Exper.* 5. Ten inches of iron-wire of $\frac{1}{70}$th of an inch diameter, were barely fuſed; three feet of the ſame wire were not ignited. *Exper.* 6. No effect was produced on imperfect conductors. *Exper.* 7. The gold-leaves of the electrometer were not affected. *Exper.* 8. When the cuticle was dry, no ſhock was given by the battery, and it was ſcarcely perceptible when the ſkin was wet.

To contraſt the effects of this apparatus with another differing in the ſize and number of plates, the author employed 200 pairs of plates, each about two inches ſquare, placed in half pint pots of common queen's ware. The ſame liquid was employed, with the addition of a freſh portion of ſulphuric acid, in the proportion of about a quarter of a pint to a gallon. The experiments with this apparatus gave the following reſults.

Exper. 1. Potaſh and barytes were readily decompoſed. *Exper.* 2. The metallization of ammonia was produced with great facility. *Exper.* 3. Charcoal was vividly ignited. *Exper.* 4. The gold leaves of the electrometer diverged conſiderably. *Exper.* 5. After the battery was in action three hours, it gave a vivid ſpark; at the end of 24 hours it metallized ammonia; at the end of 41 hours it was nearly exhauſted. From the reſults of theſe experiments, Mr Children concludes, that the theory of the mode of action of the voltaic battery propoſed by Mr Davy is confirmed, namely, that the intenſity increaſes with the number, and the quantity with the extent of the ſeries. This is proved by the effects produced on the platina and iron wires, in the 1ſt and 5th experiments with the large battery, as well as by the experiments on imperfect conductors in the ſmall apparatus; for as the platina wire is a perfect conductor, and not liable to oxidation, it allows the electricities to be freely tranſmitted, and from the immenſe quantity given out from a ſurface of ſuch extent, they evolve, on their mutual annihilation, heat ſufficient to raiſe the temperature of the platina to the point of fuſion. But a very ſmall portion of the electricity paſſes through the iron wire, in conſequence of its eaſy oxidation, and the thin coat of oxide formed on its ſurface. This ariſes from the low ſtate of the intenſity of the electricity, as appears alſo from its want of power on the gold leaves of the electrometer. From the ſame deficient intenſity, the decompoſition of barytes could not be effected by the large battery, and the ſame battery exhibited a very weak action on imperfect conductors; but the ſmall battery exerted great power on that claſs of bodies, and decompoſed them readily, although its ſurface was 30 times leſs than the ſurface of the great battery; but the number

Zinc.

ber of plates was nearly ten times greater. Another circumſtance, of conſiderable importance in conducting experiments by means of the galvanic battery, is here noticed by the author; that the long continued action of the ſmall battery was owing to the large capacity of the cells containing a proportional quantity of liquor. And beſide this advantage he adds, that with very large combinations, a certain diſtance between each pair of plates is abſolutely neceſſary to prevent ſpontaneous diſcharges, which are accompanied with vivid flaſhes of electric light. This happened to the author with a battery of 1250 four-inch plates, conſtructed according to the new method. Mr Children has conſtructed a battery of 20 pairs of ſix feet high and $2\frac{1}{2}$ broad, and with this battery he ignited 6 feet of platina wire.

From the experiments and obſervations, ſome of which we have detailed, and for others we refer to the paper itſelf, the author concludes with the following remarks: "The abſolute effect of a voltaic apparatus ſeems to be in the compound ratio of the number and ſize of the plates. The intenſity of the electricity being as the former, the quantity given out as the latter, conſequently regard muſt be had, in its conſtruction, to the purpoſes for which it is deſigned. For experiments on perfect conductors, very large plates are to be preferred, a ſmall number of which will probably be ſufficient; but where the reſiſtance of imperfect conductors is to be overcome, the combination muſt be great, but the ſize of the plates may be ſmall: but if quantity and intenſity be both required, then a large number of large plates will be neceſſary. For general purpoſes, four inches ſquare will be found to be the moſt convenient ſize *."

* *Ibid.* 37.

Diſcoveries in Galvaniſm.—At the cloſe of the article GALVANISM, we noticed ſome experiments which were made about the beginning of the year 1805, which ſeemed to lead to the concluſion, that muriatic acid and ſoda were formed by means of galvanic electricity. In experiments on the decompoſition of water, which was ſuppoſed to be in a ſtate of the utmoſt purity, the appearance of muriatic acid and ſoda was adduced in ſupport of this opinion. The accuracy of this concluſion, which ſeemed to be at variance with known facts, excited doubt, and probably led to the inveſtigation which was undertaken by Mr Davy, and carried on with great ingenuity and addreſs by the ſame philoſopher, till it terminated in the brilliant diſcoveries, an account of which we are now to detail. Mr Davy's reſearches in galvaniſm, an account of which he laid before the Royal Society in a memoir entitled, *On ſome Chemical Agencies of Electricity*, may be conſidered as the firſt ſtep in this train of inveſtigation.

With the view of diſproving the accuracy of the experiments in which the generation of acids and alkalies was ſuppoſed to have been effected by means of galvaniſm, Mr Davy employed agate cups, (fig. 1.), of a cylindrical form, and containing about one-fourth of a cubic inch each. The cups were boiled for ſome hours in diſtilled water, and a piece of white tranſparent amianthus, which had been treated in the ſame way, was made to connect them. They were then filled with diſtilled water, and expoſed by means of two platina wires, to a current of electricity, from 150 pairs of plates of copper and zinc, four inches ſquare. The liquid employed was a ſolution of alum. The action continued 48 hours, and the proceſs was then examined. Paper tinged with litmus introduced into the tube containing the poſitive wire, was reddened; paper coloured by turmeric placed in the other tube, had its colour deepened; the acid matter produced a ſlight turbidity in a ſolution of nitrate of ſilver; the fluid from the negative tube retained the property of affecting the turmeric after being boiled, and indeed became more vivid as the quantity was diminiſhed by evaporation. Carbonate of ammonia was added, and the whole being dried, and expoſed to a ſtrong heat, a minute quantity of white matter remained, which had all the properties of carbonate of ſoda.

Zinc.

Plate DLXXVIII. fig. 1.

The ſame experiment was repeated with glaſs tubes, and the reſult was, that the quantity of alkali obtained was 20 times greater, but no traces of muriatic acid could be perceived. Mr Davy ſuſpecting that the agate might contain a minute portion of ſaline matter, repeated the experiment four times. The quantity of alkaline matter diminiſhed in every operation, and in the laſt proceſs, although the battery had been kept in great activity for three days, the fluid poſſeſſed in a ſlight degree only the power of acting on paper tinged with turmeric; but its alkaline property was very ſenſible to litmus paper ſlightly reddened. The acid matter in the other tube was abundant; it had a ſour taſte, and produced no effect on ſolution of muriate of barytes, but left a black ſtain from a drop on a poliſhed plate of ſilver. Thus it appeared to be extremely diluted nitrous acid.

For the purpoſe of making the experiment with greater accuracy, two hollow cones of pure gold (fig. 2.) were employed, each containing about 25 grains of water. They were filled with diſtilled water, connected by moiſtened amianthus, as before, and expoſed to the action of a battery of 100 pairs of plates of ſix inches ſquare. The liquid uſed was a ſolution of alum, and diluted ſulphuric acid. In ten minutes the water in the negative tube changed litmus paper to a ſlight blue, and the water in the poſitive tube produced a red tint. The proceſs having continued for 14 hours, the acid was found to increaſe in quantity during the whole time, but the alkaline fluid in the other tube did not affect the teſts more than in the firſt trial. The acid ſeemed to be the pure nitrous, with an exceſs of nitrous gas. The experiment was repeated, and the proceſs carried on for three days, and ſimilar reſults were obtained. From theſe experiments it was concluded, that the diſtilled water contained a minute portion of ſaline matter, but ſo minute indeed, that it was inſenſible to the moſt delicate chemical teſts. This appeared to be the caſe by evaporating a quantity of the diſtilled water that was uſed, very ſlowly, at a heat below 140° Fahrenheit, in a ſilver ſtill. A quantity of ſolid matter equal to ſeven-tenths of a grain, of a ſaline but metallic taſte, was obtained. It ſeemed to be a mixture of nitrate of ſoda and nitrate of lead. Mr Davy then employed ſome of the water collected in the ſecond proceſs of ſlow diſtillation, in another experiment with the gold tubes and connecting amianthus. At the end of two hours the water in the negative tube had no effect on turmeric paper; litmus, it could juſt be perceived, was changed; but by heating the water ſtrongly for two or three minutes, it was deprived even of this power, and from this he ſuppoſes that it was owing to a ſmall quantity of ammonia. A ſimilar experiment was made with a portion of the ſame water in the agate tubes, and preciſely the ſame reſults were obtained. From theſe

Fig. 2.

Zinc. experiments Mr Davy fairly concludes, that the fixed alkali is not generated during the proceſs, but merely evolved, either from the ſolid materials employed, or ſome ſaline matter in the water.

Many experiments were made in veſſels compoſed of different ſubſtances, with the water procured by ſlow diſtillation; and in almoſt every inſtance ſome fixed alkali appeared. When tubes of wax were employed, the alkaline matter was a mixture of ſoda and potaſh, and the acid matter, a mixture of ſulphuric, muriatic, and nitric acids. A tube of reſin afforded alkaline matter, which was principally potaſh. A cube of Carrara marble of about an inch, having an aperture in its centre, was placed in a platina crucible, which was filled as high as the upper ſurface of the cube, with the purified water. The aperture was filled with the ſame liquid, and the crucible was poſitively electrified by a powerful battery, and the negatively electrified wire introduced into the aperture. Fixed alkali and lime were obtained in this experiment; the quantity of alkali diminiſhing as the experiment was repeated, and after 11 proceſſes, each continued for two or three hours, diſappeared altogether. The quantity of lime-water obtained was uniform.

When 500 grains of this marble were analyzed, they afforded about three-fourths of a grain of fixed ſaline matter, having ſoda for its baſe. Suſpecting that the Carrara marble might have been recently expoſed to ſea water, Mr Davy ſubjected to a ſimilar experiment, a piece of granular marble from the mountains of Donnegal, and by means of negative electricity he obtained fixed alkali. Argillaceous ſchiſtus from Cornwall gave the ſame reſult, and ſerpentine and gray wacken both afforded ſoda.

In other experiments Mr Davy ſubjected other bodies to the action of the ſame power, with the view of effecting a decompoſition. Thus, two cups of compact ſulphate of lime, each containing about 14 grain meaſures of water, were connected by fibrous ſulphate of lime moiſtened with pure water. The cups were filled with the ſame fluid, and they were introduced into the circuit of a galvanic battery with 100 pairs of plates of ſix inches. In five minutes the water in the poſitive cup became acid, while that in the oppoſite cup tinged tumeric. An hour after, a ſaturnine ſolution of lime was formed in the negative cup, and the other contained a ſolution of ſulphuric acid of moderate ſtrength.

Two cubical pieces of cryſtallized ſulphate of ſtrontites, of about an inch, with a hole drilled in each, capable of receiving eight grains of water, were plunged in pure water, in a platina crucible, and the level of the fluid was kept a few lines below the ſurface of the cubes. The holes in the earthy mineral were filled with pure water, and two platina wires were introduced into them. At the end of thirty hours the fluid in the cavity of the negative ſide precipitated ſolution of ſulphate of potaſh, and ſulphuric acid appeared in the other.

Two pieces of fluate of lime, having each a cavity, and connected by moiſt aſbeſtus, were ſubjected to a ſimilar experiment. The decompoſition was ſlow; but in two days a ſolution of lime appeared in the one tube, and an acid in the other, which precipitated acetate of lead, and left a ſpot upon the glaſs, from which it was evaporated, ſo that it muſt have been fluoric acid.

Compact zeolite being prepared in the ſame way, and electrified in the ſame manner as the cube of Carrara marble, afforded ſoda and lime. Lepidolite, by ſimilar treatment, gave potaſh; and an alkaline matter, which ſeemed to be a mixture of ſoda, potaſh and lime, was extracted from a piece of vitreous lava from Mount Etna. Zinc.

The decompoſition of ſaline bodies, which are ſoluble in water, was more rapid. A diluted ſolution of ſulphate of potaſh introduced into the agate cups connected by amianthus moiſtened with pure water, being electrified by a battery with 50 pairs of plates, produced in four hours a weak ſolution of potaſh in the negative cup, and a ſolution of ſulphuric acid in the poſitive cup. Similar phenomena were obſerved when ſulphate of ſoda, nitrate of potaſh, nitrate of barytes, ſulphate of ammonia, phoſphate of ſoda, ſuccinate, oxalate, and benzoate of ammonia and alum, were employed. The acids in a certain time collected in the tube containing the poſitive wire, and the alkalies and earths in the negative tube. Solutions of the muriatic ſalts, ſubjected to decompoſition by the ſame proceſſes, uniformly afforded oxymuriatic acid on the poſitive ſide.

Saturated ſaline ſolutions were moſt rapidly decompoſed, but the ſmalleſt proportion was alſo acted on. Thus, if a piece of paper tinged with turmeric be plunged into pure water, in a proper circuit, in contact with the negative point, the minute quantity of ſaline compound contained in the paper, produces inſtantly a brown tint near its point of contact. Acid appears alſo from litmus paper at the poſitive ſurface.

Experiments were made with the view of aſcertaining whether in theſe proceſſes the ſeparation of the conſtituent parts was complete, from the laſt portions of the compound. The following experiment ſhows that this is the caſe. "A very weak ſolution of ſulphate of potaſh, containing 20 parts of water, and one part of ſaturated ſolution at 64°, was electrified in the two agate cups, by the power of 50 pairs of plates for three days; the connecting amianthus which had been moiſtened with pure water, was removed, waſhed with pure water, and again applied twice every day. By this precaution the preſence of any neutral ſalt that might adhere to it, and diſturb the reſults, was prevented. The alkali obtained in this proceſs in the ſolution had the properties of pure potaſh, and when it had been ſaturated with nitric acid, it gave no turbidneſs by mixture with ſolution of muriate of barytes; the acid matter expoſed to a ſtrong heat, evaporated, without leaving any reſiduum."

Mr Davy then made experiments on the tranſfer of certain of the conſtituent parts of bodies, and alſo on the paſſage of acids, alkalies, and other ſubſtances, through various attracting chemical menſtrua, by means of electricity, and in theſe experiments he obtained many curious and intereſting reſults; but for an account of them, as well as of his obſervations on the different phenomena, and on the mode of decompoſition and tranſition, we muſt refer to the memoir itſelf.

After the inveſtigations in which Mr Davy had been occupied, and the ſingular and unexpected reſults which he obtained, he ventured to conclude, from the general principles on which the phenomena might be explained, that the new methods of proceeding would lead to a more intimate knowledge concerning the true elements

Zinc. of bodies. Accordingly, in November 1807, he laid before the Royal Society a moſt intereſting detail of an elaborate ſeries of experiments on the decompoſition of the alkalies.

Decompoſition of the Alkalies.

In the firſt attempts that were made on the decompoſition of potaſh, Mr Davy employed an aqueous ſolution, ſaturated at a common temperature. It was expoſed to the action of a powerful galvanic battery, compoſed of 24 plates of copper and zinc of 12 inches ſquare, 100 plates of ſix inches, and 150 plates of four inches ſquare, charged with ſolutions of alum and nitrous acid. The action was very intenſe; a great deal of heat and violent effervescence were produced, but the water only of the ſolution was effected, and its hydrogen and oxygen were diſengaged. Potaſh in the ſtate of igneous fuſion, in a ſpoon of platina, was next ſubjected to the action of a battery of 100 plates of ſix inches, highly charged. The ſpoon was connected with the poſitive ſide. In this experiment ſome brilliant phenomena were produced. The potaſh appeared to be a good conductor; and, while the communication was preſerved, a moſt intenſe light was emitted from the negative wire, and a column of flame, ſeemingly owing to the developement of combuſtible matter, aroſe from the point of contact. When the order was reverſed, and the platina ſpoon was connected with the negative ſide, a vivid and conſtant light appeared at the oppoſite point. There was no inflammation round it; but aeriform globules, which inflamed in the atmoſphere, roſe through the potaſh. The platina was conſiderably acted on.

Although potaſh, when perfectly dry, be a non-conductor, it acquires a conducting power by being ſlightly moiſtened. A ſmall piece of pure potaſh expoſed for a few ſeconds to the atmoſphere, was placed on a diſc of platina connected with the negative ſide of a battery of 250 plates of ſix and four inches, in a ſtate of intenſe activity. A platina wire from the oppoſite ſide was brought in contact with the upper ſurface of the alkali. A vivid action ſoon took place. The potaſh fuſed at both points of electriſation; a violent effervescence appeared at the upper ſurface; but at the lower or negative ſurface no elaſtic fluid was emitted, but ſmall globules like quickſilver were produced, ſome of which burnt with exploſion and bright flame as they were formed, and others remained and were only tarniſhed, and finally covered by a white film formed on their ſurfaces. Theſe globules were the baſis of potaſh. The ſame reſults were obtained, when gold and other metals, plumbago, or charcoal, were employed; and the effects were the ſame when the proceſs was conducted in an exhauſted receiver.

