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was covered with a thick inflammatory cruſt. In one of theſe patients the urine yielded an ounce and a half, and in the other an ounce, of ſaccharine matter from each pound. It had, however, an urinous ſmell, and a ſaline taſte mixed with the ſweet one; and the urine of one fermented with yeaſt, we are told, into "tolerable ſmall-beer." Both theſe patients had a voracious appetite, and perpetual gnawing ſenſe of hunger; as had alſo Dr Dobſon's patient. The inſipid urine of thoſe affected with diabetes has not been examined by phyſicians with ſufficient accuracy to enable us to ſpeak with confidence of its contents.

Cauſes. Theſe are exceedingly obſcure and uncertain; ſpaſms of the nervous ſyſtem, debility, and every thing inducing it, but eſpecially ſtrong diuretics and immoderate venery, have been accuſed as bringing on the diabetes. It has, however, occurred in perſons where none of theſe cauſes could be ſuſpected; nor have the beſt phyſicians been able to determine it.—Diſſections have only ſhown that the kidneys were in an enlarged and lax ſtate. In one of Dr Home's patients who died, they ſmelled ſour; which ſhowed that the urine peculiar to diabetes came from the kidneys, and was not ſent directly from the inteſtines by a retrograde motion of the lymphatics, as ſome imagine.

Prognoſis. The diabetes is rarely cured, unleſs when taken at the very beginning, which is ſeldom done; and in a confirmed diabetes the prognoſis muſt therefore be unfavourable.

Cure. As there is reaſon to believe that in this affection the morbid ſecretion of urine, which is both preternatural in point of quantity and of quality, ariſes from a morbid diminution of tone in the kidney, the great object in the cure muſt be the reſtoration of due tone to the ſecreting veſſels of the kidney. But as even this diminiſhed tone would not give riſe to the peculiar vitiated ſecretion without a morbid ſenſibility of that organ, it is neceſſarily a ſecond object to remove this morbid ſenſibility. But beſides this, the morbid ſecretion of urine may alſo be counteracted both by a diminution of the determination of fluids to the kidney, and by preventing the occurrence of ſuperfluous water in the general maſs of blood.

On theſe grounds the principal hopes of a cure in this diſtemper are from aſtringent and ſtrengthening medicines. Dr Dobſon's patient was relieved by the following remedies; which, however, were frequently varied, as none of them produced their good effects for any length of time: Cinchona in ſubſtance, with ſmall doſes of rhubarb; decoction of the bark, with the acid elixir of vitriol; the cold infuſion of the bark, of which he drank from a quart to two quarts daily; Dover's powder; alum whey; lime-water; antimonials combined with *tinctura thebaica*. The warm bath was uſed occaſionally when the ſkin was remarkably hot and dry, and the patient complained of reſtleſſneſs and anxiety. The tincture of cantharides was likewiſe tried; but he could never take more than 25 drops for a doſe, without exciting great uneaſineſs in his bowels. The body was kept conſtantly open, either with rhubarb or the infuſion of ſena joined with rhubarb. His common drinks were rice water, barley-water, lime-water, and milk; lime-water alone; ſage, balm, or mint tea; ſmall beer, ſimple water, and water acidulated with

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the ſulphuric acid. In ſeven months, theſe remedies, in whatever manner varied, made no further progreſs in removing the diſeaſe. In Dr Home's patients, all theſe medicines, and many others, were tried without the leaſt good effect; inſomuch that he uſes this remarkable expreſſion: "Thus, theſe two patients have exhauſted all that experience had ever recommended, and almoſt all that theory could ſuggeſt; yet in both caſes, the diſeaſe has reſiſted all the means of cure uſed." It is remarkable, that though ſeptics were given to both, in ſuch quantity as evidently to produce a putreſcency in the *primæ viæ*, the urine remained unaltered both in quantity and quality.

Bnt although this diſeaſe be frequently in its nature ſo obſtinate as to reſiſt every mode of cure, yet there can be no doubt that particular remedies have ſucceeded in different caſes. Dr Briſbane relates ſeveral caſes cured by the uſe of tincture of cantharides: and Dr M'Cormick has related ſome in the 9th volume of the Edinburgh Medical Commentaries, which yielded to Dover's powder after a variety of other remedies had been tried in vain.

But of all the modes of cure lately propoſed, that which has been moſt celebrated, is the treatment recommended by Dr Rollo of the Royal Artillery. In a valuable work lately publiſhed, entitled *Caſes of the Diabetes Mellitus*, he has recorded two remarkable examples of the good effects of a peculiar regimen in this diſeaſe. He conſiders diabetes as being a diſeaſe not of the kidney but of the alimentary canal, and as ariſing from the formation of an uncommon quantity of ſugar. He therefore ſtrictly forbids the uſe of every article of diet which can furniſh ſugar, even of bread; and by a diet conſiſting entirely of animal and alkaleſcent food his patients were much benefited. The experience of ſome other practitioners has to a certain degree confirmed the obſervations of Dr Rollo. But we are ſorry to add, that we have met with many other inſtances of diabetes mellitus, in which a diet conſiſting ſolely of animal food, had a fair trial, without producing any material benefit. And we may conclude with obſerving, that the cure of diabetes ſtill remains to be diſcovered. As allaying the exceſſive thirſt, and producing a temporary reſtoration of urinous ſmell, or the urea which it ought naturally to contain, we have found nothing equal in efficacy to a large proportion of fat meat, ſuch as pork ſteaks or butter.

Genus LXIII. HYSTERIA. 321
Hysterics.

Hyſteria, *Sauv.* gen. 135. *Lin.* 126. *Vog.* 219. *Sag.* gen. 242.

Malum hyſtericum, *Hoffm.* III. 50. *Junck.* 36.

Affectio hyſterica, *Willis* de Morb. Convulſiv. cap. 5. 10. 11. *Sydenham* Diſſ. Epiſt. ad G. Cole, *Whytt* on Nervous Diſorders.

Deſcription. The hyſteria is a convulſive diſeaſe, which comes on at uncertain intervals, ſometimes longer and ſometimes ſhorter, but at no ſtated time. The paroxyſms commonly begin with a languor and debility of the whole body; yawning, ſtretching, and reſtleſſneſs. A ſenſe of coldneſs alſo in the extremities, almoſt always precedes, and for the moſt part remains during the whole time of the paroxyſm. To this ſometimes

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times ſucceeds a ſenſe of heat; and the two ſenſations alternate with each other in different parts of the body. The face is ſometimes fluſhed and ſometimes pale: and ſometimes the paleneſs and fluſhing come alternately. There is a violent pain in the head; the eyes become dim, and pour out tears; there is a rumbling and inflation of the inteſtines; a ſenſation is felt like that of a globe aſcending from the lower part of the abdomen or hypogaſtrium, which ſometimes ſeems to roll along the whole alimentary canal. It aſcends to the ſtomach, ſometimes ſuddenly, ſometimes ſlowly; and there produces a ſenſe of inflation and weight, together with anxiety, nauſea, and vomiting. At laſt it comes up to the throat, where it produces a ſenſe of ſuffocation, and difficulty of breathing or ſwallowing. During this time there are the moſt violent pains both in the external and internal parts of the abdomen; the muſcles are convulſed; the umbilicus is drawn inwards; and there are frequently ſuch ſpaſms of the inteſtines, that neither clyſters can be injected, nor even flatus paſs downwards. Sometimes the paroxyſm remits after theſe ſymptoms have continued for a certain time, but more frequently the patients fall into fainting fits; ſometimes they lie without motion, as if they were in a deep ſleep; ſometimes they beat their breaſts violently and continually with their hands, and ſometimes they are ſeized with general convulſions, and the diſeaſe puts on the appearance of an epilepſy. In ſome patients the extremities become cold and ſtiff, and the body has the appearance of one in a catalepſy. Sometimes a moſt violent beating pain takes place in ſome part of the head, as if a nail was driven into it, and all viſible objects ſeem to turn round; grievous pains attack the loins, back, and bladder, and the patients diſcharge a ſurpriſing quantity of urine as limpid as water; which laſt is one of the ſureſt ſigns of the diſeaſe. The mind is very much affected as well as the body. Sometimes the patients are tormented with vain fears: ſometimes they will laugh, at other times cry immoderately; and ſometimes their temper becomes ſo peeviſh and fretful, that they cannot enjoy a moment's quiet. The appearances which take place in this affection are indeed ſo much varied, that they can hardly be enumerated: they may, however, with propriety, be divided into hyſteric fits, which very much reſemble thoſe of epilepſy, excepting that they are not attended with an abolition of the internal ſenſes; and hyſteric ſymptoms, ſuch as the *globus hyſtericus*, *clavus hyſtericus*, and the like, which are chiefly known to conſtitute a part of this diſeaſe from being obſerved to alternate with fits.

Cauſes, &c. The general cauſe of hyſteria is thought by the beſt phyſicians to conſiſt in a too great mobility and irritability of the nervous ſyſtem, and of conſequence the diſeaſe may be brought on by whatever debilitates and renders the body irritable. Hence it moſt frequently attacks females of a weak and lax habit of body, though there are ſome inſtances of men alſo attacked by it. It generally comes on between the time of puberty and the age of 35, and makes its attacks during the time of menſtruation more frequently than at any other. It alſo more frequently ſeizes barren women and young widows, than ſuch as are bearing children.

Prognoſis. Though the appearance of this diſeaſe be ſo very terrible, it ſeldom proves mortal unleſs by wrong treatment: but notwithſtanding this, it is extremely difficult of cure, and rarely admits of any thing elſe than being palliated; for though it ſhould ſeem to be conquered by medicine for a time, it very quickly returns, and that from the ſlighteſt cauſes.

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Cure. The ends principally to be aimed at in the cure of this diſeaſe are, in the firſt place, the removal of particular convulſive or ſpaſmodic affections immediately producing various appearances in the diſeaſe, whether under the form of proper hyſteric fits, or merely of what may be called hyſteric ſymptoms; and in the ſecond place, the prevention of the return of ſymptoms after they have been removed, by the employment of proper remedies during thoſe intervals from complaints which patients often have when labouring under this affection.

The moſt powerful remedy hitherto diſcovered in hyſteric caſes is opium, or the tincture of it. By this commonly the moſt violent paroxyſms are ſtopped, though it be inſufficient to accompliſh a radical cure. In Dr Home's Clinical Experiments we find an inſtance of a cure performed by veneſection, though this remedy has been generally condemned in hyſterical caſes. Aſafœtida ſeems to ſtand next in virtue to opium; though with ſome it diſagrees, and occaſions pains in the ſtomach and vomiting. Sulphuric æther will alſo frequently remove an hyſteric fit: but its effects are of ſhort duration; and if it do not effect a cure ſoon after its exhibition, no ſervice is to be expected either by perſeverance in the uſe of it or by increaſing the doſe; and with ſome conſtitutions it diſagrees to ſuch a degree as to occaſion convulſions. If the patient be ſeized with a violent fit, ſo that ſhe can ſwallow nothing, which is frequently the caſe, it will be proper to apply ſome ſtrong volatile alkali to her noſe; or if that be not at hand, the vapour of burning feathers is ſometimes very efficacious. In ſome inſtances benefit is derived from the ſudden application of cold water to the face or hands; but ſtill more frequently the application of water in a tepid ſtate, particularly the warm pediluvium, is found to be of very great ſervice in bringing about a favourable termination of different violent hyſteric ſymptoms. A plaſter of galbanum and aſafœtida will alſo prove ſerviceable: but it muſt be remembered, that none of theſe things will prevent the return of the diſeaſe; and therefore a radical cure is to be attempted by exerciſe, cinchona, chalybeates, mineral waters, and other tonics; but particularly, where the ſtate of the patient is ſuch as to be able to bear it, by the uſe of the cold bath, which, where it does not diſagree with the conſtitution, is often of the greateſt ſervice in preventing returns of this affection.

In hyſteria as well as in chorea Dr Hamilton has found, that in ſome inſtances very great benefit has been obtained from copious evacuations of the alimentary canal, by cathartics frequently repeated.

GENUS LXIV. HYDROPHOBIA. 322

The *Dread* of WATER.

Hydrophobia, *Sauv.* gen. 231. *Lin.* 86. *Vog.* 30. *Sag.* gen. 343. *Boerh.* 1138. *Junck.* 124. *Mead* on poiſons. *Deſſault* ſur la rage. *Sauv.* diff. ſur la la rage. *James* on canine madneſs. *Dalby*, Virtues of cinnabar and muſk againſt the bite of a mad dog. *Nugent* on the hydrophobia. *Choiſel*, Nouvelle methode pour le traitement de la rage. *Journal de Medicine*, paſſim. *Medical Obſ. and Inquiries*, vol. iii. art. 34. vol. v. art. 20. 26. and App. *Med. Tranſact.* vol. ii. art. 5. 12. and 15. *Heyſham*, Diſſ. inaug. de rab. canin. Edinb. 1777. *Parry*, Diſſ. inaug. de rab. contagioſ. ſive canin. Edinb. 1778. *Andry*, Recherches ſur la rage, 1778. *Vaughan*, Caſes of hydrophobia, ſecond edit. 1778. *Arnold*, Caſe of hydrophobia, 1795.

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Hydrophobia vulgaris, *Sauv.* ſp. I.

It is the opinion of ſome, that Dr Cullen has done wrong in employing the term *hydrophobia* as a generic name, under which canine madneſs is included: and it muſt be allowed, that the dread of water, while it is not univerſal, is alſo a ſymptom occurring only late in the diſeaſe, at leaſt in the greater part of caſes. Perhaps his arrangement would have been leſs exceptionable, if, following Linnæus, he had adopted *rabies* as a generic term, and had diſtinguiſhed this particular ſpecies by the epithet of *canina*, *contagioſa*, or the like. Diſputes, however, about names, are in general not very important; and it is ſufficient to obſerve, that the affection now to be treated of is canine madneſs, or that diſeaſe which ariſes from the bite of a mad animal.

Deſcription. This diſeaſe commonly does not make its attack till a conſiderable time after the bite. In ſome few inſtances it has commenced in ſeven or eight days from the accident; but generally the patient continues in health for 20, 30, or 40 days, or even much longer. The bite, if not prevented, will in general be healed long before that time, frequently with the greateſt eaſe; though ſometimes it reſiſts all kinds of healing applications, and forms a running ulcer which diſcharges a quantity of matter for many days. It has been ſaid, that the nearer the wounded place is to the ſalivary glands, the ſooner the ſymptoms of hydrophobia appear. The approach of the diſeaſe is known by the cicatrix of the wound becoming high, hard, and elevated, and by a peculiar ſenſe of prickling at the part; pains ſhoot from it towards the throat: ſometimes it is ſurrounded with livid or red ſtreaks, and ſeems to be in a ſtate of inflammation; though frequently there is nothing remarkable to be obſerved about it. The patient becomes melancholy, loves ſolitude, and has ſickneſs at ſtomach. Sometimes the peculiar ſymptom of the diſeaſe, *the dread of water*, comes on all at once. We have an inſtance of one who, having taken a vomit of ipecacuanha for the ſickneſs he felt at his ſtomach, was ſeized with the hydrophobia in the time he was drinking the warm water. Sometimes the diſeaſe begins like a common ſore throat; and the ſoreneſs daily increaſing, the hydrophobic ſymptoms ſhow themſelves like a convulſive ſpaſm of the muſcles of the fauces. In others, the mind ſeems to be primarily affected, and they are ſubject to deſpondency and melancholy for ſome time prior to any dread of water. And when that dread commences, it is with an evident mental affection. Dr James, in his Treatiſe on Canine Madneſs, mentions a boy ſent out to fill two bottles with water, who was ſo terrified by the noiſe of the liquid running into them, that he fled into the houſe crying out that he was bewitched. He mentions alſo the caſe of a farmer, who, going to draw ſome ale from a caſk, was terrified to ſuch a degree at its running into the veſſel, that he ran out in a great haſte with the ſpigot in his hand. But in whatever manner this ſymptom comes on, it is certain that the moſt painful ſenſations accompany every attempt to ſwallow liquids. Nay, the bare ſight of water, of a looking-glaſs, of any thing clear or pellucid, will give the utmoſt uneaſineſs, or even throws the patient into convulſions.

With regard to the affection of the mind itſelf in this diſeaſe, it does not appear that the patients are deprived of reaſon. Some have, merely by the dint of reſolution, conquered the dread of water, though they never could conquer the convulſive motions which the contact of liquids occaſioned: while this reſolution has been of no avail; for the convulſions and other ſymptoms increaſing, have almoſt always deſtroyed the unhappy patients.

In this diſeaſe there ſeems to be an extreme ſenſibility and irritability of the nervous ſyſtem. The eyes cannot bear the light, or the ſight of any thing white; the leaſt touch or motion offends them, and they want to be kept as quiet and in as dark a place as poſſible. Some complain of the coldneſs of the air, frequently when it is really warm. Others complain of violent heat; and have a great deſire for cold air, which yet never fails to increaſe the ſymptoms. In all there is a great flow of viſcid ſaliva into the mouth; which is exceedingly troubleſome to the patients, as it has the ſame effect upon their fauces that other liquids have. This therefore they perpetually blow off with violence, which in a patient of Dr Fothergill's occaſioned a noiſe not unlike the hollow barking of a dog, and which he conjectures might have given riſe to the common notion that hydrophobous patients bark like dogs. They have an inſatiable thirſt; but are unable to get down any drink, except with the utmoſt difficulty; though ſometimes they can ſwallow bread ſoaked in liquids, ſlices of oranges, or other fruits. There is a pain under the *ſcrobiculus cordis*, as in the tetanus; and the patients mournfully point to that place as the ſeat of the diſeaſe. Dr Vaughan is of opinion that it is this pain, rather than any difficulty in ſwallowing, which diſtreſſes the patient on every attempt to drink. The voice is commonly plaintive and mournful; but Dr Vaughan tells us there is a mixture of fierceneſs and timidity in the countenance which he cannot deſcribe, but by which he could know a hydrophobous perſon without aſking any queſtions.

In this diſtemper, indeed, the ſymptoms are ſo various, that they cannot be enumerated; for we will ſeldom read two caſes of hydrophobia which do not differ very remarkably in this reſpect. Some ſeem to have at times a furious delirium, and an inclination to ſpit at or bite the byſtanders; while others ſhow no ſuch inclination, but will even ſuffer people to wipe the inſide of their mouths with the corner of a handkerchief in order to clear away the viſcid ſaliva which is

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is ready to suffocate them. In some male patients there is an involuntary erection of the penis, and emission of the semen; and the urine is forced away by the frequent return of the spasms. In a letter from Dr Wolf of Warsaw to Henry Baker, F. R. S. dated Warsaw Sept. 26th, 1767, we have the following melancholy account of the cases of five persons who died of the hydrophobia: "None of them quite lost their right senses; but they were all talking without intermission, praying, lamenting, despairing, cursing, sighing, spitting a frothy saliva, screeching, sometimes belching, retching, but rarely vomiting. Every member is convulsed by fits, but most violently from the navel up to the breast and œsophagus. The fit comes on every quarter of an hour; the fauces are not red, nor the tongue dry. The pulse is not at all feverish; and when the fit is over nearly like a sound pulse. The face grows pale, then brown, and during the fit almost black; the lips livid; the head is drowsy, and the ears tingling; the urine limpid. At last they grow weary; the fits are less violent, and cease towards the end; the pulse becomes weak, intermittent, and not very quick; they sweat, and at last the whole body becomes cold. They compose themselves quietly as if to get sleep, and so they expire. The blood drawn a few hours before death appears good in every respect. A general observation was, that the lint and dressings of the wounds, even when dry, were always black, and that when the pus was very good in colour and appearance." In one of Dr Wolf's patients who recovered, the blood stunk intolerably as it was drawn from a vein; and one of Mr Vaughan's patients complained of an intolerable fetid smell proceeding from the wounded part, though nobody but himself could perceive it. In general, the violent convulsions cease a short time before death; and even the hydrophobia goes off, so that the patients can drink freely. But this does not always happen; for Mr Vaughan mentions the case of a patient, in whom, "when he had in appearance ceased to breathe, the spasmus cynicus was observable, with an odd convulsive motion in the muscles of the face; and the strange contrariety which took place in the action of these produced the most horrid assemblage of features that can well be conceived. Of this patient also it was remarkable, that in the last hours of his life he ceased to call for drink, which had been his constant request; but was perpetually asking for something to eat."

The hydrophobia seems to be a symptom peculiar to the human race; for the mad animals which communicate the infection, do not seem to have any dread of water. Dr Wolf, in the letter above quoted, says in general, that cattle bit at the same time and by the same animal (a mad wolf) which bit the persons whose cases he related, died nearly with the same frightful raging as the men; but says nothing of their having any hydrophobia: nay, Dr James and some others assert, that the hydrophobia is not always an attendant on rabies canina in the human race; and indeed it is certain that the disease has proved mortal after this terrible symptom has been removed. With regard to the symptoms of madness in dogs, they are very equivocal; and those particularly enumerated by some authors, are only such as might be expected in dogs much heated or agitated by being violently pursued and struck. One symptom indeed, if it could be depended upon, would determine the matter; namely, that all other dogs avoid and run away from one that is mad; and even large dogs will not attack one of the smallest size who is infected with this disease. Upon this supposition they point out a method of discovering whether a dog who has been killed was really mad or not; namely, by rubbing a piece of meat along the inside of his mouth, and then offering it to a sound dog. If the latter eats it, it is a sign the dog was not mad; but if the other rejects it with a kind of howling noise, it is certain that he was. Dr James tells us, that among dogs the disease is infectious by staying in the same place; and that after a kennel has been once infected, the dogs put into it will be for a considerable time afterwards in danger of going mad also. A remedy for this, he says, is, to keep geese for some time in the kennel. He rejects as false the opinion that dogs when going mad will not bark; though he owns that there is a very considerable change in their bark, which becomes hoarse and hollow.

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Of all the accounts that have been published on the characteristics of rabies in dogs, the best is to be found in Dr Arnold's late treatise: the characteristics there mentioned are given on the authority of Mr Meynell, a gentleman who has paid particular attention to this subject. From Mr Meynell's observations it appears, that most of the characteristics which have been commonly mentioned, are mere vulgar errors; and, according to him, the best marks are from their peculiar dull look, and the peculiar sound which they utter. "Mad dogs (says Mr Meynell) never bark, but occasionally utter a most dismal and plaintive howl, expressive of extreme distress, and which, they who have once heard it, can never forget; so that dogs may be known to be going mad without being seen, when only this dismal howl is heard.

Causes, &c. In no disease whatever are we more at a loss to discover the causes than in the hydrophobia. In dogs, foxes, and wolves, it seems to come on spontaneously; though this is contested by some authors. It is said, that the causes commonly assigned, viz. heat, feeding upon putrid flesh, want of water, &c. are not sufficient for producing the distemper. It does not appear that madness is more frequent among dogs in the warm than in the cold climates; nay, in the island of Antigua, where the climate is very hot, and the water very scarce, this distemper has never, it is said, been observed. As to putrid aliment, it seems natural for dogs to prefer this to any other, and they have been known to subsist upon it for a long time without any detriment. For these reasons, they think the disease arises from a specific contagion, like the smallpox and measles among the human race, which, being once produced by causes unknown, continues to be propagated by the intercourse which dogs have with each other, as the diseases just mentioned continue to be propagated among the human race.

With regard to the immediate cause among mankind, there is not the least doubt that the hydrophobia is occasioned by the saliva of the mad animal being mixed with the blood. It does not appear that this can operate through the cuticula; but, when that is rubbed off, the smallest quantity is sufficient to communicate

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When we attempt to investigate the nature of the cause of the hydrophobia by dissections, our inquiries are commonly disappointed. In two bodies opened by Dr Vaughan, there was not the least morbid appearance; in the very fauces, where we might have expected that the disease would have shown itself most evidently, there was not the least appearance even of inflammation. The stomach, intestines, diaphragm, œsophagus, &c. were all in a natural state: neither do we find in authors of credit any certain accounts of morbid appearances in the bodies of hydrophobous persons after death. Dr Vaughan therefore concludes, that the poison acts upon the nervous system; and is so wholly confined to it, that it may be doubted whether the qualities of the blood are altered by it or not; and that it acts upon the nerves by impairing and disturbing their functions to such a degree as speedily to end in a total extinction of the vital principle. As to the difficulty in swallowing generally believed to accompany dread of the water, he treats it as a misrepresentation, as well as that the œsophagus with the muscles subservient to deglutition are especially concerned in this disease. The principal foundation of the evil, he thinks, rests on a morbid sensibility both of the external and internal fauces. For the sight of a liquid, or the application of any substance to the internal fauces, but more especially of a fluid, instantly excites the most painful feelings. Nay, the same symptoms are produced by touching the external fauces with a fluid, or by the contact of cold air with these parts; and nearly in as great a degree. But a solid or fluid substance being conveyed into the œsophagus, the transit into the stomach is accomplished with little or no impediment; so that in fact the difficulty is surmounted before the patient is engaged in the action of swallowing. Nor is the excruciating pain, which never fails to be the companion of every attempt to drink, felt in the *fauces* and *throat*: it is, he says, at the *scrobiculus cordis*; to which the sufferer applies his hand. From this last circumstance, therefore, from the presence of the *risus sardonicus*, from the muscles of the abdomen being forcibly contracted, and from the sense of suffocation which seems to threaten the patient with immediate death, Dr Vaughan has been led to think that in the hydrophobia a new sympathy was established between the fauces, the diaphragm, and the abdominal muscles.

Prognosis. When a person is bit, the prognosis with regard to the ensuing hydrophobia is very uncertain. All those who are bit do not fall into the disease; nay, Dr Vaughan relates, that out of 30 bit by a mad dog, only one was seized with the hydrophobia. During the interval betwixt the bite and the time the disease comes on, there are no symptoms by which we can judge whether it will appear or not. When once it has made its appearance, the prognosis is exceedingly fatal, though there are certainly some well authenticated cases of complete recovery, particularly one recorded by Dr Arnold. Hydrophobia.

Prevention and Cure. It has been generally allowed by practitioners, that though the hydrophobia may be prevented, yet it can seldom if ever be cured after it has made its appearance. The most essential part of the treatment therefore depends on the proper use of means of prevention. The great objects to be aimed at in prevention, are, in the first place, the complete removal of the contagious matter as soon as possible; or, secondly, means of destroying it at the part, where there is even the slightest reason to believe that it has not been completely removed. Of all the means of removal, the complete cutting out the part to which the tooth has been applied, is unquestionably the most to be depended upon. This practice, therefore, should be had recourse to as soon as possible. The sooner it can be accomplished, the better. But it has been observed, that as a peculiar sensation at the part affected always precedes the accession of the disease, even when it takes place at a late period after the bite, there is good ground for believing that the removal of the part may be of advantage even after a considerable interval. But besides removal of the contagious matter, by cutting away the part to which it is attached, this should also be attempted by careful and long-continued washing. This may be done, in most instances, before a proper opportunity can be had of having recourse to the knife. Cold water should particularly be poured upon the wound from a considerable height, that the matter may be washed away with some force. Even after removal by the knife, careful washing is still a necessary and proper precaution. And after both these, to prevent as far as can be the possibility of any contagious matter lurking about the wounded part, it should not be allowed to heal, but a discharge of matter should be supported for the space of several weeks, by ointment with cantharides, or similar applications. By these means there is at least the best chance of removing the matter at a sufficiently early period And this mode of prevention seems to be of more consequence than all others put together which have hitherto been discovered. But besides removal, prevention may also be obtained by the destruction of the contagious matter at the part; and where there is the least reason to think that a complete removal has not been obtained, this should always be had recourse to. With this intention the actual cautery and burning with gun-powder have been employed. And the action of fire is probably one of the most powerful agents that can be used for this purpose. But recourse has also been had to washing both with acids and with alkalies. Of the former kind, vinegar has been chiefly used, but more may probably be expected from the latter; and particularly from the caustic alkali, so far dilated that it can be applied with safety: for from its influence as a solvent of animal mucus, it gives the

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On theſe grounds, and by theſe means, we are inclined to think that the action of this contagion on the ſyſtem, after it has been applied by the bite of a rabid animal, may be moſt effectually prevented. But after this action has once taken place, no remedy has yet been diſcovered on which much dependence can be put. A very great variety of articles indeed have at different periods been held forth as infallible, both in the prevention and cure of this affection; but their reputation has, perhaps, univerſally been founded on their being given to people, who, though really bit by a mad dog, were yet not infected with the contagion. And this happily, either from the tooth being cleaned in making the bite, or not being covered with contagious matter, is by no means an unfrequent occurrence. Mankind, however, even from the earlieſt ages, have never been without ſome boaſted ſpecific, which has been held forth as an infallible remedy for this affection till fatal experience demonſtrated the contrary. Dr Boerhaave has given a pretty full catalogue of thoſe ſpecifics from the days of Galen to his own time; and concludes, that no dependence is to be put in any of them. It is now, therefore, altogether unneceſſary to take notice of burnt crabs, the hyæna's ſkin, mithridate with tin, liver of the rabid animal, or a variety of other pretended remedies for this diſeaſe, proved by experience to be totally inefficacious. But although no greater confidence is perhaps to be put in ſpecifics of modern date, it will be proper that theſe ſhould be mentioned.

Bathing in cold water, eſpecially in the ſea, and drinking ſea-water for a certain time, have been preſcribed, and by ſome accounted a certain preventive. When this was known to fail, a long courſe of antiphlogiſtic regimen, violent ſubmerſion in water, even to danger of drowning, and keeping the wounded place open with cauteries, were recommended.—To this extreme ſeverity Dr Mead objected; and in his treatiſe on this ſubject endeavours to ſhow, that in all ages the greateſt ſucceſs has been reaped from diuretics, for which reaſon he propoſes the following powder: "Take aſh-coloured ground-liverwort, half an ounce; black-pepper, two drams: reduce them ſeparately to powder, then mix them together." This powder was firſt publiſhed in the Philoſophical Tranſactions, by Mr Dampier, in whoſe family it had been kept as a ſecret for many years. But this medicine, which was inſerted in former editions of the London and Edinburgh pharmacopœias, under the name of *Pulvis Antilyſſus*, has long loſt its credit.

There is a famous Eaſt India medicine, compoſed of 24 grains of native and as much factitious cinnabar, made into a powder with 16 grains of muſk. This is called the *Tonquin* medicine, and muſt be taken in a tea cupful of arrac or brandy; and is ſaid to ſecure the patient for 30 days, at the expiration of which it is to be repeated; but if he has any ſymptoms of the diſeaſe, it muſt be repeated in three hours; Hydrophobia. which is ſaid to be a ſufficient for a cure. The firſt doſe is to be taken as ſoon after the bite as poſſible.

Another celebrated remedy is Palmarius's powder, compoſed of the leaves of rue, vervain, ſage, polypody, wormwood, mint, mugwort, balm, betony, St John's-wort, and leſſer centaury. Theſe herbs muſt be gathered in their prime, dried ſeparately in the ſhade, and then powdered. The doſe is a dram, or a dram and an half, taken every day.

A remedy which might promiſe to be more efficacious than any of thoſe hitherto mentioned is mercury. This has been recommended in frictions, and to be taken inwardly in the form of calomel and turbith mineral, in order if poſſible to raiſe a ſlight ſalivation, on which the efficacy was thought to depend. Beſides this, veneſection, opium, cinchona, and camphor, have been tried in very large quantities; the warm bath; and, in ſhort, every thing which human invention could ſuggeſt; but with how little ſucceſs, can be judged from many well authenticated caſes.

Dr Wolf, after detailing a number of intereſting caſes, makes the following obſervations.—"Thus we ſee, that the mercury, the acids, the muſk, the feeding on the moſt famous herbs, the ſweating, the *cura antiphlogiſtica*, &c. are no ſpecifics."