Mr Davy alſo obtained the ſame ſubſtance from potaſh, fuſed by means of a lamp, and placed in glaſs tubes confined by mercury, and furniſhed with hermetically inſerted platina wires, to tranſmit the electricity; but the glaſs was rapidly diſſolved by the action of the alkali, ſo that the proceſs could not be long carried on.

In theſe experiments on potaſh, the combuſtible baſe was produced from the negative ſurface, and oxygen was evolved from the poſitive ſurface. The ſame effects invariably followed, when the experiment was conducted above mercury. The ſame thing was proved ſynthetically. The combuſtible ſubſtance obtained from the potaſh had its metallic luſtre deſtroyed in the atmoſphere, and a white cruſt formed upon it. This cruſt was found, upon examination, to be pure potaſh; but this was ſtill farther confirmed by placing globules of the combuſtible matter in tubes containing common air, or oxygen gas, confined by mercury. An abſorption of the oxygen took place, and a cruſt of alkali was formed upon the globule. When the combuſtible matter confined in given portions of oxygen, was ſtrongly heated, a rapid combuſtion, with a brilliant white flame, was produced, and the metallic globules were converted into a white and ſolid maſs, which was found to be pure potaſh. Zinc.

To the combuſtible matter thus obtained from potaſh, Mr Davy gave the name of *potaſſium*. From its ſtrong affinity for oxygen, it was extremely difficult to preſerve it unchanged, for the purpoſe of examining its properties. The ſubſtance which he found to be leaſt affected, is newly diſtilled naphtha. In this fluid potaſſium may be kept for many days nearly unaltered, and its phyſical properties may be examined in the atmoſphere, when covered by a thin film of it.

Potaſſium, at 60° Fahrenheit, is in the form of ſmall globules, which have the metallic luſtre and general appearance of mercury; at 70° it becomes more fluid, and at 100°, different globules eaſily run into one. At 50° of Fahrenheit it is ſoft and malleable, and exhibits the luſtre of poliſhed ſilver. At 32° it becomes hard and brittle, and, when broken, preſents a cryſtallized texture. To reduce it to vapour, it requires a red heat; and in proper circumſtances, it may be ſubjected to diſtillation, without change. It is a good conductor of heat, and a perfect conductor of electricity.

In the properties now mentioned, potaſſium approaches nearly to the metals; but it is very different in its ſpecific gravity. In naphtha of the ſpecific gravity of .861 it roſe to the ſurface; and it did not ſink in double diſtilled naphtha, the ſpecific gravity of which was about .770. From theſe and other experiments, Mr Davy eſtimates the ſpecific gravity of potaſſium at .6, ſo that it is the lighteſt fluid body known. In its ſolid form it is ſomewhat heavier; but, even in this ſtate, when cooled to 40° Fahrenheit, it ſwims in double diſtilled naphtha.

With the view of aſcertaining the proportions of the conſtituent parts of potaſh, Mr Davy made two experiments, by ſubjecting the metallic baſe to combuſtion in oxygen gas. In the firſt experiment, .12 of a grain of potaſſium were employed; the combuſtion was made upon platina, and was rapid and complete, and the baſis appeared to be perfectly ſaturated. The reſult of this experiment indicates 86.7 of baſis, and 13.3 of oxygen, in the 100 parts of potaſh. In another experiment, the reſult he obtained was 85.5 of baſis, and 14.5 of oxygen. The mean of theſe two experiments is 86.1 of baſis, and 13.9 of oxygen, in 100 parts of potaſh.

The reſults of the decompoſition of water by the baſis of the alkalies, which were more readily and perfectly obtained than thoſe of their combuſtion, exhibited the proportion of baſe to be 84, and that of oxygen 16; but the mean of 86.1 of baſe, and 13.9 of oxygen, and 84 baſe and 16 oxygen, is 85 of potaſſium and 15 of oxygen, which may be taken as the proportions of the elements of potaſh.

Mr Davy's diſcoveries have been confirmed by the ingenious

Zinc. ingenious experiments of Thenard and Gay-Luſſac. Theſe diſtinguiſhed chemiſts have decompoſed potaſh by a different proceſs. They introduced iron filings into a bent gun barrel, which was placed acroſs a furnace. A tube with a ſtopcock, containing a quantity of ſolid potaſh, is connected with one extremity of the gun-barrel; to the other extremity there is attached a tube of ſafety, containing mercury, for the purpoſe of excluding the atmoſpheric air, and allowing any gaſeous matter formed during the proceſs to eſcape. The potaſh in the tube is to be kept cold by means of a freezing mixture, till that part of the barrel containing the iron filings has been raiſed to a white heat. The potaſh is then fuſed by applying heat, by means of a portable furnace; and it is allowed to paſs through a ſmall opening, to come in contact with the iron filings, where it is decompoſed, the oxygen of the potaſh entering into combination with the iron, and the baſe paſſing on to the other extremity of the tube in a ſtate of ſublimation. At that extremity the metallic baſe is condenſed by the application of exceſſive cold, and in this way the potaſſium may be obtained at leſs expence, and in greater quantity, than by means of galvaniſm. During this proceſs, hydrogen gas is evolved, which, it is ſuppoſed, is owing to the decompoſition of the water contained in the alkali. The potaſſium thus obtained is in the form of brilliant laminæ, which adhere to the ſides of the gun barrel. An alloy of the ſame metal with iron is alſo found in that part of the barrel containing the filings. Mr Davy has repeated this experiment, and he finds that the baſe obtained in this manner is heavier, and its melting point higher, than what is procured by means of galvaniſm. This, it is ſuppoſed, may ariſe from its being combined with a ſmall proportion of iron. The metallic baſe of ſoda was obtained by a ſimilar proceſs.

But, according to the view which the French chemiſts have taken of theſe diſcoveries, and the reſults of their own experiments, they conclude, that the metallic ſubſtances derived from the alkalies are not ſimple, but are compounds of the ſeveral baſes with hydrogen.

Another method of decompoſing potaſh, and obtaining its baſe, which is ſtill ſimpler, has been followed by Curaudau. In this proceſs the decompoſition is effected by charcoal. A mixture of carbonate of potaſh is made with flour or charcoal and linſeed oil. This mixture is introduced into an iron or earthen tube or retort, and calcined, by gradually raiſing the heat, till a bluiſh light be ſeen in the inſide of the veſſel. Soon after an abundant evolution of vapour takes place, which is the baſe of the alkali, to be collected by introducing a clean iron rod, on which it condenſes. Care muſt be taken to withdraw the rod before it is too hot, and to plunge it in oil of turpentine, under the ſurface of which the metallic cruſt on the rod may be ſeparated. In this way a quantity of potaſſium may be procured. The baſe of ſoda is obtained by a ſimilar proceſs.

Fig. 3. Fig. 3. is a repreſentation of the apparatus employed by the French chemiſts in decompoſing potaſh. ABCE is the gun barrel laid acroſs the furnace, with its apparatus; D is the furnace, and F is the pipe of the bellows.

Fig. 4. Fig. 4. is a ſection of the tube containing the potaſh.

But the chemical relations of potaſſium are not leſs extraordinary than its phyſical properties. It combines ſlowly with oxygen, and without flame, at all temperatures below that of its vaporization. At this point combuſtion takes place, with a brilliant white light, and intenſe heat. When it is heated ſlowly in a quantity of oxygen gas, which is not ſufficient for its complete ſaturation, and at a temperature below that of inflammation, as for inſtance 400° of Fahrenheit, it changes to a red brown colour, and the ſolid form, conſiſting partly of potaſh, and partly of its baſe, is of a grayiſh colour. When expoſed to water, or again heated in freſh quantities of air, the whole is converted into potaſh. When dry potaſh and potaſſium are fuſed together under proper circumſtances, the baſe is deprived of its metallic ſplendour, and the two ſubſtances unite into a compound of a red brown colour when fluid, and of a dark gray when ſolid. This compound, when expoſed to the air, ſoon abſorbs its full proportion of oxygen, and is wholly converted into potaſh. The ſubſtance thus formed ſeems to be in a lower ſtate of oxidation, ſo that it is to be conſidered as an oxide of potaſſium with a ſmaller proportion of oxygen. Zinc.

When potaſſium is introduced into oxymuriatic acid gas, it burns ſpontaneouſly with a bright red light, and a white ſalt is formed, which is muriate of potaſh. When a globule of potaſſium is heated in hydrogen gas, at a degree below its point of vaporization, it ſeems to diſſolve in it, for the globule is diminiſhed in volume, and the gas explodes with alkaline fumes, and bright light, when brought into the air; but, by cooling, the potaſſium is wholly or principally depoſited, for the gas is deprived of its property of ſpontaneous detonation.

When potaſſium is thrown into water, it decompoſes it with great violence; an inſtantaneous exploſion, with brilliant flame, is produced, and a ſolution of pure potaſh is obtained. In theſe experiments, a white ring of ſmoke, gradually extending as it riſes in the air, is produced, ſimilar to the phenomenon of the combuſtion of phoſphorated hydrogen. When a globule of the baſis of potaſh is placed upon ice, it inſtantly burns with a bright flame; part of the ice is melted, and in the cavity there is found a ſolution of potaſh.

By placing a globule of potaſſium upon moiſtened paper, tinged with tumeric, the moment that it comes in contact with the water, it burns, and, moving rapidly upon the paper, leaves behind it a deep reddiſh brown trace, thus demonſtrating, in a very ſimple manner, the production of the alkali by the decompoſition of water.

Potaſſium readily decompoſes the ſmall quantities of water contained in alcohol and ether, even in their pureſt ſtate. As potaſh is inſoluble in ether, when the baſe is thrown into it, oxygen is furniſhed to it, and hydrogen gas evolved, and, as the alkali is formed, the ether becomes white and turbid. It is obſerved, that the energy of action of potaſſium in ether and alcohol, is proportional to the quantity of water which they contain, and hydrogen and potaſh are always produced.

When potaſſium is thrown into ſolutions of the mineral acids, it inflames and burns on the ſurface, and when plunged, by proper means, beneath the ſurface enveloped in potaſh, ſurrounded by naphtha, it acts upon the oxygen with great intenſity. In ſulphuric acid, a white ſaline ſubſtance, covered with a yellow coating, which is ſuppoſed to be ſulphate of potaſh ſurrounded with ſulphur, and a gas, having the ſmell of ſulphurous acid, and

Zinc. and which is probably a mixture of that ſubſtance with hydrogen gas, are formed. When potaſſium is thrown into nitrous acid, nitrate of potaſh is formed, and nitrous gas is diſengaged.

Potaſſium readily combines with phoſphorus and ſulphur. When preſſed upon a piece of phoſphorus, they both become fluid, enter into combuſtion, and produce phoſphate of potaſh. When the experiment is made upon naphtha, no gaſeous ſubſtance is given out; the compound has the appearance of a metallic phoſphuret, is of the colour of lead, and has the luſtre of poliſhed lead. Expoſed to the air at common temperatures, it combines ſlowly with oxygen, and is converted into phoſphate of potaſh. When heated upon a plate of platina, it gives out fumes, but does not burn till it reaches the temperature of the rapid combuſtion of potaſſium.

When potaſſium is brought into contact with ſulphur in fuſion, in tubes filled with the vapour of naphtha, they combine rapidly, with the evolution of heat and light. A gray ſubſtance is thus formed, which has the appearance of artificial ſulphuret of iron; if it be kept in fuſion, it rapidly diſſolves the glaſs. When this experiment is made in a glaſs tube, hermetically ſealed, no gas is diſengaged, if the tube be opened under mercury; but when it is made in a tube connected with a mercurial apparatus, a ſmall quantity of ſulphurated hydrogen is evolved. When the combination is effected in the atmoſphere, a great inflammation takes place, and ſulphuret of potaſh is formed, and by farther expoſure to the air, it is at laſt converted into ſulphate of potaſh.

When one part of potaſſium is added to eight or ten of mercury, in bulk, at 60° of Fahrenheit, they inſtantly unite, and form a ſubſtance like mercury in colour, but leſs coherent. When a globule is made to touch a globule of mercury about twice as large, they combine with conſiderable heat. The compound is fluid at the temperature of its formation, but, when cool, it becomes ſolid, with the appearance of ſilver. With the $\frac{1}{150}$th of potaſſium to the weight of mercury, the amalgam is hard and brittle; but with one part of potaſſium, and 70 of mercury, it is ſoft and malleable. Expoſed to the air, theſe compounds abſorb oxygen, and deliqueſcent potaſh is formed; and in a few minutes the mercury is revived. A globule of the amalgam, thrown into water, decompoſes it rapidly with a hiſſing noiſe; potaſh is formed; pure hydrogen is diſengaged, and the mercury remains free. This amalgam diſſolves all the metals, and even acts on iron and platina.

When potaſſium is heated with gold, ſilver, or copper, in a cloſe veſſel of pure glaſs, a rapid action is produced, and the compounds thrown into water effect its decompoſition; potaſh is formed, and the metals are revived. Potaſſium forms an alloy with fuſible metal, which has a higher point of fuſion than the fuſible metal itſelf.

Potaſſium has little effect on colourleſs and recently diſtilled naphtha: but, in naphtha, expoſed to the air, it is ſoon oxidated, and an alkali which unites with the naphtha into a brown ſoap that collects round the globule, is formed. Potaſſium acts ſlowly on the concrete oils, as tallow, ſpermaceti, and wax, even when heated; coaly matter is depoſited, a little gas is evolved, and a ſoap is formed. On the fluid fixed oils the effects are ſimilar, but take place more ſlowly. With the aſſiſtance of heat, volatile oils are rapidly decompoſed by potaſſium; gas is evolved, and charcoal depoſited. Zinc.

The metallic oxides, when heated in contact with potaſſium, are readily reduced. When a ſmall quantity of oxide of iron was heated with it, to a temperature approaching its point of diſtillation, a vivid action took place. Alkali, in gray metallic particles, which effervеſced in muriatic acid, appeared. The oxides of lead and tin were revived more rapidly, and with potaſſium in exceſs, an alloy was formed with the revived metal.

Potaſſium readily decompoſes flint glaſs and green glaſs, by a gentle heat. The metallic oxides are reduced, and the alkali formed diſſolves the glaſs. At a red heat, even the pureſt glaſs is acted on by potaſſium; the oxygen in the alkali of the glaſs ſeems to be divided between the potaſſium employed, and the potaſſium which is the baſe of the alkali in the glaſs, and thus effects an oxidation in the firſt degree.

Soda.—When pure ſoda was ſubjected in ſimilar circumſtances to the action of galvaniſm, ſimilar reſults were obtained as from potaſh; but the decompoſition required a more intenſe action in the battery, or it was neceſſary to have the alkali in thinner and ſmaller pieces. Potaſſium remained fluid at the temperature of the atmoſphere, at the time of its production; but the baſe obtained from ſoda, which was fluid in the degree of heat of the alkali during its formation, became ſolid on cooling, and exhibited the luſtre of ſilver. With a battery of 100 pairs of plates of ſix inches, in full activity, the decompoſition of pieces of ſoda of about 15 to 20 grains in weight only could be effected; and it was neceſſary alſo that the diſtance between the wires ſhould not exceed one-eighth or one-tenth of an inch. But when 250 pairs of plates were employed, highly charged for the decompoſition of ſoda, the globules often burnt at the moment of their formation, and ſometimes exploded and ſeparated into ſmaller globules, which darted rapidly through the air, in a ſtate of vivid combuſtion, producing a beautiful effect of continued jets of fire.

When the metallic baſe which is obtained from ſoda, and which Mr Davy has denominated *ſodium*, was expoſed to oxygen, it was converted into ſoda; and when this proceſs was conducted by ſtrongly heating the baſe in a given portion of oxygen, a rapid combuſtion with a brilliant white flame was produced, and the metallic globule was converted into a white ſolid maſs, which was found to be ſoda. The oxygen gas was abſorbed during the operation, and nothing was given out which affected the purity of the reſidual air.

The theory of the decompoſition of the alkalies is ſtated by Mr Davy in the following words. "As in all decompoſitions of compound ſubſtances which I had previouſly examined, at the ſame time that combuſtible baſes were developed at the negative ſurface in the electrical circuit, oxygen was produced, and evolved or carried into combination at the poſitive ſurface, it was reaſonable to conclude, that this ſubſtance was generated in a ſimilar manner by the electrical action of the alkali; and a number of experiments made above mercury, with the apparatus for excluding external air, proved that this was the caſe. When ſolid potaſh or ſoda, in its conducting ſtate, was included in glaſs tubes, furniſhed with electrified platina wires, the new ſubſtances were

Zinc. were generated at the negative ſurfaces; the gas given out at the other ſurface proved, by the moſt delicate examination, to be pure oxygen; and, unleſs when exceſs of water was preſent, no gas was evolved from the negative ſurface.

For the purpoſe of determining the proportions of the elements of ſoda, Mr Davy made ſimilar experiments to thoſe by which he aſcertained the proportions of the baſe and oxygen of potaſh. By ſubjecting ſodium to combuſtion in oxygen gas, it appeared that 100 parts of ſoda are compoſed of 80 of metallic baſe, and 20 of oxygen; but the reſults of its oxidation by the decompoſition of water, indicated the proportions to be 23 of oxygen, and 77 of baſe. By taking the mean proportions, obtained from the reſults of the two ſets of experiments, the elements of ſoda may be eſtimated at 78.5 of metallic baſe, and 21.5 of oxygen.

Sodium, which remains ſolid at common temperatures, is white and opaque; and examined under a film of naphtha, has the luſtre and appearance of ſilver. It is very malleable, and ſofter than common metallic ſubſtances. With a ſlight preſſure it ſpreads into thin leaves, and a globule of one-tenth or one-twelfth of an inch in diameter, is eaſily ſpread over a ſurface of one-fourth of an inch; and different globules are eaſily made to adhere, and form one maſs by ſtrong preſſure. This property of welding which belongs to iron and platina at a white heat only, is not diminiſhed when ſodium is cooled to 32° Fahrenheit.

Sodium, like potaſſium, is a conductor of electricity and heat, and ſmall globules ſubjected to galvaniſm inflame and burn with bright exploſions. Sodium ſinks in naphtha of ſpecific gravity .861; but by mixing perfectly about 12 parts of naphtha, and five of oil of ſaſſafras, the ſodium remains at reſt in any part of the fluid. This makes its ſpecific gravity = about .9348, water being taken as 1. The particles of ſodium loſe their coheſion at 120° Fahrenheit. It becomes quite fluid at 180°, ſo that it readily fuſes under boiling naphtha. The temperature at which it is volatilized is not aſcertained, but it remains fixed in a ſtate of ignition at the point of fuſion of plate glaſs.

The chemical relations of ſodium are analogous to thoſe of potaſſium, but with ſome characteriſtic differences. Expoſed to the atmoſphere, it is immediately tarniſhed, and is gradually covered with a white cruſt, which is pure ſoda. It combines ſlowly with oxygen, and without any luminous appearance at common temperatures. When heated, the combination is more rapid, but no light is emitted till it acquire a temperature near that of ignition. The flame in oxygen gas is white, and it ſends forth bright ſparks, producing a very beautiful effect; in common air, the colour of the light is like that of the combuſtion of charcoal, but brighter. When ſodium was heated in hydrogen gas, it ſeemed to have no action on it.

Sodium burns vividly in oxymuriatic acid gas, giving out numerous ſparks of a bright red colour; a ſaline matter is produced, which is muriate of ſoda. When ſodium is thrown into water, it produces a violent effervеſcence with a loud hiſſing noiſe; it combines with the oxygen of the water to form ſoda, which is diſſolved, and its hydrogen is diſengaged. During the proceſs there is no luminous appearance; but when ſodium is thrown into hot water, a more violent decompoſition takes place. A few ſcintillations are obſerved at the ſurface of the water, which is owing to ſmall particles of the baſis which are thrown out of the water, heated to ſuch a degree as to burn in paſſing through the atmoſphere. But when a globule of ſodium is brought into contact with a ſmall particle of water, or with moiſtened paper, the heat produced is uſually ſufficient for its combuſtion, as in this caſe there is no medium to carry off the heat rapidly. Zinc.

Sodium produces ſimilar effects with potaſſium when brought into contact with alcohol and ether. It acts with great energy on the ſtrong acids; with nitrous acid it produces a vivid inflammation, and with muriatic and ſulphuric acids, great heat, but no light, is generated. The effects of ſodium and potaſſium on the fixed and volatile oils, and naphtha, are quite analogous; but the appearances of the ſaponaceous compounds are ſomewhat different, the combinations with ſodium being of a darker colour, and apparently leſs ſoluble.

Sodium alſo exhibits two degrees of combination with oxygen; the firſt is of a deep brown colour, which is fluid when produced, and becomes a dark gray ſolid on cooling. By attracting oxygen from the air, or by the decompoſition of the water, it is converted into ſoda.

Sodium forms compounds with ſulphur and phoſphorus. In cloſe veſſels filled with the vapour of naphtha, it enters into combination with ſulphur, giving out during the proceſs a vivid light and heat, and often attended with exploſion, from the vaporization of a portion of ſulphur, and the diſengagement of ſulphurated hydrogen gas. The ſulphuret of ſodium is of a deep gray colour. In its combination with phoſphorus, the compound obtained has the appearance of lead, and by expoſure to the air, or by being ſubjected to combuſtion, the phoſphuret of ſodium is converted into phoſphate of ſoda.

Sodium forms compounds with the metals. In the proportion of one-fortieth with mercury, a compound is obtained, which is of the colour of ſilver, and remains ſolid; the combination is accompanied with conſiderable heat. Sodium forms an alloy with tin, without producing any change of colour, and it has ſome action upon lead and gold when heated; but in its ſtate of alloy it is ſoon converted into ſoda, by expoſure to the air, or by the action of water, which it decompoſes with diſengagement of hydrogen. The amalgam of mercury and ſodium ſeems to be capable of forming triple compounds with ſome other metals; and it would appear that iron and platina remain in combination with the mercury, after they are deprived of the ſodium by expoſure to the air. The ſame amalgam of ſodium and mercury likewiſe forms combinations with ſulphur; the triple compound thus obtained is of a dark gray colour.

Ammonia.—The chemical compoſition of ammonia has been many years conſidered as fully eſtabliſhed; but in the courſe of Mr Davy's experiments on the decompoſition of the fixed alkalies, it occurred to him that oxygen might alſo form one of the conſtituents of ammonia, and this he alſo proved by experiment. Charcoal carefully burnt, and deprived of moiſture, was ignited by a galvanic battery of 250 pairs of plates of ſix and four inches ſquare, in a ſmall quantity of pure ammoniacal gas, confined over mercury. A great expanſion of the gaſeous matter took place, and the white

ſubſtance

Fig. 1.

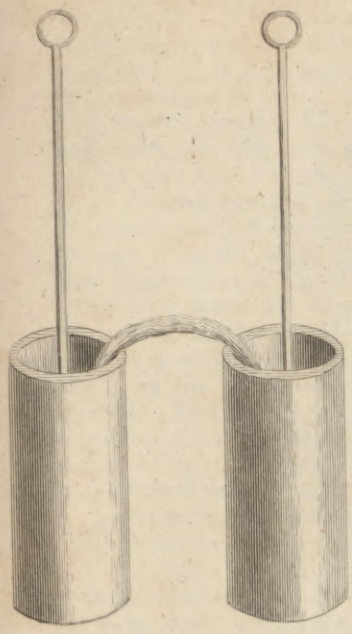


Fig. 2.

Fig. 3.

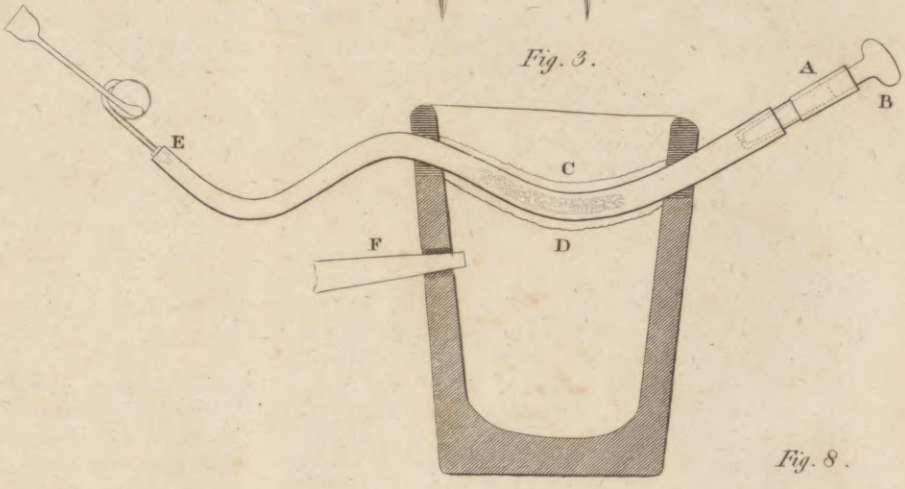


Fig. 5.

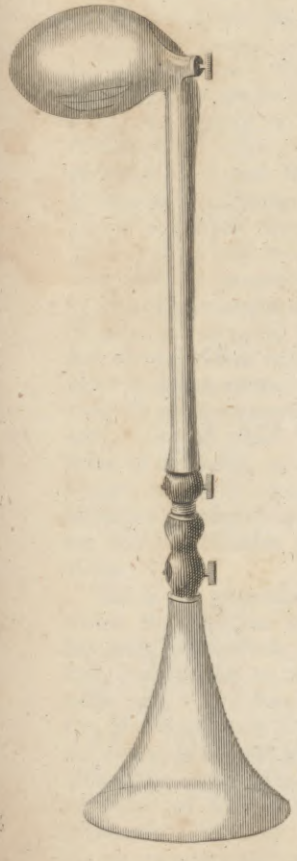


Fig. 4.

Fig. 6.

Fig. 8.

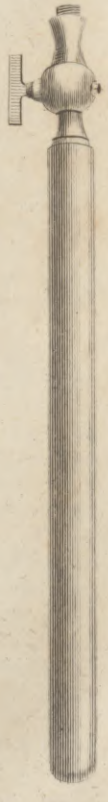
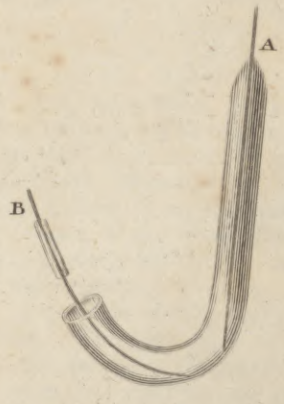


Fig. 7.



E Mitchell Sculpt

Zinc. substance formed in the process collected on the sides of the glass tube. This matter effervesced in diluted muriatic acid, so that the product was probably carbonate of ammonia. A more decisive proof of ammonia containing oxygen as one of its elements, was obtained from another process. Very pure ammoniacal gas was passed over iron wire ignited in a platina tube, and two curved glass tubes were so arranged as to be inserted into a freezing mixture, and through one of these tubes the gas entered into the platina tube, to be conveyed through it by the other glass tube into an air-holder. The temperature of the air was 55°, and no sensible quantity of water was deposited in the cooled glass tube, which transmitted the unchanged ammonia. But after being exposed to heat, moisture was very perceptible, and the gas appeared in the air-holder densely clouded. This circumstance appeared to establish the formation of the water from the decomposition of ammonia during the process. But after the gas had been passed several times through the ignited tube, from one air-holder to the other, the iron wire was found superficially converted into oxide, and had increased in weight $\frac{44}{100}$ of a grain. About four-tenths of a grain of water were collected from the cooled glass tubes by means of filtrating paper, and 33.8 cubic inches of gas were expanded into 55.3 cubic inches, and by detonation with oxygen it was found, that the hydrogen gas in these was to the nitrogen or azote as 3.2 to 1 in bulk.

Ammonia was farther subjected to experiment by taking the electric spark in it. In experiments of this kind it was understood that it is resolved into hydrogen and azotic gases; but Mr Davy found, after observing several variations in the results, that the weight of the two gases obtained was less by about one-eleventh than the weight of the ammonia employed. He ascribes this loss to the oxygen of the alkali, which had probably combined with the wires of platina employed in the experiment, and had thus disappeared. From these experiments he estimates the proportion of oxygen in ammonia at not less than 7 or 8 parts in 100; and as the gases evolved may contain more water than the gas decomposed, the proportion may even be larger. By thus considering ammonia as a triple compound of azote, hydrogen, and oxygen, the phenomena of its production and decomposition admit of an easy explanation. In all cases in which ammonia is formed, oxygen exists along with its other elements, in the substances from the decomposition of which it is obtained. In the decomposition of ammonia, on the other hand, the oxygen which forms one of its elements, may be abstracted by the substance employed in its decomposition, or it may enter into combination with portions of its hydrogen or azote.

But in the progress of investigating the nature of ammonia, to which the attention of chemical philosophers has been particularly directed, it appears that this alkali is analogous to the fixed alkalies in having a metallic base. The Swedish chemists Berzelius and Pontin, placed mercury negatively electrified in the galvanic circle, in contact with solution of ammonia. By this action the mercury increased in volume, and after an expansion of four or five times its former dimensions, it became a soft solid. From this amalgam exposed to the air, mercury and ammonia are reproduced, with the absorption of oxygen; and when the amalgam is put into water it forms ammonia, with the evolution of hydrogen, and the re-appearance of the mercury in its metallic state. Mr Davy repeated this experiment, and he found that to produce an amalgam, from 50 or 60 grains of mercury, in contact with a saturated solution of ammonia, required a considerable time, and that this amalgam changed considerably, even in the short period that was necessary for removing it from the solution. Conceiving that the de-oxidation and combination with mercury might be more easily effected in its nascent state, he placed 50 grains of mercury in a cavity in muriate of ammonia. The muriate slightly moistened was placed on a plate of platina, and connected with the positive side of a large galvanic battery. The mercury was made negative by means of a platina wire; a strong effervescence, with much heat, immediately took place; the globule of mercury in a few minutes enlarged to five times its former dimensions. It had the appearance of amalgam of zinc. Metallic crystallizations shot from it as a centre round the body of salt. They had an arborescent appearance, often became coloured at their points of contact with the muriate, and when the connection was broken, rapidly disappeared, while ammoniacal fumes were given out, and the mercury was reproduced. With a piece of carbonate of ammonia, similar phenomena were exhibited. The amalgam was formed very rapidly; but when the galvanic action was powerful in this last case, a black matter appeared in the cavity, which was probably carbone, from the decomposition of the carbonic acid. Zinc.

Mr Davy considering the strong attraction of potassium and sodium for oxygen, was led to examine whether they produced any effect in the amalgamation of ammonia, independent of electricity. With this view he united small portions of potassium and sodium with mercury, and brought them into contact with moistened muriate of ammonia. An amalgam was formed, which rapidly increased to six or seven times its volume, and the compound seemed to contain a larger proportion of ammoniacal base than that obtained by electricity. It appears, too, that a portion of the metallic base employed to effect the de-oxidation always remained in combination with the compound, so that it was not a pure amalgam. The following are the properties of the amalgam from ammonia, obtained by means of galvanism.

When this amalgam is formed at the temperature of 70° or 80°, it is in the state of a soft solid, of the consistence of butter; at 32° it becomes firmer, and assumes a crystallized form, in which small facets appear, which seem to be cubical. The amalgam of potassium crystallizes in cubes, as beautiful, and in some cases as large, as those of bismuth. The specific gravity of the amalgam is less than three, water being one. When the amalgam is thrown into water, a quantity of hydrogen equal to half its bulk, is evolved, and the water becomes a weak solution of ammonia. The amalgam being confined in a given portion of air, the air increases in bulk, and the mercury is revived. Ammoniacal gas equal to $1\frac{1}{4}$ or $1\frac{1}{5}$ths of the volume of the amalgam, is produced, and oxygen equal to one-seventh or one-eighth of the ammonia, disappears. When the amalgam is thrown into muriatic acid gas, it becomes instantly coated with muriate of ammonia, and a small portion of hydrogen is evolved. In sulphuric acid it

Zinc. becomes coated with ſulphate of ammonia, and ſulphur.

Mr Davy attempted, by various methods, to preſerve the amalgam, in the hope of ſubmitting it to diſtillation, for the purpoſe of obtaining the metallic baſe of the ammonia, which was united to the mercury, in a ſeparate form. But as it is extremely difficult to free mercury, after being once moiſtened entirely from water, he did not ſucceed in this attempt. In wiping the amalgam carefully with bibulous paper, part of the ammonia was regenerated, and in paſſing it through fine linen, with the view of ſeparating the moiſture, a complete decompoſition was effected, and the mercury was revived.

The quantity of the baſe of ammonia combined with 60 grains of quickſilver, appears not to exceed $\frac{1}{100}$ of a grain, and the quantity of oxygen required for this is not more than $\frac{1}{1000}$ of a grain of water, which might be ſupplied by merely breathing upon the amalgam. Mr Davy made various other experiments, with the view of aſcertaining the nature and properties of the amalgam of ammonia; but for an account of theſe we muſt refer to the paper itſelf. And he obſerves, that the more theſe properties are conſidered, the more extraordinary will they appear. Mercury, by combination with about $\frac{1}{12000}$ of its weight of new matter, becomes ſolid, and yet has its ſpecific gravity reduced from 13.5 to leſs than 3, retaining at the ſame time its metallic characters, its colour, luſtre, opacity, and conducting powers, undiminiſhed. Can it then be conceived, Mr Davy aſks, that a ſubſtance which forms with mercury ſo perfect an amalgam, ſhould not be metallic in its own nature? This ſubſtance he denominates *ammonium*. On what then, it is farther aſked, do the metallic properties of ammonium depend? Are hydrogen and nitrogen both metals in the gaſeous ſtate, at the uſual temperature of the atmoſphere; bodies of the ſame character, as zinc and mercury in the ſtate of ignition? Or are theſe gaſes in their common form oxides which become metallized by de-oxidation? Or are they to be conſidered as ſimple bodies, not metallic in their own nature, but capable of compoſing a metal when deprived of oxygen, and becoming an alkali with the addition of oxygen?