The following caſe by Dr Raymond of Marſeilles ſhows the inefficacy of mercury even as a *preventive*.—On the 19th of July 1765, Mr Boyer, aged 25, of a bloated cachectic habit, was bit by a mad dog in the inferior part of the leg: the wound extended half way round, bled freely, and was like a great ſcratch. The patient's legs had been ſwelled for a conſiderable time before the accident; and there were alſo two ulcers in the other leg. Some hours after the accident, the actual cautery was applied to the wound. The doctor was not preſent at this operation; but the part around the bite was rubbed with mercurial ointment immediately after, and the eſchar was dreſſed with the ſame ointment. The eſchar was ſeparated on the firſt day, but the dreſſing was continued till the wound was cicatriſed. The ſecond day a bolus of four grains of turbith and eight grains of camphor was exhibited. This procured a conſiderable evacuation both by vomit and ſtool, and a ſpitting alſo came on. The third day the bitten leg was rubbed with mercurial ointment: in the ſpace of a month the frictions were repeated five times on both legs, three drams of mercurial ointment being uſed in each friction. During the ſame time the bolus was five times repeated; and this treatment kept up a ſlight ſalivation to the 40th day. The evening of the third day he took the *Tonquin medicine*, called alſo *Sir George Cobb's powder*, in a bolus; which vomited him briſkly. This powder was repeated ſeven or eight times in the month, generally with the ſame effect. During the firſt ſeven or eight days he got four times, in the morning, a dram of the *anagallis flore puniceo*, freſh gathered and powdered. The 41ſt day, the turbith bolus was preſcribed for the ſeventh time: he was bathed in the ſea, and continued the bathing for two days more. On the 74th he was ſeized with the diſtemper; and died on the 76th, ſeemingly ſuffocated or ſtrangled, his mouth covered with ſlaver, and his

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his face bloated. He lost his senses not above half a quarter of an hour before his death. The pulse was quiet the whole time.

Another instance is mentioned by the same author, of a pregnant woman bit by the same dog and on the same day with Mr Boyer, who was never seized with the distemper. She was treated in much the same manner with him, and salivated a little more. But she was bit through a shamoy leather shoe, which must necessarily have cleaned the animal's teeth of the poisonous saliva before they reached her skin, and to this we are naturally led to ascribe her safety. One of Dr Wolf's patients also was a pregnant woman, and was not seized with the distemper. Perhaps women in a state of pregnancy may be less liable to this distemper than others; but it is more probable that the contagion was not communicated.

The same author tells us, "there are many examples of the inefficacy of mercurial frictions. A surgeon of Marseilles treated a girl about 12 years of age bit by a mad dog, with mercurial frictions; applying them as in the *lues venerea*: yet she died of the hydrophobia on the 55th day. Her wound was not cauterized."

In the following case all the most powerful remedies were tried.—In the afternoon of the 29th of Aug. 1777, Dr Vaughan was called to a boy of eight years of age labouring under a hydrophobia. He had been bit on the wrist by a cat about a month before; of which the marks remained, but without any ulcer, or even the smallest appearance of inflammation. About the middle of the day before Dr Vaughan saw him, he began to complain of a pain in the part bitten, which ascended up the arm, and affected the temple on that side; soon after which he swallowed liquids with reluctance and difficulty. He was put into the warm bath for three quarters of an hour, during which time he was easier: he had a clyster of five ounces of fresh broth, and 30 drops of laudanum, injected immediately after his coming out of it; a liniment consisting of three drams of strong mercurial ointment, with the same quantity of oil of amber, was rubbed upon the shoulders and back; two pills of a grain of flowers of zinc, and half a grain of *cuprum ammoniacum*, were taken every three or four hours: and a medicated atmosphere was prepared for him, by burning gum ammoniac in his room. As these remedies were not attended with any good effect, each dose of pills was ordered to contain two grains of *cuprum ammoniacum*, the same quantity of opium, three grains of flowers of zinc, and ten grains of asafœtida; whilst a solution of that fetid gum, with a dram of laudanum, was administered as a clyster. These pills, though repeated every four hours, afforded not the smallest relief, nor did they show the least action on the frame. At last the doctor resolved to put in practice the desperate remedy mentioned by Van Helmont, of throwing the patient into cold water, and keeping him there till he is almost drowned. With this view a large tub of cold water, well saturated with common salt, was prepared, into which the poor boy was plunged over head and ears, and there held until he ceased to struggle. He was then taken out again, and the same operation repeated until he became so quiet that the doctor was under apprehensions that a total extinction of life would take place. He was then wrapped up in a blanket and put to bed, and he remained more quiet than he had formerly been; but all his former restlessness soon returned, his pulse sunk, and he died about two o'clock in the morning.

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Another celebrated antidote against the poison of a mad dog has been known for some years by the name of the *Ormskirk medicine*. The true composition of this is kept a secret by the proprietors: however, it has been analysed, and the following composition published by Dr Heysham as perfectly similar to it in all respects.

"Take half an ounce of chalk, three drams of Armenian bole, 10 grains of alum, one dram of elecampane in powder; mix them all together, and add six drops of oil of anise."

They must certainly be very credulous who can put confidence in such an insignificant medicine as a preservative against the hydrophobia: however, there is a possibility that there may be some unknown ingredient in the genuine powder; for it is difficult to analyse powders after the ingredients are thoroughly mixed together. The efficacy of the medicine therefore must depend on the virtues of that unknown ingredient, if any such there be. The following, cases, however, too well determine that it is not *infallible*, as was at first pretended. In all probability, as well as many others, its reputation also is solely rested on its being exhibited in many cases where no contagion was communicated to the person bit, and while of course no disease could take place.

On the 14th of February 1774, Mr Bellamy of Holborn, aged 40, was bit by a cat affected with rabies, which was killed the same morning. The following day he took the celebrated Ormskirk medicine, sold by Hill and Berry in Hill-Street, Berkeley-Square, and conformed in every respect to the directions given by the vender. A servant maid, who was bitten in the leg before her master was bitten, likewise took the same remedy. About the middle of April Mr Bellamy complained of a pain in his right knee, which he supposed to be rheumatic, and which continued and increased till the 7th of June, when he got some pills of calomel, ipecacuanha, and *pil. sapon.* from an apothecary, with Huxham's tincture of the bark in small doses. In six days more he had a titillation in the urethra, a contraction of the scrotum and penis to a degree of pain, and an emission of semen after making water, to which he had frequent calls. The medicines were discontinued; and on the 16th of that month the hydrophobia came on, and Dr Fothergill was called. Six ounces of blood were taken from his arm, and a bolus of a scruple of native cinnabar and half a scruple of musk was given every four hours. The distemper manifestly increased through the day. In the evening a clyster was injected, and several times repeated during the night; he had been put into the warm bath, and two drams of strong mercurial ointment rubbed into his legs and thighs by himself. He was greatly relieved by the warm bath while he continued in it, but the symptoms returned with increased violence in the night. The next day being greatly worse, he was blooded to as great a quantity as he could bear, had the warm bath and clysters repeated, and half an ounce of mercurial ointment rubbed into his thighs and legs. Pills of opium were prescribed, but he did not take them. He died

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the same night, at half an hour after 12. This patient was a man of great resolution, and could in part conquer his aversion at water. He seemed to have totally forgot the accident of the bite: and casually said, that he thought this disorder resembled the hydrophobia, without supposing that he was afflicted with that distemper at the time.—The bite on the girl's leg refused to heal, baffled the art of a young surgeon who attempted to cure it, and continued a running ulcer for a long time. She did not fall into the hydrophobia. Hence Dr Fothergill thinks it probable, that keeping the wounds made by the teeth of mad animals open for a long time, would probably be of service as a preventive; but in some of Dr Wolf's patients, these artificial drains appear not to have been attended with success.

On the 16th of November 1773, Thomas Nourse, a strong healthy boy of 14, was admitted into the Leicester infirmary; having been that day month bitten by a mad fox-hound. The wound was a large lacerated one on the cheek, and bled very freely on being inflicted. The day after he was bit he went to the sea, where he was dipped with all the severity usually practised under so disagreeable an operation. The *Ormskirk medicine* was also administered with all due care. It was bought of the person in Leicester who is deputed by the proprietor to sell it for him. A common adhesive plaster was applied to the part after sea-bathing; and in the course of a month, without any further trouble, the wound was healed; excepting a small portion, somewhat more than an inch in length, and in breadth about one-tenth. This yielded no discharge, and was quite in a cicatrizing state. Five days before his admission into the infirmary, he began to complain of a tightness over his temples, and a pain in his head: in two days the hydrophobia began to appear; and at its commencement he complained of a *boiling heat* in his stomach, which was continually ascending to the fauces. The disease was pretty strong when he came to the infirmary. He got a bolus of a scruple of musk with two grains of opium; then a composition of 15 grains of musk, one of turbith mineral, and five grains of opium, was directed to be taken every third hour; an ounce of the stronger mercurial ointment was to be rubbed on the cervical vertebræ and shoulders, and an embrocation of two ounces of laudanum, and half an ounce of *acetum saturninum*, was directed to be applied to the throat. But by this last he was thrown into convulsions, and the same effect followed though his eyes were first covered with a napkin. The embrocation was therefore changed for a plaster of three drams of powdered camphor, half an ounce of opium, and six drams *confectio Damocritis*. By these medicines the disease seemed to be somewhat suspended, but the symptoms returned with violence in the evening. His medicine was repeated at seven; and at eight five grains of opium were exhibited without musk or turbith. At nine, another ounce of mercurial ointment was rubbed upon the shoulders, and half an ounce of laudanum with six ounces of mutton-broth was injected into the intestines, but to no purpose. A larger dose of opium was then given, but with as little effect as the former, and he died the same night.

In the month of September 1774, a farmer, aged 25, was bit by a mad dog, whose teeth made a slight wound in the fore finger of the left hand. He was dipped, as usual, in the sea; and drank the sea-water for some time on the spot, which operated briskly as a purge. He continued well till the 6th of June following, when he first felt a pain in that hand and arm; for which he bathed in a river that evening, supposing that it had been a rheumatic complaint. The next day he was sick; and in the evening was seized with a violent vomiting, which continued all that night and till the middle of the next day, when it was succeeded by the hydrophobia. He was treated with the warm bath; had a purgative clyster injected; and as soon as it had operated, a second was given, consisting of four ounces of oil, and half an ounce of laudanum: half an ounce of strong mercurial ointment was rubbed on the fauces, and the part was afterwards covered with the *cataplasma è cymino*, to which was added an ounce of opium. An embrocation was applied to the region of the stomach with continued friction, consisting of half an ounce of spirit of sal ammoniac, ten drams of olive oil, six drams of oil of amber, and ten drams of laudanum. Two ounces of strong mercurial ointment were rubbed upon the shoulders and back; and as a further means of inducing a ptyalism speedily, he received the smoke of cinnabar into the mouth by throwing a dram of that substance now and then upon a hot iron: he was also directed to take every four hours a bolus of 15 grains of musk, three grains of turbith mineral, and four grains of opium. He was easier while in the warm bath, and during the application of the ointment; but died the same night about two o'clock.

Many other instances might be adduced of the inefficacy of this pretended specific: which will, it is hoped, create a due degree of caution in those to whom they who are so unfortunate as to be bit by a mad animal may commit themselves. Another remedy may also be mentioned as having had the reputation of being sometimes successful in this disease; which is chiefly employed in different parts of India, particularly in the territory of Tanjore. The medicine to which we now allude contains indeed several articles which are altogether unknown in our materia medica: but it contains at least one very powerful substance well known to us, viz. arsenic. This medicine, known by the name of the Snake Pills, as being principally employed against the bite of the most venomous snakes, is directed to be prepared in the following manner:

Take white arsenic, of the roots of nelli navi, of nevi visham, of the kernels of the ner valum, of pepper, of quicksilver, each an equal quantity. The quicksilver is to be rubbed with the juice of the wild cotton till the globules are perfectly extinguished. The arsenic being first levigated, the other ingredients, reduced to a powder, are then to be added, and the whole beat together with the juice of the wild cotton to a consistence fit to be divided into pills.

Though these pills are principally used against the bite of the cobra de capello, yet they are said also to be successful in the cure of other venomous bites; and, for the prevention of rabies canina, one is taken every morning for some length of time. Of this remedy European practitioners have, we believe, as yet no experience; and if, in the accounts transmitted by

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by East India practitioners, it cannot be said that we have authentic evidence of its want of success, it can as little be pretended that there is indubitable evidence of its efficacy in any instance; and it is by no means improbable, that it will be found equally inefficacious with others at one time considered as infallible.

Of the great variety of remedies which have had their day of reputation, there is not one which has not possessed the credit, some time or other, of preventing the noxious effects arising from the bite of a mad dog. A more adequate experience has with all of them discovered the deception. It was above observed, that rabies is by no means the infallible consequence of being bit by a mad animal; and that of between 20 and 30 persons who were bit by the dog which gave the fatal wound to one of Dr Vaughan's patients, not one felt the least ill effect but himself. "In the above number (says the doctor) were some who took the Ormskirk medicine; others went to the salt water; and a part of them used no remedy, who yet fared equally well with the most attentive to their injury. The same thing has often happened before; and much merit, I doubt not, has been attributed to the medicine taken, from that celebrated one of *Sir George Cobb* down to the *infallible* one which my good *Lady Bountiful*'s receipt-book furnishes."

From all that has been said, the reader will judge how far the hydrophobia is capable of being subdued by any of the medicinal powers which have yet been tried. Some eminent physicians assert that it is totally incurable; and allege that the instances recorded by different authors of its cure have not been the genuine kind, but that which comes on spontaneously, and which is by no means so dangerous. Indeed two of Dr Wolf's patients recovered, where the disease seems to have been perfectly genuine: but in these the poison seemed to vent itself partly on some other place besides the nervous system. In one the blood was evidently infected, as it had an abominable fœtor; and the other had a violent pain and swelling in the belly. In all the others, it seemed to have attacked only the nervous system; which perhaps has not the same ability to throw off any offending matter as the vascular system.

There is, however, a possibility that the prodigious affections of the nerves may arise only from a vitiated state of the gastric juices; for it is well known, that the most terrible convulsions, nay the hydrophobia itself, will arise from an affection of the stomach, without any bite of a mad animal. This seems to be somewhat confirmed from one of Dr Wolf's patients, who, though he vomited more than 50 times, yet still threw up a frothy matter, which was therefore evidently secreted into the stomach, just as a continual vomiting of bilious matter shows a continual and extraordinary secretion of bile. Dr Wolf himself adopts this hypothesis so far as to say, that perhaps the *serum* may become frothy; but in blood drawn from a vein not the least fault appears either in the serum or crassamentum. He affirms, however, that the duodenum appears to be one of the parts first and principally affected; and as it is not inflamed, it would seem that the affection it sustains must arise from the vitiated state of its juices.

Be this as it will, however, in the hydrophobia, the stomach seems totally, or in a great measure, to lose the power which at other times it possesses. Two grains of *cuprum ammoniacum* were repeatedly given to a child of eight years of age without effect; but this dose would occasion violent vomiting in a strong healthy man. Something or other therefore must have prevented this substance from acting on the nervous coat of the stomach; and this we can only suppose to have been the exceedingly disordered state of the gastric juice, which occasioned such violent irritation through the whole body, that the weaker stimulus of the medicine was entirely lost. It would seem proper therefore to consider the stomach in hydrophobic cases as really containing a poisonous matter, which could not be expelled by vomiting, because it is renewed as fast as evacuated. The indication therefore must be, to change its nature by such medicines as are certainly more powerful than the poison; and this indication will naturally lead us to think of large doses of alkaline salts. These, it is certain, will destroy any animal substance with which they come in contact, and render even the poison of serpents inactive. By exhibiting a few doses of them, larger no doubt than what could be safely done on other occasions, we would be certain to change the state of the stomachic juices; and thus might free the patient from those intolerable spasms which always occasion death in such a short time. Dr Wolf seems inclined to think that volatile alkalies were of service; but the above hypothesis would incline us to use rather the fixed kind. At any rate, it seems vain for physicians to trust much to the power of opium, mercury, musk, or cinnabar, either singly or combined in any possible way. Cinchona has also failed, and the most celebrated specifics have been found ineffectual. Alkalies are the next most powerful remedies which the *materia* medica affords, and they cannot be more unsuccessful than the others have generally been.

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Another remedy which seems adapted to change the nature of the gastric juices is ardent spirits. In one of Dr Wolf's patients two bottles of brandy seem to have effected a cure. The oil mixed with it was of no efficacy in other cases, and the opium and turbith seem not to have been exhibited till the worst was past. In this case the disease seems to have attacked the vascular as well as the nervous system.

In all the patients the warm bath seems to have been a palliative, and a very powerful one, and as such it ought never to be omitted, though we can by no means trust to it as a radical cure; and the above histories abundantly show, that though the warm bath and opium may palliate for a short time, the cause on which the spasms depend is still going on and increasing, till at last the symptoms become too strong to be palliated even for a moment by any medicine however powerful. At any rate, the above-mentioned hypothesis suggests a new indication, which, if attended to, may perhaps lead to useful discoveries. In cases where putrescent bile is abundantly secreted, columbo root and vegetable acids are recommended to change the nature of the poison which the body is perpetually producing in itself. Where corrosive mercury has been swallowed, alkaline salt is recommended to destroy the poison which nature cannot expel by vomiting; and why

Spafmi.

why fhould not fomething be attempted to deftroy the poifon which the ftomach feems to fecrete in the hydrophobia, and which nature attempts to expel, though in vain, by violent efforts to vomit?

But whatever plan may be purfued in the hopes of curing this dreadful malady after any of the fymptoms have made their appearance, we ought, in every inftance, to direct our immediate care to *prevention*, as being perhaps the only real ground of hope: And the moft certain and efficacious way of preventing the ill confequences, is inftantly (if it can be done) to cut out the piece that happens to be bitten. Dr James, indeed, fays, that he would have little opinion of cutting or cauterizing, if ten minutes were fuffered to elapfe from the receiving of the bite before the operation was performed. But in an inaugural differtation lately publifhed at Edinburgh by Dr Parry, the author is of opinion that excifion will be of ufe a confiderable time after the bite is received. He adopts this opinion from what happens in the fmallpox, where the blood does not feem to receive the infection till fome days after inoculation has been performed. A fecond inflammation, he tells us, then takes place, and the infection is conveyed into the blood. In like manner, when the hydrophobous infection is about to be conveyed into the blood, according to him, the wound, or its cicatrix, begins again to be inflamed; and it is this fecond inflammation which does all the mifchief. Excifion, or the cautery, will therefore be effectual any time between the bite and the fecond inflammation of the wound. Without implicitly trufting to this doctrine, however, or confidering it as in any degree afcertained in what manner the poifon diffufes itfelf, by what marks its progrefs may be known, or how foon the fyftem may be irremediably tainted with its malignity, it is undoubtedly fafeft not to lofe unneceffarily a moment's time in applying the knife. This, or a dilation of the wound if it be fmall, Dr Vaughan confiders as the only prophylactics that can be depended upon. In the latter cafe, he directs to fill the wound with gunpowder, and fet fire to it; which would produce a laceration of the part, and poffibly the action of ignited powder upon the poifon may have its ufe. In all cafes, likewife, after thefe practices have been employed, the wound fhould be prevented from healing for fome length of time.

324 Sp. II. The *Spontaneous* HYDROPHOBIA.

Hydrophobia fpontanea, *Sauv.* fp. 2.

This difeafe very much refembles the former, fo that it has undoubtedly been often miftaken for it. It has been known to come on from an inflammation of the ftomach, where it was cured by repeated and large bloodletting; in hyfteria, where it was cured by opium, mufk, or other antifpafmodics; and in putrid fevers, where it was cured by evacuating the inteftinal canal of the putrid matters by repeated clyfters. A very good method of diftinguifhing the two is, that in the fpontaneous hydrophobia the patient is much more delirious than in the genuine fpecies. In the inftance mentioned in the Medical Effays of this fymptom attending the inflammation of the ftomach, the patient *raved in the moft extraordinary manner.* Dr Raymond fays he remembers a fpontaneous hydrophobia *attended with madnefs;* and in almoft all the cafes of hydrophobia which are faid to have been cured, the patient was very delirious. Dr Nugent's patient was very frequently delirious, and dreaded *dogs* as well as water. In the Medical Tranfactions a cafe is communicated by W. Wrightfon furgeon in Sedgefield, Durham, of *canine madnefs* fuccefsfully treated. This madnefs indeed came on after the bite of a dog faid to be mad: but it appeared only four days after the accident happened, and was attended with fymptoms very unlike any of thofe above mentioned; for he fuddenly ftarted up in a fit of delirium, and ran out of the houfe, and after being brought in, caught hold of the hot bars of the grate which held the fire: Whereas, in the true hydrophobia, the patients dread the fire, light, or any thing which makes a ftrong impreffion on the fenfes. It is probable, therefore, that this was only a fpontaneous hydrophobia, efpecially as it readily yielded to venefection, 30 drops of laudanum, and pills of a grain and an half of opium given every three hours, fome bolufes of mufk and cinnabar, &c. while in fome of the former cafes as much opium was given to a boy as would have deprived of life the ftrongeft healthy man had he fwallowed it; and yet this amazing quantity produced fcarcely any effect. This patient alfo dreaded the fight of a dog.

Hydrophobia.

ORDER IV. VESANIÆ. 325

Paranoiæ, *Vog.* Clafs IX.
Deliria, *Sauv.* Clafs VIII. Ord. III. *Sag.* Clafs XI. Ord. III.
Ideales, *Lin.* Clafs V. Ord. I.

GENUS LXV. AMENTIA. 326

FOLLY, or *Idiotifm*.

Amentia, *Sauv.* gen. 233. *Vog.* 337. *Sag.* 346.
Morofis, *Lin.* 106.
Stupiditas, Morofis, Fatuitas, *Vog.* 336.
Amnefia, *Sauv.* gen. 237. *Sag.* 347.
Oblivio, *Lin.* 107. *Vog.* 338.
Memoriæ debilitas, *Junck.* 120.

GENUS LXVI. MELANCHOLIA. 327

MELANCHOLY *Madnefs*.

Melancholia, *Sauv.* gen. 234. *Lin.* 71. *Vog.* 332. *Sag.* 347. *Boerh.* 1089. *Junck.* 121.
Dæmonomania, *Sauv.* gen. 236. *Sag.* 348.
Dæmonia, *Lin.* 69.
Vefania, *Lin.* 70.
Paraphobia, *Lin.* 75.
Athymia, *Vog.* 329.
Delirium melancholicum, *Hoffm.* III. 251.
Erotomania, *Lin.* 82.
Noftalgia, *Sauv.* gen. 226. *Lin.* 83. *Sag.* 338. *Junck.* 125.
Melancholia nervea, *Cl. Lorry* de melancholia, P. I.

GENUS LXVII. MANIA. 328

RAVING or FURIOUS *Madnefs*.

Mania, *Sauv.* gen. 235. *Lin.* 68. *Vog.* 331. *Sag.* 349. *Boerh.* 1118. *Junck.* 122. *Battie* on Madnefs.
Paraphrofyne, *Lin.* 66.

Amentia,

Amentia, *Lin.* 67.
Delirium maniacum, *Hoffm.* III. 251.

Although these distempers may be considered as distinct genera, yet they are so nearly allied, and so readily change into each other, that it sufficiently justifies the treating all of them together.

The distinguishing characteristic of madness, according to Dr Battie, is a *false perception*; and under this general character may be comprehended all kinds of what is called *madness*, from the most silly stupidity and idiotism to the most furious lunacy. Frequently the different kinds of madness are changed into each other by the casual excitement of some passion: thus, an idiot may become furiously mad, by being put in a violent passion; though this does not so often happen as the change of melancholy into the raving madness, and *vice versa*.

It is a very surprising circumstance, that mad people are not only less liable to be seized with infectious disorders than those who are in perfect health; but even when labouring under other diseases, if the patients chance to be seized with madness, they are sometimes freed from their former complaints. Of this kind Dr Mead relates two very remarkable instances.

On the other hand, it has been known, that an intermittent fever, supervening upon madness of long standing, has proved a cure for the madness; the senses having returned when the fever terminated. Dr Monro saw two instances of this himself; and mentions it as an observation made also by his predecessor in the care of Bethlehem hospital.

Another remarkable circumstance is, that immoderate joy, long continued, as effectually disorders the mind as anxiety and grief. For it was observable in the famous South Sea year, when so many immense fortunes were suddenly gained, and as suddenly lost, that more people had their heads turned, from the prodigious flow of unexpected riches, than from the entire loss of their whole substance.

Mad people, especially of the melancholic kind, sometimes obstinately persevere in doing things which must excite great pain; whence it should seem as if their minds were troubled with some distracting notions, which make them patiently bear the present distress, lest more severe tortures should be inflicted; or possibly they may think, that, by thus tormenting the body, they render themselves more acceptable to the divine Being, and expiate the heinous sins of which they may imagine themselves to have been guilty.

It, is, however, also highly probable, that their feelings differ exceedingly from what they are in a natural state; at least they are every day observed to endure, apparently without the smallest uneasiness, watching, hunger, and cold, to an extent which in a state of health would not only be highly distressing, but to the greater part of individuals would even prove fatal. And this resistance of hunger, cold, and sleep, affords perhaps the best test for distinguishing cases of real insanity, from cases where the disease is only feigned, and appearances of it put on, to answer particular purposes; at least where this power of resistance is present, we have good reason to conclude that the affection is not feigned.

Cure. Although we be well acquainted with many of the remote causes of this disease, some of the principal of which have already been mentioned, yet we are still so ignorant of the influence of these upon the system, as giving a derangement of the mental faculties, that no general principles on which the cure may be conducted, can with any confidence be pointed out.

It may, however, be observed, that while some remedies seem to operate by producing an artificial termination of this complaint, many others have effect only as aiding a natural termination. And where a recovery from this disease does take place, it most frequently happens in consequence of a natural convalescence. All the species and degrees of madness which are hereditary, or that grow up with people from their early youth, are out of the power of physic; and so, for the most part, are all maniacal cases of more than one year's standing, from whatever source they may arise. Very often mere debility, the dregs of some particular disease, such as an ague, the small-pox, or a nervous fever, shall occasion different degrees of foolishness or madness. In these cases, the cure must not be attempted by evacuations; but, on the contrary, by nourishing diet, clear air, moderate exercise, and the use of wine: whereas, in almost all the other maniacal cases, which arise from different sources, and which come on in consequence of intemperate living, violent passions, or intense thinking, it is generally held, that evacuations of every kind are necessary, unless the constitution of the patient be such as absolutely forbids them.

Blood is most conveniently drawn either from the arm or jugulars; and if the weakness be such as renders it improper to take away much blood, we may apply cupping glasses to the occiput.

Vomiting, in weakly people, must be excited by the vinum ipecacuanhæ; but in the more robust by emetic tartar or antimonial wine: the most efficacious cathartics are the infusion or tincture of black hellebore, or infusion of senna quickened with tincture of jalap; but if there be suppression of the menses, or of an habitual hæmorrhoidal discharge, then aloetic purges will be more proper; and in some instances cooling saline purgatives, such as lixiviated tartar, are of great service. In general, mad people require very large doses, both of the emetics and cathartics, before any considerable operation ensues.

Dr Monro assures us, that the evacuation by vomiting is infinitely preferable to any other: the prodigious quantity of phlegm with which the patients in this disease abound, he says, is not to be overcome but by repeated emetics; and he observes, that the purges have not their right effect, or do not operate to so good purpose, until the phlegm be broken and attenuated by frequent emetics. He mentions the case of a gentleman who had laboured under a melancholy for three years, from which he was relieved entirely by the use of vomits and a proper regimen. Increasing the discharge by urine, is also of the greatest moment, especially when any degree of fever is present. The cutaneous discharges are also to be promoted; for which purpose the hot bath is of the highest service in maniacal cases. Hoffman asserts, that he has seen numerous instances, both of inveterate melancholy and raging madness, happily cured by means of warm bathing; bleeding

Veſaniæ. bleeding and nitrous medicines having been premiſed. Camphor has alſo been highly commended; but, if we can believe Dr Locker of Vienna, not very deſervedly. Having found very good effects from a ſolution of this medicine in vinegar, he took it for granted that all the ſucceſs was owing to the camphor; therefore, in order to give it a fair trial, he ſelected ſeven patients, and gave it in large doſes of half a dram twice a-day. This was continued for two months, and the doctor was ſurpriſed to find that only one of his patients received any benefit. He then returned the other ſix back to the camphorated julep made with vinegar, and in a few weeks four of them recovered the uſe of their reaſon. This inclined him to think that the virtue depended ſolely on the vinegar, and accordingly he began to make the trial. Common vinegar was firſt given: but after a little while he fixed on that which had been diſtilled, and gave about an ounce and a half of it every day; the patients having been previouſly prepared by bleeding and purging, which was repeated according as it was found neceſſary. He gives a liſt of eight patients who were cured by this method; ſome in ſix weeks, others in two months, and none of them took up more than three months in perfecting the cure. He does not indeed give the ages of the patients, nor mention the circumſtances of the caſes; he only mentions the day on which the uſe of the vinegar was begun and the day on which they were diſcharged; and he adds, that they all continued well at the time of his writing.

Dr Locker informs us, that this medicine acts chiefly as a ſudorific; and he obſerved, that the more the patients ſweated, the ſooner they were cured: it was alſo found to promote the menſtrual diſcharge in ſuch as had been obſtructed, or had too little of this ſalutary evacuation.

Both reaſon and experience ſhow the neceſſity of confining ſuch as are deprived of their ſenſes; and no ſmall ſhare of the management conſiſts in preventing them from hurting either themſelves or others. It has ſometimes been uſual to chain and to beat them: but this is both cruel and abſurd; ſince the contrivance called the *ſtrait waiſtcoat* anſwers every purpoſe of reſtraining the patients without hurting them.

Theſe waiſtcoats are made of ticken, or ſome ſuch ſtrong ſtuff; are open at the back, and laced on like a pair of ſtays; the ſleeves are made tight, and long enough to cover the ends of the fingers, where they are drawn cloſe with a ſtring like a purſe mouth, by which contrivance the patient has no power of his fingers; and when laid on his back in bed, and the arms brought acroſs the cheſt, and faſtened in that poſition by tying the ſleeve-ſtrings round the waiſt, he has no uſe of his hands. A broad ſtrap of girth-web is then carried acroſs the breaſt, and faſtened to the bedſtead, by which means the patient is confined on his back; and if he ſhould be ſo outrageous as to require further reſtraint, the legs are ſecured by ligatures to the foot of the bed; or they may be ſecured by being both put into one bag not very wide, which may be more eaſily fixed than the feet themſelves, at leaſt without giving pain.

It is of great uſe in practice to bear in mind, that all mad people are cowardly, and can be awed even by the menacing look of a very expreſſive countenance; and when thoſe who have charge of them once impreſs them with the notion of fear, they eaſily ſubmit to any thing that is required. The phyſician, however, ſhould never deceive them in any thing, but more eſpecially with regard to their diſtemper: for as they are generally conſcious of it themſelves, they acquire a kind of reverence for thoſe who know it; and by letting them ſee that he is thoroughly acquainted with their complaint, he may very often gain ſuch an aſcendant over them that they will readily follow his directions. Mania.