In the farther proſecution of the experiments relative to the nature of ammonia, Mr Davy employed potaſſium. He brought ammonia into contact with about twice its weight of potaſſium at common temperatures; but excepting a ſlight diminution in the volume of the gas, and the metal loſing its luſtre and becoming white, no other effects were produced. The white cruſt when examined, proved to be potaſh, and a ſmall portion of hydrogen was found in the ammonia, but not more than equal in volume to the metal. When the potaſſium was heated in the gas, by means of a ſpirit lamp applied to Fig. 5. the bottom of the retort, (fig. 5.) the colour of the cruſt changed from white to bright azure, and gradually to bright blue, green, and dark olive. The cruſt and the metal then fuſed together. This proceſs is attended with effervescence; and the cruſt paſſing off to the ſides, exhibits the ſhining ſurface of the potaſſium. When heated a ſecond time, it ſwells conſiderably, becomes porous, cryſtallized, and of a beautiful azure tint. A gas is evolved during this operation, which gives the ſame diminution by detonation with oxygen, as hydrogen, and ammonia diſappears.

It has been obſerved that the proportion of ammonia Zinc. which loſes its elaſtic form, varies according as the gas employed contains more or leſs moiſture. Thus, in ammonia ſaturated with water at 63° Fahrenheit, potaſſium cauſed the diſappearance of twelve and a half cubical inches of ammonia; but in ammonia deprived of moiſture, by expoſure for two days to potaſh that had been ignited, the ſame quantity of potaſſium occaſioned the diſappearance of 16 cubical inches; but whatever were the degrees of moiſture of the gas, the quantity of hydrogen generated always appeared equal for equal quantities of metal; and according to the French chemiſts, the portions are ſtated to have been the ſame as would have reſulted from the action of water upon potaſſium. But in Mr Davy's experiments, the proportions were rather leſs. In one, conducted with great care, eight grains of potaſſium generated, by their action upon water, eight and a half cubical inches of hydrogen gas; and eight grains of potaſſium from the ſame maſs, by their operation upon ammonia, produced $8\frac{1}{3}$ cubical inches of hydrogen gas. This difference, although inconſiderable, Mr Davy found always to take place.

In Mr Davy's experiments on the action of potaſſium on ammonia, he employed retorts of plate glaſs. The potaſſium was faſtened upon trays of platina or iron, which were introduced into the glaſs retorts furniſhed with ſtop-cocks. The retorts were exhauſted by an air-pump, then filled with hydrogen, exhauſted a ſecond time, and afterwards filled with ammonia. (See fig. 5. Fig. 5. and and 6.). 6.

The following are the properties of the ſubſtance obtained from the action of ammonia on potaſſium. 1. It is cryſtallized, and preſents irregular facets, which are extremely dark, and in colour and luſtre not unlike the green oxide of iron; it is opaque when examined in large maſſes, but is ſemitranſparent in thin films, and appears of a bright brown colour by tranſmitted light. 2. It is fuſible at a heat a little above that of boiling water, and if heated much higher, emits globules of gas. 3. It appears to be conſiderably heavier than water, for it ſinks rapidly in oil of ſaſſafras. 4. It is a non-conductor of electricity. 5. When it is melted in oxygen gas, it burns with great vividneſs, emitting bright ſparks. Oxygen is abſorbed, nitrogen is emitted, and potaſh, which from its great fuſibility ſeems to contain water, is formed. 6. When brought into contact with water, it acts upon it with much energy, produces heat, and often inflammation, and evolves ammonia. When thrown upon water, it diſappears with a hiſſing noiſe, and globules from it often move in a ſtate of ignition upon the ſurface of the water. It rapidly effervesces and deliqueſces in air, but can be preſerved under naphtha, in which, however, it ſoftens ſlowly, and ſeems partially to diſſolve. When it is plunged under water filling an inverted jar, by means of a proper tube, it inſtantly diſappears with effervescence, and the non-abſorbable elaſtic fluid liberated is found to be hydrogen gas.

It is found that the weight of this ſubſtance is greater than that of the potaſſium from which it is formed; and from this it is concluded, that part of the ammonia, or of its elements, enters into its compoſition. When this ſubſtance is decompoſed by heat, nitrogen and hydrogen gaſes, with a portion of ammonia, are given out. It appears, however, that the production of the ammonia

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Zinc. is in proportion to the moiſture admitted, and when the moiſture is conſiderable, the whole product is ammonia. When this ſubſtance is expoſed to heat, a matter remains, which even by increaſing the heat, is no farther changed. On this reſiduum water acts violently, and with efferveſcence, from the evolution of hydrogen gas. Ammonia and potaſh are at the ſame time reproduced. Mr Davy's concluſion from theſe experiments is, that the ſubſtance formed by the action of ammonia on potaſſium is a compound of the latter with a ſmall proportion of oxygen and nitrogen; and as it is found that the quantity of hydrogen given out during its formation is nearly equal to the hydrogen contained in the ammonia, it follows that neither hydrogen nor the ammonia itſelf can be ſuppoſed to enter into its compoſition.

In proſecuting this inveſtigation, Mr Davy made various experiments, and whether the ſubſtance was acted on by water, expoſed to the action of oxygen, or decompoſed by heat, it was found, contrary to expectation, that the quantity of nitrogen evolved during its decompoſition was much leſs than in proportion to the quantity of ammonia which had diſappeared in its formation. In one experiment, in which the decompoſition was effected by heat, the gaſeous product was examined, and was found to be partly potaſh, and partly potaſſium; but it afforded no traces of ammonia, when acted on by water, which is a proof that it retained no nitrogen. In another experiment, 11 cubic inches of ammonia, or 2.05 grains, were decompoſed by potaſſium. The product was 3.6 cubic inches of nitrogen, equal to 1.06 grain; 16 cubic inches of hydrogen, equal to .382 grain; and there was added to the potaſſium a quantity of oxygen equal to .6 grain. Theſe products taken together amount to 2.04 grains, which is nearly equal to the quantity of ammonia employed; but this quantity of ammonia, if the proportions of its elements be eſtimated, from its decompoſition by electricity, would have yielded 5.5 cubic inches of nitrogen, equal to 1.6 grain, and only 14 cubic inches equal to .33; and allowing the ſeparation of oxygen in this proceſs in water, it cannot be eſtimated at more than .11 or .12; and hence, if the analyſis of ammonia by electricity come near to accuracy, there is in this proceſs a conſiderable loſs of nitrogen, and the production of oxygen and hydrogen.

How, ſays Mr Davy, can theſe extraordinary reſults be explained? The decompoſition and compoſition of nitrogen ſeem proved, and one of its elements appears to be oxygen; but what is the other element? Is the gas that appears to poſſeſs the properties of hydrogen a new ſpecies of inflammable aeriform ſubſtance? Or has nitrogen a metallic baſis, which alloys with the iron or platina? Or is water alike the ponderable matter of nitrogen, hydrogen, and oxygen? Or is nitrogen a compound of hydrogen, with a larger proportion of oxygen than exiſts in water? Of theſe important queſtions, Mr Davy adds, the two firſt ſeem the leaſt likely to be anſwered in the affirmative, from the correſpondence between the weight of the ammonia decompoſed, and the products, ſuppoſing them to be known ſubſtances.

In concluding this ſubject, we muſt obſerve, that it ſtill remains in a conſiderable degree of obſcurity. It ſeems, however, to be aſcertained, that the baſe of ammonia is of a metallic nature, which muſt be derived, either from the nitrogen or the hydrogen, or from both, or perhaps theſe ſubſtances are only different forms of combination of the elementary baſe. Or if nitrogen be ſuppoſed to be an oxide of hydrogen, then hydrogen in its gaſeous form is either a metallic ſubſtance, or has a metallic baſe, which latter enters into combination with the mercury employed in the decompoſition of ammonia. Zinc.

Decompoſition of the Earths.

From the reſults of the experiments on potaſh and ſoda, which Mr Davy obtained, he was led to entertain the ſtrongeſt hopes of being able to effect the decompoſition both of the alkaline and common earths; and the phenomena which took place in the firſt imperfect trials made upon theſe bodies countenanced the ideas, that had obtained ſince the earlieſt periods of chemiſtry, of their being metallic in their nature.

The earths, like the fixed alkalies, are non-conductors of electricity; but the fixed alkalies become conductors by fuſion: the infuſible nature of the earths, however, rendered it impoſſible to operate upon them in this ſtate: the ſtrong affinity of their baſes for oxygen, made it unavailing, to act upon them in ſolution in water; and the only methods that proved ſucceſsful, were thoſe of operating upon them by electricity in ſome of their combinations, or of combining them at the moment of their decompoſition by electricity in metallic alloys, ſo as to obtain evidences of their nature and properties. To render the experiments upon the earths ſatisfactory, a more powerful battery will be required, than Mr Davy has a proſpect of ſeeing very ſoon conſtructed; he therefore prefers the imputation of having publiſhed unfiniſhed labours, to that of having concealed any new facts.

Barytes, ſtrontites, and lime, ſlightly moiſtened, were electrified by iron wires under naphtha, by the ſame methods, and with the ſame powers, as thoſe employed for the decompoſition of the fixed alkalies. In theſe caſes gas was copiouſly evolved, which was inflammable; and the earths, where in contact with the negative metallic wires, became dark coloured, and exhibited ſmall points, having a metallic luſtre, which, when expoſed to air, gradually became white: they became white likewiſe when plunged under water; and when examined in this experiment with a magnifier, a greeniſh powder ſeemed to ſeparate from them, and ſmall globules of gas were diſengaged.

In theſe experiments there was great reaſon to believe that the earths had been decompoſed; and that their baſes had combined with the iron, ſo as to form alloys decompoſable by the oxygen of the air or water; but the indiſtinctneſs of the effect, and the complicated circumſtances required for producing it, were ſuch as to compel Mr Davy to form other plans of operation.

Mr Davy bearing in mind the ſtrong attraction of potaſſium for oxygen, was induced to try whether this body might not detach the oxygen from the earths, in the ſame manner as charcoal decompoſes the common metallic oxides. He heated potaſſium in contact with dry pure lime barytes, ſtrontites, and magneſia, in tubes of plate-glaſs; but as he was obliged to uſe very ſmall quantities, and as he could not raiſe the heat to ignition without fuſing the glaſs, he obtained no good reſults in this

Zinc. manner. The potaſſium appeared to act upon the earths and on the glaſs, and dark brown ſubſtances were obtained, which evolved gas from water; but no diſtinct metallic globules could be procured: from theſe, and other like circumſtances, it ſeemed probable, that though potaſſium may partially deoxigenate the earths, yet its affinity for oxygen, at leaſt at the temperature employed, is not ſufficient to effect their decompoſition. Mr Davy, having made mixtures of dry potaſh in exceſs and dry barytes, lime, ſtrontites, and magneſia, brought them into fuſion, and acted upon them in the galvanic circuit in the ſame manner as he employed for obtaining the metals of the alkalies. He expected that the potaſſium and the metals of the earths might be deoxigenated at the ſame time, and enter into combination in alloy.

In this way of operating, the reſults were more diſtinct than in the laſt: metallic ſubſtances appeared leſs fuſible than potaſſium, which burned the inſtant after they had formed, and which by burning produced a mixture of potaſh and the earth employed. An attempt was made to form the metallic ſubſtances under naphtha, but without much ſucceſs. To produce the reſult at all, required a charge by the action of nitric acid, which the ſtate of the batteries would not often allow of; and the metal was generated only in very minute films, which could not be detached by fuſion, and which were inſtantly deſtroyed by expoſure to air.

Mr Davy had found in his reſearches upon potaſſium, that when a mixture of potaſh and the oxide of mercury, tin, or lead, was electrified in the galvanic circuit, the decompoſition was very rapid, and an amalgam, or an alloy of potaſſium, was obtained; the attraction between the common metals and potaſſium apparently accelerating the ſeparation of the oxygen. The idea that a ſimilar kind of action might aſſiſt the decompoſition of the alkaline earths, induced him to electrify mixtures of theſe bodies and the oxide of tin, of iron, of lead, of ſilver, and of mercury; and theſe operations were far more ſatisfactory than any of the others.

A mixture of two-thirds of barytes, and one-third of oxide of ſilver very ſlightly moiſtened, was electrified by iron wires; an effervescence took place at both points of contact, and a minute quantity of a ſubſtance, poſſeſſing the whiteneſs of ſilver, formed at the negative point. When the iron wire to which this ſubſtance adhered, was plunged into water containing a little alum in ſolution, gas was diſengaged, which proved to be hydrogen; and white clouds, which were found to be ſulphate of barytes, deſcended from the point of the wire.

A mixture of barytes and red oxide of mercury, in the ſame proportions, was electrified in the ſame manner. A ſmall maſs of ſolid amalgam adhered to the negative wire, which evidently contained a ſubſtance, that produced barytes by expoſure to the air, with the abſorption of oxygen; and which occaſioned the evolution of hydrogen from water, leaving pure mercury, and producing a ſolution of barytes.

Mixtures of lime, ſtrontites, magneſia, and red oxide of mercury, treated in the ſame manner, gave ſimilar amalgams, from which the alkaline earths were regenerated by the action of air or water, with like phenomena; but the quantities of metallic ſubſtances obtained were exceedingly minute; they appeared as mere ſuperficial formations ſurrounding the point of the wire, nor did they increaſe after the firſt few minutes of electrization, even when the proceſs was carried on for ſome hours. Zinc.

Theſe experiments were at firſt made when the batteries were in bad order; but were afterwards reſumed with a new and much more powerful apparatus, conſtructed in the laboratory of the Royal Inſtitution, and conſiſting of five hundred pairs of double plates of ſix inches ſquare.

When Mr Davy attempted to obtain amalgams with this apparatus, the tranſmitting wires being of platina, of about $\frac{1}{46}$ of an inch diameter, the heat generated was ſo great as to burn both the mercury and baſis of the amalgam at the moment of its formation; and when, by extending the ſurfaces of the conductors, this power of ignition was modified, yet ſtill the amalgam was only procured in thin films, and globules ſufficiently large to ſubmit to diſtillation could not be procured. When the tranſmitting wires were of iron of the ſame thickneſs, the iron acquired the temperature of ignition, and combined with the baſes of the earths in preference to the mercury; and metallic alloys of a dark gray colour were obtained, which acted on water with the evolution of hydrogen, and were converted into oxide of iron and alkaline earths.

While Mr Davy was engaged in theſe experiments, he received a letter from Profeſſor Berzelius of Stockholm, who ſtated that in conjunction with Dr Pontin, he had ſucceeded in decompoſing barytes and lime, by negatively electrifying mercury in contact with them, and that in this way he had obtained amalgams of the metals of theſe earths.

Mr Davy immediately repeated theſe operations with perfect ſucceſs; a globule of mercury, electrified by the power of the battery of 500, weakly charged, was made to act upon a ſurface of ſlightly moiſtened barytes, fixed upon a plate of platina. The mercury gradually became leſs fluid, and after a few minutes was found covered with a white film of barytes, and when the amalgam was thrown into water, hydrogen was diſengaged, the mercury remained free, and a ſolution of barytes was formed.

The reſult with lime, as theſe gentlemen had ſtated, was preciſely analogous. Strontites and magneſia were decompoſed in the ſame manner.

From ſtrontites the expected reſult ſoon took place; but from magneſia, in the firſt trials, no amalgam could be procured. By continuing the proceſs, however, for a longer time, and keeping the earth continually moiſt, at laſt a combination of the baſis with mercury was obtained, which ſlowly produced magneſia by abſorbing oxygen from the air, or by the action of water.

Mr Davy found that all theſe amalgams might be preſerved for a conſiderable period under naphtha. In length of time, however, they became covered with a white cruſt under this fluid. In water, the amalgam of barytes was moſt rapidly decompoſed; that of ſtrontites and that of lime next in order: but the amalgam from magneſia, as might be expected from the weak affinity of the earth for water, very ſlowly changed. When a little ſulphuric acid was added to the water, however, the evolution of hydrogen, and the production and ſolution of magneſia, were exceedingly rapid, and the mercury ſoon remained free.

Mr Davy believed, that one reaſon why magneſia was leſs eaſy to metallize, than the other alkaline earths,

Zinc. was owing to its inſolubility in water, which would prevent it from being preſented in the naſcent ſtate, detached from its ſolution at the negative ſurface. Zinc.