It is a more difficult matter to manage thoſe whoſe madneſs is accompanied either with exceſſive joy or with great dejection and deſpondency, than thoſe who are agitated with rage: and all that can be done is to endeavour to excite contrary ideas, by repreſſing the immoderate fits of laughter in the one kind by chiding or threatening (taking care, however, not abſolutely to terrify them, which can never be done without danger, and has often added to the miſery of the unhappy ſufferer); and diſpelling the gloomy thoughts in the other, by introducing pleaſing concerts of muſic, or any other ſpecies of entertainment which the patients have been known to delight in while they had the uſe of their reaſon. Upon the whole, in the cure of inſanity, more is perhaps to be effected by moral than by medical treatment. And this moral treatment ſhould be as gentle as is conſiſtent with ſafety. Chains, bolts, and ſeverity of every kind are to be avoided as much as poſſible. But while great benefit is often derived from company and amuſement, ſo alſo on the other hand, ſolitary confinement is in not a few caſes productive of the beſt effects.

Though bliſtering the head has generally been directed, Dr Mead ſays he has oftener found it to do harm than ſervice: but he recommends iſſues in the back; and adviſes to keep the head always cloſe ſhaved, and to waſh it from time to time with warm vinegar. Opium has by many been forbidden in maniacal caſes, from a ſuppoſition that it always increaſes the diſturbance; but there are inſtances where large doſes of this medicine have been found to prove a cure, and perhaps if it were tried oftener we ſhould find powerful effects from it: there certainly cannot much harm enſue from a few doſes, which may be immediately diſuſed if they ſhould be found to exaſperate the diſeaſe.

The diet of maniacal patients ought to be perfectly light and thin: their meals ſhould be moderate; but they ſhould never be ſuffered to live too low, eſpecially while they are under a courſe of phyſic: they ſhould be obliged to obſerve great regularity in their hours: even their amuſements ſhould be ſuch as are beſt ſuited to their diſpoſition. After the diſeaſe appears to be ſubdued, chalybeate waters and the cold bath will be highly proper to ſtrengthen their whole frame and ſecure them againſt a relapſe.

Genus LXVIII. ONEIRODYNIA. 329

Uneasiness in Sleep.

Somnium, *Vog.* 339.
Somnambuliſmus, *Sauv.* gen. 221. *Lin.* 77. *Sag.* 333.
Hypnobataſis, *Vog.* 340.

Noctambulatio,

Noctambulatio, *Junck.* 124.
Ephialtes, *Sauv.* gen. 138. *Lin.* 163. *Sag.* 245.
Incubus, *Vog.* 221. *Junck.* 50.

The greateſt uneaſineſs which people feel in ſleep is that commonly called the *incubus* or *night-mare.* Thoſe ſeized with it ſeem to have a weight on their breaſts and about their præcordia. Sometimes they imagine they ſee ſpectres of various kinds which oppreſs or threaten them with ſuffocation. Neither does this uneaſineſs continue only while they are aſleep; for it is ſome time after they awake before they can turn themſelves in their beds or ſpeak; nay, ſometimes, though rarely, the diſtemper has proved mortal.—The incubus rarely ſeizes people except when the ſtomach is oppreſſed with aliments of hard digeſtion, and the patient lies on his back. It is to be cured by eating light ſuppers, and raiſing the head high; or, if it become very troubleſome, antiſpaſmodic medicines are to be adminiſtered, and the body ſtrengthened by chalybeates. The ſame method is to be followed by thoſe who are ſubject to walking in their ſleep; a practice which muſt neceſſarily be attended with the greateſt danger: and ſomnambuliſm may juſtly be conſidered as merely a different modification of this diſeaſe. Accordingly Dr Cullen has diſtinguiſhed the one by the title of *oneirodynia activa*, and the other by that of *oneirodynia gravans*.

330 Class III. CACHEXIÆ.

Cachexiæ, *Sauv.* Claſs X. and Claſs VIII. *Sag.* Claſs III.
Deformes, *Lin.* Claſs. X.

331 Order I. MARCORES.

Macies, *Sauv.* Claſs X. Order I. *Sag.* Claſs III. Order I.
Emaciantes, *Lin.* Claſs X. Order I.

332 Genus LXIX. TABES.

Wasting of the *Body*.

Tabes, *Sauv.* gen. 275. *Lin.* 209. *Vog.* 306. *Sag.* 100.

This diſorder is occaſioned by the abſorption of pus from ſome ulcer, external or internal, which produces an hectic fever. The primary indication therefore muſt be to heal the ulcer, and thus take away the cauſe of the diſeaſe. If the ulcer cannot be healed, the patient will certainly die in an emaciated ſtate. But the proper treatment of the tabes proceeding from this cauſe, falls to be conſidered under the head of *Ulcer* in Surgery, and likewiſe under the genera Siphylis, Scrofula, Scorbutics, &c. diſeaſes in which ulcers are at leaſt a very common ſymptom.

333 Genus LXX. ATROPHIA.

Nervous Consumption.

Deſcription. This affection conſiſts principally in a waſting of the body, without any remarkable fever, cough, or difficulty of breathing; but attended with want of appetite and a bad digeſtion, whence the whole body grows languid, and waſtes by degrees.—Dr Cullen, however, aſſerts, that ſome degree of fever, or at leaſt of increaſed quickneſs of the pulſe, always attends this diſeaſe.

Cauſes. Sometimes this diſtemper will come on without any evident cauſe. Sometimes it will ariſe from paſſions of the mind; from an abuſe of ſpirituous liquors; from exceſſive evacuations, eſpecially of the ſemen, in which caſe the diſtemper has got the name of *tabes dorſalis.* It may ariſe from mere old age, or from famine.

Prognoſis. This diſtemper, from whatever cauſe it may ariſe, is very difficult to cure, and often terminates in a fatal dropſy.

Cure. The general principles on which the treatment of this diſeaſe is to be regulated, very much depend on the cauſe by which it is induced; and it is unneceſſary to add, that this muſt be removed as far as poſſible. Next to this, the diſeaſe is moſt effectually combated by the introduction of nutritious aliment into the ſyſtem, and by obtaining the proper aſſimilation and digeſtion of this. With the firſt of theſe intentions, recourſe muſt be had to the diet which is moſt nutritious, and at the ſame time of eaſieſt digeſtion. But from the condition of the ſtomach commonly attending this diſeaſe, it is neceſſary that ſmall quantities only ſhould be taken at a time, and that it ſhould be frequently repeated. With the ſecond intention, ſtomachic and nervous medicines are the articles chiefly at leaſt to be depended upon in this caſe. The Peruvian bark, ſulphuric acid, and chalybeates, are excellent; and theſe ſhould be conjoined with gentle exerciſe, as far as the ſtrength and other circumſtances of the patient will admit. In that ſpecies of the diſtemper occaſioned by venereal exceſſes, it is ſo eſſentially neceſſary to abſtain from them, that without it the beſt remedies will prove altogether uſeleſs.

Order II. INTUMESCENTIÆ. 334

Intumeſcentiæ, *Sauv.* Claſs X. Ord. II. *Sag.* Claſs III. Ord. II.
Tumidoſi, *Lin.* Claſs X. Ord. II.

Genus LXXI. POLYSARCIA. 335

Corpulency.

Polyſarcia, *Sauv.* gen. 279. *Lin.* 213. *Vog.* 540. *Sag.* 160. Steatites, *Vog.* 390.

In a natural and healthy ſtate, the fat, or animal oil, is not allowed to diffuſe itſelf throughout the cellular interſtices at large, but is confined to the places where ſuch an oily fluid is neceſſary, by a particular apparatus of diſtinct veſicles. But in ſome conſtitutions the oily part of the blood appears to exceed the requiſite proportion, and eaſily ſeparates from the other conſtituent parts; or there is an uncommon tendency to the ſeparation of oily matter. In theſe caſes it is apt to accumulate in ſuch quantities, that we may ſuppoſe it to burſt thoſe veſicles which were originally deſtined to hinder it from ſpreading too far; or almoſt every cell of the membrana adipoſa, many of which are in ordinary caſes altogether empty, may be completely filled and diſtended with fat.

The increaſe of the omentum particularly, and the accumulation

Intumeſcentiæ.

accumulation of fat about the kidneys and meſentery, ſwell the abdomen, and obſtruct the motions of the diaphragm; whence one reaſon of the difficulty of breathing which is peculiar to corpulent people; while the heart, and the large veſſels connected with it, are in like manner ſo encumbered, that neither the ſyſtaltic nor ſubſultory motion can be performed with ſufficient freedom, whence weakneſs and ſlowneſs of the pulſe: but when the whole habit is in a manner overwhelmed with an oily fluid, the enlargement of the cellular interſtices will neceſſarily interrupt the general diſtribution and circulation throughout the nervous and vaſcular ſyſtems; impeding the action of the muſcular fibres, and producing inſenſibility, ſomnolency, and death.

Theſe caſes are the more deplorable, as there is but little proſpect of a cure. For the animal oil is of too groſs a nature to be eaſily taken up by abſorption; and we know, that when fluids are accumulated in the cellular ſyſtem, there are only two ways in which they can be carried off or eſcape; namely, by the abſorbents, which take their riſe from the cellular interſtices, and through the pores of the ſkin by tranſudation.

Another misfortune is, that the diſeaſe ſteals on ſo imperceptibly, that it becomes inveterate before people begin to think of purſuing the proper means of relief.

In this diſeaſe the cure muſt turn upon two points: Firſt, on preventing the farther depoſition of fat, by avoiding the introduction of ſuperfluous aliment, particularly of fatty matters, into the ſyſtem; and, ſecondly, on promoting and forwarding the abſorption of fat. On theſe grounds, beſides what may be done by proper regimen, a variety of articles have been recommended in the way of medicine.

Soap has been propoſed as a remedy to melt down and facilitate the abſorption of the fat in corpulent people; and Dr Fleming ſome years ago publiſhed a little treatiſe, wherein he recommends this medicine, and relates the caſe of a gentleman who is ſaid to have received conſiderable benefit from it. But perhaps the ſoap-leys would be more powerful, and might be more eaſily taken ſheathed, in the manner directed when uſed as a diſſolvent of the ſtone.

Lieutaud adviſes to take *acetum ſcilliticum* in ſmall doſes, with frequent purging and briſk exerciſe. But it will ſeldom happen that the patients will be found ſufficiently ſteady to perſiſt in any of theſe courſes, it being the nature of the diſorder to render them irreſolute and inattentive to their condition. Therefore the principal uſe of rules muſt be with a view to prevention; and perſons who are diſpoſed to corpulency ſhould take care in time to prevent it from becoming an abſolute diſeaſe, by uſing a great deal of exerciſe, not indulging in ſleep, and abridging their meals, eſpecially that of ſupper. Salted meats are leſs fattening than ſuch as are freſh; and drinking freely of coffee is recommended to corpulent people.

But Dr Fothergill obſerves, that a ſtrict adherence to vegetable diet reduces exuberant fat more certainly than any other means that he knows; and gives two caſes in which this regimen ſucceeded remarkably well. The famous Dr Cheyne brought himſelf down in this way, from a moſt unwieldy bulk to a reaſonable degree of weight; as he himſelf informs us. It deſerves, however, to be remarked, that every practice for the removal or prevention of fatneſs muſt be uſed with great caution and prudence: for not a few, anxious to prevent this affection, have had recourſe to a regimen and to medicine which have proved fatal. This has particularly ariſen from the exceſſive uſe of acids, probably operating by entirely deſtroying the action of the chylopoietic viſcera.

Pneumatoſis.

GENUS LXXII. PNEUMATOSIS. 336

EMPHYSEMA, or *Windy Swelling.*

Pneumatoſis, *Sauv.* gen. 280. *Vog.* 391. *Sag.* 107.
Emphyſema, *Sauv.* gen. 13. *Lin.* 288. *Vog.* 392.
Leucophlegmatia, *Lin.* 214.

The emphyſema ſometimes comes on ſpontaneouſly; but more frequently is occaſioned by wounds of the lungs, which, giving vent to the air, that fluid inſinuates itſelf into the cellular texture, and often blows it up to a ſurpriſing degree. It muſt be obſerved, however, that it is only in caſes of laceration of the lungs where this diſeaſe can take place; for in a ſimple wound, the effuſion of blood always prevents the air from getting out. The cure is to be accompliſhed by ſcarifications and compreſſes; but in ſome caſes only by the paracenteſis of the thorax. When air introduced from the lungs is collected in a conſiderable quantity in the cavity of the thorax, the operation of the paracenteſis is perhaps the only means of cure. Upon an opening being thus made, the air ſometimes ruſhes out with incredible violence; and the patient receives at leaſt immediate relief from circumſtances the moſt diſtreſſing imaginable. In ſome inſtances it is followed even by a complete cure.

GENUS LXXIII. TYMPANITES. 337

TYMPANY.

Tympanites, *Sauv.* gen. 291. *Lin.* 219. *Vog.* 316. *Sag.* 118. *Boerh.* 226. *Junck.* 87.
Affectio tympanitica, *Hoffm.* III. 339.
Meteoriſmus, *Sauv.* gen. 292.

This in an inflation of the abdomen, and is of two kinds: 1. That in which the flatus is contained in the inteſtines, in which the patient has frequent exploſions of wind, with a ſwelling of the belly commonly unequal. 2. When the flatus is contained in the cavity of the abdomen; in which caſe the ſwelling is more equal, and the belly ſounds when ſtruck, without any conſiderable emiſſion of flatus. Of theſe two, however, the former diſeaſe is by much the moſt common; inſomuch, that many, even extenſively engaged in practice, have never met with an inſtance of true abdominal tympanites. In both caſes the reſt of the body falls away.

Cauſes, &c. The tympany ſometimes takes place in thoſe who have been long troubled with flatulencies in the ſtomach and inteſtines. It happens frequently to women after abortion; to both ſexes after the ſuppreſſion of the hæmorrhoids; and ſometimes from tedious febrile diſorders injudiciouſly treated.

Prognoſis. This diſeaſe is generally very obſtinate, and for the moſt part proves fatal by degenerating into

Intumescentiæ. to an afcites. Sometimes, if the patient be healthy and ftrong, the difeafe may terminate favourably, and that the more readily if it has followed from fome diforder. A hectic confumption, dry cough, and emaciated countenance in a tympany, with a fwelling of the feet, denote approaching death in a very fhort time.

Cure. With a view to the prevention of this affection, it is neceffary, in the firft place, to avoid, as far as it can be done, caufes giving rife to an uncommon extrication of air, by preferving the proper tone of the alimentary canal. After the affection has taken place, the indications are, firft, to expel the air already extricated and confined in different cavities; and, fecondly, to prevent further accumulation. On thefe grounds different remedies are employed. The cure, however, is principally attempted by carminative, refolvent, and ftomachic medicines, gentle laxatives, and at laft tonics, efpecially chalybeates. In the Edinburgh Medical Effays, vol. i. we have a very remarkable hiftory of a tympany by Dr Monro fenior. The patient was a young woman of 22 years of age, who fell into the diftemper after a tertian ague, in which fhe was badly treated. She became a patient in the Edinburgh Infirmary the 24th of March 1730; took feveral purgatives, and fome dofes of calomel; ufed the warm bath; and had an antihyfteric plafter applied over the whole belly, but with very little effect. She was monftroufly diftended, infomuch that the fkin feemed to be in danger of burfting: her breathing was much ftraitened; but the fwelling fometimes gradually decreafed without any evacuation. The returns and degree of this fwelling were very uncertain; and when the belly was moft detumefied, feveral unequal and protuberant balls could be felt over the whole abdomen, but efpecially at its fides. Her ftomach was good, fhe had no thirft, and her urine was in proportion to the quantity fhe drank. She was very coftive, had her menfes at irregular periods, but no œdematous fwellings appeared in the feet or any where elfe. In this fituation fhe continued from the time of her admiffion till the 21ft of June, during which interval fhe had only menftruated twice. Throughout this fpace of time, the following circumftances were obferved, 1. Several times, upon the falling of the fwelling, fhe complained of a headach; once of pains throughout all her body, once of a giddinefs, twice of a naufea and vomiting, and the laft time threw up green bile; and once her ftomach fwelled greatly, whilft the reft of the abdomen fubfided. 2. During the flowing of the menfes fhe did not fwell, but became very big upon their ftopping. 3. Blood-letting and emetics, which were made ufe of for fome accidental urgent fymptoms, had no very fenfible effect in making the tympany either better or worfe. 4. She never had paffage of wind either way, except a little belching fome days before the monthly evacuation.

Some time before the laft eruption of the menfes, the purgatives were given more fparingly; and antihyfterics of the ftrongeft kinds, fuch as afafœtida, oleum corn. cerv. &c. mixed with foap, were given in large dofes, accompanied with the hotter antifcorbutics as they are called, as horferadifh and ginger-root infufed in ftrong-ale with fteel. The patient was ordered to ufe frequent and ftrong frictions to all the trunk of her body and extremities, and to ufe moderate exercife. Immediately before the menfes began to flow, clyfters of the fame kind of medicines were injected. The menfes were in fufficient quantity; but as foon as they ceafed, her belly increafed in its circumference four inches and a half, but foon fubfided. She then complained of pains, which a gentle fweat carried off. Borborygmi were for the firft time obferved on the fame day, June 25th; and having taken fome *tinctura facra* at night, fhe paffed a fmall quantity of blood next day by ftool. This was the firft appearance of the return of the hæmorrhoids, to which fhe had been formerly fubject.

Phyfometra. The two following days her faponaceous, antihyfteric, and antifcorbutic medicines being ftill continued, fhe had fuch explofions of wind upwards and downwards, that none of the other patients would remain in the fame room, nay fcarce on the fame floor with her. Her belly became lefs and fofter than it had been from the firft attack of the difeafe; her medicines, with a dofe of fyrup of buckthorn at proper intervals, ftill were continued, only the proportion of fteel was increafed; her flatulent difcharge went on fuccefsfully, and fhe gradually recovered her former health.

Genus LXXIV. PHYSOMETRA. 338

Windy Swelling of the Uterus.

Phyfometra, *Sauv.* gen. 290. *Sag.* 119.
Hyfterophyfe, *Vog.* 317.

The treatment of this is not different from that of the tympany. It is however, upon the whole, a very rare difeafe; and when it takes place, very feldom if ever admits of a cure.

Genus LXXV. ANASARCA. 339

Watery Swelling over the Whole Body.

Anafarca, *Sauv.* gen. 281. *Lin.* 215. *Vog.* 313. *Sag.* 108. *Boerh.* 1225. *Hoffm.* III. 322. *Junck.* 87. *Monro* on the Dropfy. *Millman* Animadverfiones de hydrope 1779.
Phlegmatia, *Sauv.* gen. 282.
Angina aquofa, *Boerh.* 791.

In this difeafe the feet firft begin to fwell, efpecially in the evening, after exercife, and when the patient has ftood or fat long; this fwelling rifes frequently to the thighs. By lying in bed, the fwelling becomes lefs, or even almoft difappears. In the progrefs of the difeafe, the fwelling often rifes to the hips, loins, and belly, and at laft covers the whole body. This difeafe, befides the other fymptoms afterwards mentioned under Ascites, is attended with a remarkable difficulty of breathing. In the cure of this, as well as other fpecies of dropfy, the general intentions are, firft, the evacuation of the water already effufed either by natural or artificial outlets; and, fecondly, the prevention of frefh accumulation, which is chiefly to be expected from fupporting a due action of the abforbents, and from keeping up a proper difcharge by the ferous excretories.

The remedies employed with thefe intentions are much the fame with what are employed againft the more

Intumescentiæ. more important genus of ascites. Only it may be here noticed, that in anasarca it has by many been recommended to scarify the feet and legs. By this means the water is often discharged: but the operator must be cautious not to make the incisions too deep; they ought barely to penetrate through the skin; and especial care must be taken, by spirituous fomentations and proper digestives, to prevent a gangrene. Dr Fothergill observes, that the safest and most efficacious way of making these drains is by the instrument used for cupping, called a *scarificator;* and he always orders it to be so applied as to make the little wounds transversely; as they not only discharge better, but are also longer in healing, than when made longitudinally.

Notwithstanding every precaution, however, gangrene will often ensue; and it is upon the whole a much safer practice to evacuate the water by the natural outlets, the valvular lymphatic absorbents; and with this intention emetics and cathartics, but particularly diuretics, are often employed with success.

340 GENUS LXXVI. HYDROCEPHALUS.

WATER in the HEAD.

External or *Chronic* HYDROCEPHALUS.

Hydrocephalus, *Sauv.* gen. 285. *Lin.* 216. *Boerh.* 1217.
Hydrocephalum, *Vog.* 384.

This differs from the hydrocephalus formerly treated of at some length under the title of Apoplexia Hydrocephalica, chiefly in the water being collected in the external parts of the head, whereas the former is entirely within the skull. In the fifth volume of the Medical Observations we have an account of a very extraordinary case of this kind. The patient was a child only of a few days old, and had a tumor on his head about the size of a common tea-cup, which had the appearance of a bladder distended with water; near the apex was a small opening, through which a bloody serum was discharged. In other respects the child was healthy. No application was used but a piece of linen dipt in brandy. The tumor continued to increase for many months; at the end of which time the membrane containing the water appeared equally thick with the other part of the scalp, except at one place about the size of a shilling, which continued thin, and at times appeared as if it would burst. He remained in this situation for about 17 months, when the circumference of the head was 20 inches, the base $16\frac{1}{2}$, the middle $18\frac{1}{2}$, and from the base to the apex near $8\frac{1}{2}$. The water was then drawn off, and the child died in two days. Almost all other cases of this distemper have proved fatal; the sutures of the skull generally give way, and the whole external part of the head is equally enlarged: but in the instance just now given there was a deficiency of part of the bones. Although, however, in some instances where the head is thus enlarged to an enormous size, the water is exterior to the brain, and therefore entitled to the appellation of hydrocephalus exterior, yet much more frequently in those instances where there is a manifest separation of the bones of the cranium at the sutures, the water is still contained within the ventricles; and accordingly the disease may be much more properly distinguished into the *acute* and *chronic* hydrocephalus, than as is commonly done into the *internal* and *external*. Although the latter be much slower in its progress, sometimes subsisting even for years, yet it is equally difficult of cure with the former, and very often it proves fatal in a few days if the water be drawn off by an artificial opening, which may be very easily performed by a mere puncture with a common lancet, without either pain or any immediate hazard from the operation itself, although the water be lodged in the ventricles; for these are distended to an enormous size, and the substance of the brain almost totally destroyed, so that hardly any thing is to be punctured but membrane.

GENUS LXXVII. HYDRORACHITIS. 341

SPINA BIFIDA.

Hydrorachitis. Hydrorachitis, *Sauv.* gen. 287. *Morgagn.* de sed. XII. 9. *et seq.*
Spinola, *Lin.* 289.
Spina bifida, *Vog.* 386.

This disease, which consists in a soft tumor on the lumbar vertebræ, attended with a separation of the vertebræ themselves, though generally considered as approaching to the nature of rachitis, is commonly referred to the article SURGERY, which may be consulted with regard to this affection.

GENUS LXXVIII. HYDROTHORAX. 342

DROPSY of the BREAST.

Hydrothorax, *Sauv.* gen. 150. *Vog.* 311. *Boerh.* 1219.

This affection, particularly with respect to its causes, is in many circumstances similar to other kinds of dropsy, particularly to ascites. But from the situation of the water, which is here deposited in the cavity of the thorax, it may naturally be supposed that some peculiar symptoms will occur. Besides the common symptoms of dropsy, paleness of the countenance, scarcity of urine, and the like, this disease is, in some instances, attended with a fluctuation of water within the breast; which when it does occur may be considered as a certain distinguishing mark of this affection. But besides this, it is also distinguished by the remarkable affections of circulation and respiration with which it is attended.

The breathing is peculiarly difficult, especially in a recumbent posture; and in many instances patients cannot breath with tolerable ease, unless when sitting erect, or even stooping somewhat forwards. The pulse is very irregular, and has often remarkable intermissions. But the disease has been thought to be principally characterized by a sudden starting from sleep, in consequence of an almost inexpressible uneasy sensation referred to the breast, and attended with strong palpitation, which may probably arise from an affection either of circulation or of respiration.

That these symptoms are common attendants of this disease, is undeniable; and they are certainly the best characteristics of this affection with which we are yet acquainted: but it must be allowed that they are present in some cases where there is no water in the breast; and

and that in other inſtances where the diſeaſe exiſts, they are either altogether wanting, or occur only to a very ſlight degree. Certain diagnoſtics, therefore, of this diſeaſe ſtill remain to be diſcovered.

When hydrothorax is preſent, from the affection of the vital functions with which it is attended, it may readily be concluded that it is a dangerous diſeaſe, and in many inſtances it proves fatal. The cure, as far as it can be accompliſhed, is obtained very much on the ſame principles as in other dropſies. Here, however, probably from the uncertainty of the diagnoſtics, the artificial abſtraction of water, by paracenteſis of the thorax, is leſs frequently had recourſe to than in aſcites; though in ſome inſtances, after other means have failed, it has been ſaid not only to give relief of ſymptoms highly urgent, particularly dyſpnœa, but even to produce a complete cure. Benefit is often obtained from an artificial diſcharge of water by the application of bliſters to the breaſt: but in this, as well as other dropſies, a diſcharge is chiefly effected by the natural outlets, particularly from the uſe of cathartics and diuretics. In this ſpecies of dropſy, more perhaps than in any other, recourſe has been had to the uſe of the digitalis purpurea, or foxglove, ſo ſtrongly recommended as a diuretic by Dr Withering in his treatiſe reſpecting the uſe of it. There can be no doubt that this article, though ſometimes productive of inconvenience from the diſtreſſing ſickneſs and ſevere vomiting which it not unfrequently excites, though uſed even but in ſmall doſes, often operates as a powerful diuretic, and produces a complete evacuation of water, after other articles have failed. From the effects mentioned above, however, as well as from its influence on the pulſe, which it renders much ſlower, it is neceſſary that it ſhould be employed with great caution, and in ſmall doſes. A dram of the dried leaves of the digitalis, macerated for four hours in half a pint of warm water, forms an infuſion which may be given in doſes of an ounce, and the dried powder of the leaves in doſes of one or two grains: theſe doſes may be gradually increaſed, and repeated twice or oftener in the day; but this requires to be done with great caution, leſt ſevere vomiting, or other diſtreſſing ſymptoms, ſhould take place.

343 Genus LXXIX. ASCITES.

Dropsy of the *Abdomen*.

Aſcites, *Sauv.* gen. 288. *Lin.* 217. *Vog.* 314. *Sag.* gen. 115. *Boerh.* 1226. *Hoffm.* III. 322. *Junck.* 87. *Dr Monro* on the Dropſy, 1765. *Milman*, Animadverſiones de Hydrope, 1779.

Deſcription. This diſeaſe aſſumes three different forms: 1. When the water immediately waſhes the inteſtines. 2. When it is interpoſed between the abdominal muſcles and peritonæum; or, 3. When it is contained in facs and hollow veſicles; in which caſe it is called the *encysted dropſy*. Some phyſicians of great reputation have aſſerted, that the water was often placed within the duplicature of the peritonæum: but this is alleged by Dr Milman to be a miſtake, as that membrane is looked upon by the beſt anatomiſts to be ſingle; and he thinks that the above-mentioned phyſicians have been led into this error from obſerving the water collected in the cellular ſubſtance of the peritonæum.

In the beginning of an aſcites the patient becomes languid, breathleſs, and has an averſion to motion: his belly ſwells; and, when ſtruck, the ſound of fluctuating water is perceptible; there is a difficulty of breathing when the belly is preſſed. There is an almoſt continual thirſt, which in the progreſs of the diſeaſe becomes very urgent; the urine is thick, in ſmall quantity, and high coloured. The pulſe is ſmall and frequent; and as the belly ſwells, the other parts waſte away. A fever at laſt ariſes, which, conſtantly increaſing, in the end carries off the patient. Theſe ſymptoms are moſt urgent where the waters are in immediate contact with the inteſtines: in the other kinds the reſt of the body is leſs waſted; nor is there ſo great thirſt or difficulty of breathing.

Cauſes, &c. The immediate cauſe of dropſy is a greater effuſion of ſerum by the exhalant arteries than the abſorbents take up. This may be occaſioned either by too great a quantity of liquid thrown out by the former, or by an inability of the latter to perform their office. This commonly happens in people whoſe bodies are of a weak and lax texture, and hence women are more ſubject to this malady than men; chlorotic girls eſpecially are very apt to become dropſical.

Sometimes, however, this diſeaſe is occaſioned by a debility of the vital powers, by great evacuations of blood, or by acute diſeaſes accidentally protracted beyond their uſual period; and although this cauſe ſeems very different from a laxity of fibres, yet the dropſy ſeems to be produced in a ſimilar manner by both. For the vital powers being debilitated by either of theſe cauſes, naturally bring on a certain debility and laxity of the ſolids; and, on the other hand, a debility of the ſolids always brings on a debility of the vital powers; and from this debility of the vital powers in both caſes it happens, that thoſe humours which ought to be expelled from the body are not diſcharged, but accumulate by degrees in its cavities. There, is, however, this difference between the two kinds of dropſy ariſing from theſe two different cauſes: That in the one which ariſes from laxity the ſolid parts are more injured that in that which ariſes from a debility of the vital powers. In the former, therefore, the water ſeems to flow out from every quarter, and the body ſwells all over. But when the diſeaſe is occaſioned by a debility of the vital powers, though the ſolids be leſs diſeaſed, yet the power of the heart being much diminiſhed, and the humours ſcarce propelled through the extreme veſſels, the thin liquids, by which in a healthy ſtate the body is daily recruited, are carried by their own weight either into the cavities or into the cellular texture. Hence thoſe aqueous effuſions which follow great evacuations of blood, or violent looſeneſſes, begin in the more depending parts of the body, gradually aſcending, till they arrive at the cavity of the abdomen, or even the thorax.

But another and much more ſufficient cauſe for the production of dropſy is an obſtruction of the circulation; and this may take place from polypi in the heart or large veſſels, and hard ſwellings in the abdomen. Inſtances have been obſerved of a dropſy ariſing from ſteatomatous tumors in the omentum, and many more from a ſcirrhous liver or ſpleen, and from an infarction

Intumescentiæ.

tion and obstruction of the mesenteric glands, by which means the lymph coming from the extremities is prevented from arriving at the heart. Scirrhosity of the liver, the most common cause of ascites, probably operates by augmenting effusion, in consequence of its preventing the return of the venous blood, the greater part of the veins from the abdomen going to the formation of the vena portarum.

Lastly, Whatever, either within or without the vessels, contracts or shuts up their cavities, produces a more copious and easy transmission of the thin humours through the exhalant arteries, at the same time that it prevents their return by the absorbent veins. This has been established by experiment: For Lower having perforated the right side of the thorax in a dog, tied the *vena cava*, and sewed up the wound. The animal languished for a few hours, and then died. On dissection, a great quantity of serum was found in the abdomen, as if he had long laboured under an ascites. In like manner, having tied the jugular veins of another dog, a surprising swelling took place in those parts above the ligatures, and in two days the animal died. On dissection, all the muscles and glands were vastly distended, and quite pellucid, with limpid serum. From these experiments, and some cases of the disease mentioned by different authors, it appears, that when the veins are obstructed so that they cannot receive the arterial blood, the serum is separated as by a filtre into the more open cavities and laxer parts of the body, while the thicker part stagnates and is collected in the proper blood-vessels.