He then made the experiment, uſing moiſtened ſulphate of magneſia inſtead of the pure earth; and the amalgam was much ſooner obtained. Here the magneſia was attracted from the ſulphuric acid, and probably deoxigenated and combined with the quickſilver at the ſame inſtant.

The amalgams of the other baſes of the alkaline earths could be obtained in the ſame manner from their ſaline compounds: muriate and ſulphate of lime, the muriate of ſtrontites and barytes, and nitrate of barytes, were decompoſed by the ſame means as the other earths. The earths, ſeparated at the deoxigenating ſurface, theſe ſeemed inſtantly to undergo decompoſition, and, ſeized upon by the mercury, were in ſome meaſure defended from the action of air, and from the contact of water, and preſerved by their ſtrong attraction for this metal.

In attempting to procure the metals of the alkaline earths, the latter were ſlightly moiſtened, and mixed with one-third of red oxide of mercury; the mixture was placed on a plate of platina; a cavity was made in the upper part of it to receive a globule of mercury, of from 50 to 60 grains in weight; the whole was covered by a film of naphtha, and the plate was made poſitive, and the mercury negative, by a proper communication with the battery of five hundred.

The amalgams obtained in this way were diſtilled in tubes of plate-glaſs, or in ſome caſes in tubes of common glaſs. Theſe tubes were bent in the middle, and the extremities were enlarged and rendered globular by blowing, ſo as to ſerve the purpoſes of a retort and receiver. The tube, after the amalgam had been introduced, was filled with naphtha, which was afterwards expelled, by boiling, through a ſmall orifice in the end correſponding to the receiver, which was hermetically ſealed when the tube contained nothing but the vapour of naphtha, and the amalgam. It was found immediately that the mercury roſe pure by diſtillation from the amalgam, and it was very eaſy to ſeparate a part of it; but to produce a complete decompoſition was very difficult, as nearly a red heat was required for the purpoſe, and as at a red heat the baſes of the earths inſtantly acted upon the glaſs, and became oxigenated. When the tube was large in proportion to the quantity of amalgam uſed, the vapour of the naphtha furniſhed oxygen ſufficient to deſtroy part of the baſes: and when a ſmall tube was employed, it was difficult to heat the part uſed as a retort ſufficient to drive off the whole of the mercury from the baſes, without raiſing too highly the temperature of the part ſerving for the receiver, ſo as to burſt the tube.

In conſequence of theſe difficulties, in a multitude of trials, only a very few ſucceſsful reſults were obtained; and in no caſe could our author be abſolutely certain, that there was not a minute portion of mercury ſtill in combination with the metals of the earths.

In the beſt reſult obtained from the diſtillation of the amalgam of barytes, the reſiduum appeared as a white metal, of the colour of ſilver. It was fixed at all common temperatures, but became fluid at a heat below redneſs, and did not riſe in vapour when heated to redneſs, in a tube of plate-glaſs, but acted violently upon the glaſs, producing a black maſs, which ſeemed to contain barytes, and a fixed alkaline baſis, in the firſt degree of oxigenation. When expoſed to air, it rapidly tarniſhed, and fell into a white powder, which was barytes. When this proceſs was conducted in a ſmall portion of air, the oxygen was abſorbed and the nitrogen remained unaltered; when a portion of it was introduced into water, it acted upon it with great violence and ſunk to the bottom, producing in it barytes; and hydrogen was generated. From the minuteneſs of the quantities obtained, neither its phyſical nor chemical qualities could be examined correctly. It ſunk rapidly in water, and even in ſulphuric acid, though ſurrounded by globules of hydrogen, equal to two or three times its volume; from which it ſeems probable, that it cannot be leſs than four or five times as heavy as water. It flattened by preſſure, but required a conſiderable force to produce this effect.

The metal from ſtrontites ſunk in ſulphuric acid, and exhibited the ſame characters as that from barytes, except in producing ſtrontites by oxidation.

The metal from lime, Mr Davy has never been able to examine, either when expoſed to air, or when under naphtha. In the caſe in which he was able to diſtil the quickſilver from it to the greateſt extent, the tube unfortunately broke, while warm, and at the moment that the air entered, the metal, which had the colour and luſtre of ſilver, inſtantly took fire, and burned with an intenſe white light into quicklime.

The metal from magneſia ſeemed to act upon the glaſs, even before the whole of the quickſilver was diſtilled from it. In an experiment in which the proceſs was ſtopped before the mercury was entirely driven off, it appeared as a ſolid; having the ſame whiteneſs and luſtre as the metals of the other earths. It ſunk rapidly in water, though ſurrounded by globules of gas producing magneſia, and quickly changed in air, becoming covered with a white cruſt, and falling into a fine powder, which proved to be magneſia.

In ſeveral caſes in which amalgams of the metals were obtained, containing only a ſmall quantity of mercury, they were expoſed to air on a delicate balance, and it was always found, that, during the converſion of metal into earth, there was a conſiderable increaſe of weight.

Mr Davy endeavoured to aſcertain the proportions of oxygen and baſis in barytes and ſtrontites, by heating amalgams of them in tubes filled with oxygen, but without ſucceſs. He ſatisfied himſelf, however, that when the metals of the earths were burned in a ſmall quantity of air, they abſorbed oxygen, gained weight in the proceſs, and were in the highly cauſtic or unſlaked ſtate; for they produced ſtrong heat by the contact of water, and did not efferveſce during their ſolution in acids.

The evidence for the compoſition of the alkaline earths is then of the ſame kind as that for the compoſition of the common metallic oxides; and the principles of their decompoſition are preciſely ſimilar, the inflammable matters in all caſes ſeparating at the negative ſurface in the galvanic circuit, and the oxygen at the poſitive ſurface.

Mr Davy has denominated the metals obtained from the alkaline earths, *barium*, *ſtrontium*, *calcium*, and *magnium*.

In attempting the decompoſition of the other earths, Mr

Zinc. Mr Davy was leſs fortunate in obtaining diſtinct reſults; and he obſerves that the methods which have uſually proved ſucceſsful, as well as ſome others, failed. When alumina was ſubjected to the action of electricity, it was in a ſtate of fuſion with potaſh. In this proceſs metallic globules were produced, but they conſiſted chiefly of the baſe of the alkali. Some appearances, however, ſhewed, that the alumina itſelf was decompoſed; for when ſoda was employed, the metallic product obtained was leſs fuſible than ſodium itſelf, and when it was acted on by water, it produced ſoda and a white powder. When potaſh was fuſed with the alumina, and ſubjected to galvanic action, the metallic product decompoſed water with great rapidity, and the ſolution obtained depoſited alumina by the action of an acid. When potaſſium in the ſtate of amalgam, with one-third of mercury, in contact with alumina, was negatively electrified under naphtha, and after the proceſs had been continued for ſome time, the amalgam was added to water, a decompoſition took place, and a ſolution was obtained, which produced a cloudineſs on the addition of an acid; but all theſe reſults are to be conſidered as very imperfect evidence of the decompoſition of alumina.

Mr Davy was ſtill leſs ſucceſsful in attempting the decompoſition of ſilica, partly from its inſolubility, and partly from its being ſcarcely, if at all, affected with electricity, when diffuſed in water, and placed in the galvanic circuit; but by following the ſame proceſſes as in his experiments on alumina, ſome indications of decompoſition appeared. When ſilica was fuſed with ſix parts of potaſh, and was placed in fuſion in the galvanic circuit, metallic matter was obtained, from which, by expoſure to the air, or by dropping it into water, a minute quantity of ſilica was reproduced. When potaſſium, amalgamated with one-third of mercury, and in contact with ſilica, was negatively electrified, he obtained a ſimilar reſult; but in none of the experiments could the product obtained be conſidered as the pure baſe of the earth.

The earths of zirconia and glucina were alſo ſubjected to the action of galvaniſm, by proceſſes ſimilar to thoſe which have now been deſcribed, and in both there were ſome indications of decompoſition; but the reſults were not ſo perfect as to lead to any certain concluſion reſpecting their nature.

Decompoſition of Sulphur and Phoſphorus.

Sulphur.—Sulphur, which had formerly been conſidered as a ſimple ſubſtance, appears, from the experiments of ſome of the French chemiſts, and particularly thoſe of Berthollet junior, to be a compound of ſulphur and hydrogen. The latter chemiſt, in his experiments to inveſtigate the nature of this ſubſtance, cauſed ſulphur to paſs through a coated glaſs tube, which was heated to whiteneſs; ſome indications of ſulphurated hydrogen were obtained. He then formed metallic ſulphurets, as of iron, copper, and mercury, and in theſe proceſſes, which were performed in an earthen retort with great care, ſulphurated hydrogen gas was alſo obtained. Water in the ſtate of vapour being paſſed over ſulphur in fuſion, cauſed the evolution of ſulphurated hydrogen; the water was not decompoſed, for no trace of acid could be obſerved. It ſeemed only to have effected the diſengagement of hydrogen from the ſulphur.

Mr Davy, in the courſe of his experiments in galvaniſm, ſubjected ſulphur to the action of that power. The ſulphur which he employed was ſublimed in a retort, filled with azotic gas, and it was kept hot till the commencement of the experiment. The reaſon of this preliminary proceſs was, to avoid any uncertainty which might ariſe from water abſorbed by the ſulphur. The ſulphur introduced into a curved tube, fig. 7. which was furniſhed with wires of platina A and B, the upper wire A being hermetically ſealed into the end of the tube, was then placed in the galvanic circuit of a battery of 500 pairs of plates of ſix inches, in a ſtate of great activity. A very intenſe action followed, accompanied by great heat and a brilliant light. The ſulphur ſoon entered into ebullition, and gave out a great quantity of elaſtic fluid, a good deal of which was permanent. The ſulphur itſelf aſſumed a deep red brown colour. The gas obtained was ſulphurated hydrogen. In another experiment made on 200 grains of ſulphur, the amount of ſulphurated hydrogen obtained was equal to more than five times the volume of the ſulphur. A conſiderable action was obſerved to have taken place on the wires of platina; and the ſulphur, at its point of contact with the wires, reddened moiſt litmus paper. When ſulphur and potaſſium are heated together, a very powerful action takes place. Sulphurated hydrogen is diſengaged with very intenſe heat and light. From theſe experiments the concluſion ſeems fair and obvious, that hydrogen exiſts in ſulphur, for a ſubſtance, as Mr Davy obſerves, which can be produced from it in ſuch abundance, is not to be conſidered merely as an accidental ingredient. Zinc. Fig. 7.

But as it is admitted that ſulphurated hydrogen contains oxygen, Mr Davy contends that oxygen is to be regarded as one of the conſtituents of ſulphur. In this opinion he is ſupported by experiment. He heated potaſſium in ſulphurated hydrogen gas, from which moiſture had been as much as poſſible abſtracted, by muriate of lime. The potaſſium took fire, and burnt with a brilliant flame. When four grains of potaſſium were heated in 20 cubic inches of gas, the quantity of gas diminiſhed only about $2\frac{1}{2}$ cubic inches; but the properties of the gas were totally changed. A ſmall portion only of it was abſorbed by water, and the remainder was hydrogen, holding in ſolution a minute portion of ſulphur. Some ſulphur was obſerved on the ſides of the retort, and a ſolid matter was formed, which on the ſurface was of a red colour, like ſulphuret of potaſh, but internally dark gray, like ſulphuret of potaſſium. By ſubjecting this ſubſtance to the action of muriatic acid, ſulphurated hydrogen gas was obtained, but the proportion was leſs than would have been given out, had the potaſſium been in combination with pure combuſtible mattter. From this Mr Davy concludes, that there is a principle in ſulphurated hydrogen which is capable of deſtroying partially the inflammability of potaſſium, and of producing upon it all the effects of oxygen. As ſulphurated hydrogen is obtained by heating ſulphur ſtrongly in hydrogen gas, Mr Davy introduced four grains of ſulphur in a glaſs retort, containing about 20 cubical inches of hydrogen, and by means of a ſpirit lamp, he raiſed the heat nearly to redneſs. No perceptible change took place in the volume of the gas after the proceſs. The ſublimed ſulphur was unchanged in its properties, and about three cubical inches of unelaſtic fluid, abſorbable by water, reddening litmus, and having all the properties of ſulphurated hydrogen gas, were formed. Suppoſing then

ſulphurated

Zinc. sulphurated hydrogen to be conſtituted by ſulphur diſſolved in its unchanged ſtate in hydrogen, and admit the exiſtence of oxygen in this gas, its exiſtence muſt likewiſe be allowed in ſulphur. From theſe experiments Mr Davy thinks it not unreaſonable to aſſume, that ſulphur in its common ſtate is a compound of ſmall quantities of oxygen and hydrogen, with a large quantity of a baſe, which produces the acids of ſulphur in combuſtion; and as this baſis, it is added, poſſeſſes ſtrong attractions for other bodies, it will probably be very difficult to obtain it in its uncombined ſtate.

Sulphur combines readily with potaſſium, when brought into contact in tubes filled with the vapour of naphtha; heat and light are rapidly evolved during the combination, and a gray ſubſtance like artificial ſulphuret of iron, is produced. The ſulphurated hydrogen in ſmall quantity is formed at the moment of combination, the hydrogen of which, it is ſuppoſed, is derived from the ſulphur. The ſulphuret of potaſſium readily inflames, and when expoſed to the air, it is gradually oxidated, and converted into ſulphate of potaſh.

Sulphur alſo enters into combination with ſodium, accompanied alſo with the evolution of heat and light. An exploſion ſometimes takes place, which is owing to the volatilization of a portion of ſulphur, and the diſengagement of ſulphurated hydrogen gas. The ſulphuret of ſodium is of a deep gray colour.

Phoſphorus.—Mr Davy ſubjected phoſphorus to ſimilar experiments, and he found that the ſame analogies are applicable to this combuſtible. Common electrical ſparks tranſmitted through phoſphorus produce no evolution of permanent gas; but when acted upon by the ſame galvanic battery, and in the ſame circumſtances as the ſulphur, a conſiderable evolution of gas was effected, and the phoſphorus became of a deep red brown colour. The gas was phoſphorated hydrogen; and in an experiment continued for ſome hours, the quantity evolved was four times the volume of the phoſphorus. The light by the galvanic ſpark was at firſt a brilliant yellow, and afterwards orange.

Three grains of potaſſium were heated in 16 cubical inches of phoſphorated hydrogen. As the fuſion was effected, the retort was filled with white fumes, and a reddiſh ſubſtance was depoſited upon the upper part and ſides; the heat was applied for ſome minutes, but no inflammation took place. When the retort cooled, the abſorption was leſs than a cubical inch; the potaſſium externally was of a deep brown, and interiorly of a lead colour. The reſidual gas ſeemed to contain in ſolution a little phoſphorus, but it had not the property of ſpontaneous inflammation. While the phoſphuret was acted upon over mercury by a ſolution of muriatic acid, it gave out only $1\frac{1}{4}$ cubical inch of phoſphorated hydrogen.

One grain of potaſſium, and one of phoſphorus, were fuſed together. In combining, a very vivid light and intenſe ignition were produced; $\frac{1}{10}$ of a cubical inch of phoſphorated hydrogen was evolved, and the phoſphuret, with diluted muriatic acid over mercury, gave out $\frac{3}{10}$ of a cubical inch of phoſphorated hydrogen. In another experiment with one grain of potaſſium, and three of phoſphorus, nearly one-fourth of a cubical inch of phoſphorated hydrogen was obtained; but the compound yielded by muriatic acid, only $\frac{1}{10}$ of a cubical inch.

From theſe experiments it is concluded, that phoſphorated hydrogen contains a minute proportion of oxygen, and conſequently that the ſame element enters into the compoſition of phoſphorus. The deficiency of phoſphorated hydrogen in the laſt experiment can only be referred to the ſupply of oxygen to the potaſſium from the phoſphorus; and the quantity of phoſphorated hydrogen produced in the experiment with equal parts of potaſſium and phoſphorus, is much leſs than could be expected, if the potaſſium and phoſphorus conſiſted merely of pure combuſtible matter. Zinc.

Mr Davy alſo inſtituted a ſet of intereſting experiments on the ſtates of the carbonaceous principle in plumbago, charcoal, and the diamond, and the reſults of theſe are detailed in the ſame memoir; but for an account of them we muſt refer to the paper itſelf.

Decompoſition of Boracic, Fluoric, and Muriatic acids.

The properties of boracic, fluoric, and muriatic acids, many of which are quite analogous to thoſe of other acids whoſe elements have been diſcovered, have led chemiſts to conclude that oxygen is alſo the acidifying principle in the former; but the ſeparate exiſtence or nature of the baſe of theſe three acids was, till the late reſearches of galvaniſm were inſtituted, utterly unknown. The inveſtigation of the nature of theſe ſubſtances has been proſecuted by Mr Davy, and ſome of the French chemiſts; and of their experiments we ſhall now give a very ſhort account.