The too great tenuity of the humours is very frequently accused as the cause of dropsy, and many authors have asserted that dropsy might arise merely from a superabundance of water in the blood. For this, some experiments are quoted, from which they would infer, that when a great quantity of aqueous fluid is introduced into the blood, the superfluous fluid ought by no means to pass through the extremities of the sanguiferous arteries into the veins in the common course of circulation, but by being effused into the cavities should produce a dropsy. But this can only happen when the vital powers are very much diminished; for, in a natural state, the superfluous quantity is immediately thrown out by the skin or the kidneys: and agreeable to this we have an experiment of Schultzius, who induced a dropsy in a dog by causing him drink a great quantity of water; but he had first bled him almost *ad deliquium*, so that the vital powers were in a manner oppressed by the deluge of water. In this manner do those become hydropic who are seized with the disease on drinking large quantities of water either when wearied with labour, or weakened by some kinds of diseases. Dr Fothergill relates an instance of a person who, being advised to drink plentifully of barley-water, in order to remove a fever, rashly drunk 12 pounds of that liquor every day for a month, and thus fell into an almost incurable dropsy. But if this quantity had been taken only during the prevalence of the fever, he would, in all probability, have suffered no inconvenience, as may be inferred from what has been related concerning the *dieta aquea* used by the Italians.

It is moreover evident from experiments, that, in a healthy state, not only water is not deposited in the cavities, but that if it is injected into them it will be absorbed, unless some laxity of the solids has already taken place. Dr Musgrave injected into the right side of the thorax of a dog four ounces of warm water; whence a difficulty of breathing and weakness immediately followed. But these symptoms continually lessened, and in the space of a week the animal seemed to be in as good health as before. Afterwards he injected 16 ounces of warm water into the left cavity of the thorax in the same dog; the same effects followed, together with great heat, and strong pulsation of the heart; but he again recovered in the space of a week. Lastly, He injected 18 ounces of water into one side of the thorax, and only six into the other: the same symptoms followed, but vanished in a much shorter time; for within five days the dog was restored to perfect health. During this time, however, he observed that the dog made a greater quantity of urine than usual.

Ascites.

The remote causes of dropsy are many and various. Whatever relaxes the solids in such a manner as to give an occasion of accumulation to the serous fluids, disposes to the dropsy. A lazy indolent life, rainy wet weather, a swampy or low soil, and every thing which conduces to vitiate the viscera, or insensibly to produce obstructions in them, paves the way for a dropsy. Hence those are ready to fall into the disease who use hard and viscid aliments, such as poor people in some countries who use coarse brown bread, and children who are fed with unwholesome aliments; and the same thing happens to those who drink immoderately of spirituous liquors.

Prognosis. When the dropsy arises from a scirrhus of the liver or spleen, or any of the other viscera, the prognosis must always be unfavourable, and also when it arises from disorders of the lungs. Neither is the case more favourable to those in whom the small vessels are ruptured, and pour out their liquids into the cavity of the abdomen. Those certainly die who have polypi in the vessels, or tumors compressing the veins and vessels of the abdomen. A dropsy arising from obstructions in the mesenteric glands is likewise difficult to cure, whether such obstructions arise from a bad habit of body, or from any other cause; if we can, however, by any means remove the disease of the glands, the dropsy soon ceases. But in those who fall into dropsy without any disease preceding, it is not quite so dangerous; and even though a disease has preceded, if the patient's strength be not greatly weakened, if the respiration be free, and the person be not affected with any particular pain, we may entertain great hopes of a cure. But where a great loss of blood is followed by a fever, and that by a dropsy, the patients almost always die, and that in a short time: those, however, are very frequently cured who fall into this disease without any preceding hæmorrhage.

Cure. In the cure of this disease authors chiefly mention two indications: 1. To expel the effused water; and, 2. To prevent its being again collected. But before we proceed to speak of the remedies, it is necessary to take notice, that by the laws of the animal economy, if a great evacuation of a fluid takes place in any part of the body, all the other fluids in the body are directed towards that part, and those which lie, as it were, lurking in different parts will be immediately absorbed, and thrown out by the same passage. Hence the humours which in hydropic persons

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sons are extravasated into the different cavities of the body will be thrown into the intestines, and evacuated by purgatives; or by diuretics will be thrown upon the kidneys, and evacuated by urine. It is, however, not only necessary to excite these evacuations in order to remove this malady, but they must be assiduously promoted and kept up till the abundant humour is totally expelled. For this reason Sydenham has advised purgatives to be administered every day, unless, either through the too great weakness of the body, or the violent operation of the purgative, it shall be necessary to interpose a day or two now and then; because if any considerable intervals be allowed to take place between the exhibition of the purgatives, an opportunity is given to the waters of collecting again. In this method, however, there is the following inconvenience, that, when the waters are totally evacuated, the strength is at the same time so much exhausted, that the distemper commonly returns in a very short time. Hence our chief hopes of curing a dropsy consist in gently evacuating the waters by means of diuretics. But the efficacy of these is generally very doubtful. Dr Freind has long ago observed, that this part of medicine is of all others the most lame and imperfect; but a French physician, Mr Bacher, lately discovered, as he alleges, a method of making the diuretics much more succesful. His reputation became at last so great, that the French king thought proper to purchase his secret for a great sum of money. The basis of his medicine was the black hellebore root, the malignant qualities of which he pretended to correct in the following manner: A quantity of the dried roots of black hellebore were pounded, and then put into a glazed earthen vessel, and afterwards sprinkled with spirit of wine. They were suffered to stand for twelve hours, stirring them about twice or thrice during that space of time. They were then sprinkled again, and at last good Rhenish wine was poured on till it stood six fingers above the roots. The mixture was frequently agitated with a wooden spatula; and as the wine was imbibed by the roots, more was poured on, so as to keep it always at the same height for 48 hours. The whole was then put on the fire and boiled for half an hour, after which the decoction was violently pressed out; the same quantity of wine was added as at first, and the mixture boiled as before. After the second expression the woody residuum was thrown away as useless. Both the strained liquors were then mixed together with two parts of boiling water to one of the decoction. The whole is afterwards evaporated in a silver vessel to the consistence of a syrup. One part of the extract is again mixed with two parts of boiling water, and the whole inspissated as before.—By this means, says he, the volatile nauseous acrid particles are separated by evaporation, and the fixed ones remain corrected and prepared for medicinal uses; adding, towards the end, a ninth part of old brandy, and evaporating to the consistence of turpentine. Mr Bacher reasons a good deal on the way in which this process corrects the medicine; but tells us, that notwithstanding the improvement, his pills will not have the desired effect unless properly made up. For forming them, they ought to be mixed with matters both of an inviscating and indurating nature; yet so prepared that it will be readily soluble in the stomach, even of a person much debilitated. For answering these purposes, he chose myrrh and carduus benedictus, and he gives the following receipt for the formation of his pills:—

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"Take of the extract of hellebore prepared as above directed, and of solution of myrrh, each one ounce; of powdered carduus benedictus, three drams and a scruple. Mix them together, and form into a mass, dividing it into pills of a grain and a half each." To these pills Mr Bacher gives the name of the *pilulæ tonicæ*, from an idea, that while they evacuate the water, they at the same time act as tonics; and thus, from augmenting the action of the lymphatics, prevent the return of the disease. And if both these intentions could be effectually answered by the use of the same remedy, it would unquestionably be of great importance in practice.

The effects of these pills were, we are told, very surprising. Dr Daignan relates, that he gave them to 18 hydropic patients at once; and these he divided into three classes, according to the degree of the disease with which they were affected. The first class contained those who laboured under an anasarca following intermittent fevers. The second class contained those who had an anasarca, together with some degree of ascites, arising from tedious febrile disorders. All these were cured; but these two classes consisted of such cases as are most easily removed. But the third contained six who were seized with a most violent anasarca and ascites, after being much weakened by tedious disorders, and of consequence in whom the disease was very difficult to be cured. Even of these, however, four were cured, and the other two died. The body of one of these being dissected, both sides of the cavity of the thorax were found to be full of a blackish-red water. The lungs were unsound; there was a polypous concretion in the right ventricle of the heart; the liver and spleen were hard, and of a preternatural bulk; and the glands of the mesentery were obstructed and infarcted. In the other, the liver and pancreas were scirrhous, and the spleen very hard.

The same medicines were given by De Horne to eight persons, six of whom had both an anasarca and ascites, but the other two only an ascites. Four of these recovered; three died without being freed from the dropsy; one in whom the dropsy was cured died in a short time after, having for some time before his death become speechless.

By these patients 10 of the pills were taken at once; and the same dose repeated to the third time, with an interval of an hour betwixt each dose. At first they proved purgative, and then diuretic: by which last evacuation they finally cured the disease. But though Mr Bacher was firmly of opinion that his pills cured the dropsy by reason of the above-related correction, yet it is certain that, in the hands of other practitioners, these very pills have failed, unless they also made use of the same regimen recommended by that physician; while, on the other hand, it is also certain, that different medicines will prove equally efficacious in dropsical cases, provided this regimen is made use of.

For a great number of ages it has been recommended to dropsical patients to abstain as much as possible from drink, and thus to the torments of their disease was added that of an intolerable thirst; and how great this torment was, we may understand from an example of a friend of King Antigonus, who, having

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been closely watched both by order of the physicians and also of the king, was so unable to bear the raging thirst occasioned by his disease, that he swallowed his own excrements and urine, and thus speedily put an end to his life. Dr Milman shows at great length the pernicious tendency of this practice. He maintains that it is quite contrary to the sentiments of Hippocrates and the best ancient physicians. He asserts, that unless plenty of diluting drink be given, the best diuretics can have no effect. He condemns also in the strongest terms the practice of giving dropsical patients only dry, hard, and indigestible aliments. These would oppress the stomach even of the most healthy; and how much more must they do so to those who are already debilitated by labouring under a tedious disorder! By what means also are these aliments to be dissolved in the stomach when drink is withheld? In this disease the saliva is viscid, and in small quantity; from whence it may be reasonably conjectured, that the rest of the fluids are of the same nature, and the gastric juices likewise depraved. Thus the aliments lie long in the stomach; and if the viscera were formerly free of obstructions, they are now generated; the strength fails; perspiration and other excretions are obstructed; the viscid and pituitous humours produced by these kinds of food float about the præcordia, and increase the disease, while the surface of the body becomes quite dry. Nay, so much does this kind of diet conspire with the disease, that 100 pounds of fluid will sometimes be imbibed in a few days by hydropic persons who take no drink. Even in health, if the body from any cause becomes dry, or deprived of a considerable part of its juices, as by hunger, labour, &c. it will imbibe a considerable quantity of moisture from the air; so that we must impute the above-mentioned extraordinary inhalation, in part at least, to the denial of drink, and to the nature of the aliment given to the sick. The following is the account given by Sir Francis Milman of his practice in the Middlesex hospital.

If the patient be not very much debilitated, he is sometimes treated with the purging waters, and a dose of jalap and calomel alternately. On the intermediate days he gets a saline mixture, with 40 or 60 drops of *acetum scilliticum* every sixth hour; drinking with the purgatives oat-gruel and some thin broths. That he might the better ascertain what share the liquids given along with the medicines had in producing a copious flow of urine, he sometimes gave the medicines in the beginning of the distemper without allowing the drink: but though the swellings were usually diminished a little by the purgatives, the urine still continued scanty, and the patients were greatly weakened. Fearing, therefore, lest, by following this course, the strength of the sick might be too much reduced, he then began his course of diuretic medicines, giving large quantities of barley water with a little *sal diureticus;* by which means, sometimes in the short space of 48 hours after the course was begun, the urine flowed out in very large quantity: but as saline drinks are very disagreeable to the taste, a drink was composed purposely for hydropic persons, of half an ounce of supertartrite of potash, dissolved in two pounds of barley water, made agreeably sweet with syrup, adding one or two ounces of French brandy.

To this composition Sir Francis Milman was induced by the great praises given to supertartrite of potash by some physicians in hydropic cases. In the *Acta Bononiensia*, 15 cases of hydropic patients are related who were cured only by taking half an ounce of cream of tartar daily. But it is remarkable, that by these very patients the cream of tartar was taken for 20, 30, nay 40 days, often without any perceptible effect; yet when dissolved in a large quantity of water, it showed its salutary effects frequently within as many hours, by producing a plentiful flow of urine. This liquor is now the common drink of hydropic patients in the hospital above mentioned, of which they drink at pleasure along with their medicines.

Among purgative medicines Sir Francis Milman recommends the *radix senckæ;* but says the decoction of it, according to the Edinburgh Pharmacopœia is too strong, as he always found it excite vomiting when prepared as there directed, and thus greatly to distress the patients: but when only half an ounce or six drams of the root are used to a pound of decoction, instead of a whole ounce as directed by the Edinburgh college, he finds it an excellent remedy; and though it may sometimes induce a little vomiting, and frequently a nausea, yet it seldom failed to procure nine or ten stools a-day, and sometimes also proved diuretic. But we must take care not to be too free in the use of seneka, or any other purgative, if the patients be very weak; and therefore, after having used purgatives for some time, it will be proper to depend upon diuretics entirely for perfecting the cure; and of the success of this method our author gives some very remarkable instances. But he observes, that after the dropsy is removed, the patients will sometimes die without any evident cause; and of this it is proper that the physicians should be aware. It is remarkable with what ease a flux of urine is induced in those who have a scirrhous liver; while, on the other hand, in one who had the mesenteric glands obstructed, along with a scirrhosity of the liver and vitiated state of the lungs, the most powerful diuretics proved ineffectual. In some cases Sir Francis Milman thinks the kidneys may be so pressed with the weight of the water, as to be unable to perform their office. With regard, however, to diuretics in general, it may be remarked, that the operation of none of them can be certainly depended upon. In particular constitutions, and at particular times, one will be observed to succeed, after another, though commonly much more powerful, has been tried in vain. Accordingly various articles of this kind are often used in succession. Recourse is particularly often had to the root of taraxacum, of colchicum, and of squills; the latter, especially when combined with calomel, is often found to be a very powerful diuretic. And indeed mercury in different forms, probably from acting as a deobstruent, is often of very great use in dropsical complaints. Among other diuretics, the lactuca virosa has of late been highly extolled by Dr Collins of Vienna, and the nicotiana tabaccum by Dr Fowler of York: but neither has been extensively introduced into practice, although we have known some instances in which the latter, in particular, has been used with great advantage.

The water having been drawn off, we are to put the patient on a course of strengtheners; such as cinchona, with some of the warm aromatics, and a due proportion of of rhubarb infuſed in wine and chalybeates. Gentle exerciſe, and frictions on the belly, with ſuch a courſe of diet as ſhall be light and nouriſhing, are alſo to be enjoined: and it may be obſerved, that the uſe of tonic medicines is by no means to be delayed till a complete evacuation of the water can be obtained. On the contrary, by alternating, and even combining the uſe of evacuants and tonics, the influence of both is often very much promoted.

When the patient can by no other means be relieved, the operation of paracenteſis muſt be had recourſe to, which is deſcribed under the article SURGERY.

344 GENUS LXXX. HYDROMETRA.

DROPSY of the *Uterus*.

Hydrometra, *Sauv.* gen. 289. *Sag.* 116. *Boerh.* 1224.

345 GENUS LXXXI. HYDROCELE.

DROPSY of the *Scrotum*.

Oſcheocele, *Sauv.* gen. 41. *Vog.* 388.
Oſcheophyma, *Sag.* 44.
Hydrops ſcroti, *Vog.* 389.
Hydrops teſtium, *Boerh.* 1227.

For the treatment of theſe two diſeaſes, we may refer the reader to what has already been ſaid of other ſpecies of dropſy, particularly Aſcites. But both are chiefly to be combated by chirurgical operation, eſpecially the latter, in which it ſeldom fails to produce a complete cure.

346 GENUS LXXXII. PHYSCONIA.

SWELLING of the *Belly*.

Phyſconia, *Sauv.* gen. 283. *Vog.* 325. *Sag.* gen. 110.
Hypoſarca, *Lin.* 218.

This diſeaſe may ariſe from a variety of cauſes, as from a ſwelling of the liver, ſpleen, kidneys, uterus, omentum, ovarium, meſentery, inteſtines, &c. and ſometimes it ariſes merely from fat. In the former caſes, as the viſcera are generally ſcirrhous and indurated, the diſtemper is for the moſt part incurable; neither is the proſpect much better where the diſeaſe is occaſioned by a great quantity of fat.

347 GENUS LXXXIII. RACHITIS.

The *RICKETS*.

Rachitis, *Sauv.* gen. 294. *Lin.* 212. *Vog.* 312. *Sag.* gen. 120. *Boerh.* 1480. *Hoffm.* III. 487. *Zeviani* della Rachitide. *Gliſſon* de Rachitide.

Deſcription. This is one of the diſeaſes peculiar to infancy. It ſeldom attacks children till they are nine months, nor after they are two years old; but it frequently happens in the intermediate ſpace between theſe two periods. The diſeaſe ſhows itſelf by a flaccid tumor of the head and face, a looſe flabby ſkin, a ſwelling of the abdomen, and falling away of the other parts, eſpecially of the muſcles. There are protuberances of the epiphyſes of the joints; the jugular veins ſwell, while the reſt decreaſe; and the legs grow crooked. If the child has begun to walk before he be ſeized with this diſeaſe, there is a ſlowneſs, debility, and tottering in his motion, which ſoon brings on a conſtant deſire of ſitting, and afterwards of lying down; inſomuch that nothing at laſt is moveable but the neck and head. As they grow older, the head is greatly enlarged, with ample ſutures; the thorax is compreſſed on the ſides, and the ſternum riſes up ſharp, while the extremities of the ribs are knotty. The abdomen is protuberant, and the teeth black and carious. In ſuch patients as have died of this diſeaſe, all the ſolids appear ſoft and flaccid, and the fluids diſſolved and mucous.

Cauſes. The rickets may proceed from ſcrophulous or venereal taints in the parents, and may be increaſed by thoſe of the nurſe. It is likewiſe promoted by feeding the child with aqueous and mucous ſubſtances, crude ſummer fruits, fiſh, unleavened farinaceous aliment, and too great a quantity of ſweet things.—Sometimes it follows intermittent fevers and chronic diſorders; and in ſhort, is cauſed by any thing which tends to debilitate the body, and induce a viſcid and unhealthy ſtate of the juices.

Prognoſis. The rickets do not uſually prove fatal by themſelves, but if not cured in time, they make the perſon throughout life deformed in various ways; and often produce very pernicious diſorders, ſuch as carious bones in different parts of the body.

Cure. This is to be effected by mild cathartics, alteratives, and tonics, ſuch as are uſed in other diſeaſes attended with a debility of the ſyſtem and a vitiated ſtate of the blood and juices. In the Weſtern iſlands of Scotland, the medicine uſed for the cure of the rickets is an oil extracted from the liver of the ſkate-fiſh. The method of application is as follows: Firſt, the wriſts and ankles are rubbed with the oil in the evening: this immediately raiſes a fever of ſeveral hours duration. When the fever from the firſt rubbing ſubſides, the ſame parts are rubbed again the night following; and repeatedly as long as the rubbing of theſe parts continues to excite the fever.—When no fever can be excited by rubbing the wriſts and ankles alone, they are rubbed again along with the knees and elbows. This increaſed unction brings on the fever again; and is practiſed as before, till it no longer has that effect. Then the vertebræ and ſides are rubbed, along with the former parts; and this unction, which again brings on the ferver, is repeated as the former. When no fever can be any longer excited by this unction, a flannel ſhirt dipped in the oil is put upon the body of the patient: this brings on a more violent and ſenſible fever than any of the former unctions; and is continued till the cure be completed, which it commonly is in a ſhort time.

A German phyſician, Dr Strack, has lately publiſhed a paper, in which he recommends the filings of iron as a certain remedy in the rickets. This diſeaſe, he obſerves, in general begins with children when they are about 16 months old. It is ſeldom obſerved with children before they be one year old, and ſeldom attacks them after they paſs two; and it is very generally worſe where it begins early than where it begins late.

For

Impetigines.

For effecting a cure, it is, he affirms, a matter of the utmost consequence to be able to distinguish, very early, whether a child will be afflicted with rickets or not. And this, he assures us, may be determined by the following symptoms: Paleness and swelling of the countenance; and in that part of the cheeks which should naturally be red, a yellow colour approaching to that of sulphur. When that is the case, he directs that a medicine should be immediately had recourse to which will retard the further progress of the disease, and remove what has already taken place. For this purpose, he advises that five grains of the filings of iron, and as much rhubarb, should be rubbed up with ten grains of sugar, and given for a dose every morning fasting, and every evening an hour before supper. But if considerable looseness should be produced, it will be necessary, at first, to persist in the use of one dose only every day.

After a month's continuance in this course, according to Dr Strack, there in general ensues a keen appetite for food, quick digestion, and a copious flow of urine; by means of which the fulness of the face and yellowness of the complexion are by degrees removed, while the natural colour of the countenance and firmness of the body in general are gradually restored. This practice, he assures us, has never failed of success in any one instance; not even in those children born of parents greatly afflicted with the rickets.

In addition to the use of chalybeates, great benefit is often also obtained in this disease from the use of the cold bath; which under prudent administration, is perhaps one of the most effectual remedies for this complaint with which we are yet acquainted.

Mr Bonhome of Paris, in a late treatise on the subject of rachitis, has endeavoured to prove, that the disease arises from a peculiar acid, and in the cure he particularly recommends phosphate of soda, phosphate and muriate of lime; but above all other articles alkaline lotions. The efficacy of these remedies, however, is not yet confirmed by experience. And we may conclude with observing, that both in the prevention and cure nothing has been found so successful as cold bathing.

When the bones of rickety children begin to bend, they may sometimes be restored to their natural shape by compresses, bolsters, and proper supports. See the article SURGERY.

348 ORDER III. IMPETIGINES.

Impetigines, *Sauv.* Class X. Ord. V. *Sag.* Class III. Ord. V.

349 GENUS LXXXIV. SCROPHULA.

KING's EVIL.

Scrophula, *Sauv.* gen. 285. *Vog.* 397. *Sag.* 121. Struma, *Lin.* 284.

Description. This disease shows itself by hard, scirrhous, and often indolent tumors, which arise by degrees in the glands of the neck, under the chin, armpits, and different parts of the body, but most commonly in the neck, and behind the ears. In process of time, the cellular substance, ligaments of the joints, and even the bones themselves, are affected. In scrophula the swellings are much more moveable than those of the scirrhous kind; they are generally softer, and seldom attended with much pain; they are tedious in coming to suppuration; are very apt to disappear suddenly, and again to rise in some other part of the body. We may likewise mention as characteristic circumstances of this disease, a remarkable softness of the skin, a kind of fulness of the face, generally with large eyes, and a very delicate complexion.

Scrophula.

Causes. A variety of causes have been mentioned as tending to produce scrophula, viz. a crude indigestible food; bad water; living in damp, low situations; its being an hereditary disease, and in some countries endemic, &c. But whatever may in different circumstances be the exciting or predisposing causes of the scrophula, the disease itself either depends upon, or is at least much connected with, a debility of the constitution in general, and probably of the lymphatic system in particular, the complaint always showing itself by some affections of the latter. And that debility has at least a considerable influence in its production is probable, not only from the manifest nature of some of the causes said to be productive of scrophula, but likewise from such remedies as are found most serviceable in the cure, which are all of a tonic invigorating nature.

Prognosis. The scrophula is a distemper which often eludes the most powerful medicines, and therefore physicians cannot with any certainty promise a cure. It is seldom, however, that it proves mortal in a short time, unless it attacks the internal parts, such as the lungs, where it frequently produces tubercles that bring on a fatal consumption. When it attacks the joints, it frequently produces ulcers, which continue for a long time, and gradually waste the patient; while in the mean time the bones become foul and corroded, and death ensues after a long scene of misery. The prognosis in this respect must be regulated entirely by the nature of the symptoms.

Cure. It was long supposed that scrophula depended upon an acid acrimony of the fluids; and this, it is probable, gave rise to the use of burnt sponge, different kinds of soap, and other alkaline substances, as the best remedies for acidity. But although a sourness of the stomach and *primæ viæ* does no doubt frequently occur in these complaints, yet this symptom seems to be entirely the consequence of that general relaxation which in scrophula so universally prevails, and which does not render it in the least necessary to suppose a general acescency of the fluids to take place; as the one very frequently, it is well known, even in other complaints, occurs without the least suspicion of any acid acrimony existing in the other. This is also rendered very probable from the indolent nature of scrophulous tumors, which have been known to subsist for years without giving any uneasiness; which could not have been the case, if an acid, or any other acrimony, had prevailed in them.

In the treatment of scrophula, different morbid conditions, existing in different parts, require, according to circumstances, various means of cure: but, upon the whole, the remedies directed may be considered as used with a view either to the tumours, to the ulcerations, or to the general state of the system.

Gentle

Impetigines.

Gentle mercurials are ſometimes of uſe as reſolvents in ſcrophulous ſwellings; but nothing has ſuch conſiderable influence as a frequent and copious uſe of cinchona. Cold bathing too, eſpecially in the ſea, together with frequent moderate exerciſe, is often of ſingular ſervice here; as is likewiſe change of air, eſpecially to a warm climate.

In the ſcrophulous inflammation of the eyes, or ophthalmia ſtrumoſa, the cinchona has alſo been given with extraordinary advantage: and we meet with an inſtance of its having cured the gutta roſacea in the face; a complaint which it is often difficult to remove, and which is extremely diſagreeable to the fair ſex.

From the various caſes related of tumefied glands it appears, that when the habit is relaxed and the circulation weak, either from conſtitution or accident, cinchona is a moſt efficacious medicine, and that it acts as a reſolvent and diſcutient. It will not, however, ſucceed in all caſes; but there are few in which a trial can be attended with much detriment. Dr Fothergill obſerves, that he has never known it avail much where the bones were affected, nor where the ſcrophulous tumor was ſo ſituated as to be accompanied with much pain, as in the joints, or under the membranous coverings of the muſcles; for when the diſeaſe attacks thoſe parts, the perioſtæum ſeldom eſcapes without ſome injury, by which the bone will of courſe be likewiſe affected. Here cinchona is of no effect: inſtead of leſſening, it rather increaſes the fever that accompanies thoſe circumſtances: and, if it do not really aggravate the complaint, it ſeems at leaſt to accelerate the progreſs of the diſeaſe.

Various are the modes in which cinchona is adminiſtered: Dr Fothergill makes uſe of a decoction, with the addition of ſome aromatic ingredients and a ſmall quantity of liquorice root, as a form in which a ſufficient quantity may be given without exciting diſguſt. But where it is eaſily retained in the ſtomach in ſubſtance, perhaps the beſt form of exhibiting it is that of powder; and in this ſtate it is often advantageouſly conjoined with powder of cicuta, an article poſſeſſing very great deobſtruent powers.

The powder, however, ſoon becomes diſagreeable to very young patients; and the extract ſeems not ſo much to be depended upon as may have been imagined. In making the extract, it is expoſed to ſo much heat, as muſt have ſome effect upon its virtues, perhaps to their detriment. In adminiſtering it, likewiſe, if great care be not taken to mix it intimately with a proper vehicle, or ſome very ſoluble ſubſtance, in weak bowels it very often purges, and thereby not only diſappoints the phyſician, but injures the patient. A ſmall quantity of the *cortex Winteranus* added gives the medicine a grateful warmth; and a little liquorice, a few raiſins, gum arabic or the like, added to the decoction before it be taken from the fire, by making the liquor viſcid enables it to ſuſpend more of the fine particles of the bark; by which proceſs the medicine is not only improved in efficacy, but at the ſame time rendered leſs diſagreeable.

In indolent ſwellings of the glands from viſcid humours, ſea water has been ſtrongly recommended by Dr Ruſſel.

Dr Fothergill alſo acquaints us, that the cicuta even by itſelf is not without a conſiderable ſhare of efficacy in removing ſcrophulous diſorders. He mentions the caſe of a gentlewoman, about 28 years of age, afflicted from her infancy with ſcrophulous complaints, ſevere ophthalmies, glandular ſwellings, &c. cured by the *extractum cicutæ* taken conſtantly for the ſpace of a year. He obſerves, however, that when given to children, even in very ſmall doſes, it is apt to produce ſpaſmodic affections; for which reaſon he rarely exhibits it to them when very young, or even to adults of very irritable habits.

Scrophula.

Dr Fothergill gives ſeveral other inſtances of the ſucceſs of cicuta in ſcrophulous caſes, and even in one which ſeemed to be not far removed from a confirmed phthiſis; but owns that it ſeldom had ſuch good effects afterwards: yet he is of opinion, that where there are ſymptoms of tubercles forming, a ſtrumous habit, and a tendency to phthiſis, the cicuta will often be ſerviceable. It is anodyne, corrects acrimony, and promotes the formation of good matter. With regard to the quality of the medicine, he obſerves, that the extract prepared from hemlock before the plant arrives at maturity, is much inferior to that which is made when the hemlock has acquired its full vigour, and is rather on the verge of decline: juſt when the flowers fade, the rudiments of the ſeeds become obſervable, and the habit of the plant inclines to yellow; this, he thinks, is the proper time to collect the hemlock. It has then had the full benefit of the ſummer heat; and the plants that grow in expoſed places will generally be found more active than thoſe that grow in the ſhade. The leſs heat it undergoes during the preparation, the better. Therefore, if a conſiderable quantity of the dry powder of the plant gathered at a proper ſeaſon be added, leſs boiling will be neceſſary, and the medicine will be the more efficacious. But let the extract be prepared in what manner ſoever it may, provided it be made from the genuine plant, at a proper ſeaſon, and be not deſtroyed by boiling, the chief difference obſervable in uſing it is, that a larger quantity of one kind is required to produce a certain effect than of another. Twenty grains of one ſort of extract have been found equal in point of efficacy to thirty, nay near forty, of another; yet both of them made from the genuine plant, and moſt probably prepared with equal fidelity. To prevent the inconveniences ariſing from this uncertainty, it ſeems always expedient to begin with ſmall doſes, and proceed ſtep by ſtep till the extract produces certain effects, which ſeldom fail to ariſe from a full doſe. Theſe effects are different in different conſtitutions. But, for the moſt part, a giddineſs affecting the head, and motions of the eyes, as if ſomething puſhed them outwards, are firſt felt; a ſlight ſickneſs, and trembling agitation of the body; a laxative ſtool or two. One or all of theſe ſymptoms are the marks of a full doſe, let the quantity in weight be what it will. Here we muſt ſtop till none of theſe effects be felt; and in three or four days advance a few grains more. For it has been ſuppoſed by moſt of thoſe who have uſed this medicine to any good purpoſe, that the cicuta ſeldom procures any benefit, though given for a long time, unleſs in as large a doſe as the patient can bear without ſuffering any of the inconveniences above mentioned. There is however reaſon to believe, that its effects, as a diſcutient, are in no degree dependent on its narcotic powers:

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and we are inclined to think, that recourſe is often had to larger doſes than are neceſſary; or at leaſt that the ſame benefit might be derived from ſmaller ones continued for an equal length of time.

Patients commonly bear a greater quantity of the extract at night than at noon, and at noon than in the morning. Two drams may be divided into thirty pills. Adults begin with two in the morning, two at noon, and three or four at night, with directions to increaſe each doſe, by the addition of a pill to each, as they can bear it.

But, after all, the beſt form under which the cicuta can, we think, be exhibited, is that of powder from the leaves. This, either under the form of powder or made into pills, may be given at firſt to the extent of four or five grains, and the doſe gradually riſing till it amount to 15 or 20 grains twice or thrice a-day. Given to this extent, particularly when conjoined with cinchona, it has often been found of great ſervice in ſcrophulous caſes. At the ſame time it muſt be allowed, that ſuch patients, after reſiſting every mode of cure, will have in ſome inſtances a ſpontaneous recovery in the progreſs of life, probably from the ſyſtem acquiring additional vigour.

Different mineral waters, particularly the ſulphureous ones, as thoſe of Harrowgate, Moffat, and Gillsland, have been much recommended in ſcrophula, and ſometimes productive of benefit. Recourſe has ſometimes alſo been had with advantage to zinc, iron, and barytes, particularly muriate of barytes. But as well as in rachitis, no remedy has been found more efficacious in ſcrophula than cold bathing, eſpecially ſea-bathing.

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Lues Venerea, or *French Pox.*

Siphylis, *Sauv.* gen. 3086. *Lin.* 6. *Vog.* 319. *Sag.* 126.
Lues venerea, *Boerh.* 1440. *Hoffm.* III. 413. *Junck.* 96. *Aſtruc* de Lue Venerea.

Dr Aſtruc, who writes a very accurate hiſtory of the lues venerea, is fully convinced that it is a new diſeaſe, which never appeared in Europe till ſome time between the years 1494 and 1496, having been imported from America by the companions of Chriſtopher Columbus; though this opinion is not without its opponents. Dr Sanches in particular has contended with much learning and ability, that it appeared in Europe at an earlier period: But it is at leaſt certain that it was altogether unknown to the medical practitioners of Greece and Rome, and that it was a very common diſeaſe in America when the Europeans firſt viſited that country. But at whatever period it may have been introduced into Europe, or from whatever ſource it may have been obtained, there can be no doubt that, as well as ſmallpox or meaſles, ſiphylis depends on a peculiar ſpecific contagion; on a matter *ſui generis*, which is alone capable of inducing this diſeaſe.

The venereal infection, however, cannot, like the contagious miaſmata of the ſmallpox and ſome other diſeaſes, be carried through the air, and thus ſpread from place to place: for unleſs it is tranſmitted from the parents to the children, there is no other way of contracting the diſeaſe but from actual contact with the infectious matter. Thus, when a nurſe happens to labour under the diſeaſe, the infant that ſhe ſuckles will receive the infection; as, on the other hand, when the child is infected, the nurſe is liable to receive it: and there have even been inſtances known of lying-in women being infected very violently, from having employed a perſon to draw their breaſts who happened to have venereal ulcers in the throat. It may be caught by touching venereal ſores, if the cuticle be abraded or torn: and in this way accoucheurs and midwives have ſometimes been infected ſeverely. Dr Macbride ſays, the moſt inveterate pox he ever ſaw was caught by a midwife, who happened to have a whitelow on one of her fingers when ſhe delivered a woman ill of the lues venerea.

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But by far the moſt ready way of contracting this diſeaſe is by coition, the genital parts being much more bibulous than the reſt of the body. When the diſorder is communicated, the places where the morbific matter enters are generally thoſe where it firſt makes its appearance; and as coition is the moſt uſual way of contracting it, ſo the firſt ſymptoms commonly appear on or near the pudenda.

The patient's own account will, for the moſt part, help us to diſtinguiſh the diſeaſe: but there are ſometimes caſes wherein we cannot avail ourſelves of this information, and where, inſtead of confeſſing, the parties ſhall conceal all circumſtances; while, on the other hand, there are now and then people to be met with, who perſuade themſelves that ſymptoms are venereal, which in reality are owing to ſome other cauſe: and therefore it is of the utmoſt importance to inform ourſelves thoroughly of the nature of thoſe ſymptoms and appearances which may be conſidered as pathognomic ſigns of lues venerea.

In the firſt place, when we find that the local ſymptoms, ſuch as chancres, buboes, phymoſis, and the like, do not give way to the uſual methods; or when theſe complaints, after having been cured, break out again without a freſh infection; we may juſtly ſuſpect that the virus has entered the whole maſs of fluids: but if at the ſame time ulcers break out in the throat, and the face is deformed by callous tubercles, covered with a brown or yellow ſcab, we may be aſſured that the caſe is now become a confirmed lues, which will require a mercurial courſe.

When eruptions of the furfuraceous and ſuperficial kind are venereal, they are not attended with itching; and the ſcale being picked off, the ſkin appears of a reddiſh brown, or rather copper colour, underneath; whereas leprous eruptions are itchy, throw off a greater quantity of ſcales, and riſe in greater blotches, eſpecially about the joints of the knees and elbows. Venereal tubercles or puſtules are eaſily diſtinguiſhed from carbuncles of the face, by not occupying the cheeks or the noſe, nor as having a purulent apex, but are covered at top, either with a dry branny ſcurf like the ſuperficial eruptions juſt now mentioned, or elſe with a hard dry ſcab of a tawney yellow hue; they particularly break out among the hair or near to it, on the forehead or on the temples.

Venereal ulcers affecting the mouth are diſtinguiſhable from thoſe which are ſcorbutic, in the following manner: 1. Venereal ulcers firſt affect the tonſils, fauces

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ces and uvula; then the gums, but these very rarely: on the contrary, scorbutic ulcers affect the gums first of all; then the fauces, tonsils, and uvula. 2. Venereal ulcers frequently spread to the nose; scorbutic ones almost never. 3. Venereal ulcers are callous in the edges; scorbutic ones are not so. 4. Venereal ulcers are circumscribed, and, for the most part, are circular, at least they are confined to certain places; scorbutic ones are of a more irregular form, spread wider, and frequently affect the whole mouth. 5. Venereal ulcers are for the most part hollow, and generally covered at bottom with a white or yellow slough; but scorbutic ones are more apt to grow up into loose fungi. 6. Venereal ulcers are red in their circumference, but scorbutic ones are always livid. 7. Venereal ulcers frequently rot the subjacent bones, the scorbutic ones seldom or never. 8. And lastly, Venereal ulcers are generally combined with other symptoms which are known to be venereal; scorbutic ones with the distinguishing signs of the scurvy, such as difficult breathing, listlessness, swelling of the legs, rotten gums, &c.

Another strong sign of the confirmed lues is often afforded from certain deep-seated nocturnal pains, particularly of the shins, arms, and head. As for any superficial wandering pains that have no fixed seat, and which affect the membranes of the muscles and ligaments of the joints, they, for the most part, will be found to belong to the gout or rheumatism, and can never be considered as venereal unless accompanied with some other evident signs; but with regard to the pains that are deeply seated, and always fixed to the same place, and which affect the middle and more solid part of the ulna, tibia, and bones of the cranium, and rage chiefly and with greatest violence in the forepart of the night, so that the patient can get no rest till morning approaches, these may serve to convince us that the disease has spread itself throughout the whole habit, whether they be accompanied with other symptoms of the lues or not. *Gummata* in the fleshy parts, *nodes* in the periosteum, *ganglia* upon the tendons, *tophi* upon the ligaments, *exostoses* upon the bones, and *fici* at the verge of the anus, are all of them signs of the confirmed lues: these are hard indolent swellings; but as they sometimes arise independently of any venereal infection, and perhaps may proceed from a scrophulous taint, unless they be accompanied or have been preceded by some of the more certain and evident symptoms of the lues, we must be cautious about pronouncing them venereal. When these swellings are not owing to the siphylitic virus, they are very seldom painful, or tend to inflame and suppurate, whereas those that are venereal usually do, and if they lie upon a bone generally bring on a caries.

These carious ulcers are most commonly met with upon the ulna, tibia, and bones of the cranium; and when accompanied with nocturnal pains, we can never hesitate about declaring their genuine nature. Frequent abortions, or the exclusion of scabby, ulcerated, half-rotten, and dead fœtuses, happening without any manifest cause to disturb the fœtus before its time, or to destroy it in the womb, may be reckoned as a sign that at least one of the parents is infected.

These then are the principal and most evident signs of the confirmed lues. There are others which are more

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equivocal, and which, unless we can fairly trace them back to some that are more certain, cannot be held as signs of the venereal disease: Such are, 1. Obstinate inflammations of the eyes, frequently returning with great heat, itching, and ulceration of the eyelids. 2. A singing and hissing noise in the ears, with ulcers or caries in the bones of the meatus auditorius. 3. Obstinate headachs. 4. Obstinate cutaneous eruptions, of the itchy or leprous appearance, not yielding to the milder methods of treatment. 5. Swellings of the bones; and, 6. Wandering and obstinate pains. None of these symptoms, however, can be known to be venereal, except they happen to coincide with some one or other of the more certain signs.

It may, perhaps, be considered as a singularity in this disease, that the diagnosis is often more difficult in the advanced than in the early periods of the affection. That is, with those who have been certainly subjected to siphylis, it is often very difficult to say whether certain symptoms, remaining after the ordinary modes of cure have been employed, be siphylitic or not. Very frequently, as appears from the sequel, nocturnal pains, ulcerations, and the like, remaining after a long course of mercury has been employed, are in no degree of a venereal nature, but are in reality to be considered as consequences rather of the remedy than of the disease; and are accordingly best removed by nourishing diet, gentle exercise, and tonics. But as long as any symptoms of any kind remain, it is often impossible to convince some patients that they are cured; and it is often impossible for a physician with certainty to affirm that the disease is altogether overcome.

Upon the whole, we are first to distinguish and consider the several symptoms apart; and then, by comparing them with each other, a clear judgement may be formed upon the general review.

Prognosis. Being thoroughly convinced that the case is venereal, we are to consider, first of all, whether it be of a longer or shorter date; for the more recent it is, it will, *cæteris paribus*, be less difficult to remove. But there are other circumstances which will assist us in forming a prognostic as to the event. As,

1. The age of the patient. This disorder is more dangerous to infants and old people, than to such as are in the flower and vigour of life, in whom some part of the virus may be expelled by exercise, or may be subdued in some degree by the strength of the constitution.

2. The sex. Though women are for the most part weaker than men, and therefore should seem less able to resist the force of any disease, yet experience shows that this is easier borne by them than by men; perhaps owing to the menstrual and other uterine discharges, by which a good portion of the virus may be carried off immediately from the parts where it was first applied; for it is observable, that whenever these discharges are obstructed, or cease by the ordinary course of nature, all the symptoms of this disease grow worse.

3. The habit of body. Persons who have acrid juices will be liable to suffer more from the venereal poison than such as have their blood in a milder state; hence, when people of a scorbutic or scrophulous habit contract venereal disorders, the symptoms are always remarkably violent, and difficult to cure. And for

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for the same reasons, the confirmed lues is much more to be dreaded in a person already inclined to an asthma, phthisis, dropsy, gout, or any other chronic distemper, than in one of a sound and healthy constitution. For as the original disease is increased by the accession of the venereal poison, so the lues is aggravated by being joined to an old disorder. The more numerous the symptoms, and the more they affect the bones, the more difficult the cure. Of all combinations the union of siphylis with scrophula is perhaps the most difficult to overcome: but if the acrimony should seize on the nobler internal parts, such as the brain, the lungs or the liver, then the disease becomes incurable, and the patient will either go off suddenly in an apoplectic fit, or sink under a consumption.

Cure. Viewing this disease as depending on a peculiar contagious matter introduced into the system, and multiplied there, it is possible to conceive that a cure may be obtained on one of three principles; either by the evacuation of the matter from the system, by the destruction of its activity, or by counteracting its influence in the system. It is not impossible that articles exist in nature capable of removing this complaint on each of these grounds: but we may venture at least to assert, that few such are yet discovered. Notwithstanding numbers of pretended infallible remedies for siphylis, mercury is perhaps the only article on which dependence is placed among European practitioners; and with regard to its mode of operation, all the three different opinions pointed out have been adopted and supported by different theorists.—But although many ingenious arguments have been employed in support of each, we are, upon the whole, inclined to think it more probable that mercury operates by destroying the activity of the venereal virus, than that it has effect either by evacuating it, or by exciting a state of action by which its influence is counteracted. Some practitioners have affirmed, that the disease may be totally extirpated without the use of mercury; but, excepting in slight cases, it appears from the most accurate observations, that this grand specific is indispensable; whether it be introduced through the pores of the skin, in the form of ointments, plasters, washes, &c.; or given by the mouth, disguised in the different shapes of pills, troches, powders, or solutions.

Formerly it was held as a rule, that a salivation ought to be raised, and a great discharge excited. But this is now found to be unnecessary: for as mercury probably acts by some specific power in subduing and correcting the venereal virus, all that is required is to throw in a sufficient quantity of the medicine for this purpose; and if it can be diverted from the salivary glands so much the better, since the inconveniences attending a spitting are such as we should always wish to avoid.

Mercury, when combined with any saline substance, has its activity prodigiously increased; hence the great variety of chemical preparations which have been contrived to unite it with different acids.

Corrosive sublimate or the murias hydrargyri corrosivus is one of the most active of all the mercurial preparations, insomuch as to become a poison even in very small doses. It therefore cannot safely be given in substance; but must be dissolved in order to render it capable of a more minute division. We may see, by looking into Wiseman, that this is an old medicine, though seldom given by regular practitioners. How it came to be introduced into so remote a part of the world as Siberia, is not easily found out; but Dr Clerc, author of the *Histoire Naturelle de l'Homme Malade*, assures us, that the sublimate solution has been in use there time out of mind.

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It appears to have been totally forgotten in other places, until of late years, when Baron Van Swieten brought it into vogue; so that at one period, if we may credit Dr Locker, they used no other mercurial preparation at Vienna. The number of patients cured by this remedy alone in the hospital of St Mark, which is under the care of this gentleman, from 1754 to 1761 inclusive, being 4880.

The method of preparing the solution is, to dissolve as much sublimate in any kind of ardent spirit (at Vienna they use only corn brandy) as will give half a grain to an ounce of solution. The dose to a grown person is one spoonful mixed with a pint of any light ptisan or barley water, and this to be taken morning and evening: the patients should keep principally in a warm chamber, and lie in bed to sweat after taking the medicine; their diet should be light; and they ought to drink plentifully throughout the day, of whey, ptisan, or barley water. If the solution does not keep the belly open, a mild purge must be given from time to time; for Locker observes, that those whom it purges two or three times a-day, get well sooner than those whom it does not purge: he also says, that it very seldom affects the mouth, but that it promotes the urinary and cutaneous discharges. This course is not only to be continued till all the symptoms disappear, but for some weeks longer. The shortest time in which Locker used to let the patients out was six weeks; and they were continued on a course of decoction of the woods for some weeks after they left off the solution.

This method has been introduced both in Britain and Ireland, though by no means to the exclusion of others; but it appears, that the solution does not turn out so infallible a remedy, either in these kingdoms, or in France, as they say it has done in Germany. It was seldom if ever found to perform a radical cure, and the frequent use of it proved in many cases highly prejudicial. It has therefore been succeeded in practice, even at Vienna, by mercury exhibited in other forms; and, among these, by a remedy first recommended by Dr Plenck, and since improved by Dr Saunders; consisting of mercury united with mucilage of gum arabic, which is said to render its exhibition perfectly mild and safe. For particulars, we refer to Dr Saunders's treatise.

But a late French writer, supposed to be Dr Petit, in a small book, entitled, *A parallel of the different methods of treating the venereal disease*, insists, that there is neither certainty nor safety in any other method than the repeated frictions with mercurial ointment.

If, therefore, it is determined to have recourse to the mercurial frictions, the patient may with advantage be prepared by going into the warm bath some days successively; having been previously blooded if of a plethoric habit, and taking a dose or two of some proper cathartic.

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The patient being fitted with the neceſſary apparatus of flannels, is then to enter on the courſe.

If he be of a robuſt habit, and in the prime of life, we may begin with two drams of the *unguentum hydrargyri fortius*, (Ph. Lond.) which is to be rubbed in about the ankles by an aſſiſtant whoſe hands are covered with bladders: then having intermitted a day, we may expend two drams more of the ointment, and reſt for two days; after which, if no ſoreneſs of the mouth comes on, uſe only one dram; and at every ſubſequent friction aſcend till the ointment ſhall reach the trunk of the body; after which the rubbings are to be begun at the wriſts, and from thence gradually extended to the ſhoulders. In order to prevent the mercury from laying too much hold of the mouth, it muſt be diverted to the ſkin, by keeping the patient in a conſtant perſpiration from the warmth of the room, and by drinking plentifully of barley-water, whey, or ptiſan; but if, nevertheleſs, the mercury ſhould tend to raiſe a ſpitting, then, from time to time, we are either to give ſome gentle cathartic, or order the patient into a vapour or warm bath; and thus we are to go on, rubbing in a dram of the ointment every ſecond, third, or fourth night, according as it may be found to operate; and on the intermediate days either purging or bathing, unleſs we ſhould chooſe to let the ſalivation come on; which, however, it is much better to avoid, as we ſhall thus be able to throw in a larger quantity of mercury.

It is impoſſible to aſcertain the quantity of mercury that may be neceſſary to be rubbed in, as this will vary according to circumſtances: but we are always to continue the frictions, for a fortnight at leaſt, after all ſymptoms of the diſeaſe ſhall have totally diſappeared; and when we have done with the mercury, warm bathing, and ſudorific decoctions of the woods, are to be continued for ſome time longer.

This is a general ſketch of the methods of treatment for the confirmed lues; but for a complete hiſtory of the diſeaſe, and for ample directions in every ſituation, we refer to Aſtruc, and his abridger Dr Chapman.—We have to add, however, that a method of curing this diſeaſe by mercurial fumigation has been lately recommended in France, but it ſeems not to meet with great encouragement. One of the moſt recent propoſals for the cure of the venereal diſeaſe is that of Mr Clare, and conſiſts in rubbing a ſmall quantity of mercury under the form of the *ſubmurias hydrargyri*, or *calomel* as it is commonly called, on the inſide of the cheek; by which means it has been ſuppoſed that we will not only avoid the inconveniences of unction, but alſo the purgative effects that are often produced by this medicine when taken into the ſtomach. But after all, the introduction of mercury under the form of unction, as recommended by the lateſt and beſt writers in Britain on the venereal diſeaſe, Dr Swediaur, Mr John Hunter, and others, is ſtill very generally preferred to any mode that has yet been propoſed.

Where, after a long trial of mercury, diſtreſſing ſymptoms ſtill remain, particularly obſtinate ulcerations and ſevere pains, benefit has often been derived from the uſe of opium: but there is little reaſon to believe, as has been held by ſome, that of itſelf it affords an infallible cure of this diſeaſe; at leaſt we are inclined to think, that all the facts hitherto brought in ſupport of the cure of ſiphylis by opium are at the utmoſt very doubtful.

The ſame obſervation may perhaps be made with regard to another remedy which has of late been highly extolled in ſiphylis, viz. the nitric acid. This article ſeems to have been firſt introduced both againſt affections of the liver and venereal complaints by Dr Scott of Bombay. It has ſince been highly extolled by Dr Beddoes and other writers in Britain. And there are many well authenticated caſes on record in which it has produced a cure. But it is very rarely preferable to mercury; and it is chiefly uſeful when, from ſome peculiarity of conſtitution, mercury cannot be exhibited.

In obſtinate ulcerations, remaining probably after the venereal virus has been overcome, and reſiſting the uſe of mercury, a complete cure has in many inſtances been obtained from the uſe of the root of the mezereon, the daphne mezereum of Linnæus. This article has been chiefly employed under the form of decoction; and it now appears that it is the baſis of an article at one time highly celebrated in venereal complaints, under the title of *Liſbon diet drink*. But, upon the whole, theſe ſequelæ of this diſeaſe are perhaps more readily overcome by country air, gentle exerciſe, and nouriſhing diet, particularly a milk diet, than by the uſe of any medicine whatever. It muſt indeed be allowed, that for combating different ſequelæ, various practices accommodated to the nature of theſe will on particular occaſions be requiſite. But into the conſideration of theſe we cannot here propoſe to enter.

GENUS LXXXVI. SCORBUTUS. 351

Scurvy.

Scorbutus, *Sauv.* gen 391. *Lin.* 223. *Vog.* 318. *Sag.* 127. *Boerh.* 1148. *Hoffm.* III. 369. *Junck.* 91. *Lind* on the Scurvy. *Hulme* de Scorbuto. *Rouppe* de Morbis Navigantium.

Deſcription. The firſt indication of the ſcorbutic diatheſis is generally a change of colour in the face, from the natural and healthy look to a pale and bloated complexion, with a liſtleſſneſs, and averſion from every ſort of exerciſe; the gums ſoon after become itchy, ſwell, and are apt to bleed on the ſlighteſt touch; the breath grows offenſive; and the gums, ſwelling daily more and more, turn livid, and at length become extremely fungous and putrid, as being continually in contact with the external air; which in every caſe favours the putrefaction of ſubſtances diſpoſed to run into that ſtate, and is indeed in ſome reſpects abſolutely requiſite for the production of actual putridity.

The ſymptoms of the ſcurvy, like thoſe of every other diſeaſe, are ſomewhat different in different ſubjects, according to the various circumſtances of conſtitution; and they do not always proceed in the ſame regular courſe in every patient. But what is very remarkable in this diſeaſe, notwithſtanding the various and immenſe load of diſtreſs under which the patients labour, there is no ſickneſs at the ſtomach, the appetite keeps up, and the ſenſes remain entire almoſt to the very laſt: when lying at reſt, ſcorbutic patients make no complaints, and feel little diſtreſs or pain; but the

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the moment they attempt to rise or stir themselves, then the breathing becomes difficult, with a kind of straitness or catching, and great oppression, and sometimes they have been known to fall into a syncope. This catching of the breath upon motion, with the loss of strength, dejection of spirit, and rotten gums, are held as the essential or distinguishing symptoms of the disease. The skin is generally dry, except in the very last stage, when the patients become exceedingly subject to faintings, and then it grows clammy and moist: in some it has an anserine appearance: but much oftener it is smooth and shining; and, when examined, is found to be spread over with spots not rising above the surface, of a redish, bluish, livid or purple colour, with a sort of yellow rim round them. At first these spots are for the most part small, but in time they increase to large blotches. The legs and thighs are the places where they are principally seen: more rarely on the head and face. Many have a swelling of the legs, which is harder, and retains the impression of the finger longer than the common dropsical or truly œdematous swellings. The slightest wounds and bruises, in scorbutic habits, degenerate into foul and untoward ulcers; and the appearance of these ulcers is so singular and uniform, that they are easily distinguished from all others. Scorbutic ulcers afford no good digestion, but give out a thin and fetid ichor mixed with blood, which at length has the appearance of coagulated gore lying caked on the surface of the sore, not to be separated or wiped off without some difficulty. The flesh underneath these sloughs feels to the probe soft and spongy, and is very putrid. Neither detergents nor escharotics are here of any service; for though such sloughs be with great pains taken away, they are found again at the next dressing, where the same sanguineous putrid appearance always presents itself. Their edges are generally of a livid colour, and puffed up with excrescences of proud flesh arising from below the skin. As the violence of the disease increases, the ulcers shoot out a soft bloody fungus, which often rises in a night's time to a monstrous size; and although destroyed by cauteries, actual or potential, or cut away with the knife, is found at next dressing as large as ever. It is a considerable time, however, before these ulcers, bad as they are, come to affect the bones with rottenness. These appearances will always serve to assure us that an ulcer is scorbutic; and should put us on our guard with respect to the giving mercurials, which are very generally pernicious in these cases.

Scorbutic people, as the disease advances, are seldom free from pains; though they have not the same seat in all, and often in the same person shift their place. Some complain of universal pain in all their bones; but most violent in the limbs, and especially the joints: the most frequent seat of their pain, however, is some part of the breast. The pains of this disease seem to arise from the distraction of the sensible fibres by the extravasated blood being forced into the interstices of the periosteum and of the tendinous and ligamentous parts; whose texture being so firm, the fibres are liable to higher degrees of tension, and consequently of pain.

The states of the bowels are various: in some there is an obstinate costiveness; in others a tendency to a flux, with extremely fetid stools: the urine is also rank and fetid, generally high coloured; and, when it has stood for some hours, throws up an oily scum on the surface. The pulse is variable; but most commonly slower and more feeble than in the time of perfect health. A stiffness in the tendons, and weakness in the joints of the knees, appear early in the disease: but as it grows more inveterate, the patients generally lose the use of their limbs altogether; having a contraction of the flexor tendons in the ham, with a swelling and pain in the joint of the knee. Some have their legs monstrously swelled, and covered over with livid spots or ecchymoses; others have had tumours there; some, though without swelling, have the calves of the legs and the flesh of the thighs quite indurated. As persons far gone in the scurvy are apt to faint, and even expire, on being moved and brought out into the fresh air, the utmost care and circumspection are requisite when it is necessary to stir or remove them.

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Scorbutic patients are at all times, but more especially as the disease advances, extremely subject to profuse bleedings from different parts of the body; as from the nose, gums, intestines, lungs, &c. and likewise from their ulcers, which generally bleed plentifully if the fungus be cut away. It is not easy to conceive a more dismal and diversified scene of misery than what is beheld in the third and last stage of this distemper; it being then that the anomalous and more extraordinary symptoms appear, such as the bursting out of old wounds, and the dissolution of old fractures that have been long united.

Causes. The term *scurvy* has been indiscriminately applied, even by physicians, to almost all the different kinds of cutaneous foulness; owing to some writers of the last century, who comprehended such a variety of symptoms under this denomination, that there are few chronic distempers which may not be so called, according to their scheme: but the disease here meant is the true putrid scurvy, so often fatal to seamen, that with many it has got the name of sea-scurvy, though it be a disease frequently occurring on shore, as was experienced by the British garrisons of Boston, Minorca, and many other places. Indeed no disease is perhaps more frequent or more destructive to people pent up in garrisons without sufficient supplies of sound animal food and fresh vegetables. It is sometimes known to be endemic in certain countries, where the nature of the soil, the general state of the atmosphere, and the common course of diet, all combine in producing that singular species of corruption in the mass of blood which constitutes the scorbutic diathesis; for the appearances, on dissecting scorbutic subjects, sufficiently show that the scurvy may, with great propriety, be termed a disease of the blood.

Dr Lind has, in a postscript to the third edition of his treatise on the scurvy, given the result of his observations drawn from the dissection of a considerable number of victims to this fatal malady; from which it appears that the true scorbutic state, in an advanced stage of the distemper, consists in numerous effusions of blood into the cellular interstices of most parts of the body, superficial as well as internal; particularly the gums and the legs; the texture of the former being almost entirely cellular, and the generally dependent state of the latter rendering these parts, of all others in the whole body, the most apt to receive and

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and retain the ſtagnant blood, when its craſis comes to be deſtroyed; and when it loſes that glutinous quality which, during health, hinders it from eſcaping through the pores in the coats of the blood-veſſels or through exhalant extremities.

A dropſical indiſpoſition, eſpecially in the legs and breaſt, was frequently, but not always, obſerved in the ſubjects that were opened, and the pericardium was ſometimes found diſtended with water: the water thus collected was often ſo ſharp as to ſhrivel the hands of the diſſector; and in ſome inſtances, where the ſkin happened to be broken, it irritated and feſtered the wound.

The fleſhy fibres were found ſo extremely lax and tender, and the bellies of the muſcles in the legs and thighs ſo ſtuffed with the effuſed ſtagnating blood, that it was always difficult, and ſometimes impoſſible, to raiſe or ſeparate one muſcle from another. He ſays that the quantity of this effuſed blood was amazing; in ſome bodies it ſeemed that almoſt a fourth part of the whole maſs had eſcaped from the veſſels; and it often lay in large concretions on the perioſteum, and in ſome few inſtances under this membrane immediately on the bone. Notwithſtanding this diſſolved and depraved ſtate of the external fleſhy parts, the brain always appeared perfectly ſound, and the viſcera of the abdomen, as well as thoſe in the thorax, were in general found quite uncorrupted. There were ſpots indeed, from extravaſated blood, obſerved on the meſentery, inteſtines, ſtomach, and omentum; but theſe ſpots were firm, and free from any mortified taint; and, more than once, an effuſion of blood, as large as a hand's breadth, has been ſeen on the ſurface of the ſtomach; and what was remarkable, that very ſubject was not known while living to have made any complaint of ſickneſs, pain, or other diſorder, in either ſtomach or bowels.

Theſe circumſtances and appearances, with many others that are not here enumerated, all prove to a demonſtration a putreſcent, or at leaſt a highly depraved ſtate of the blood: and yet Dr Lind takes no ſmall pains to combat the idea of the ſcurvy's proceeding from animal putrefaction; a notion which, according to him, "may, and hath miſled phyſicians to propoſe and adminiſter remedies for it altogether ineffectual."

He alſo, in the preface to his third edition, talks of the miſchief done by an attachment to deluſive theories. He ſays, "it is not probable that a remedy for the ſcurvy will ever be diſcovered from a preconceived hypotheſis, or by ſpeculative men in the cloſet, who have never ſeen the diſeaſe, or who have ſeen at moſt only a few caſes of it;" and adds, "that though a few partial facts and obſervations may, for a little, flatter with hopes of greater ſucceſs, yet more enlarged experience muſt ever evince the fallacy of all poſitive aſſertions in the healing art."

Sir John Pringle, however, is of a very different opinion. He "is perſuaded, after long reflection, and the opportunities he has had of converſing with thoſe who to much ſagacity had joined no ſmall experience in nautical practice, that upon an examination of the ſeveral articles which have either been of old approved, or have of late been introduced into the navy, it will appear, that though theſe means may vary in form and in mode of operating, yet they all ſome way contribute towards preventing putrefaction; whether of the air in the cloſer parts of a ſhip, of the meats, of the water, of the clothes and bedding, or of the body itſelf."

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What Dr Lind has above advanced is the more remarkable, as, in the two former editions of his book, he embraced the hypotheſis of animal putrefaction being the cauſe of the ſcurvy; and if theſe effuſions of blood, from a deſtruction of its craſis and the diſſolved ſtate of the muſcular fibres, together with the rotten condition of the mouth and gums, do not betray putreſcency, it is hard to ſay what does, or what other name we ſhall beſtow on this peculiar ſpecies of depravation which conſtitutes the ſcurvy.

The blood, no doubt, derives its healthy properties, and maintains them, from the due ſupplies of wholeſome food; while the inſoluble, ſuperfluous, effete, and acrid parts, are carried off by the ſeveral diſcharges of ſtool, urine, and perſpiration.

Our ſenſes of taſte and ſmell are ſufficient to inform us when our food is in a ſtate of ſoundneſs and ſweetneſs, and conſequently wholeſome; but it is from chemiſtry that we muſt learn the principles on which theſe qualities chiefly depend.

Experiments of various kinds have proved, that the ſoundneſs of animal and vegetable ſubſtances depends very much, if not entirely, on the preſence of their aërial principle. Rottenneſs is never obſerved to take place without an emiſſion of fixed air from the putrefying ſubſtance: and even when putrefaction has made a conſiderable progreſs, if aërial acid can be transferred, in ſufficient quantity, from ſome other ſubſtance in a ſtate of effervеſcence or fermentation, into the putrid body, the offenſive ſmell of this will be deſtroyed. If it be a bit of rotten fleſh with which the experiment is made, the firmneſs of its fibres will be found in ſome meaſure reſtored.

The experiments of Dr Hales, as well as many others made ſince his time, ſhow that an aërial principle is greatly connected with, and remarkably abundant in, the gelatinous parts of animal bodies, and in the mucilage or farina of vegetables. But theſe are the parts of our food which are moſt particularly nutritive; and Dr Cullen, whoſe opinion on this as on every other medical ſubject muſt be allowed of the greateſt weight, affirms, in his Lectures on the Materia Medica, that the ſubſtances on which we feed are nutritious only in proportion to the quantities of oil and ſugar which they reſpectively contain. This oil and ſugar are blended together in the gelatinous part of our animal food, and in the mucilaginous and farinaceous part of eſculent vegetables; and, while thus intimately combined, are not perceivable by our taſte, though very capable of being developed and rendered diſtinct by the power of the digeſtive organs; for in conſequence of the changes produced during digeſtion, the oily and the ſaccharine matter become manifeſt to our ſenſes, as we may ſee and taſte in the milk of animals, which is chiefly chyle a little advanced in its progreſs toward ſanguification; the oil is obſerved to ſeparate ſpontaneouſly, and from which a quantity of actual ſugar may be obtained by a very ſimple proceſs.