Boracic acid.—When boracic acid was moiſtened with water, and expoſed between two ſurfaces of platina, and then ſubjected to the battery of 500 plates, an olive brown matter formed on the negative ſurface, and, increaſing in thickneſs, appeared at laſt almoſt black. This ſubſtance was permanent in water, but it diſſolved and effervеſced in warm nitrous acid. Heated to redneſs on the platina, it burned ſlowly, and gave off white fumes, which reddened moiſtened litmus paper. A black maſs remained, which through a magnifier appeared vitreous, and ſeemed to contain a fixed acid. The inference drawn from this experiment is, that the acid was decompoſed, and again by the latter proceſs reproduced.

When equal weights of potaſſium and boracic acid were heated together in a green glaſs tube, which had been exhauſted, after being twice filled with hydrogen gas, an intenſe ignition, with vivid inflammation, where the potaſſium was in contact with the boracic acid, took place, even before the temperature approached near to a red heat. When the acid had been heated to whiteneſs, before being introduced into the tube, and powdered and uſed while yet warm, the quantity of gas which was hydrogen, given out in the operation, did not exceed twice the volume of the acid. In this mode of conducting the experiment, 12 or 14 grains of each of the two ſubſtances only could be employed, on account of the intenſe heat and conſequent fuſion of the glaſs tube with larger proportions. Mr Davy found in ſeveral experiments, in which he employed equal parts of acid and potaſſium, that a great proportion of the former remained undecompoſed, and he aſcertained that twenty grains of potaſſium had their inflammability deſtroyed by eight grains of boracic acid.

To collect the ſubſtances formed in the proceſs, metallic tubes with ſtop-cocks, and exhauſted, after being filled with hydrogen, were employed. With tubes of braſs or copper, a dull red heat only, but with iron tubes,

Zinc. tubes, a white heat was applied; and in all cafes the acid was decompofed with the fame refults. The fubftance obtained from the iron tube was in fome parts of a dark olive colour, and in others almoft black. It did not effervefce with warm water, but was rapidly acted upon by it. The folutions obtained confifted of fubborate of potafh, and potafh.

The following are the properties of the fubftance obtained in the decompofition of boracic acid by means of procefles conducted in brafs tubes, which afforded it in largeft proportion. To this fubftance Mr Davy has given the name of *boracium*, which, as it is produced in the manner now defcribed, is in the form of a pulverulent mafs of the darkeft fhades of olive; it is opaque, very friable; the powder does not fcratch glafs, and is a non-conductor of electricity. Dried at 100° or 120°, it gives off moifture, by decreafing the temperature; and when heated in the atmofphere, takes fire at a temperature below the boiling point of olive oil, emitting a red light, and fparks like charcoal. When excluded from air, and fubjected to a white heat in a platina tube, exhaufted after being filled with hydrogen, it remains unchanged, excepting in becoming a little darker, and acquiring a greater fpecific gravity.

Boracium introduced into a retort filled with oxygen gas, and heated by a fpirit lamp, throws off vivid fcintillations like thofe of the combuftion of the bark of charcoal, and the mafs gives out a brilliant light. A fublimate appears, which is boracid acid; it becomes coated with a vitreous fubftance, which is alfo found to be the fame acid. When this is waflied off, the black refiduum requires a greater heat, but it is alfo inflamed, and converted into boracic acid. When boracium is brought into contact with oxymuriatic acid gas, at common temperatures, it immediately takes fire, and burns with a brilliant white light, coating the infide of the veffel with a white fubftance, which is boracic acid. Boracium heated to redneis with hydrogen or nitrogen, became of a darker colour, and gave out a little moifture, but remained otherwife unchanged. Thrown into concentrated nitric acid, it rendered it bright red; nitrous gas was produced and abforbed, but no rapid folution took place till the acid was heated, when the boracium difappeared with effervefcence, and the evolution of nitrous gas, and the fluid yielded boracic acid. The action of boracium on fulphuric and muriatic acids was not remarkable. It combined with the fixed alkalies, both by fufion and aqueous folution, and formed pale olive-coloured compounds, which by muriatic acid were precipitated of a dark colour. When fufed with fulphur, it diffolved flowly, and the fulphur became of an olive colour. Its action with phofphorus in the fame circumftances was ftill feebler, but it communicated a fhade of pale green.

From the experiments now detailed, it appears that boracium obtained by means of potaffium, is different from any other known fpecies of matter, and feems to be the fame as that obtained from boracic acid by electricity. According to the refult of experiments made by Mr Davy, boracic acid is compofed of one part of boracium, and about 1.8 of oxygen; and fuppofing the dark refidual fubftance to be an oxide, it confifts of 4.7 of boracium, and 1.55 of oxygen.

For an account of the experiments of Gay Luffac and Thenard, in inveftigating the nature of boracic acid, fee Jour. de Phyfique, tom. lxvii. or Nichol. Jour. xxiii. 260. Zinc.

Fluoric acid.—According to the experiments of Mr Davy, potaffium, when heated in fluoric acid gas, undergoes combuftion, and a great abforption of the gas takes place. In other experiments, he found, that when fluoric acid gas, procured in contact with glafs, is introduced into a plate glafs retort, exhaufted after being filled with hydrogen gas, white fumes appear from the action of the potaffium, which lofes its fplendour, and becomes coloured with a gray cruft. The fumes are more copious when the bottom of the retort is gently heated. The volume of the gas examined at this time appears to be a little increafed, with the addition of hydrogen; and when the temperature is raifed nearly to the point of fublimation of the potaffium, the metal rifes through the cruft, becomes firft of a copper colour, and then inflames and burns with a brilliant red light. After this combuftion, the fluoric acid is either wholly or partially deftroyed, according as the quantity of potaffium is great or fmall; and a mafs of a chocolate colour is found in the bottom of the retort; the fides and the top are lined with a fublimate, which is partly chocolate, and partly of a yellow colour. When the refidual gas is waflied with water, mixed with oxygen gas, and expofed to the action of an electrical fpark, it detonates, and affords a diminution in the fame way as hydrogen gas.

In one experiment with 19 cubical inches of fluoric acid gas, and ten grains and a half of potaffium, 14 cubical inches of the gas difappeared, and about two and a quarter of hydrogen gas were produced. The gas had not been artificially dried; little fublimate was produced, but the whole of the bottom of the retort was covered with a brown cruft. When this mafs was examined with a magnifier, it feemed to confift of different kinds of matter. It did not conduct electricity; it effervefced violently in water, with the evolution of an inflammable gas, which had fomewhat of the odour of phofphorated hydrogen. Part of the mafs heated in the air, burnt flowly, and was converted into a white faline matter. It alfo burnt with difficulty in heated oxygen gas, but it abforbed a portion that required nearly a red heat. The light emitted refembled that from the combuftion of liver of fulphur. Chocolate coloured particles were found floating in the water, acted on by a portion of the mafs, and when the folid matter was feparated by the filter, the fluid was found to contain fluate of potafh and potafh. The folid refiduum was heated in a fmall glafs retort filled with oxygen gas; it burnt before reaching a red heat, and became white. Oxygen was abforbed, and acid matter produced. The remainder had the properties of the fubftance formed from fluoric acid gas, holding filiceous earth in folution by the action of water.

"The decompofition of the fluoric acid, Mr Davy obferves, by potaffium, feems analogous to that of the acids of fulphur and phofphorus. In neither of thefe cafes are the pure bafes, or even the bafes in their common form, evolved; but new compounds refult, and in one cafe, fulphurets and fulphites, and in the other phofphurets and phofphites of potafh, are generated."

In another experiment Mr Davy attempted the decompofition of fluoric acid gas, which was perfectly dry, and free from filiceous earth, by mixing 100 grs. of

Zinc. of dry boracic acid, and 200 grains of fluor ſpar. The mixture was introduced into the bottom of an iron tube, having a ſtop-cock and tube of ſafety attached. The tube was inſerted horizontally in a forge, and 20 grains of potaſſium in an iron tray were placed in that part of it where the heat was only of a dull red. The bottom of the tube was raiſed to a white heat, and the acid, as it was generated, was acted upon by the heated potaſſium. The reſult obtained was a ſubſtance in ſome parts black, and in others of a dark brown colour. It did not effervesce with water, and when lixiviated, afforded a dark brown combuſtible maſs which did not conduct electricity, and, when burnt in oxygen gas, afforded boracic and fluoric acids. This ſubſtance did not inflame ſpontaneouſly in oxymuriatic acid gas; but it effervesced violently, and diſſolved in nitric acid. Mr Davy thinks that this ſubſtance is a compound of the olive-coloured oxide of boracium, and an oxide of the baſe of fluoric acid; but he had not examined its properties particularly.

Muriatic acid.—Many conjectures have been offered with regard to the nature and conſtitution of muriatic acid, and many attempts have been made to effect its decompoſition. Mr Davy has extended his reſearches to this ſubſtance, and has proſecuted the inveſtigation with his uſual ardour. It is ſtill, however, to be regretted, that his ſucceſs has not been commenſurate with his ingenuity and induſtry. Some have ſuppoſed, that the baſe of muriatic acid is hydrogen, while others contend that the baſe is a compound of hydrogen and nitrogen.

The reſult of Mr Davy's firſt experiments in this inquiry ſhowed, that the water alone in combination with the muriatic acid is decompoſed, and that this elaſtic fluid contains a larger proportion of water than is uſually ſuſpected; and from various experiments he concludes, that muriatic acid gas, in its common ſtate, is combined with at leaſt one-third of its weight of water. In the proſecution of his reſearches, therefore, his object was to obtain the muriatic acid free from water. With this view he heated dry muriate of lime, mixed both with phoſphoric acid, and dry boracic acid, in tubes of porcelain and of iron, and employed the blaſt of an excellent forge; but by none of theſe methods was any gas obtained, till a little moiſture was added to the mixture, and then muriatic acid was given out in ſuch quantity as almoſt to produce exploſions. In diſtilling the liquor of Libavius, or the fuming muriate of tin, which contains dry muriatic acid, with ſulphur and with phoſphorus, no ſeparation of the acid took place; but with the addition of water, muriatic acid gas was evolved with great heat and violence. By diſtilling mixtures of corroſive ſublimate and ſulphur, and of calomel and ſulphur in their common ſtates, muriatic acid gas was evolved; but when theſe ſubſtances were dried by a gentle heat, the quantity of gas obtained was greatly diminiſhed. Mr Davy, and alſo the French chemiſts, endeavoured to procure dry muriatic acid by the diſtillation of a mixture of calomel and phoſphorus. The reſult obtained is conſidered as a compound of muriatic acid, phoſphorus, and oxygen. In Mr Davy's experiments, the product was more copious when corroſive ſublimate was employed. With the ſame view of procuring dry muriatic acid gas, he expoſed phoſphorus to the action of oxymuriatic acid gas, in the hope that in the oxidation of the phoſphorus, the whole of the moiſture would be abſorbed; but the examination of the reſult ſhowed, that no muriatic acid gas had been evolved during the proceſs, ſo that the muriatic acid which had diſappeared, muſt exiſt, either in the white ſublimate which had collected in the top of the retort, or in a limpid fluid which had formed in its neck. When the ſublimate was expoſed to the air, it emitted fumes of muriatic acid, and when brought into contact with water, muriatic acid gas was evolved, and phoſphoric and muriatic acids remained in ſolution in the water. Mr Davy regards this white ſublimate as a combination of phoſphoric and muriatic acids in their dry ſtates. The limpid fluid was of a pale greeniſh yellow colour; it rapidly diſappeared on expoſure to the air, emitting denſe white fumes, which had a ſtrong ſmell, differing a little from that of muriatic acid. Mr Davy thinks that this is a compound of phoſphoric and muriatic acids, both free from water.

Zinc || Zinzendorff.

Mr Davy made other experiments, for the purpoſe of procuring muriatic acid in its uncombined ſtate, but with no better ſucceſs. He then tried the effects of potaſſium introduced into the fluid generated by the action of phoſphorus on corroſive ſublimate; but ſuch was the violent action of the ſubſtances operated upon, that the apparatus was generally deſtroyed, and he was thus precluded from examining the reſults. But for a particular detail of the experiments, we muſt refer to the memoir itſelf; and for the extended account of Mr Davy's inveſtigations on this curious and intereſting ſubject, of which we have given as comprehenſive a view as our limits would permit, ſee Phil. Tranſ. 1807, 1808, and 1809.

ZINNIA, a genus of plants of the claſs *ſyngeneſia*, and in the natural ſyſtem arranged under the 49th order, *Compoſitæ*. See BOTANY *Index*.

ZINZENDORFF, NICHOLAS LEWIS, COUNT, was the noted founder of the German religious ſect called *Moravians*, or *Herrnhuters*, or, as they pretend, the reſtorer of that ſociety. From his own narrative, it appears, that when he came of age in 1721, his thoughts were wholly bent on gathering together a little ſociety of believers, among whom he might live, and who ſhould entirely employ themſelves in exerciſes of devotion under him. He accordingly purchaſed an eſtate at Bertholſdorff in Upper Luſatia, where, being joined by ſome followers, he gave the curacy of the village to a perſon of his own complexion; and Bertholſdorff ſoon became talked of for a new mode of piety. One Chriſtian David, a carpenter, brought a few proſelytes from Moravia: they began a new town about half a league from the village, where Count Zinzendorff fixed his reſidence among them, and whither great numbers of Moravians flocked and eſtabliſhed themſelves under his protection: ſo that in 1732 their number amounted to 600. An adjacent hill, called the *Hutsberg*, gave occaſion to theſe coloniſts to call their new ſettlement *Huth des Herrn*, and afterwards *Herrnhuth*; which may be interpreted "The guard or protection of the Lord:" and from this the whole ſect have taken their name. The count ſpared neither pains nor art to propagate his opinions; he went himſelf all over Europe, and at leaſt twice to America; and ſent miſſionaries throughout the world. Count Zinzendorff died in 1760. Thoſe who wiſh to know more of the Moravian tenets may conſult Rimius's

Zinzendorff || Zion.

account of them, tranſlated in 1753. See UNITED BRETHREN.

ZISCA, JOHN, a famous general of the forces of the Huſſites, in the 15th century, was a gentleman educated at the court of Bohemia, in the reign of Wenceſlaus. He entered very young into the army, and after diſtinguiſhing himſelf on ſeveral occaſions, loſt an eye in a battle, whence he was called *Ziſca* or *One-eyed*. At length the Reformation, begun by John Huſs, ſpreading through almoſt all Bohemia, Ziſca placed himſelf at the head of the Huſſites, and had ſoon under his command a body of 40,000 men. With this army he gained ſeveral victories over thoſe of the Romiſh religion, who carried on a kind of cruſade againſt them, and built a town in an advantageous ſituation, to which he gave the name of *Tabor*; whence the Huſſites were afterwards called *Taborites*. Ziſca loſt his other eye by an arrow at the ſiege of the city of Rubi; but this did not prevent his continuing the war, his fighting battles, and gaining ſeveral great victories, among which was that of Auſig on the Elbe, in which 9000 of the enemy were left dead on the field. The emperor Sigiſmund, alarmed at his progreſs, cauſed very advantageous propoſals to be offered to him; which he readily accepted, and ſet out to meet Sigiſmund, but died on the road. He ordered that his body ſhould be left a prey to the birds and wild beaſts; and that a drum ſhould be made of his ſkin, being perſuaded that the enemy would fly as ſoon as they heard the ſound. It is added, that the Huſſites executed his will; and that the news of this order made ſuch an impreſſion on the diſturbed imaginations of the German Papiſts, that in many battles they actually fled at the beat of the drum with the utmoſt precipitation, leaving their baggage and artillery behind them.

ZINZIBER, or ZINGIBER. See AMOMUM, BOTANY and MATERIA MEDICA *Index*.

ZION, or SION, in *Ancient Geography*, a very famous mountain, ſtanding on the north ſide of the city of Jeruſalem, (Pſal. xlvii. 2.); containing the upper city, built by King David; and where ſtood the royal palace, (Joſephus.). A part of Zion, ſituated at its extremity, was called *Millo*, of or in the city of David, (2 Chron. xxxii. 5.). Modern travellers, who have been upon the ſpot, ſay, that Zion is the whole of the mountain, on which Jeruſalem ſtands at this day, though not to the extent in which it anciently ſtood on the ſame mountain, as appears Pſal. ix. 12. 15. lxv. 1. lxxxvii. 2, 3. Iſ. lxii. 1. It is ſwelled into ſeveral eminences or tops; as Moriah, Acra Bezetha, and Zion a particular eminence or mount, and Zion Proper, &c. encompaſſed on three ſides, eaſt, weſt, and ſouth, with one continued very deep and ſteep valley; by means of which it was impregnable on theſe three ſides, and always attacked and taken, according to Joſephus, by the enemy on the north ſide, where Mount Zion became level, and the vales of Gihon and Jehoſhaphat gradually loſe themſelves. This deep and ſteep valley inconteſtably conſtitutes the compaſs of the old Jeruſalem on thoſe three ſides, as plainly appears to any perſon who has been upon the ſpot. On that particular top of the mount called *Zion* ſtood the fortreſs of the Jebuſites; which being afterwards taken by David came to be called the *City of David*, where he had his royal reſidence and kept his court. That part of the valley which lay to the eaſt was called *Jehoſhaphat's*, having Mount Olivet lying beyond it; that to the ſouth *Gehinnon*; and that to the weſt, *Gihon*, from cognominal mountains lying beyond them. At the weſt end of Gihon, without the city, ſtood Golgotha or Calvary. The pretended Golgotha, ſhown at this day within the walls, is the ſpurious brat of intereſted and fraudulent monks, (Korte). There is another *Zion*, the ſame with HERMON.