Thus much being premiſed, we can now readily comprehend

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comprehend how the blood may come to lose those qualities of smoothness, mildness, and tenacity which are natural to it. For if, in the first place, the fluids, and organs subservient to digestion, should be so far distempered or debilitated that the nutritious parts of the food cannot be properly developed, the blood must be defrauded of its due supplies; which will also be the case if the aliment should not originally contain enough of oily and saccharine matter, or should be so circumstanced, from being dried or salted, as to hinder the ready extrication of the nutritious parts; or, lastly, if the natural discharges should be interrupted or suspended, so that the superfluous, acrid, and effete fluids are retained in the general mass; in all these instances the blood must of necessity run into proportionate degrees of depravation.

And hence we may understand how it may possibly happen, that when persons are greatly weakened by some preceding disorder, and at the same time debarred the use of proper bodily exercise, the scorbutic diathesis should take place, even though they enjoy the advantages of pure air and wholesome diet. But these are solitary cases, and very rarely seen; for whenever the scurvy seizes numbers, and can be considered as an epidemic disease, it will be found to depend on a combination of the major part, or perhaps all, of the following circumstances:

1. A moist atmosphere, and more especially if cold be joined to this moisture. 2. Too long cessation from bodily exercise, whether it be from constraint, or a lazy slothful disposition. 3. Dejection of mind. 4. Neglect of cleanliness, and want of sufficient clothing. 5. Want of wholesome drink, either of pure water or fermented liquors. And, 6. Above all, the being obliged to live continually on salted meats, perhaps not well cured, without a due proportion of the vegetables sufficient to correct the pernicious tendency of the salt, by supplying the bland oil and saccharine matter requisite for the purposes of nutrition.

These general principles respecting the causes and nature of scurvy, seem to afford a better explanation of the phenomena of the disease than any conjectures respecting it that have hitherto been proposed. It must, however, be allowed, that Dr Lind is by no means the only writer who is disposed to consider this disease as not referable to the condition of the circulating fluids. In a late ingenious treatise on this subject by Sir F. Milman, he strenuously contends, that the primary morbid affection in this complaint is a debilitated state of the solids arising principally from want of aliment. But his arguments on this subject, as well as those of Dr Lind, are very ably answered by a still later writer on this subject, Dr Trotter, who has drawn his observations respecting it from very extensive experience, and who considers it as clearly established, by incontrovertible facts, that the proximate cause of scurvy depends on some peculiar state of the blood.—That this disease does not depend on a debilitated state of the solids, is demonstratively proved from numerous cases where every possible degree of debility occurs in the solids without the slightest appearance of scurvy. Dr Trotter, in the second edition of his Observations on the Scurvy, from the result of farther observation and later discoveries in chemistry, has attempted, with much ingenuity, to prove that the morbid condition of the blood, which takes place in scurvy, arises from the abstraction of vital air, or, as it is now generally called, *oxygene*; and this opinion, though still, perhaps, in some particulars requiring farther confirmation, is, it must be allowed, supported by many plausible arguments.

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Prevention and Cure. The scurvy may be prevented, by obviating and correcting these circumstances in respect of the non-naturals which were mentioned as contributing to the disease, and laid down as causes. It is therefore a duty highly incumbent on officers commanding at sea, or in garrisons, to use every possible precaution; and, in the first place, to correct the coldness and moisture of the atmosphere by sufficient fires: in the next, to see that their men be lodged in dry, clean, and well ventilated births or apartments: thirdly, to promote cheerfulness, and enjoin frequent exercise, which alone is of infinite use in preventing the scurvy: fourthly, to take care that the clothing be proper, and cleanliness of person strictly observed: fifthly, to supply them with wholesome drink, either pure water or sound fermented liquors; and if spirits be allowed, to have them properly diluted with water and sweetened with melasses or coarse sugar: and lastly, to order the salted meats to be sparingly used, or sometimes entirely abstained from; and in their place, let the people live on different compositions of the dried vegetables; fresh meat and recent vegetables being introduced as often as they can possibly be procured.

A close attention to these matters will, in general, prevent the scurvy from making its appearance at all, and will always hinder it from spreading its influence far. But when these precautions have been neglected, or the circumstances such that they cannot be put in practice, and the disease has actually taken place, our whole endeavour must be to restore the blood to its original state of soundness: and happily, such is the nature of this disease, that if a sufficiency of new matter, of the truly mild nutritious sort, and particularly such as abounds with vital air, such as recent vegetables, or different acid fruits, can be thrown into the circulation while the fleshy fibres retain any tolerable degree of firmness, the patient will recover; and that in a surprisingly short space of time, provided a pure air, comfortable lodgings, sufficient clothing, cleanliness, and exercise, lend their necessary aid.

This being the case, the plan of treatment is to be conducted almost entirely in the dietetic way; as the change in the mass of blood, which it is necessary to produce, must be brought about by things that can be received into the stomach by pints or pounds, and not by those which are administered in drops or grains, drams or ounces. For here, as there is no disorder of the nervous system, we have no need of those active drugs which are indispensably necessary in febrile or nervous diseases; the scorbutic diathesis being quite opposite to that which tends to produce a fever or any species of spasmodic disorders; nay, Dr Lind says, he has repeatedly found, that even the infection of an hospital fever is long resisted by a scorbutic habit.

It will now naturally occur to the reader, what those alimentary substances must be which bid the fairest

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fairest to restore the blood to its healthy state; and he needs scarcely to be told, that they are of those kinds which the stomach can bear with pleasure though taken in large quantities, which abound in jelly or mucilage, and which allow those nutritious parts to be easily developed; for though the viscera in scorbutic patients may be all perfectly sound, yet we cannot expect that either the digestive fluids or organs should possess the same degrees of power, which enable them, during health, to convert the crude dry farinacea, and the hard salted flesh of animals, into nourishment. We must therefore search for the *antiscorbutic virtue* in the tender sweet flesh of herbivorous animals; in new milk; and in the mucilaginous acid juices of recent vegetables, whether they be fruits, leaves, or roots.

The sour juices of lemons, oranges, and limes, have been generally held as antiscorbutics in an eminent degree, and their power ascribed to their acid; from an idea that acids of all kinds are the only correctors of putrefaction. But the general current of practical observations shows, and our experiments confirm it, that the virtue of these juices depends on their *aerial principle;* accordingly, while perfectly recent and in the mucilaginous state, and especially if mixed with wine and sugar, the juices of any one of these fruits will be found a most grateful and powerful antiscorbutic.

Dr Lind observing, "that the lemon juice, when given by itself undiluted, was apt, especially if overdosed, to have too violent an operation, by occasioning pain and sickness at the stomach, and sometimes a vomiting; found it necessary to add to it wine and sugar. A pint of Madeira wine, and two ounces of sugar, were put to four ounces and a half of juice, and this quantity was found sufficient for weak patients to use in 24 hours: such as were very weak sipped a little of this frequently according as their strength would permit; others who were stronger took about two ounces of it every two hours; and when the patients grew still stronger, they were allowed eight ounces of lemon juice in 24 hours."

While this very pleasant mixture, which is both a cordial and an antiseptic, may be had, it would be needless to think of prescribing any other; but when the fresh juice cannot be procured, we must have recourse to such other things as may be obtained. But the various modes of combining and administering these, so as to render them perfectly agreeable to the stomach, must always be regulated by circumstances, and therefore it will be in vain to lay down particular directions; since all that we have to do is, to fix on such fruits and other fresh vegetables as can be most conveniently had and taken, and contrive to give them in those forms, either alone or boiled up with flesh meat into soups, which will allow the patients to consume the greatest quantities.

The first promising alteration from such a course is usually a gentle diarrhœa; and if, in a few days, the skin becomes soft and moist, it is an infallible sign of recovery; especially if the patient gain strength, and can bear being stirred or carried into the open air without fainting.

But if the belly should not be loosened by the use of the fresh vegetables, nor the skin become soft and moist, then they must be assisted by stewed prunes, or a decoction of tamarinds with supertartrite of potash, in order to abate the costiveness; and by drinking a light decoction of the woods, and warm bathing, in order to relax the pores of the skin; for nothing contributes more to the recovery of scorbutic patients than moderate sweating.

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With regard to particular symptoms, antiseptic mouth waters composed of a decoction of cinchona and infusion of roses, with a solution of myrrh, must be used occasionally, in order to cleanse the mouth, and give firmness to the spongy gums. Swelled and indurated limbs, and stiffened joints, must be bathed with warm vinegar, and relaxed by the steam of warm water, repeatedly conveyed to them, and confined to the parts by means of close blankets: ulcers on the legs must never be treated with unctuous applications nor sharp escharotics; but the dressing should consist of lint or soft rags, dipt in a strong decoction of cinchona.

This disease at no time requires, or indeed bears, large evacuations, either by bleeding or purging; and as has been already mentioned, the belly must only be kept open by the fresh vegetables or the mildest laxatives. But we are always to be careful that scorbutic persons, after a long abstinence from greens and fruits, be not permitted to eat voraciously at first, lest they fall into a fatal dysentery.

All, however, that has now been laid down as necessary towards the cure, supposes the patients to be in situations where they can be plentifully furnished with all the requisites; but unhappily these things are not to be procured at sea, and often deficient in garrisons: in order therefore, that a remedy for the scurvy might never be wanting, Dr Macbride, in the year 1762, first conceived the notion, that the *infusion of malt*, commonly called *wort*, might be substituted for the common antiscorbutics; and it was accordingly tried.

More than three years elapsed before any account arrived of the experiments having been made: at length, ten histories of cases were received, wherein the wort had been tried, with very remarkable success; and this being judged a matter of great importance to the seafaring part of mankind, these were immediately communicated to the public in a pamphlet, under the title of *An historical account of a new method of treating the scurvy at sea.*

This was in 1767; but after that time a considerable number of letters and medical journals, sufficient to make up a small volume, were transmitted to Dr Macbride, particularly by the surgeons of his Majesty's ships who had been employed of late years for making discoveries in the southern hemisphere. Certain it is, that in many instances it has succeeded beyond expectation. In others it has fallen short: but whether this was owing to the untoward situation of the patients, or inattention on the part of the persons who were charged with the administration of the wort, not preparing it properly, or not giving it in sufficient quantity, or to its own want of power, must be collected from the cases and journals themselves.

During Captain Cook's third voyage, the most remarkable, in respect of the healthiness of the crew, that ever was performed, the wort is acknowledged to have been of singular use.

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In a letter which this very celebrated and successful circumnavigator wrote to Sir John Pringle, he gives an account of the methods pursued for preserving the health of his people; and which were productive of such happy effects, that he performed "a voyage of three years and 18 days, through all the climates from 52° north to 71° south, with the loss of one man only by disease, and who died of a complicated and lingering illness, without any mixture of scurvy. Two others were unfortunately drowned, and one killed by a fall; so that out of the whole number 118 with which he set out from England, he lost only four."

He says, that much was owing to the extraordinary attention of the admiralty, in causing such articles to be put on board as either by experience or conjecture were judged to tend most to preserve the health of seamen: and with respect to the wort, he expresses himself as follows:

"We had on board a large quantity of *malt*, of which was made *sweet wort*, and given (not only to those men who had manifest symptoms of the scurvy, but to such also as were, from circumstances, judged to be most liable to that disorder) from one or two to three pints in the day to each man, or in such proportion as the surgeon thought necessary, which sometimes amounted to three quarts in the 24 hours: this is without doubt one of the best sea antiscorbutic medicines yet found out; and if given in time, will, with proper attention to other things, I am persuaded, prevent the scurvy from making any great progress for a considerable time: but I am not altogether of opinion that it will cure it, in an advanced state, at sea."

On this last point, however, the captain and his surgeon differ; for this gentleman positively asserts, and his journal (in Dr Macbride's possession) confirms it, that the infusion of malt did effect a cure in a confirmed case, and at sea.

The malt being thoroughly dried, and packed up in small casks, is carried to sea, where it will keep sound, in every variety of climate, for at least two years: when wanted for use, it is to be ground in a hand mill, and the infusion prepared from day to day, by pouring three measures of boiling water on one of the ground malt; the mixture being well mashed, is left to infuse for 10 or 12 hours, and the clear infusion then strained off. The patients are to drink it in such quantities as may be deemed necessary, from one to three quarts in the course of the 24 hours: a panada is also to be made of it, by adding biscuit, and currants or raisins; and this palatable mess is used by way of solid food. This course of diet, like that of the recent vegetables, generally keeps the bowels sufficiently open; but in cases where costiveness nevertheless prevails, gentle laxatives must be interposed from time to time, together with diaphoretics, and the topical assistants, fomentations and gargles, as in the common way of management.

Captain Cook was also provided with a large stock of *sour krout;* (cabbage leaves cut small, fermented and stopped in the second stage of fermentation, and afterwards preserved by a due quantity of salt.) A pound of this was served to each man, twice a-week, while they were at sea. Sour krout, since the trial made of it on board Captain Cook's ships, has been extensively used by direction of the British government in many other situations, where scorbutus has prevailed; and it has been found to be highly serviceable both in preventing and in curing the disease. It was particularly found, during the late American war, to be highly beneficial to the British troops besieged in Boston, who were at that time entirely fed on salt provisions sent from England, and among whom true scorbutus was very fatal till the sour krout arrived. The scurvy at one period broke out among them with very alarming appearances; but by the seasonable arrival of a quantity of sour krout, it was effectually overcome. Care, however, must be bestowed, that this article be properly prepared and properly kept. When due attention is paid to these particulars, it may be preserved in good condition for many months; and is considered both by sailors and soldiers as a very acceptable addition to their salt provisions. But when served out to them in a putrid state, it is not only highly disagreeable to the taste, but probably also pernicious in its effects.

Among other means of preventing scurvy, Captain Cook had also a liberal supply of *portable soup;* of which the men had generally an ounce, three days in the week, boiled up with their pease; and sometimes it was served to them oftener; and when they could get fresh greens, it was boiled up with them, and made such an agreeable mess, that it was the means of making the people eat a greater quantity of greens than they would otherwise have done. And what was still of further advantage, they were furnished with sugar in lieu of butter or oil, which is seldom of the sweetest sort; so that the crew were undoubtedly great gainers by the exchange.

In addition to all these advantages of being so well provided with every necessary, either in the way of diet or medicine, Captain Cook was remarkably attentive to all the circumstances respecting cleanliness, exercise, sufficient clothing, provision of pure water, and purification of the air in the closer parts of the ship.

From the effect of these different means, as employed by Captain Cook, there can be little doubt that they will with due attention be sufficient for the prevention and cure of the disease, at least in most situations: but besides these, there are also some other articles which may be employed with great advantage.

Newly brewed spruce beer made from a decoction of the tops of the spruce fir and melasses, is an excellent antiscorbutic; it acts in the same way that the wort does, and will be found of equal efficacy, and therefore may be substituted. Where the tops of the spruce fir are not to be had, this beer may be prepared from the essence of spruce as it has been called, an article which keeps easily for a great length of time. But in situations where neither the one nor the other can be had, a most salutary mess may be prepared from oatmeal, by infusing it in water, in a wooden vessel, till it ferments, and begins to turn sourish; which generally happens, in moderately warm weather, in the space of two days.—The liquor is then strained off from the grounds, and

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and boiled down to the consistence of a jelly, which is to be eaten with wine and sugar, or with butter and sugar.

Nothing is more commonly talked of than a *land scurvy*, as a distinct species of disease from that which has been now described; but no writer has yet given a description so clear as to enable us to distinguish it from the various kinds of cutaneous foulness and eruption, which indeed are vulgarly termed *scorbutic*, but which are akin to the itch or leprosy, and for the most part require mercurials. These, however, are very different diseases from the true scorbutus, which, it is well known, may prevail in certain situations on land as well as at sea, and is in no degree to be attributed to sea air.

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Genus LXXXVII. ELEPHANTIASIS.

Elephantiasis, *Sauv.* gen. 302. *Vog.* 321. *Sag.* gen. 128,

Elephantia Arabum, *Vog.* 322.

The best account of this disease is that by Dr Heberden, published in the first volume of the Medical Transactions. According to him, frequently the first symptom is a sudden eruption of tubercles, or bumps of different sizes, of a red colour, more or less intense (attended with great heat and itching), on the body, legs, arms, and face; sometimes in the face and neck alone, at other times occupying the limbs only; the patient is feverish; the fever ceasing, the tubercles remain indolent, and in some degree scirrhous, of a livid or copper colour, but sometimes of the natural colour of the skin, or at least very little altered; and after some months they not unfrequently ulcerate, discharging a fetid ichorous humour in small quantity, but never laudable pus.

The features of the face swell and enlarge greatly; the part above the eyebrows seems inflated; the hair of the eyebrows falls off, as does the hair of the beard; but Dr Heberden has never seen any one whose hair has not remained on his head. The *alæ nasi* are swelled and scabrous; the nostrils patulous, and sometimes affected with ulcers, which, corroding the cartilage and *septum nasi*, occasion the nose to fall. The lips are tumid; the voice is hoarse; which symptom has been observed when no ulcers have appeared in the throat, although sometimes both the throat and gums are ulcerated. The ears, particularly the lobes, are thickened, and occupied by tubercles. The nails grow scabrous and rugose, appearing something like the rough bark of a tree; and the distemper advancing, corrodes the parts gradually with a dry sordid scab or gangrenous ulcer; so that the fingers and toes rot and separate joint after joint. In some patients the legs seem rather posts than legs, being no longer of the natural shape, but swelled to an enormous size, and indurated, not yielding to the pressure of the fingers; and the superficies is covered with very thin scales, of a dull whitish colour, seemingly much finer, but not so white as those observed in the *lepra Græcorum*. The whole limb is overspread with tubercles, interspersed with deep fissures; sometimes the limb is covered with a thick moist scabby crust, and not unfrequently the tubercles ulcerate. In others the legs are emaciated, and sometimes ulcerated; at other times affected with tubercles without ulceration. The muscular flesh between the thumb and forefinger is generally extenuated.

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The whole skin, particularly that of the face, has a remarkably shining appearance, as if it was varnished or finely polished. The sensation in the parts affected is very obtuse, or totally abolished; so that pinching, or puncturing the part, gives little or no uneasiness; and in some patients, the motion of the fingers and toes is quite destroyed. The breath is very offensive; the pulse in general weak and slow.

The disease often attacks the patient in a different manner from that above described, beginning almost insensibly; a few indolent tubercles appearing on various parts of the body or limbs, generally on the legs or arms, sometimes on the face, neck, or breast, and sometimes in the lobes of the ears, increasing by very slow degrees, without any disorder, previous or concomitant, in respect of pain or uneasiness.

To distinguish the distemper from its manner of attacking the patient, Dr Heberden styles the first by *fluxion* and the other by *congestion*. That by fluxion is often the attendant of a crapula, or surfeit from gross foods; whereby, perhaps, the latent seeds of the disorder yet dormant in the mass of blood are excited; and probably from frequent observations of this kind (the last meal being always blamed), it is, that, according to the received opinion, either fish, (the tunny, mackarel, and shell-fish, in particular), melons, cucumbers, young garden-beans, or mulberries, eaten at the same meal with butter, cheese, or any preparation of milk, are supposed to produce the distemper, and are accordingly religiously avoided.

Violent commotions of the mind, as anger, fear, and grief, have more than once been observed to have given rise to the disorder; and more frequently, in the female sex, a sudden suppression of an accustomed evacuation, by bathing the legs and feet in cold water at an improper season.

The disorder by fluxion is what is the oftenest endeavoured to be remedied by timely application; that by congestion, not being so conspicuous, is generally either neglected or attempted to be concealed, until perhaps it be too late to be cured, at least unless the patients would submit to a longer course of medicine and stricter regimen of diet than they are commonly inclined to do.

Several incipient disorders by fluxion have been known to yield to an antiphlogistic method, as bleeding, refrigerant salts in the saline draughts, and a solution of crystals of tartar in water, for common drink, (by this means endeavouring to precipitate part of the peccant matter, perhaps too gross to pass the pores by the kidneys); and when once the fever is overcome, cinchona, combined with sassafras, is the remedy principally to be relied on. The only topical medicine prescribed by Dr Heberden, was an attenuating embrocation of brandy and alkaline spirit. By the same method some confirmed cases have been palliated. But, excepting in one patient, Dr Heberden never saw or heard of a confirmed elephantiasis radically cured. He adds, however, that he never met with another patient possessed of prudence and perseverance enough to prosecute the cure as he ought.

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353 Genus LXXXVIII. LEPRA.

The *Leprosy*.

Lepra, *Sauv.* gen. 303. *Lin.* 262. *Sag.* 129.
Lepra *Græcorum*, *Vog.* 320.

This distemper is but little known to physicians in the western parts of Europe. Wallis tells us, that it first begins with red pimples, or pustules, breaking out in various parts of the body. Sometimes they appear single; sometimes a great number arise together, especially on the arms and legs; as the disease increases, fresh pimples appear, which, joining the former, make a sort of clusters: all which enlarge their borders, and spread in an orbicular form. The superficies of these pustules are rough, whitish, and scaly; when they are scratched the scales fall off, upon which a thin ichor oozes out, which soon dries and hardens into a scaly crust. These clusters of pustules are at first small and few; perhaps only three or four in an arm or leg, and of the size of a silver penny. But if the disease be suffered to go on, they become more numerous, and the clusters increase to the size of a crown-piece, but not exactly round. Afterwards the affection increases to such a degree, that the whole body is covered with a leprous scurf. The cure of this distemper is very much the same with that of the Elephantiasis. Here, however, recourse is frequently had to antimonial and mercurial medicines, continued for a considerable length of time. In conjunction with these, warm bathing, particularly the vapour bath, has often been employed with advantage.

Although what can strictly be called lepra is now, at least, a very rare disease in this country, yet to this general head may be referred a variety of cutaneous affections which are here very common, and which in many instances prove very obstinate. These appear under a variety of different forms; sometimes under that of red pustules; sometimes of white scurfs; sometimes of ulcerations; and not unfrequently a transition takes place from one form to another, so that they cannot be divided into different genera from the external appearance. These affections will often yield to the remedies already mentioned; but where antimonials and mercurials either fail, or from different circumstances are considered as unadviseable, a cure may sometimes be effected by others. In particular cases, purging mineral waters, the decoction of cinchona, the infusion of the œnanthe crocata, and various others, have been employed with success. Different external applications also have sometimes been employed with advantage. An article used in this way, known under the name of Gowland's lotion, with the composition of which we are unacquainted, has been much celebrated, and has been said to be employed with great success, particularly against eruptions on the face and nose.

354 Genus LXXXIX. FRAMBOESIA.

The *Yaws*.

Frambœsia, *Sauv.* gen. 125. *Sag.* 125.

Description. The description which is given of this distemper by the anonymous author of a paper in the 6th volume of the Edinburgh Medical Essays, (art. 76.) differs, in some circumstances, from one that Sauvages received from M. Virgile, an eminent surgeon of Montpelier, who practised twelve years in the island of St Domingo; and therefore he distinguishes the *frambœsia* into two species, *Guineensis* and *Americana*.

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The *frambœsia Guineensis* is said by the first-mentioned writer to be so common on the coast of Guinea and other parts of Africa, that it seldom fails to attack each individual of both sexes, one time or other, in the course of their lives; but most commonly during childhood or youth. "It makes its appearance in little spots on the cuticle, level with the skin, at first no larger than a pin's head, which increase daily, and become protuberant like pimples: soon after the cuticle frets off, and then, instead of finding pus or ichor, in this small tumor, only white sloughs or sordes appear, under which is a small red fungus, growing out of the cutis, increasing gradually to very different magnitudes, some less than the smallest wood strawberry, some as big as a raspberry, and others exceeding in size even the largest mulberries; which berries they very much resemble, being knobbed as these are." These protuberances, which give the name to the disease, appear on all parts of the body: but the greatest numbers, and the largest sized, are generally found in the groins, and about the pudenda or anus, in the armpits, and on the face: when the yaws are very large, they are few in number; and when remarkably numerous, they are less in size. The patients, in all other respects, enjoy good health, do not lose their appetite, and seem to have little other uneasiness than what the sores occasion.

M. Virgile describes the species of yaws that is common among the negroes of St Domingo, and which Sauvages has termed *frambœsia Americana*, as beginning from an ulcer that breaks out indiscriminately in different parts of the body, though most commonly on the legs; at first superficial, and not different from a common ulcer in any other circumstance saving its not healing by the usual applications; sooner or later, numerous fungous excrescences break out on the surface of the body, as before described, like little berries, moist, with a reddish mucus. Besides these, the soles of the feet and palms of the hands become raw, the skin fretting off, so as to leave the muscles bare; these excoriations are sometimes moist with ichor and sometimes dry, but always painful, and consequently very distressing. They are mentioned also by the author of the article in the Medical Essays; and both he and M. Virgile observe, that there is always one excrescence, or yaw, of an uncommon size, which is longer in falling off than the others, and which is considered as the *master-yaw*, and so termed. An ingenious inaugural dissertation on the subject of the yaws was lately published at Edinburgh by Dr Jonathan Anderson Ludford, now physician in Jamaica. The author of that dissertation considers Dr Cullen as improperly referring frambœsia to the class of cachexiæ. He thinks that this disease ought rather to be referred to the exanthemata; for, like the smallpox, he tells us, it has its accession, height, and decline. It begins with some degree of fever, either more or less violent; it may be propagated by inoculation; and it attacks the

the ſame individual only once in the courſe of a lifetime, thoſe who recover from the diſeaſe being never afterwards affected with it. Theſe particulars reſpecting framboeſia are reſted not merely on the authority of Dr Ludford, but are ſupported alſo by the teſtimony of Dr William Wright, a phyſician of diſtinguiſhed eminence, who, while he reſided in Jamaica, had, in the courſe of extenſive practice, many opportunities of obſerving this diſeaſe, and to whom Dr Ludford acknowledges great obligations for having communicated to him many important facts reſpecting it.

Dr Ludford conſiders the yaws as being in every inſtance the conſequence of contagion, and as depending on a matter *ſui generis*. He ſuppoſes no peculiar prediſpoſition from diet, colour, or other circumſtances, as being in any degree neceſſary. He views the diſeaſe as chiefly ariſing from contact with the matter, in conſequence of ſleeping in the ſame bed, waſhing in the ſame veſſel with the infected, or the like. In ſhort, the yaws may be communicated by any kind of contact; nay, it is even believed that flies often convey the infection, when, after having gorged themſelves with the virulent matter by ſucking the ulcers of thoſe who are diſeaſed, they make punctures in the ſkin of ſuch as are ſound, and thus inoculate them; in conſequence of which the diſorder will ſoon appear.

Prognoſis. The yaws are not dangerous, if the cure be ſkilfully managed at a proper time; but if the patient has been prematurely ſalivated, or has taken any quantity of mercury, and if his ſkin has been ſuddenly cleared, the cure will be very difficult, if not impracticable.

Cure. In attempting the cure of this diſeaſe, the four following indications are chiefly to be held in view:

1. To ſupport the ſtrength of the patient.
2. To promote excretion by the ſkin.
3. To correct the vitiated fluids.
4. To remove and counteract the injuries done either to the conſtitution in general, or to particular parts, by the diſeaſe.

With the firſt of theſe intentions, a liberal diet, conſiſting of a conſiderable quantity of animal food, with a conſiderable proportion of wine, and gentle exerciſe, are to be employed: but the cure is principally to be effected by mercurial ſalivation, after the virulent matter has been completely thrown out to the ſurface of the body by ſudorifics. The following are the particular directions given on this head by the author of the article in the Medical Eſſays. The yaws being an infectious diſeaſe, as ſoon as they begin to appear on a negro, he muſt be removed to a houſe by himſelf; or, if it is not certain whether the eruption be the yaws or not, ſhut him up ſeven days, and look on him again, as the Jews were commanded to do with their lepers, and in that time you may in moſt caſes be certain.

As ſoon as you are convinced that it is the yaws, give a bolus of flowers of ſulphur, with camphor and theriaca. Repeat this bolus every night for a fortnight or three weeks, or till the yaws come to the height; that is, when they neither increaſe in ſize or number: then throw your patient into a gentle ſalivation with calomel given in ſmall doſes, without farther preparation; five grains repeated once, twice, or thrice a-day, is ſufficient, as the patient can bear it. If he ſpits a quart in 24 hours, it is enough. Generally, when the ſalivation is at this height, all the yaws are covered with dry ſcaly cruſts or ſcabs; which, if numerous, look terribly. Theſe fall off daily in ſmall white ſcales; and in ten or twelve days leave the ſkin ſmooth and clean. Then the calomel may be omitted, and the ſalivation permitted to go off ſpontaneouſly. A dram of corroſive ſublimate diſſolved in an ounce of rum or brandy, and the ſolution daubed on the yaws, will, it is ſaid, in general clear the ſkin in two days time.

After the ſalivation, ſweat the patient twice or thrice in a frame or chair with ſpirits of wine; and give an alterative electuary of æthiops and gum guaiac. He may likewiſe uſe the decoction of guaiacum and ſaſſafras fermented with melaſſes, for his conſtant drink while the electuary is taking, and a week or a fortnight after the electuary is finiſhed.

The maſter-yaw muſt be conſumed an eighth or a tenth part of an inch below the ſkin, with *Mercur. corroſ. rub. et alum. uſt. part. æqual.* and digeſted with *Ung. baſil. flav.* ℥j. and *mercur. corroſ. rub.* ʒj. and cicatrized with lint preſſed out of ſpirits of wine, and with the ſulphate of copper.

After the yaws are cured, ſome patients are afflicted with carbuncles in their feet; which ſometimes render them incapable of walking, unleſs with pain. The method of cure is, by bathing and paring to deſtroy the cuticle, and then proceed as in the maſter-yaw. The gentle eſcharotics are to be preferred; and all imaginable care is to be taken to avoid the tendons and perioſteum.

To children under ſix or ſeven years old, at the proper time of ſalivating, when the yaws are come to their full growth, give a grain or two of calomel in white ſugar, once a-day, once in two days, or once in three days, ſo as only to keep their mouths a little ſore till the yaws dry, and, falling off in white ſcales, leave the ſkin clean. This ſucceeds always, but requires a longer time than in adults.

In St Domingo they are ſalivated by unction; but it does not appear that ſucceſs always followed this practice. It is alſo uſual in that iſland to give the ſolution of corroſive ſublimate along with a decoction of ſarſaparilla. Twelve ounces of this root, and 12 pounds of the coarſeſt ſugar, macerated for 15 days in 12 quarts of water, is mentioned as a ſpecific, and ſaid to be the preſcription of an Engliſh phyſician; the doſe is four ounces every ſixth hour.

Genus XC. TRICHOMA. 355

The *Plica Polonica*, or *Plaited Hair*.

Trichoma, *Sauv.* gen. 311. *Sag.* 137.
Plica, *Lin.* 313.
Plica ſive Rhopaloſis, *Vog.* 323.

This diſorder is only met with in Poland and Lithuania, and conſiſts of ſeveral blood-veſſels running from the head into the ends of the hairs; which cleave together, and hang from the head in broad flat pieces, generally about an ell in length, but ſometimes they are five

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No method of relief is yet known; for if the diſcharge be checked, or the veſſels cut off, the conſequence is an increaſe of more miſerable ſymptoms, and in the end death. Sennertus ſays, when all the morbid matter is thrown out of the body the plicæ fall off ſpontaneouſly. He further obſerves, that the only ſafe practice in this caſe is, to ſollicit the peccant matter to the hairs, to which it naturally tends; and that this is beſt anſwered by lotions of bear's-breech. Some ſay that a decoction of the herb club-moſs, and its ſeeds, with which the head is to be waſhed, is a ſpecific.

356 Genus XCI. ICTERUS.

The *Jaundice*.