Zion || Zodiac.

ZION, or *Zion College*. See LONDON, N° 76.

ZIPH, or SIPH, in *Ancient Geography*, the name of a wilderneſs or deſert in the tribe of Judah, where David was fugitive; lying to the ſouth-eaſt of Hebron; ſo called from Ziph or Siph, a twofold town in this tribe; the one more to the ſouth towards Idumea, on the confines of Eleutheropolis, (Jerome); the other eight miles to the eaſt of Hebron, towards the Dead ſea, inclining ſouthwards, becauſe near Mount Carmel. Here was a mountain, mentioned 1 Sam. xxiii. 14. in which David abode, ſaid by Jerome to be rugged, diſmal, and always overcaſt. *Ziphim*, *Ziphæi*, or *Ziphenſes*, the inhabitants of Ziph, ver. 19.

ZIRCHNITZER-SEE, otherwiſe called the *Lake of Czircknitz*, in Carniola, is about one German or four Engliſh miles in length, and half as much in breadth, contains three beautiful iſlands, and is encompaſſed at ſome diſtance with mountains and foreſts. But what is moſt remarkable is, that it diſappears generally once a-year, about St John's or St James's day, running off through holes or pits in the bottom; ſometimes it diſappears twice or thrice a-year, and ſometimes even in winter if the weather be dry. On the other hand, it has been known to continue two or three years without running off. Of the holes or pits, there are five much larger than the reſt, each of which ſucceſſively, when the water runs off, ſtands empty five days; ſo that the whole lake becomes dry in 25. As ſoon as the beginning of the ebb is obſerved, the fiſhing in the pits begins, which belongs to five ſeignories. The fiſh, which are carp, tench, pike, eels, and two other ſorts called *ſchleien* and *ruten*, are caught by laying nets over the holes. Mr Keyſler tells us, that upon the ringing of a bell at Zirknitz, when the waters begin to fall, the peaſants, both men and women, run to the pools quite naked.

ZIRCON, a mineral ſubſtance containing a peculiar earth. See MINERALOGY *Index*.

ZIRCONIA, a peculiar earth. See CHEMISTRY *Index*.

ZIZANIA, a genus of plants of the claſs monœcia; and in the natural ſyſtem arranged under the 4th order, *Gramina*. See BOTANY *Index*.

ZODIAC, a broad circle, whoſe middle is the ecliptic, and its extremes two circles parallel thereto, at ſuch a diſtance from it as to bound or comprehend the excurſions of the ſun and planets, (ſee ASTRONOMY). It is a curious enough fact, that the ſolar diviſion of the Indian zodiac is the ſame in ſubſtance with that of the Greeks, and yet that it has not been borrowed either from the Greeks or the Arabians. The identity, or at leaſt ſtriking ſimilarity, of the diviſion, is univerſally known; and M. Montucla has endeavoured to prove, that the Bramins received it from the Arabs. His opinion, we believe, has been very generally admitted; but in the ſecond volume of the Aſiatic Reſearches, the accompliſhed preſident Sir William Jones has proved unanſwerably, that neither of thoſe nations borrowed that diviſion from the other; that it has been known among the

Zodiac || Zoophytes.

the Hindoos from time immemorial; and that it was probably invented by the firſt progenitors of that race, whom he conſiders as the moſt ancient of mankind, before their diſperſion. The queſtion is not of importance ſufficiently general, ſtraitened as we are by the limits preſcribed us, for our entering into the diſpute; but we think it our duty to mention it, that our aſtronomical readers, if they think it worth their while, may have recourſe to the original writers for further information.

ZOEGÆA, a genus of plants of the claſs ſyngeneſia. See BOTANY *Index*.

ZONE, in *Geography* and *Aſtronomy*, a diviſion of the terraqueous globe with reſpect to the different degrees of heat found in the different parts thereof. The zones are denominated torrid, frigid, and temperate. The torrid zone is a band, ſurrounding the terraqueous globe, and terminated by the two tropics. Its breadth is 46° 58′. The equator, running through the middle of it, divides it into two equal parts, each containing 23° 29′. The ancients imagined the torrid zone uninhabitable. The temperate zones are contained between the tropics and the polar circles. The breadth of each is 43° 2′. The frigid zones are ſegments of the ſurface of the earth, terminated, one by the antarctic, and the other by the arctic circle. The breadth of each is 46° 58′.

ZOOLOGY, is that part of natural hiſtory which relates to *animals*. See NATURAL HISTORY.

ZOOPHYTES. The name ZOOPHYTES, *Zoophyta* (i. e. *animal plants*, from ζωον, *animal*, and φυτον, *plant*,) has been long appropriated to a numerous aſſemblage of marine or aqueous productions, which have puzzled the ingenuity of naturaliſts to aſcertain their place in the chain of nature's works, and which have been alternately ranked among vegetable and animal, and ſometimes even among mineral ſubſtances. At length, however, they ſeem, by general conſent, to have been conſigned over to the animal kingdom, and, with the addition of ſeveral tribes from the Linnæan orders of *Inteſtina*, *Molluſca*, and *Infuſoria*, have, by Cuvier and his colleagues of the French ſchool, been elevated to the rank of a ſeparate claſs. See HELMINTHOLOGY, N° 11.

In the Linnæan ſyſtem, the zoophytes of earlier modern naturaliſts conſtitute the 4th order of the claſs VERMES, and as ſuch have been enumerated under HELMINTHOLOGY; but as the circumſcribed limits of that article did not admit of our deſcribing or figuring many ſpecies, we ſhall now as far as poſſible ſupply that deficiency by ſelecting a few of the moſt curious or intereſting ſpecies of the Linnæan zoophytes; and we ſhall take this opportunity of making a few obſervations on ſome of the genera to which they belong.

Tubipora Muſica. Plate DLXXIX. Fig. 1. & 2.

Figs. 1. and 2. repreſent the TUBIPORA *muſica*, *crimſon tubipore*, or *organ coral;* one of the moſt elegant of theſe ſingular productions. This ſpecies is diſtinguiſhed from its congeners by *having the tubes connected into faſciculæ* or *bundles, and ſeparated from each other by tranſverſe membranous partitions.* The whole maſs conſiſts of upright parallel tubes, riſing over each other by ſtages, ſomething like the cells of a honeycomb. Theſe tubes vary in height from half an inch to an inch; and are from one-tenth to one-eighth of an inch in diameter. Examined internally, they appear to contain a ſmaller tube divided at certain diſtances by radiated partitions (ſee fig. 2.), by means of which the tranſverſe *ſepta* ſometimes communicate with each other. Theſe tranſverſe *ſepta* are of unequal heights. The colour of the maſs is a deep purple, or a rich crimſon. The ſize of the maſs varies conſiderably; but ſpecimens have been obtained of from a foot to three feet in diameter. It is found abundantly in the Pacific ocean, and on the ſhores of ſome of the iſlands in the Indian ſea. Zoophytes.

In its recent ſtate it is covered with a mucous or gelatinous ſubſtance, which pervades the whole maſs and enters within each tube. The inhabiting animal is not certainly aſcertained, but ſeems to be allied to the *nereis* tribe.

Madrepora fungites. Fig. 3. & 4.

Figs. 3. and 4. exhibit two views of the MADREPORA *fungites*, or *muſhroom madrepore*. This body ſo exactly reſembles a muſhroom that it has very commonly been regarded as that vegetable in a ſtate of petrifaction; but recent obſervations ſeem to prove that it is formed by ſmall animals like *meduſæ*. The convex ſide of this madrepore is conical, ſometimes obtuſely pointed, and exhibits on its ſurface thoſe ſtellated pores which form the diſtinguiſhing character of the genus, while the concave ſurface is divided into numerous radiated furrows ſo as to repreſent the *gills* of a muſhroom. When firſt obtained, it is of a delicate white colour, eſpecially on the concave part, but it ſoon acquires a brown or yellowiſh tinge. It is found of various ſizes, from an inch to ſix inches in diameter. It is met with chiefly in the Indian ocean and Red ſea.

Iſis hippuris. Fig. 5. & 6.

At fig. 5. is repreſented that elegant coral called by Linnæus ISIS *hippuris*, the *black and white jointed coral* of Ellis. The ſpecific character of this coral is that it is *compoſed of white ſtriated joints united by black junctures;* but that ſtructure is not viſible till after the coral has been freed from a whitiſh ſoft ſpongy part, with which the branches are covered in their natural ſtate. See fig. 6. It is found chiefly in the Indian ſeas, and varies in height from a few inches to nearly two feet.

Antipathes myriophylla. Plate DLXXX. Fig. 7. & 8.

Fig. 7. repreſents the ANTIPATHES *myriophylla*, *yarrow antipathes*, or *ſea yarrow*, of its natural ſize; while fig. 8. ſhews one of the pinnæ conſiderably magnified.

This is one of thoſe zoophytes which in their habit and appearance almoſt exactly reſemble ſome of the vegetable tribes, and hence have received the names of *ſea-heath*, *ſea-cypreſs*, *ſea-fennel*, &c. From their colour they are uſually denominated *black coral*. This ſpecies, though one of the ſmalleſt, is not the leaſt elegant of the tribe. It conſiſts of numerous branches, compoſed of very ſlender pinnæ arranged in no certain order. The whole coral is ſeldom above a foot in height, and rough on its outer ſurface. This alſo is a native of the Indian ocean, being found more eſpecially on the coaſts of the Molucca iſlands, and is ſometimes met with in the Great South ſea.

Gorgonia nobilis. Fig. 9. & 10.

Fig. 9. exhibits a ſpecimen of *red coral*, the ISIS *nobilis* of Linné, and GORGONIA *nobilis* of later naturaliſts. This ſubſtance, though now nearly exploded from the *materia medica*, will ſtill retain a place in our cabinets for its intrinſic beauty and elegant appearance; but when examined on its native beds, or ſoon after being fiſhed up, it ſhews a very different ſurface from that under which we uſually ſee it. Fig. 9. repreſents it as prepared for ſale by being deprived of its fleſhy animal *bark* or coating, but retaining the ſtriated appearance which marks its ſpecific character; but fig. 10. exhibits a piece of it in its natural ſtate, with polypes extruded from the fleſhy coat, and ſhewing ſtill more diſtinctly at the extremities the ſtreaks below.

Zoophytes.

Red coral is found in large beds or reefs in ſeveral parts of the Mediterranean ſea, and coral fiſheries are eſtabliſhed on the coaſts and near the iſlands. A fiſhery of this kind in the ſtraits of Meſſina is minutely deſcribed by Spallanzani in his *Travels in the two Sicilies*, vol. iv. To tear the coral from the rocks they make uſe of a machine compoſed of two beams tied acroſs each other, and furniſhed with a leaden weight to ſink them, and a quantity of looſe hemp and ſeveral ſtrong nets to entangle the branches of the coral. To this machine is attached a ſtrong rope, which is held by the fiſhers, and ſerves both to direct the net and to draw it up when the coral is entangled. Several boats go in company, each containing eight men, and the fiſhery laſts from April to July. The quantity collected every year amounts on an average to twelve Sicilian quintals, each equal to 250 pounds Troy, and each pound uſually ſells for about four ſhillings and ſixpence. They do not fiſh on the ſame bank oftener than once in ten years, as this time is deemed neceſſary for the coral to acquire its full ſize and vigour.

Gorgonia ceratophyta.

Fig. 11.

Another beautiful ſpecies of gorgonia, the GORGONIA *ceratophyta*, is figured at fig. 11. This is diſtinguiſhed by its *dichotomous flattiſh ſtem, and aſcending branches*. The outer fleſh is of a purpliſh colour, and the branches are furniſhed with two rows of ſcattered pores from which the polypi appear. It is found in the Mediterranean, and ſometimes on the eaſtern coaſts of America.

Alcyonium gorgonoides.

Fig. 12.

Nearly allied to the gorgoniæ is the ſpecies of alcyonium repreſented at fig. 12. This is the ALCYONIUM *gorgonoides* of Gmelin. It is of a cinereous colour, of a ſandy fleſhy conſiſtence, having radiated warty cellules. It is found on the northern coaſt of South America, eſpecially near the iſland of Curaçoa.

The zoophytes which naturaliſts diſtinguiſh by the generic name alcyonium, ſometimes form independent bodies of a rounded form, ſuch as thoſe called the *ſea-orange*, *ſea-fig*, &c.; or cover the ſurface of ſhells and other marine bodies like a kind of bark. Their internal part or baſe is friable, and, when dried, appears to be compoſed of fine fibres, which are either longitudinal, as in the preſent caſe, diverging, or circular. This baſe is covered with a ſoft cruſt, that in drying aſſumes a leathery conſiſtence, and is pierced with numerous little cells inhabited by polypi. In ſome ſpecies theſe cells are diſperſed over the whole ſurface of the coral, while in others they are confined to particular ſpots or tubercles. They are all inhabitants of the ocean, where they are uſually fixed to rocks or other ſolid bodies.

Spongia tubuloſa. Plate DLXXXI. Fig. 13.

In the article HELMINTHOLOGY we have ſufficiently treated of the nature and properties of the ſponges, and have there mentioned particularly the common or *officinal* ſponge. At fig. 13. is repreſented a more curious ſpecies, the SP. *tubuloſa* or *fiſtularis*, the *tubular* or *pipey ſponge*. This conſiſts of ſimple upright, attenuated, rigid tubes, tuberculated on the outer ſurface, which is of a black colour. It is found in the ſeas that waſh the coaſts of America.

Fluſtra areno ſa.

Fig. 14.

The *fluſtræ* are a tribe of inſignificant zoophytes, which ſeem ſcarcely entitled to the rank which they hold in the animal creation. They are formed of a congeries of ſuperficial cells, placed cloſe together, like thoſe of a honeycomb, but generally occupying only a ſingle ſurface. Sometimes this ſubſtance forms a coating to ſome other marine body, at others it is unattached and forms a floating foliaceous maſs or *mat*. The ſpecies repreſented at fig. 14. is one of the moſt curious, and is deſcribed by Ellis under the name of *Engliſh ſea-mat*, called in the *Linnæan Tranſactions*, vol. v. FLUSTRA *arenoſa*. It is compoſed of ſandy particles agglutinated together with ſlime, and in ſhape reſembles the fore part of a horſe's hoof. It is very friable, and ſo thin as to be eaſily broken. Theſe *fluſtræ* are found abundantly on the coaſt of Kent, and about Holy-head on the Welſh coaſt.

Zoophytes.

Sertularia ſetacea. Fig. 15. & 16.

Fig. 15. repreſents a ſpecimen of SERTULARIA *ſetacea*, the *ſmall ſea-briſtle coralline* of Ellis, of its natural ſize; and fig. 16. ſhews the ſame ſpecimen conſiderably magnified. This ſpecies is diſtinguiſhed by being *ſimply pinnated, with bent alternate pinnæ, furniſhed with very remote proceſſes growing only on one ſide, and oblong axillary ovaries*. It is one of the ſmalleſt and moſt delicate of the tribe, ſeldom exceeding an inch and a half in height. It is very common, and is found on the Britiſh coaſts.

None of the zoophytes bear a nearer reſemblance to vegetables than the *ſertulariæ*. Their creeping roots, their branched ſtem, and tufts of ſeeming flowers (the polypine proceſſes) give them all the air of plants. Hence they were long conſidered as *ſea-moſſes*, and deſcribed by botaniſts under that name. See Ray's *Synopſis*, p. 38. and 39. When attentively examined, however, their animal nature will ſcarcely be diſputed. Externally they are compoſed of a horny ſubſtance, perfectly tranſparent, and through this may be diſtinguiſhed the animal ſubſtance traverſing the centre of the ſtem and branches like the pith of a plant, and appearing externally as little knots or protuberances in the form of tentaculated polypes. Theſe extraneous polypes are conſidered by Cuvier (*Tableau Elementaire*, p. 768.) not as diſtinct animals, but only as parts of the ſame animal which conſtitutes the ſole inhabitant of the ſertularia. Theſe zoophytes adhere to rocks, ſhells, &c. by creeping roots, and appear to propagate by means of eggs. They are among the moſt common of this claſs of animated beings.