Icterus, *Lin.* 224. *Vog.* 306. *Boerh.* 918. *Junck.* 90.
Aurigo, *Sauv.* gen. 306. *Sag.* 132.
Cachexia icterica, *Hoffm.* III. 301.

Deſcription. The jaundice firſt ſhows itſelf by a liſtleſſneſs and want of appetite, the patient becomes dull, oppreſſed, and generally coſtive. Theſe ſymptoms have continued but a very ſhort time, when a yellow colour begins to diffuſe itſelf over the *tunica albuginea*, or white part of the eye, and the nails of the fingers; the urine becomes high-coloured, with a yellowiſh ſediment capable of giving a yellow tinct to linen; the ſtools are whitiſh or gray. In ſome there is a moſt violent pain in the epigaſtric region, which is conſiderably increaſed after meals. Sometimes the patient has a continual propenſity to ſleep; but in others there is too great watchfulneſs; and ſometimes the pain is ſo great, that though the patient be ſleepy he cannot compoſe himſelf to reſt. The pains come by fits; and moſt women who have had the jaundice and born children, agree, that they are more violent than labour-pains. As the diſeaſe increaſes, the yellow colour becomes more and more deep; an itching is felt all over the ſkin; and even the internal membranes of the viſcera, the bones, and the brain itſelf, become tinged, as hath been ſhown from diſſections, where the bones have been found tinged ſometimes for years after the jaundice has been cured.

In like manner, all the ſecretions are affected with the yellow colour of the bile, which in this diſeaſe is diffuſed throughout the whole maſs of fluids. The ſaliva becomes yellowiſh and bitter; the urine exceſſively high coloured, in ſuch a manner as to appear almoſt black; nay, the blood itſelf is ſometimes ſaid to appear of a yellow colour when drawn from a vein; yet Dr Heberden ſays, that he never ſaw the milk altered in its colour, even in caſes of very deep jaundice. In proceſs of time the blood begins to acquire a tendency to diſſolution and putrefaction; which is known by the patient's colour changing from a deep yellow to a black or dark yellow. Hæmorrhages enſue from various parts of the body, and the patients frequently die of an apoplexy; though in ſome the diſeaſe degenerates into an incurable dropſy; and there have not been wanting inſtances of ſome who have died of the dropſy after the jaundice itſelf had been totally removed. Icterus.

Cauſes. As the jaundice conſiſts in a diffuſion of the bile throughout the whole ſyſtem, it thence follows, that whatever may favour the diffuſion is alſo to be reckoned among the cauſes of jaundice. Many diſputes have ariſen concerning the manner in which the bile is introduced into the blood; but it is now generally agreed that it is taken up by the lymphatics of the gall-bladder and biliary ducts. Hence, a jaundice may ariſe from any thing obſtructing the paſſage of the bile into the duodenum, or from any thing which alters the ſtate of the lymphatics in ſuch a manner as to make them capable of abſorbing the bile in its natural ſtate. Hence the jaundice may ariſe from ſcirrhi of the liver or other viſcera preſſing upon the biliary ducts, and obſtructing the paſſage of the bile; from flatus diſtending the duodenum, and ſhutting up the entrance of the ductus communis choledochus into it; from the ſame orifice being plugged up by viſcid bile, or other ſordes; but by far the moſt frequent cauſe of jaundice is the formation of calculi, or more properly biliary concretions: for although they were long conſidered as being of a calcareous nature, yet more accurate experiments have now demonſtrated, that they conſiſt principally of a ſebaceous matter; accordingly, while they are ſo light as to ſwim in water, they are alſo highly inflammable. Theſe are found of almoſt all ſizes, from that of a ſmall pea to that of a walnut, or bigger: they are of different colours; and ſometimes appear as if formed in the inward part by cryſtallization, but of lamellæ on the outer part; though ſometimes the outward part is covered with rough and ſhining cryſtals, while the inward part is lamellated. Theſe enter into the biliary ducts, and obſtruct them, cauſing a jaundice, with violent pain for ſome time; and which can be cured by no means till the concretion is either paſſed entirely through the ductus communis or returned into the gall-bladder. Sometimes, in the opinion of many celebrated phyſicians, the jaundice is occaſioned by ſpaſmodic conſtrictions of the biliary ducts; but this is denied by others, and it is not yet aſcertained whether theſe ducts are capable of being affected by ſpaſm or not, as the exiſtence of muſcular fibres in them has not with certainty been diſcovered. It cannot, however, be denied, that violent fits of paſſion have often produced jaundice, ſometimes temporary, but frequently permanent. This has been by ſome deemed a ſufficient proof of the ſpaſmodic contraction of the ducts; but their opponents ſuppoſed, that the agitation occaſioned by the paſſion might puſh forward ſome biliary concretion into a narrow part of the duct, by which means a jaundice would certainly be produced, till the concretion was either driven backward or forward into the duodenum altogether. But even ſuppoſing the ducts themſelves to be incapable of ſpaſm, yet there can be no doubt that by a ſpaſm of the inteſtines biliary concretions may be retained in the ducts; and

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In a very relaxed state of the body there is also an absorption of the bile, as in the yellow fever; and indeed in all putrid disorders there is a kind of yellowish tinct over the skin, though much less than in the true jaundice. The reason of this is, that in these disorders there is usually an increased secretion of bile, commonly of a thinner consistence than in a healthy state, while the orifices of the lymphatics are probably enlarged, and thus ready to absorb a fluid somewhat thicker than what they ought to take up in a healthy state; but these disorders are of short duration in comparison with the real jaundice, which sometimes lasts for many years. These affections, however, cannot with propriety in any case be considered as real instances of jaundice; for, to constitute that disease bile must not only be present in the blood, but wanting in the alimentary canal.

It is observable, that women are more subject to jaundice than men, which probably arises from their more sedentary life; for this, together with some of the depressing passions of the mind, is found to promote the accession of the disease, if not absolutely to produce it. Pregnant women also are frequently attacked by the jaundice, which goes off after their delivery.

Prognosis. As jaundice may arise from many different causes, some of which cannot be discovered during the patient's life, the prognosis must on this account be very uncertain. The only cases which admit of a cure are those depending upon biliary concretions, or obstructions of the biliary ducts by viscid bile; for the concretions are seldom of such a size that the ducts will not let them pass through, though frequently not without extreme pain. Indeed this pain, though so violent, and almost intolerable to the sick person, affords the best prognosis; as the physician may readily assure his patient that there is great hope of his being relieved from it. The coming on of a gentle diarrhœa, attended with bilious stools, together with the cessation of pain, are signs of the disease being cured. We are not, however, always to conclude, because the disease is not attended with acute pain, that it is therefore incurable; for frequently the passage of a concretion through the biliary ducts is accompanied only with a sensation of slight uneasiness.

Cure. The great object to be aimed at in the cure of jaundice is unquestionably the removal of the cause which obstructs the passage of bile into the intestines: But before this can be accomplished, practices are often necessary for alleviating urgent symptoms; which may be done sometimes by supplying the want of bile in the alimentary canal, sometimes by affording an exit for bilious matter from the general mass of blood, but most frequently by obviating the effects of distention and obstruction to the circulation in the system of the liver.

The measures to be employed for the removal of the obstruction must depend very much on the nature of the obstructing cause.

When the jaundice arises from indurated swellings or scirrhi of the viscera, it is absolutely incurable; nevertheless, as these cannot always be discovered, the physician ought to proceed in every case of jaundice as if it arose from calculi. The indications here are, 1. To dissolve the concretions; and, 2. To prevent their formation a second time. But unhappily the medical art has not yet afforded a solvent for biliary concretions. They cannot even be dissolved when tried out of the body either by acids or alkalies, or any thing but a mixture of oil of turpentine and spirit of wine; and these substances are by far too irritating to be given in sufficient quantity to affect a concretion in the biliary ducts. Boerhaave observes, that diseases of the liver are much more difficult to cure than those in any other part of the body; because of the difficulty there is in getting at the part affected, and the tedious and round-about passage the blood has to it. The juice of common grass has indeed been recommended as a specific in the jaundice, but on no good foundation. Glisson observes, that black cattle are subject to biliary concretions when fed with hay or dried straw in winter, but are cured by the succulent grass in the spring; and Van Swieten tells a strange story of a man who cured himself of the jaundice by living almost entirely on grass, of which he devoured such quantities, that the farmers were wont to drive him out of their fields; but other practitioners have by no means found this in any degree effectual. The only method of cure now attempted in the jaundice is to expel the concretion into the intestines; for which vomits and exercise are the principal medicines. The former are justly reckoned the most efficacious medicines, as they powerfully shake all the abdominal and thoracic viscera; and thus tend to dislodge any obstructing matter that may be contained in them. But if there be a tendency to inflammation, vomits must not be exhibited till bleeding has been premised. We must also proceed with caution if the pain be very sharp; for in all cases where the disease is attended with violent pain, it will be necessary to allay it by opiates before the exhibition of an emetic. There is also danger, that, by a continued use of vomits, a concretion which is too large to pass, may be so impacted in the ducts, that it cannot even be returned into the gall-bladder, which would otherwise have happened. In all cases, therefore, if no relief follows the exhibition of the second or third emetic, it will be prudent to forbear their farther use for some time.

Icterus.

Of all kinds of exercise, that of riding on horseback is most to be depended upon in this disease. It operates in the same manner with vomits, namely, by the concussion it gives to the viscera; and therefore the cautions necessary to be observed in the use of vomits are also necessary to be observed in the use of riding. Cathartics also may be of service, by cleansing the *primæ viæ*, and soliciting a discharge of the bile into the intestines; but they must not be of too drastic a nature, else they may produce incurable obstructions, by bringing forward concretions that are too large to pass. Anodynes and the warm bath are serviceable by their relaxing quality; and there can be no doubt, that, from acting as powerful antispasmodics, they often give an opportunity for the discharge of concretions by very slight causes, when they would otherwise be firmly retained. Soap has been supposed to do service as as a ſolvent; but this is now found to be a miſtake, and it acts in no other way than as a relaxant or as a gentle purgative.

But when all means of relief fail, as in caſes of ſcirrhus, we can then only attempt to palliate the ſymptoms, and preſerve the patient's life as long as poſſible. This is beſt accompliſhed by diuretics; for thus a great quantity of bilious matter is evacuated, and the ſyſtem is freed from the bad conſequences which enſue on its ſtagnation in the habit. But even this is by no means equal to the common evacuation by ſtool; nor can all the attempts to ſupply the want of bile in the inteſtines by bitters and other ſtomachics reſtore the patient to his wonted appetite and vigour. If the pain be very violent, we muſt on all occaſions have recourſe to opiates; or if the blood has acquired a tendency to diſſolution, it muſt be counteracted by proper antiſeptics.

If the diſeaſe goes off, its return muſt be prevented by a courſe of tonic medicines, particularly the cinchona and antiſeptics: but we can by no means be certain that the jaundice will not return, and that at any interval; for there may be a number of concretions in the gall-bladder, and though one has paſſed, another may very quickly follow, and produce a new fit of jaundice; and thus ſome people have continued to be affected with the diſtemper, at ſhort intervals, during life.

In the Eaſt Indies, mercury has been lately recommended as exceedingly efficacious in diſorders of the liver, eſpecially thoſe which follow intermitting and remitting fevers. Dr Monro, in his Obſervations on the means of preſerving the health of ſoldiers, acquaints us, that he has ſeen ſome icteric caſes which, he thought, received benefit from taking a few grains of the ſubmurias hydrargyri at night, and a purge next morning; and this repeated two or three times a-week.

Infants are ſubject to a temporary jaundice, commonly called the *gum*, ſoon after birth; the cauſe of which is not well underſtood. It differs remarkably from the common jaundice; as, in the latter, the diſeaſe is firſt diſcoverable in the white of the eyes; but though the ſkin of infants in the gum is all over yellow, their eyes always remain clear. The diſorder goes off ſpontaneouſly, or by the uſe of a gentle purgative or two.

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Class IV. LOCALES.

Vitia, *Sauv.* Claſs I. *Lin.* Claſs XI. *Vog.* Claſs X. *Sag.* Claſs. I.
Plagæ, *Sag.* Claſs II.
Morbi organici Auctorum.

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Order I. DYSÆSTHESIÆ.

Dyſæſtheſiæ, *Sauv.* Claſs VI. Ord. I. *Sag.* Claſs IX. Ord. I.

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Genus XCII. CALIGO.

The *Cataract.*

Caligo, *Sauv.* gen. 153. *Vog.* 288. *Sag.* gen. 259.
Cataracta, *Lin.* 109.

A *cataract* is an obſtruction of the pupil, by the interpoſition of ſome opaque ſubſtance which either diminiſhes or totally extinguiſhes the ſight. It is generally an opacity in the cryſtalline humour. In a recent or beginning *cataract*, the ſame medicines are to be uſed as in the *gutta ſerena;* and they will ſometimes ſucceed. But when this does not happen, and the cataract becomes firm, it muſt be couched, or rather extracted; for which operation, ſee Surgery.—Dr Buchan ſays he has reſolved a recent cataract by giving the patient ſome purges with calomel, keeping a poultice of freſh hemlock conſtantly upon the eye, and a perpetual bliſter on the neck.

There is, however, but little reaſon to ſuppoſe that theſe practices will frequently ſucceed. A reſolution can only be effected here by an abſorption of the opaque matter; and where this is poſſible, there is perhaps a better chance of its being effected by the agency of the electric fluid than by any other means. For this purpoſe electricity is chiefly applied under the form of the *electric aura*, as it has been called; but even this is very rarely ſucceſsful.

Genus XCIII. AMAUROSIS. 360

The *Gutta Serena.*

Amauroſis, *Sauv.* gen. 155. *Lin.* 110. *Vog.* 238. *Sag.* 261.
Amblyopia, *Lin.* 108. *Vog.* 236.

A *gutta ſerena* is an abolition of the ſight without any apparent cauſe or fault in the eyes. In every caſe it depends on an affection of ſome part of the optic nerve. But the affections which may produce this diſeaſe are of different kinds. When it is owing to a decay or waſting of the optic nerve, it does not admit of a cure; but when it proceeds from a compreſſion of the nerves by redundant humours, theſe may be in ſome meaſure drained off, and the patient relieved. For this purpoſe, the body muſt be kept open with the laxative mercurial pills. If the patient be young, and of a ſanguine habit, he may be bled. Cupping with ſcarifications on the back part of the head will likewiſe be of uſe. A running at the noſe may be promoted by volatile ſalts, ſtimulating powders, &c. But the moſt likely means of relieving the patient, are iſſues or bliſters kept open for a long time on the back part of the head, behind the ears, or on the neck; which have been known to reſtore ſight even after it had been for a conſiderable time loſt.—Should theſe fail, recourſe muſt be had to a mercurial ſalivation; or, what will perhaps anſwer the purpoſe better, 12 grains of the corroſive ſublimate mercury may be diſſolved in an Engliſh pint and a half of brandy, and a table ſpoonful of it taken twice a-day, drinking half a pint of the decoction of ſarſaparilla after it.—Of late electricity has been much celebrated as efficacious, when no other thing could do ſervice; and here it has in ſome degree the ſame chance of ſucceſs as in other caſes of inſenſibility, depending on an affection of the nerves, in ſome of which it has certainly in particular caſes been of uſe.

In the amauroſis, Dr Porterfield obſerves, that it is of the utmoſt conſequence to know of how long ſtanding the diſeaſe has been; which is not always eaſily done if one eye only be affected. This is a very eſſential

tial point; becauſe an amauroſis of long ſtanding is altogether incurable. Mr Boyle mentions the caſe of a man who had a cataract for ſeveral years without knowing it himſelf, though others did. He diſcovered it at laſt by happening to rub his ſound eye, and was ſurpriſed to find himſelf in the dark. When a perſon therefore has a gutta ſerena only in one of the eyes, he may think that the eye has but lately loſt the power of ſight; though this perhaps has been the caſe for ſeveral years. On the other hand, he may imagine that a recent diſeaſe of this kind is really of long ſtanding. But by inquiring at what time he firſt became ſubject to miſtakes in all actions that require the diſtance to be exactly diſtinguiſhed, as in pouring liquor into a glaſs, ſnuffing a candle, or threading a needle, we may diſcover the age of the diſeaſe, and thence be aſſiſted to form a more juſt prognoſtic with reſpect to its cure. Dr Porterfield gives an inſtance of his conjecturing in this manner concerning the caſe of a young lady who had diſcovered a loſs of ſight in one of her eyes only the day before. The diſeaſe was thought to be of long ſtanding; but as the doctor found that ſhe had only been ſubject to miſtakes of the kind above mentioned for about a month, he drew a favourable prognoſtic, and the diſeaſe was cured.

361 Genus XCIV. DYSOPIA.

Depraved Vision.

Amblyopia, *Sauv.* gen. 154. *Sag.* 258.

There are ſeveral ſpecies referred to this genus by Dr Cullen, viz.

1. *Dyſopia* Tenebrarum; 2. *Dyſopia* Luminis.—The former of theſe is properly the *nyctalopia*, or night-blindneſs, of ancient authors. But amongſt both the Greek and Latin writers, there is a direct oppoſition in the uſe of this word *nyctalopia;* ſome ſaying it ſignifies "thoſe who *cannot* ſee by night," and others expreſs by it "thoſe who cannot ſee during the day, but during the *night*."—The difference in the account of this diſorder, as to its appearing in the night or in the day, is reconciled by conſidering it as of the intermitting kind: the difference then will conſiſt in the different times of its approach; ſo it may be called *periodical blindneſs*. Intermittents appearing in a variety of modes, and the ſucceſs of cinchona in ſome inſtances of this ſort of blindneſs, both favour the opinion of its being an intermittent diſeaſe of the eyes; and this view has accordingly been taken of it by ſome late writers, particularly in ſome papers in the London Medical Obſervations, and Medical Tranſactions.

3. *Dyſopia* Proximorum (*Preſbytia*), or the defect of thoſe who *ſee only at too great diſtance*. 4. *Dyſopia* Dissitorum (*Myopia*), or the defect of thoſe who are *ſhortſighted*.—Theſe are diſorders which depend on the original ſtructure or figure of the eye, therefore admit of no cure. The inconveniences ariſing from them may, however, be in ſome meaſure remedied by the help of proper glaſſes. The former requires the aid of a convex, and the latter of a concave glaſs.

5. *Dyſopia* Lateralis; a defect by which objects cannot be viewed diſtinctly but in an oblique poſition.—Thus, in viewing an object placed on the left, they turn their face and eyes to the right, and *vice verſa*.—This diſorder may proceed from various cauſes both natural and accidental, ſome of which admit of no remedy. If it be occaſioned by a partial adheſion of the eyelids, the hand of the ſurgeon is required: if by a tranſverſe poſition of the pupil, ſome mechanical contrivance is neceſſary. If it be owing to an *albugo* covering part of the pupil, or to a film rendering a portion of the cornea opaque, the remedies for theſe affections are to be here applied.

Genus XCV. PSEUDOBLEPSIS. 362

Imaginary Vision of Objects which do not exiſt.

Suffuſio, *Sauv.* gen. 217. *Sag.* 329.
Phantaſma, *Lin.* 73. *Sag.* 289.

This very often takes place when the body is diſeaſed, and then the patient is ſaid to be delirious. Sometimes, however, in theſe caſes, it does not amount to delirium; but the perſon imagines he ſees gnats or other inſects flying before his eyes; or ſometimes, that every thing he looks at has black ſpots in it, which laſt is a very dangerous ſign. Sometimes alſo ſparks of fire appear before the eyes; which appearances are not to be diſregarded, as they frequently precede apoplexy or epilepſy. Sometimes, however, people have been affected in this manner during life without feeling any other inconvenience. Such a diſorder can rarely if ever be cured.

Genus XCVI. DYSECŒA. 363

Deafness, or *Difficulty of Hearing.*

Genus XCVII. PARACUSIS. 364

Depravation of Hearing.

Paracuſis, *Sauv.* gen. 159. *Sag.* 265.
Syrigmus, *Sauv.* gen. 219. *Sag.* 231.

The functions of the ear may be injured by wounds, ulcers, or any thing that hurts its fabric. The hearing may likewiſe be hurt by exceſſive noiſe; violent colds in the head; fevers; hard wax, or other ſubſtances ſticking in the cavity of the ear; too great a degree of moiſture or dryneſs of the ear. Deafneſs is very often the effect of old age, and is incident to moſt people in the decline of life. Sometimes it is owing to an original fault in the ſtructure or formation of the ear itſelf. When this is the caſe it admits of no cure; and the unhappy perſon not only continues deaf, but generally likewiſe dumb, for life.

When deafneſs is the effect of wounds or ulcers of the ears, or of old age, it is not eaſily removed. When it proceeds from cold applied to the head, the patient muſt be careful to keep his head warm, eſpecially in the night; he ſhould likewiſe take ſome gentle purges, and keep his feet warm, and bathe them frequently in lukewarm water at bedtime. When deafneſs is the effect of a fever, it generally goes off after the patient recovers. If it proceed from dry wax ſticking in the ears, it may be ſoftened by dropping oil into them; afterwards they muſt be ſyringed with warm milk and water.

If deafneſs proceeds from dryneſs of the ears, which

may

Dyſæſtheſiæ.

may be known by looking into them, half an ounce of the oil of ſweet almonds, and the ſame quantity of camphorated ſpirit of wine, or tincture of aſafœtida, may be mixed together, and a few drops of it put into the ear every night at bedtime, ſtopping them afterwards with a little wool or cotton. Some, inſtead of oil, put a ſmall ſlice of the fat of bacon into each ear, which is ſaid to anſwer the purpoſe very well.—When the ears abound with moiſture, it may be drained off by an iſſue or ſeton, which ſhould be made as near the affected parts as poſſible.

Some, for the cure of deafneſs, recommend the gall of an eel mixed with ſpirit of wine, to be dropped into the ear; others, equal parts of Hungary water and ſpirit of lavender. Etmuller extols amber and muſk; and Brookes ſays, he has often known hardneſs of hearing cured by putting a grain or two of muſk into the ear with cotton wool. Where, however, an application with conſiderable ſtimulant power is neceſſary, camphorated oil, with the addition of a few drops of volatile alkaline ſpirit, may be conſidered as one of the beſt. It is proper, however, to begin with a ſmall quantity of the alkali, increaſing it as the ear is found to bear it. In ſome inſtances, where deafneſs depends on a ſtate of inſenſibility in the nerves, electricity, particularly under the form either of ſparks or of the electric aura, has been employed with great ſucceſs. Great benefit has alſo in ſome caſes been derived from galvaniſm. But theſe and other applications muſt be varied according to the cauſe of the diſorder.

Though ſuch applications may ſometimes be of ſervice, yet they much oftener fail, and frequently they do hurt. Neither the eyes nor ears ought to be tampered with; they are tender organs, and require a very delicate touch. For this reaſon, what we would chiefly recommend in deafneſs, is to keep the head warm. From whatever cauſe this diſorder proceeds, this is always proper; and more benefit has often been derived from it alone, in the moſt obſtinate caſes of deafneſs, than from any medicines whatever.

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Genus XCVIII. ANOSMIA.

Defect of Smelling.

Anoſmia, *Sauv.* gen. 156. *Lin.* 113. *Vog.* 248. *Sag.* 262.

Cauſes. Morbid affections in the ſenſe of ſmelling, may be conſidered with reſpect to their cauſes, as ariſing from one of two ſources; either from ſome organic affection of the parts here principally concerned, or from a mere atonic ſtate of the parts without any obvious affection. The ſenſe of ſmelling may be diminiſhed or deſtroyed by various diſeaſes of the parts; as, the moiſture, dryneſs, inflammation or ſuppuration of that membrane which lines the inſide of the noſe commonly called the *olfactory membrane;* the compreſſion of the nerves which ſupply this membrane, or ſome fault in the brain itſelf at their origin. A defect, or too great a degree of ſolidity, of the ſmall ſpongy bones of the upper jaw, the caverns of the forehead, &c. may likewiſe impair the ſenſe of ſmelling. It may alſo be injured by a collection of fetid matter in thoſe caverns, which keeps conſtantly exhaling from them. Few things are more hurtful to the ſenſe of ſmelling than taking great quantities of ſnuff.

Ageuſtia.

Cure. When the noſe abounds with moiſture, after gentle evacuations, ſuch things as tend to take off irritation and coagulate the thin ſharp ſerum may be applied; as the oil of aniſe mixed with fine flour, camphire diſſolved in oil of almonds, &c. The vapours of amber, frankincenſe, gum maſtic, and benzoin, may likewiſe be received into the noſe and mouth. For moiſtening the mucus when it is too dry, ſome recommend ſnuff made of the leaves of marjoram, mixed with oil of amber, and aniſeed; or a ſternutatory of calcined ſulphate of zinc, 12 grains of which may be mixed with two ounces of marjoram-water and filtrated. The ſteam or vapour of vinegar thrown upon hot iron received up the noſtrils is likewiſe of uſe for ſoftening the mucus, opening obſtructions, &c.

If there be an ulcer in the noiſe, it ought to be dreſſed with ſome emollient ointment, to which, if the pain be very great, a little laudanum may be added. If it be a venereal ulcer, it is not to be cured without mercury. In that caſe, the ſolution of the corroſive ſublimate in brandy may be taken, as directed in the gutta ſerena. The ulcer ought likewiſe to be waſhed with it; and the fumes of cinnabar may be received up the noſtrils.

If there be reaſon to ſuſpect that the nerves which ſupply the organs of ſmelling are inert or want ſtimulating, volatile ſalts, ſtrong ſnuffs, and other things which occaſion ſneezing, may be applied to the noſe. The forehead may likewiſe by anointed with balſam of Peru, to which may be added a little of the oil of amber.

Genus XCIX. AGEUSTIA. 266

Defect of Tasting.

Ageuſtia, *Sauv.* gen. 157. *Sag.* 263.
Ageuſtia, *Lin.* 114.
Apogeuſis, *Vog.* 449.

Cauſe. This diſeaſe alſo may ariſe either from an organic affection, or an atonic ſtate of the parts. The taſte may be diminiſhed by cruſts, filth, mucus, aphthæ, pellicles, warts, &c. covering the tongue; it may be depraved by a fault of the ſaliva, which, being diſcharged into the mouth, gives the ſame ſenſation as if the food which the perſon takes had really a bad taſte; or it may be entirely deſtroyed by injuries done to the nerves of the tongue and palate. Few things prove more hurtful either to the ſenſe of taſting or ſmelling than obſtinate colds, eſpecially thoſe which affect the head.

Cure. When the taſte is diminiſhed by filth, mucus, &c. the tongue ought to be ſcraped, and frequently waſhed with a mixture of water, vinegar, and honey, or ſome other detergent. When the ſaliva is vitiated, which ſeldom happens unleſs in fevers or other diſeaſes, the curing of the diſorder is the cure of this ſymptom. To relieve it, however, in the mean time, the following practices may be of uſe: if there be a bitter taſte, it may be taken away by vomits, purges, and other things which evacuate bile: what is called a *nidorous taſte*, ariſing from putrid humours, is

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is corrected by the juice of citrons, oranges, and other acids: a ſalt taſte is cured by plentiful dilution with watery liquors: an acid taſte is deſtroyed by abſorbents and alkaline ſalts, as powder of oyſter-ſhells, ſalt of wormwood, &c.

When the ſenſibility of the nerves which ſupply the organs of taſte is diminiſhed, the chewing of horſe-radiſh, and or other ſtimulating ſubſtances, will help to recover it.

367 Genus C. ANÆSTHESIA.

Defect of the Senſe of Feeling.

Sauv. gen. 161. *Lin.* 218. *Vog.* 267.

Cauſes, &c. This ſenſe may be hurt by any thing that obſtructs the nervous influence, or prevents its being regularly conveyed to the organs of touching, as preſſure, extreme cold, &c. It may likewiſe be hurt by too great a degree of ſenſibility, when the nerve is not ſufficiently covered by the cuticle or ſcarf-ſkin, or where there is too great a tenſion of it, or it is too delicate. Whatever diſorders the functions of the brain and nerves, hurts the ſenſe of touching. Hence it appears to proceed from the ſame general cauſes as palſy and apoplexy, and requires nearly the ſame method of treatment.

In a *ſtupor*, or defect of touching, which ariſes from an obſtruction of the cutaneous nerves, the patient muſt firſt be purged; afterwards ſuch medicines as excite the action of the nerves, or ſtimulate the ſyſtem, may be uſed. For this purpoſe, the ſpirit of hartſhorn, either by itſelf or combined with eſſential oils, horſe-radiſh, &c. may be taken inwardly; the diſordered parts, at the ſame time, may be frequently rubbed with freſh nettles or ſpirit of ſal ammoniac. Bliſters and ſinapiſms applied to the parts will likewiſe be of uſe; and alſo warm bathing, eſpecially in the natural hot baths.

368 Order II. DYSOREXIÆ.

Sect. I. *APPETITUS ERRONEI.*

Moroſitates, *Sauv.* Claſs VIII. Order II. *Sag.* Claſs XIII. Order II.
Pathetici, *Lin.* Claſs V. Order II.
Hyperæſtheſes, *Vog.* Claſs VII.

369 Genus CI. BULIMIA.

Insatiable Hunger, or *Canine Appetite.*

Bulimia, *Sauv.* gen. 223. *Lin.* 79. *Sag.* gen. 335.
Bulimus, *Vog.* 296.
Addephagia, *Vog.* 297.
Cynorexia, *Vog.* 298.

This diſeaſe is commonly owing to ſome fault in the ſtomach, by which the aliments are thrown out too ſoon; and unleſs the perſon be indulged in his deſire for eating, he frequently falls into fainting fits. Sometimes it is attended with ſuch a ſtate of the ſtomach, that the aliment is rejected by vomit almoſt immediately after being ſwallowed; after which the appetite for food returns as violent as ever. But there

Bulimia.

are many circumſtances which ſeem to render it probable that it more frequently ariſes from a morbid condition of the ſecreted fluid poured into the ſtomach, by means of which the aliment is diſſolved. When the activity of this fluid is morbidly increaſed, it will both produce too ſudden a ſolution of the ſolid aliment, and likewiſe operate as a powerful and peculiar ſtimulus to the ſtomach, giving an uneaſy ſenſation, ſimilar to that which takes place in natural hunger. Such things are proper for the cure as may enable the ſtomach to perform its office: chalybeates and other tonics will generally be proper. In ſome, brandy drunk in a morning has been uſeful; and frequent ſmoking tobacco has relieved others. Oil, fat meat, pork, opiates, and in ſhort every thing which in a ſound perſon would be moſt apt to pall the appetite, may alſo be uſed as temporary expedients, but cannot be expected to perform a cure. In ſome, the pylorus has been found too large; in which caſe the diſeaſe muſt have been incurable.

Genus CII. POLYDIPSIA. 370

Excessive Thirst.

Polydipſia, *Sauv.* gen. 224. *Lin.* 80. *Vog.* 275. *Sag.* 336.

This is almoſt always ſymptomatic; and occurs in fever, dropſy, fluxes, &c. The cure is very generally obtained only by the removal of the primary diſeaſe; and it is beſt palliated by the gradual introduction of diluents: But when theſe are contraindicated, it may often be ſucceſsfully obviated by ſuch articles taken into the mouth as have effect in augmenting the flow of ſaliva.

Genus CIII. PICA.

Longing, or *Falſe Appetite.* 371

Pica, *Sauv.* gen. 222. *Sag.* 334.
Citta, *Lin.* 78.
Allotriophagia, *Vog.* 299.
Malacia, *Vog.* 300.