Pennatula phoſphorea. Fig. 17. & 18.

The PENNATULÆ, or *Sea-pens*, conſtitute a very curious tribe of zoophytes, which are completely locomotive, and ſwim in the manner of fiſhes. They conſiſt of an internal bone or rather horny ſubſtance, covered with a ſenſible fleſhy coat. Their lower extremity is ſimple like the barrel of a quill, while the upper extremity is expanded into a flattened part, that is generally compoſed of pinnæ like the barbs of a quill, though it is ſometimes merely a ſimple expanded maſs furniſhed with polypine proceſſes.

Fig. 17. repreſents one of the moſt common *ſea-pens* properly ſo called, the PENNATULA *phoſphorea*, *phoſphoreſcent pennatula*, of its natural ſize. It has *a fleſhy ſtem, a rough middle part, and imbricated pinnules*. The pinnæ are furniſhed on one ſide with leſſer *pinnulæ*, at the extremities of which appear the polypes. See fig. 18. which ſhews one of the ſeparate pinnæ, a little magnified. This ſpecies is of a fine red or light ſcarlet colour, and when alive exhibits a ſtrong phoſphoreſcent light, ſo as to render diſtinctly viſible objects that are near it. It is pretty common on the coaſts of Britain, and is ſometimes taken in the fiſhermen's nets, or adhering to the baits.

For figures of two other Linnæan zoophytes, the TUBULARIA *magnifica*, and HYDRA *viridis*, ſee Plate CCLIII.

Fig. 1.

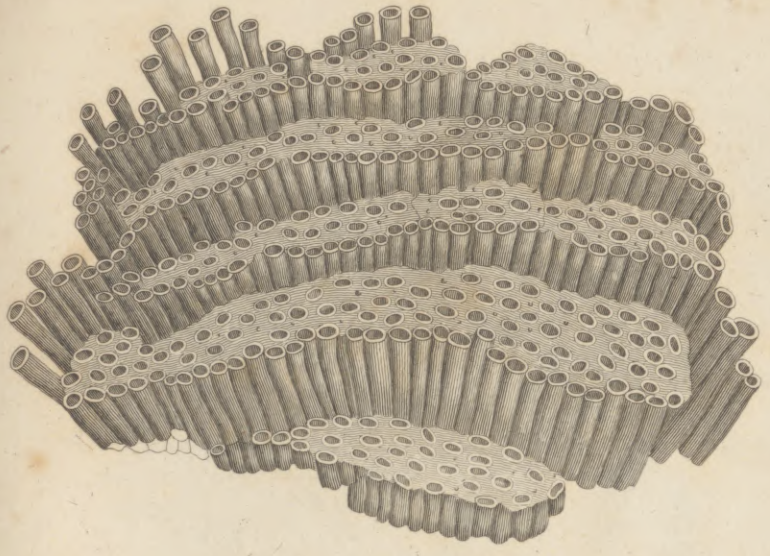


Fig. 2.

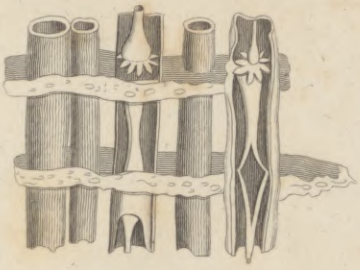


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

W. Archibald sc.

Fig. 8.

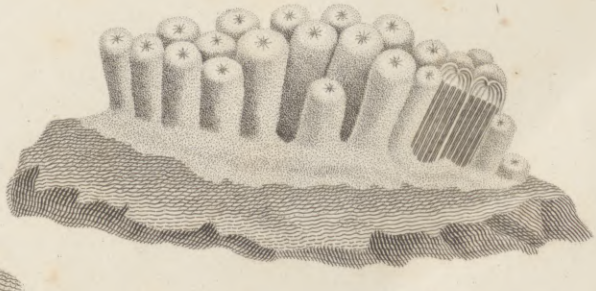
Fig. 7.

Fig. 11.

Fig. 9.

Fig. 10.

Fig. 12.



W. Archibald sc.

Fig. 13.

Fig. 14.

Fig. 16.

Fig. 17.

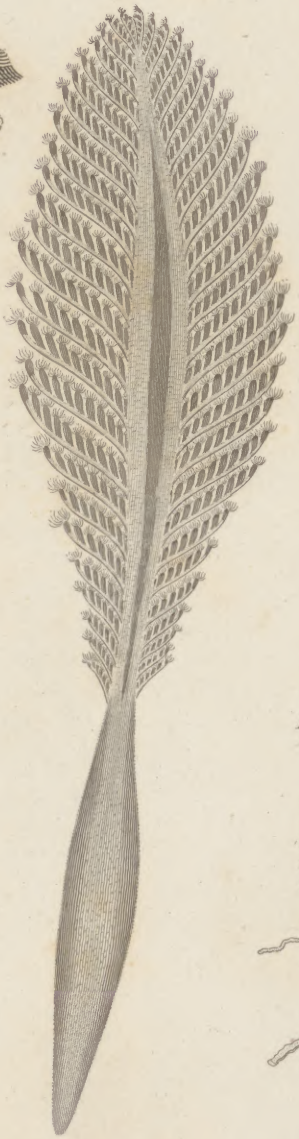


Fig. 18.

Fig. 15.

W. Archibald sc.

Zoophytes || Zug.

CCLIII. Several of Cuvier's zoophytes are represented in Plates XXXIV. CCLI. and CCLII. and some of the *Infusoria* in Plates XXXV. and XXXVI.

ZOOTOMY, the art of dissecting animals or living creatures, being the same with anatomy. See ANATOMY.

ZORILLE, a species of weesel which inhabits Peru, and other parts of South America; and is said to be remarkable for its fetid odour.

ZOROASTER, or ZERDUSHT, a celebrated ancient philosopher, said to have been the reformer or the founder of the religion of the magi. It is wholly uncertain to how many eminent men the name of Zoroaster belonged. Some have maintained that there was but one Zoroaster, and that he was a Persian; others have said that there were six eminent founders of philosophy of this name. Ham the son of Noah, Moses, Osiris, Mithras, and others, both gods and men have by different writers been asserted to have been the same with Zoroaster. Many different opinions have also been advanced concerning the time in which he flourished. Aristotle and Pliny fix his date at so remote a period as 6000 years before the death of Plato. According to Laertius, he flourished 600 years before the Trojan war; according to Suidas, 500. If, in the midst of so much uncertainty, any thing can be advanced with the appearance of probability, it seems to be this; that there was a Zoroaster, a Perso-Median, who flourished about the time of Darius Hystaspes; and that besides him there was another Zoroaster, who lived in a much more remote period among the Babylonians, and taught them astronomy. The Greek and Arabian writers are agreed concerning the existence of the Persian Zoroaster; and the ancients unanimously ascribe to a philosopher, whom they call *Zoroaster*, the origin of the Chaldean astronomy, which is certainly of much earlier date than the time of Hystaspes: it seems, therefore, necessary to suppose a Chaldean Zoroaster distinct from the Persian. Concerning this Zoroaster, however, nothing more is known, than that he flourished towards the beginning of the Babylonish empire, and was the father of the Chaldean astrology and magic. All the writings that have been ascribed to Zoroaster are unquestionably spurious.

ZOSTERA, a genus of plants of the class gynandria, and in the natural system arranged under the second order, *Piperitæ*. See BOTANY *Index*.

ZOSIMUS, an ancient historian who lived at the end of the fourth and beginning of the fifth century. There are six books of his history extant; in the first of which he runs over the Roman affairs in a very succinct manner from Augustus to Diocletian; the other five are written more diffusely. Zosimus was a zealous Pagan; whence we find him frequently inveighing with great bitterness against the Christian princes, particularly against Constantine the Great, and the elder Theodosius. His history has been published with the Latin version of Leunclavius at Frankfort, 1590, with the other minor historians of Rome, in folio; and at Oxford in 8vo, 1679.

ZUG, a canton of Switzerland, bounded on the east and north by that of Zurich, on the south by Schweitz and Lucern, and on the west by the canton of Lucern and the Freye-Amt or Free Provinces. It is not above 12 miles either way; but very populous and fruitful, yielding wine, wheat, chesnuts, and other fruits, in its vales, and excellent pasture on its mountains. The inhabitants of this canton are staunch Roman Catholics. It lies in the diocese of Constance, and its government is democratical. There are two lakes in it abounding in fish, particularly large carps, pikes, and a species of trouts called *rotels;* as well as several woods full of game. Zug, which gives name to it, and is its capital, stands on the east side of a lake of the same name, about seven miles long, and is a strong neat town, containing a priory and two convents.

Zug || Zurich.

ZUILA, a town in the territory of Fezzan, in Africa, which stands on a space of about a mile in circuit, but was formerly of much greater extent. The environs are level, well supplied with water, and fertile, planted with groves of date trees, and the inhabitants pay much attention to agriculture. N. Lat. 27. 29. E. Long. 16. 39.

ZUINGLIUS, ULRICUS, an able and zealous reformer, who laid the foundation of a separation from Rome in Switzerland, at the same time that Luther did the like in Saxony, was born at Wildehausen in 1487. While he officiated as preacher at Zurich, a Franciscan sent by Leo X. came to publish indulgences there; against which Zuinglius, after the example of Luther, declaimed powerfully. In the course of this opposition he started a new doctrine, which he called *Evangelical Truth;* and from the beginning of 1519 to 1523, he preached not only against indulgences, but against other articles of the Romish church. But though Zuinglius made no less progress than Luther, he conducted himself with more moderation and prudence; and wishing to have the concurrence of the civil powers, procured two assemblies to be called at Zurich: by the first, he was authorised to proceed as he had begun; and by the second, the outward worship and ceremonies of the church of Rome were abolished. During these transactions, Zuinglius published several books in defence of his doctrines; but treating of the eucharist, and prescribing a form of celebrating the Lord's Supper different from Luther, he was involved in violent disputes with the rest of his reforming brethren. Respecting the divine DECREES, the opinion of Zuinglius and his followers differed very little from that of the PELAGIANS: and instead of declaring with Calvin, that the church is a separate independent body, vested with the right of legislation for itself, Zuinglius ascribed to the civil magistrate an absolute and unbounded power in religious matters, allowing at the same time a certain subordination among the ministers of the church. This was abundantly agreeable to the magistrates of Zurich; but the rest of the Swiss cantons disallowing of their proceedings, other assemblies were called, and things tending to tumult, both sides had recourse to arms; when Zuinglius, who began as a preacher, died in arms as a soldier, in 1531. His works are in four volumes folio.

ZURICH, a canton of Switzerland, bounded to the north by Swabia and the canton of Schaffhausen; to the south by the town and territory of Rapperschweil and the cantons of Switz and Zug; to the east by the Thurgau, Toggenburg, and Utznach; and to the west by the free bailiages and county of Baden. It is about 60 miles from north to south, and 48 from east to west. With respect to its face, air, and soil, it is said to be an epitome of all Switzerland, as containing in it hills, valleys,

Zurich. valleys, plains, corn-lands, vineyards, lakes, and rivers. Their wines have a tartneſs at firſt, but the longer they are kept the more agrecable they are. The other products are excellent fruits, corn, paſture, fine clay, chalk, ſeveral coloured earths, pit-coal, turf, and ſulphur. There are alſo ſome mineral ſprings in the canton, and ſome lakes; Zurich is the moſt conſiderable, it is 24 miles long, and two broad. The reformation was introduced here by Zuinglius in the year 1517. This canton is the firſt in rank, and inferior only to that of Bern in extent, power, and wealth; in conſequence of which, its repreſentatives preſide in the general diets, when held in any place belonging in common to the cantons; and the affairs relating to the whole confederacy are tranſacted in its offices. Its quota, for the defence of the ſeveral members of the confederacy, is 1400 men. Of one of the two armies raiſed on theſe occaſions, it nominates one of the commanders in chief, as Lucern does the other. Its revenue is ſaid to be about 150,000 crowns a-year; of which, one year with another, two thirds are expended in the charges of government, and the reſt laid up in the treaſury. It can bring 50,000 fighting men into the field at a very ſhort warning.

ZURICH, the capital of a canton of the ſame name in Switzerland, ſtands in a pleaſant country, near where the river Aa iſſues from the lake that takes its name from the town, 23 miles from Schaffhauſen, and 114 from Geneva. After having been ruined by Attila the Hun, it is ſaid to have been reſtored by Thuricus, ſon of Theodoric king of the Goths, from whom it took the name of *Thuricum*, corrupted afterwards into that of *Zurich*. It is fortified in the modern way, and has wide ditches, faced with free-ſtone. There are five arſenals in it, well ſtored with arms and artillery; an academy or college, having 15 profeſſors; a muſeum, or chamber of rarities; a ſtately town-houſe, the pillars in the front of which are of black marble, ſtreaked with white; and a town library. The ſovereignty and adminiſtration of all affairs are lodged in the greater and leſſer council, out of which are choſen the city-officers, as the councils are out of the 13 companies of burghers. There are ſeveral other councils or colleges, each of which has its particular department. Here are a great variety of ſilk, woollen, linen, cotton, and other manufactures; this being the place of the greateſt trade in all Switzerland. The town is well ſupplied with proviſions by and from its lake. The ſtreets are neat, and houſes well built, but not magnificent. In the town-library are ſeveral letters to Bullinger from Lady Jane Gray, daughter to the duke of Suffolk. In one of the arſenals is the figure of William Tell, dreſſed and armed in the ancient Swiſs manner, with the croſs-bow whence he ſhot the arrow that ſtruck the apple off his child's head. Zurich || Zymoſimeter.

Both men and women are ſo fond of muſic, that there are few of them that cannot play on ſome inſtrument. If a burgher goes out of town, or a peaſant enters it, without a ſword, they are liable to be fined. No perſons, whatever their rank or office may be, are exempted from the ſumptuary laws. The burgomaſters, who are the ſame as the advoyers at Bern, have the title of excellence. The hoſpitals here are neat and well endowed. The environs are pleaſant and fruitful; for which it is not a little indebted to the lake. That part of it which is next Zurich is called the *Lower Lake*, and the other end the *Upper*. The cathedral, or great church here, is collegiate. The preſent city is ſaid to owe its origin to a nunnery, founded by the emperor Lewis I. near where the ancient Tigurum ſtood. E. Long. 8. 30. N. Lat. 47. 20.

ZUTPHEN, a ſtrong and conſiderable town of the United Provinces in Guelderland, and capital of a county of the ſame name. It has a magnificent church, and is ſurrounded with walls. It was taken by the French in 1672, who in 1674 delivered it up to the States-General. It is ſeated at the confluence of the rivers Berkel and Yeſſel, nine miles ſouth-eaſt of Deventer, and 55 eaſt by ſouth of Amſterdam. E. Long. 6. 0. N. Lat. 52. 10.

ZUYDER-ZEE, a great gulf or bay of the German ocean, which extends from ſouth to north in the United Provinces, between Frieſland, Over-Yeſſel, Guelderland, and Holland. It is ſo called from its ſituation towards the ſouth. It is ſaid that the Zuyder-zee was formerly a lake, and that the land is ſwallowed up which united North-Holland with Frieſland.

ZYGOMA, a bone of the head, or rather an union or aſſemblage of two proceſſes or eminences of bones. See *Bones of the Head*, under ANATOMY.

ZYGOMATICUS, a muſcle of the head, ariſing from the *Os ZYGOMA*, whence its name, and terminating at the angle of the lips.

ZYGOPHYLLUM, BEAN-CAPER, a genus of plants of the claſs of decandria, and in the natural ſyſtem arranged under the 14th order, *Gruinales*. See BOTANY *Index*.

ZYMOSIMETER (formed from ζυμωσις, *fermentation*, and μετρον, *meaſure*), an inſtrument propoſed by Swammerdam, in his book *De Reſpiratione*, with which to meaſure the degree of fermentation occaſioned by the mixture of different matters, and the degree of heat which thoſe matters acquire in fermenting; the ſame inſtrument is employed to aſcertain the heat or temperament of the blood of animals.

FINIS.

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DIRECTIONS FOR PLACING THE PLATES OF VOL. XX.

PART I.

Plate DXIII.—DXXIV.	to face	page 112
DXXV.—DXXVII.	- -	120
DXXVIII.	- - -	232
DXXIX.—DXXXI.	- -	272
DXXXII.	- - -	280
DXXXIII. & DXXXIV.	- -	400

PART II.

DXXXXV.	- - - 410
DXXXVI.	- - - 432
DXXXVII. & DXXXVIII.	- 488
DXXXIX.	- - - 496
DXL.	- - - 512
DXLI.—DXLIII.	- - 542
DXLIV.—DLXX.	- - 632
DLXXI. & DLXXII.	- - 646
DLXXIII. & DLXXIV.	- - 680
DLXXV. & DLXXVI.	- - 686
DLXXVII.	- - - 700
DLXXVIII.	- - 792
DLXXIX.—DLXXXI.	- - 804