The pica is alſo very generally ſymptomatic of other diſeaſes, as of worms, chloroſis, pregnancy, &c.; and is therefore chiefly to be combated by the removal of the primary affection. It may, however, be obſerved, that peculiar longings occurring in certain diſeaſes, as for example in fevers, often point out a natural cure. The indulgence of ſuch appetites to a moderate degree is ſeldom productive of any inconvenience, and often followed by the beſt conſequences. —Hence there are ſome practitioners who think that ſuch craving ſhould very generally be indulged; particularly when the patient can aſſign no reaſon whatever for ſuch particular longings, but is merely prompted by an uncommon and inexplicable deſire.

Genus CIV. SATYRIASIS. 372

Satyriaſis, *Sauv.* gen. 228. *Lin.* 81. *Sag.* 340.

Satyriaſis is a violent deſire of venery in men, even ſo that reaſon is depraved by it. The pulſe is quick, and the breathing ſhort; the patient is ſleepleſs, thirſty, and

Dyſorexiæ. and loathes his food; the urine is evacuated with difficulty, and a fever ſoon comes on. Theſe ſymptoms, however, are probably not ſo much the conſequence of ſatyriaſis, as merely concomitant effects reſulting from the ſame cauſe. And indeed this affection is moſt frequently the concomitant of a certain modification of inſanity. The nature and cauſe of this affection are in moſt inſtances very little aſcertained; but as far as we are acquainted with the treatment, it agrees very much with the affection next to be mentioned, which, of the two, is the moſt common occurrence.

373 Genus CV. NYMPHOMANIA.

Furor Uterinus.

Nymphomania, *Sauv.* 229. *Sag.* 341.
Satyriaſis, *Lin.* 81.

The *furor uterinus* is in moſt inſtances either a ſpecies of madneſs or a high degree of hyſterics. Its immediate cauſe is a preternatural irritability of the uterus and pudenda of women (to whom the diſorder is proper), or an unuſual acrimony of the fluids in theſe parts.—Its preſence is known by the wanton behaviour of the patient: ſhe ſpeaks and acts with unreſtrained obſcenity; and as the diſorder increaſes, ſhe ſcolds, cries, and laughs, by turns. While reaſon is retained, ſhe is ſilent, and ſeems melancholy, but her eyes diſcover an unuſual wantonneſs. The ſymptoms are better and worſe until the greateſt degree of the diſorder approaches, and then by every word and action her condition is too manifeſt.—In the beginning a cure may be hoped for; but if it continue, it degenerates into a mania.—In order to the cure, blood-letting is commonly recommended in proportion to the patient's ſtrength. Camphor in doſes of 15 or 20 grains, with nitre, and ſmall doſes of the tincture of opium, ſhould be repeated at proper intervals. Some venture to give ceruſa acetata in doſes from three to five grains. Beſides bleeding, cooling purges ſhould alſo be repeated in proportion to the violence of ſymptoms, &c. What is uſeful in maniacal and hypochondriac diſorders, is alſo uſeful here, regard being had to ſanguine or phlegmatic habits, &c. When the delirium is at the height, give opiates to compoſe; and uſe the ſame method as in a phrenitis or a mania. Injections of barley-water, with a ſmall quantity of hemlock-juice, according to Riverius, may be frequently thrown up into the uterus: this is called *ſpecific*; but matrimony, if poſſible, ſhould be preferred. For although this cannot be repreſented as a cure for the diſeaſe when in an advanced ſtate, yet there is reaſon to believe that it has not unfrequently prevented it where it would otherwiſe have taken place.

374 Genus CVI. NOSTALGIA.

Vehement Desire *of* revisiting *one's* Country.

Noſtalgia, *Sauv.* gen 226. *Lin.* 83. *Sag.* 338.

This is to be reckoned a ſpecies of melancholy; and unleſs it be indulged, it very commonly proves not only incurable but even fatal. Although it cannot be conſidered as altogether peculiar to any nation, yet it is obſerved to be much more frequent with ſome than with others; and it has particularly been remarked among Swiſs ſoldiers in the ſervice of foreign ſtates. Noſtalgia.

Sect. II. *APPETITUS DEFICIENTES.*

Anepithymiæ, *Sauv.* Claſs VI. Ord. II. *Sag.* IX, Ord. II.
Privativi, *Lin.* Claſs VI. Order III.
Adynamiæ, *Vog.* Claſs VI.

Genus CVII. ANOREXIA. 375

Want of Appetite.

Anorexia, *Sauv.* gen. 162. *Lin.* 116. *Vog.* 279. *Sag.* 268.

The anorexia is ſymptomatic of many diſeaſes, but ſeldom appears as a primary affection; and it is very generally overcome only by the removal of the affection on which it depends.

Genus CVIII. ADIPSIA. 376

Want of Thirst.

Adipſia, *Sauv.* gen. 163. *Lin.* 117. *Vog.* 281. *Sag.* 269.

This by Dr Cullen is reckoned to be always ſymptomatic of ſome diſtemper affecting the *ſenſorium commune.*

Genus CIX. ANAPHRODISIA. 377

Impotence to Venery.

Anaphrodiſia, *Sauv.* gen. 164. *Sag.* 270.
Atecnia, *Lin.* 119.
Ageneſia, *Vog.* 283.

For this, ſee the article Impotence in the alphabetical order.

Order III. DYSCINESIÆ. 378

Genus CX. APHONIA. 379

Loſs of Voice.

Aphonia, *Sauv.* gen. 166. *Lin.* 115. *Vog.* 253. *Sag.* 272.

The loſs of voice may proceed from various cauſes. If one of the recurrent nerves, which are formed by the *par vagum* and the *nervus acceſſorius*, and reach the larynx, be cut, the perſon is capable of only as it were a half-pronunciation; but if both be cut, the ſpeech and voice are both loſt. The loſs of ſpeech happening in hyſteric patients is alſo called *aphonia*; but more properly that loſs of ſpeech is thus named which depends on ſome fault of the tongue.

Since the motion of any part is deſtroyed, or leſſened at leaſt, by the interception of the nervous fluid in its paſſage thither, and ſince the nerves deſtined for the motion of the tongue ariſe principally from the fifth pair, it appears that the ſeat of this diſorder is in the fifth pair of nerves, and that the immediate cauſe is is a diminution or total deſtruction of the nervous power in them. Hence a palſy of the tongue, which is either antecedent or ſubſequent to hemiplectic or apoplectic diſorders, demand our utmoſt attention.

If an aphonia appears alone, it generally beſpeaks an approaching hemiplegia or apoplexy; but if it ſucceed theſe diſorders, and is complicated with a weak memory and a ſluggiſhneſs of the mental powers, it threatens their return. That aphony uſually terminates the beſt which proceeds from a ſtagnation of ſerous humours compreſſing the branches of the fifth pair of nerves, which run to the tongue; but it is no leſs afflictive to the patient, and is very obſtinate of cure.

Other cauſes of this diſorder are, the ſtriking in of eruptions on the ſkin, a congeſtion of blood in the fauces and tongue, obſtructed periodical evacuations in plethoric habits, ſpaſmodic affections, worms, a crumb of bread falling into the larynx, fear, too free an uſe of ſpirituous liquors; alſo whatever deſtroys the ligaments which go from the arytænoid to the thyroid cartilages, will deſtroy the voice.

The *prognoſtics* vary according to the cauſe. That ſpecies which is owing immediately to ſpaſms, ſoon gives way on the removal of them. If a palſy of the tongue be the cauſe, it is very apt to return, though relieved, but often continues incurable.

In order to the *cure*, we muſt endeavour firſt to remove whatever obſtructs the influx of the nervous fluid into the tongue, and ſecondly to ſtrengthen the weak parts. Theſe general intentions, in all caſes, being regarded, the particular cauſes muſt be removed by remedies accommodated to each.

If worms be the cauſe, antiſpaſmodics may give preſent relief; but the cure depends on the deſtruction or expulſion of the animals themſelves. In caſe of a congeſtion of blood about the head, bleeding and nitrous medicines are to be uſed.—That ſpecies of aphony which remains after the ſhock of an hemiplegia or apoplexy, requires bliſters to be applied to the nape of the neck; if ſpaſmodic conſtrictions about the fauces and and tongue be the cauſe, external paregorics are of the greateſt ſervice, anodyne antiſpaſmodics may be laid under the tongue, and the feet bathed in warm water; carminative clyſters alſo are uſeful.—When a palſy of the tongue produces this complaint, evacuations, according to the patient's habit, muſt be made, and warm nervous medicines muſt be externally applied, and internally adminiſtered; bliſters alſo ſhould be placed between the ſhoulders.—In caſe of repelled cuticular eruptions, ſudorifics ſhould be given, and the patient's drink ſhould be warm. The ſpiritus ammoniæ ſuccinatus, or vinum antimonii, may be employed either in combination with other articles, or by themſelves, and given at proper diſtances of time, in the patient's drink, or on a bit of ſugar.—Sometimes the ſerum flows ſo rapidly to the fauces and adjacent parts, in a ſalivation, as to deprive the patient of all power to ſpeak; in this caſe diaphoretics and laxatives, with a forbearance of all mercurials, are the ſpeedieſt remedies.

380 GENUS CXI. MUTITAS.

DUMBNESS.

Mutitas, *Sauv.* gen. 165. *Vog.* 257. *Sag.* 271.

Dumb people are generally born deaf; in which caſe the diſtemper is incurable by medicine: though even ſuch people may be taught not only to read and write, but alſo to ſpeak and to underſtand what others ſay to them. For ſome obſervations on the method in which this has been accompliſhed, we may refer the reader to the article DUMBNESS, in the alphabetical order. But in theſe caſes, admitting of cure in the manner above alluded to, the dumbneſs proceeds principally, if not ſolely, from the deafneſs. For when it proceeds from a defect of any of the organs neceſſary for ſpeech, the tongue for inſtance, it is always incurable; but if it ariſe from a palſy, the medicines applicable in that caſe will ſometimes reſtore the ſpeech.

GENUS CXII. PARAPHONIA. 381

Change in the Sound of the VOICE.

Paraphonia, *Sauv.* gen. 168.
Cacophonia, *Sag.* 274.
Raucedo, *Lin.* 146.
Raucitas, *Vog.* 252.
Aſaphia, &c. *Vog.* 250, 251, 254, 255, 256.

The voice may be changed from various cauſes. In males it becomes much more hard about the time of puberty; but this can by no means be reckoned a diſeaſe. In others it proceeds from a catarrh, or what we call a *cold;* it ariſes alſo from affections of the noſe and palate, as polypi, ulcers, &c. in which caſe the cure belongs properly to SURGERY. In ſome it ariſes from a laxity of the *velum pendulum palati* and glottis which makes a kind of ſnoring noiſe during inſpiration. The cure of this laſt caſe is to be attempted by tonics and ſuch other medicines as are of ſervice in diſeaſes attended with laxity.

GENUS CXIII. PSELLISMUS. 382

Defect in PRONUNCIATION.

Pſelliſmus, *Sauv.* gen. 167. *Lin.* 139. *Sag.* 273.
Traulotis, &c. *Vog.* 258, 259, 260, 261.

Of this diſeaſe (if ſuch it may be called), there are many different kinds. Some cannot pronounce the letter S; others labour under the ſame difficulty with R, L, M, K: &c.; while ſome who can with ſufficient eaſe pronounce all the letters, yet repeat their words, or the firſt ſyllables of them, in ſuch a ſtrange manner, that they can ſcarce be underſtood. Very frequently theſe defects ariſe entirely from habit, and may then be got the better of by thoſe who have the reſolution to attempt it; as we are told that Demoſthenes the celebrated orator got the better of a habit of ſtammering by declaiming with pebbles in his mouth. Sometimes, however, pronunciation may be impeded by a wrong conformation of the tongue or organs of ſpeech; and then it cannot by any pains whatever be totally removed.

GENUS CXIV. STRABISMUS. 383

SQUINTING.

Strabiſmus, *Sauv.* gen. 116. *Lin.* 304. *Vog.* 514. *Sag.* 222.

Dyſcineſiæ. Strabiſmus.

Deſcription. This diſeaſe ſhows itſelf by an uncommon contraction of the muſcles of the eye; whereby the axis of the pupil is drawn towards the noſe, temples, forehead, or cheeks, ſo that the perſon cannot behold an object directly.

Cauſes, Prognoſis, &c. I. This diſeaſe may proceed from cuſtom and habit; while in the eye itſelf, or in its muſcles, nothing is preternatural or defective.

Thus children by imitating thoſe that ſquint, and infants by having many agreeable objects preſented to them at once, which invite them to turn one eye to one and the other eye to another, do frequently contract a habit of moving their eyes differently, which afterwards they cannot ſo eaſily correct. Infants likewiſe get a cuſtom of ſquinting by being placed obliquely towards a candle, window, or any other agreeable object capable of attracting their ſight: for though, to ſee the object, they may at firſt turn both eyes towards it; yet, becauſe ſuch an oblique ſituation is painful and laborious, eſpecially to the moſt diſtant eye, they ſoon relax one of the eyes, and content themſelves with examining it with the eye that is next it; whence ariſes a diverſity of ſituation and a habit of moving the eyes differently.

In this caſe, which may admit of a cure if not too much confirmed, it is evident, that objects will be ſeen in the ſame place by both eyes, and therefore muſt appear ſingle as to other men; but becauſe, in the eye that ſquints, the image of the object to which the other eye is directed falls not on the moſt ſenſible and delicate part of the retina, which is naturally in the axis of the eye, it is eaſy to ſee that it muſt be but faintly perceived by this eye. Hence it is, that while they are attentive in viewing any object, if the hand be brought before the other eye, this object will be but obſcurely ſeen, till the eye change its ſituation and have its axis directed to it; which change of ſituation is indeed very eaſy for them, becauſe it depends on the muſcles of the eyes, whoſe functions are entire; but, by reaſon of the habit they have contracted of moving their eyes differently, the other eye is at the ſame time frequently turned aſide, ſo that only one at a time is directed to this object.

II. The *ſtrabiſmus* may proceed from a fault in the firſt conformation, by which the moſt delicate and ſenſible part of the retina is removed from its natural ſituation, which is directly oppoſite to the pupil, and is placed a little to a ſide of the axis of the eye; which obliges ſuch people to turn away the eye from the object they would view, that its picture may fall on this moſt ſenſible part of the organ.

When this is the caſe, the diſeaſe is altogether incurable, and the phenomena that ariſe therefrom differ in nothing from the phenomena of the former caſe, excepting only that here, 1. The object to which the eye is not directed will be beſt ſeen; which is the reverſe of what happens when this diſeaſe ariſes barely from habit and cuſtom. 2. No object will appear altogether clear and diſtinct: for all objects to which the eye is directed, by having their image painted in the retina at the axis of the eye, where it is not very ſenſible, will be but obſcurely ſeen; and objects that are placed ſo far to a ſide of the optic axis as is neceſſary for making their image fall on the moſt ſenſible and delicate part of the retina, muſt appear a little confuſed, becauſe the ſeveral pencils of rays that come therefrom fall too obliquely on the cryſtalline to be accurately collected in ſo many diſtinct points of the retina; though it muſt be acknowledged, that this confuſion will, for the moſt part, be ſo ſmall as to eſcape unobſerved.

III. This diſeaſe may proceed from an oblique poſion of the cryſtalline, where the rays that come directly to the eye from an object, and that ought to converge to the point of the retina, which is in the axis of the eye, are, by reaſon of the obliquity of the cryſtalline, made to converge to another point on that ſide of the viſual axis where the cryſtalline is moſt elevated; and therefore the object is but obſcurely ſeen, becauſe its image falls not on the retina at the axis of the eye, where it is moſt ſenſible: But the rays that fall obliquely on the eye, will after refraction, converge to this moſt ſenſible part of the retina; and, by converging there, muſt impreſs the mind with a clear idea of the object from whence they came. It is for this reaſon that the eye never moves uniformly with the other, but turns away from the object it would view, being attentive to the object to which it is not directed. When this is the caſe, it is in vain to expect any good from medicine.

The ſymptoms which naturally ariſe from it are, 1. The object to which the eye is directed will be but faintly ſeen, becauſe its image falls on the retina where it is not very ſenſible. 2. The object to which the eye is not directed, by having its image painted on the retina at the axis of the eye, will be clearly perceived. But, 3. This ſame object muſt appear ſomewhat indiſtinct, becauſe the pencils of rays that flow from it are not accurately collected in ſo many diſtinct points in the retina, by reaſon of their oblique incidence on the cryſtalline. 4. It muſt be ſeen, not in its proper place, but thence tranſlated to ſome other place ſituated in the axis of viſion. And, 5. Being thus tranſlated from its true place, where it is ſeen by the other eye that does not ſquint, it muſt neceſſarily appear double; and the diſtance between the places of its appearance will be ſtill greater, if the cryſtalline of the other eye incline to the contrary ſide.

IV. This diſeaſe may ariſe from an oblique poſition of the cornea; which, in this caſe, is generally more arched and prominent than what it is naturally.

When the eye has this conformation, no object to which it is directed can be clearly ſeen, becauſe its image falls not on the retina at the axis of the eye; and therefore the eye turns aſide from the object it would view, that its image may fall on the moſt ſenſible part of the retina.

When the ſtrabiſmus proceeds from this cauſe, the prognoſtic and the phænomena that attend it will be much the ſame as in the caſe immediately preceding; from which nevertheleſs it may be diſtinguiſhed by the obliquity of the cornea, which is manifeſt to the ſenſes and if the cornea be alſo more arched and prominent than what it is naturally, which is commonly the caſe, the eye will alſo be ſhort-ſighted.

V. This want of uniformity in the motions of our eyes, may ariſe from a defect, or any great weakneſs or

Dyscinesiæ. or imperfection, in the sight of both or either of the eyes; and this, according to Dr Porterfield, is the most common cause of this disease. The prognostic in this case is the same with that of the disease from which it proceeds.

VI. Another cause from which the strabismus may proceed, lies in the muscles that move the eye. When any of those muscles are too short or too long, too tense or too lax, or are seized with a spasm or paralysis, their equilibrium will be destroyed, and the eye will be turned towards or from that side where the muscles are faulty.

In this case, the disease frequently yields to medicine, and therefore admits of favourable prognostic; excepting only when, by a fault in the first conformation, any of the muscles are longer or shorter than their antagonist; in which case, if ever it should happen, no medicine can be of any use.

As to what concerns the optical phænomena, they are the same here as in case first: only when the disease commences not till, by custom and habit, the uniform motion of the eyes has been rendered necessary, all objects do for some time appear double; but in time they appear single.

Lastly, This want of uniformity in the motions of our eyes may proceed from a preternatural adhesion or attachment to the eyelids: of this we have an instance in Langius. And that the same thing may also be occasioned by a tumor of any kind within the orbit, pressing the eye aside, and restraining it from following the motions of the other, is so evident, that instances need not be brought to prove it. Here also the case may admit of a favourable prognostic; and as for what concerns the optical phænomena, they must be the same as in the case immediately preceding.

The *cure*, in confirmed cases, is to be effected by mechanical contrivances, by which the person may be obliged to look straight upon objects, or not see them at all; or at least that he may see with uneasiness and confusedly when he squints. In the 68th volume of the Philosophical Transactions we have an account of a confirmed case of squinting of a very uncommon kind. The patient was a boy of five years old, and viewed every object which was presented to him with but one eye at a time. If the object was presented on his right side, he viewed it with his left eye; and if it was presented on his left side, he viewed it with his right eye. He turned the pupil of that eye which was on the same side with the object in such a direction that the image of the object might fall on that part of the bottom of the eye where the optic nerve enters it. When an object was held directly before him, he turned his head a little to one side, and observed it with but one eye, viz. that most distant from the object, turning away the other in the manner above described; and when he became tired of observing it with that eye, he turned his head the contrary way, and observed it with the other eye alone, with equal facility; but never turned the axis of both eyes on it at the same time. He saw letters which were written on bits of paper, so as to name them with equal ease, and at equal distances, with one eye as with the other. There was no perceptible difference in the diameters of the irises, nor in the contractility of them after having covered his eyes from Strabismus. the light. These observations were carefully made by writing single letters on shreds of paper, and laying wagers with the child that he could not read them when they were presented at certain distances and in certain directions.

As from these circumstances it appeared that there was no defect in either eye, which is frequently the case with persons who squint, and hence that the disease was simply a depraved habit of moving his eyes, the disease seemed capable of a cure. A paper gnomon was made for this purpose, and fixed to a cap; and when this artificial nose was placed over his real nose, so as to project an inch between his eyes, the child, rather than turn his head so far to look at oblique objects, immediately began to view them with that eye which was next to them. But having the misfortune to lose his father soon after this method was begun to be followed, the child was neglected for six years, during which time the habit was confirmed in such a manner as seemed to leave little room to hope for a cure. The same physician, however, being again called, attempted a second time to remove the deformity by a similar contrivance. A gnomon of thin brass was made to stand over his nose, with a half circle of the same metal to go round his temples: these were covered with black silk, and by means of a buckle behind his head, and a cross piece over the crown of his head, this gnomon was worn without any inconvenience, and projected before his nose about two inches and an half. By the use of this machine he soon found it less inconvenient to view all oblique objects with the eye next to them than the eye opposite to them.

After this habit was weakened by a week's use of the gnomon, two bits of wood, about the size of a goose-quill, were blackened all but a quarter of an inch at their summits; these were frequently presented to him to look at, one being held on one side the extremity of his black gnomon, and the other on the other side of it. As he viewed these, they were gradually brought forwards beyond the gnomon, and then one was concealed behind the other: by these means, in another week, he could bend both his eyes on the same object for half a minute together; and by continuing the use of the same machine, he was in a fair way of being cured when the paper was written.

Dr Darwin, who writes the history of the above case, adds, that all the other squinting people he had occasion to attend, had one eye much less perfect than the other: these patients, says he, are certainly cureable by covering the best eye many hours in a day; as by a more frequent use of the weak eye, it not only acquires a habit of turning to the objects which the patient wishes to see, but gains at the same time a more distinct vision; and the better eye at the same time seems to lose somewhat in both these respects, which also facilitates the cure.

GENUS CXV. CONTRACTURA. 384

Contractions of the LIMBS.

Contractura, *Sauv.* gen. 119. *Lin.* 299. *Sag.* 225.
Obstipitas, *Sauv.* gen. 11.

Caput

Apocenoses.

Caput obstipum, *Vog.* 513.
Digitium, *Vog.* 221.

The contraction of various muscles of the body is generally the consequence of some other disease, as the rheumatism, gout, scurvy, or palsy, especially that species of the latter which follows the *colica Pictonum.* It is exceedingly difficult of cure; though the warm medicinal waters are much recommended, and have sometimes done great service. Of late electricity has been found to perform surprising cures in this way.

385 ORDER IV. APOCENOSES.

Apocenoses, *Vog.* Class II. Ord. II.
Fluxus, *Sauv.* Class IX. *Sag.* Class V.
Morbi evacuatorii, *Lin.* Class IX.

386 GENUS CXVI. PROFUSIO.

FLUX of BLOOD.

Profusio, *Lin.* 239.
Hæmorrhagia, *Vog.* 81. *Boerh.* 218.

The disease commonly known by the name of *bloody flux*, is the putrid or contagious dysentery, a disease which has already been treated of. But independent of the discharge of blood which then takes place, hæmorrhagy may take place from the alimentary canal as well as from other parts of the system. In such instances, however, if we except the place from which the discharge occurs, the phenomena are very much the same as in menorrhagia, hæmoptysis, and other hæmorrhagies already treated of; while the disease is to be combated on the same principles and by the same remedies.

387 GENUS CXVII. EPHIDROSIS.

Excessive SWEATING.

Ephidrosis, *Sauv.* gen. 258. *Sag.* gen. 194.
Sudor, *Lin.* 208.
Hydropedesis, *Vog.* 121.

This is generally symptomatic; and occurs in almost all fevers, but especially in the latter stages of the hectic. Sometimes it is a primary disease, arising merely from weakness; and then easily admits of a cure by the use of the cinchona, the cold bath, and other tonics.

388 GENUS CXVIII. EPIPHORA.

FLUX of the LACHRYMAL HUMOUR.

Epiphora, *Sauv.* gen. 259. *Lin.* 172. *Vog.* 99. *Sag.* 195.

This by Sauvages is described as an involuntary effusion of tears without any remarkable itching, heat, or pain. It follows long continued ophthalmias; or it may be occasioned by immoderate study, or any thing that weakens the eyes: hence it comes on about the age of 50 years, when the eyesight naturally becomes weak. It in general grows worse in the winter-time, and is very hard to cure. Some authors recommend purgatives, and blisters on the nape of the neck, in order to draw off the abundant humours; but as the disease evidently proceeds from weakness, it would rather seem proper to pursue a contrary method. Sauvages recommends to the patients to abstain from study, wine, and salted meats; and also to avoid smoke or wind, and at night to foment the eyes with an infusion of four cloves in two ounces of proof-spirit.—Hungary water, rose water with sulphate of zinc dissolved it it, &c. have also been recommended.

Ptyalismus.

GENUS CXIX. PTYALISMUS. 389

SALIVATION.

Ptyalismus, *Sauv.* gen. 261. *Lin.* 176. *Vog.* 103. *Sag.* 197.

A salivation is often symptomatic, but rarely a primary disease. Dr Cullen is of opinion, that when the latter happens to be the case, it arises from laxity; and then is to be cured by astringents and tonics. In the Medical Transactions we have the following account of a salivation brought on by a foreign substance irritating one of the parotid glands.

In the month of April 1751, a young lady about the age of 16 years, of a delicate habit, but subject to no particular complaints, perceived the beginning of a disease which afterwards proved most obstinate and loathsome, viz. an incessant spitting. The quantity of this discharge was different at different times, varying from one pint to two pints and an half in 24 hours. As to its quality, it seemed to be no other than the ordinary secretion of the salival glands. By so large and constant an evacuation, her strength became extremely impaired, and the most efficacious medicines had proved useless. She had taken large quantities of cinchona, both alone and combined with preparations of iron: and afterwards the fetid gums, opium, amber, alum, and the Neville-Holt water, had in succession been given her. In the mean time an exact regimen had been prescribed: she had been ordered to ride constantly; and to confine herself to a mucilaginous diet, such as veal, calves feet, &c. Likewise a gentle opening medicine had now and then been interposed. The disease still continuing unaltered, she had afterwards tried the *tinctura saturnina;* and had, at the same time, been encouraged to chew cinchona, and to swallow the saliva. But all these attempts had been vain; and after she had taken some or other of the medicines above mentioned until the end of September 1753, namely, above two years, it appeared to her physician, Sir George Baker, unreasonable to expect relief in such a case from any internal medicines whatever.

He now conceived a suspicion, that some extraneous body having accidentally found its way into the *meatus auditorius*, might possibly be the cause of this extraordinary secretion, by keeping up a continued irritation in the parotid glands. With this view he examined her ears, and extracted from them a quantity of fetid wool. How, or when, it came thither, no account could be given.

To this substance he attributed the beginning of the salivation, notwithstanding that the disease did not immediately abate on the removal of the wool; as it appeared to be no improbable supposition that the discharge

Apocenoſes. charge might be continued by the force of habit, though the original cauſe no longer remained.

It ſeemed, therefore, expedient to introduce ſome other habit, in the place of the increaſed ſecretion of ſaliva; which habit might afterwards be gradually left off. With this intention, he prevailed on the patient to chew perpetually a little dry bread, and to ſwallow it with her ſpittle. In a few weeks, it became neceſſary for her to chew the bread only at certain hours in the day; and thus, after two months, ſhe became entirely free from a moſt diſguſtful and tedious diſorder.

It is worthy of obſervation, that, at firſt, the ſwallowing of ſo much ſaliva frequently occaſioned a nauſea; and that then, for a few hours, ſhe was obliged to ſpit it out as uſual; and that, during the greateſt part of the time, when ſhe chewed the bread, ſhe had a ſtool or two every day more than common.

390 GENUS CXX. ENURESIS.

An involuntary FLUX *of* URINE.

Enureſis, *Sauv.* gen. 264. *Lin.* 195. *Vog.* 113. *Sag.* 200.

This is a diſtemper which frequently affects children, otherwiſe healthy, when aſleep; and is extremely diſagreeable. Often it is merely the effect of lazineſs, and may be driven off by proper correction; but ſometimes it proceeds from an atony or weakneſs of the ſphincter of the bladder. Many ridiculous cures have been preſcribed for it, and among the reſt field-mice dried and powdered. Tonics are frequently of uſe; but ſometimes the diſtemper proves obſtinate, in ſpite of every thing we can uſe. In the London Medical Obſervations we find bliſters much recommended in this diſeaſe, when applied to the region of the os ſacrum. A girl of 13 years of age had been ſubject to an enureſis for four years. She could retain her water but a very little while in the day-time, but it flowed continually in the night. She had taken Peruvian bark and elixir of vitriol in conſiderable quantities; alſo valerian and the volatile julep, without effect. She was ſeverely threatened, as the phyſician ſuſpected it might ariſe from a bad habit; but this producing no effect, a bliſter was applied to the os ſacrum, which in 24 hours totally removed the diſeaſe. A man aged 32, having been ſeized with an incontinence of urine and palſy of the lower extremities in conſequence of taking a quack medicine, was cured of the incontinence of urine in 24 hours by one bliſter, and of the palſy itſelf by another. A woman of 50 having been ſeized with an enureſis and paralytic affection of the right thigh and leg in conſequence of a ſprain, was cured of both by a ſingle bliſter. Several other caſes are mentioned, by which the power of bliſters in removing this diſtemper ſeems to exceed that of every other medicine whatever.

391 GENUS CXXI. GONORRHOEA.

Gonorrhœa, *Sauv.* gen. 208. *Lin.* 200. *Vog.* 118. *Sag.* 204.

The gonorrhœa is a flux of viſcid matter of various colours, from the urethra in men and the vagina in women. It commonly proceeds from coition with a perſon infected with the venereal diſeaſe, and is one of the moſt common forms under which that diſeaſe ſhows itſelf. Gonorrhœa.

Deſcription. The firſt ſymptoms of the diſeaſe in men are commonly a ſenſation at the end of the penis not unlike a flea-bite, together with a fulneſs of the lips of the urethra, and ſome degree of tenſion in the penis, the urinary canal feeling as if tightened, and the urine flowing in a ſmall and unequal ſtream: a little whitiſh mucus is to be ſeen about the orifice of the urethra, and oozing from it when ſlightly preſſed, eſpecially if the preſſure be made on the ſpot where the ſoreneſs is moſt felt. The diſcharge ſoon increaſes in quantity, and varies in its colour according to the degree of inflammation. The patient feels a ſenſation of heat and pain in evacuating his urine, particularly at certain ſpots of the urethra, and above all towards its orifice; and the involuntary erections to which he is ſubjected from the ſtimulus, particularly when warm in bed, occaſion a diſtortion or curvature of the penis, attended with exquiſite pain. When the inflammation is violent, the glans appears tumid and tranſparent, the tenſion extends through the whole of the penis, the perinæum is affected with ſwelling and redneſs, and even the loins, buttocks, and anus, ſympathize and afford a very uneaſy ſenſation. Sometimes the prepuce inflames about the end of the penis, and cannot be drawn back, occaſioning what is called a *phymoſis*; at other times, as in the *paraphymoſis*, it remains in an inflamed ſtate below the glans, ſo that it cannot be drawn forwards; and, if the ſtricture and inflammation be violent, may terminate in gangrene. Now and then, eſpecially when there is a phymoſis, we may perceive a hard chord extending along the back of the penis. This is an inflamed lymphatic, and may be conſidered as a prelude to a bubo. When, however, a bubo does appear, almoſt univerſally ſome ulceration is previouſly to be diſcovered about the præputium, or glans penis; which gives ground to preſume that ſome other contagious matter beſides that of gonorrhœa may have been applied to the urethra. For it is certain that matter capable of communicating the contagion of gonorrhœa to a female, is often copiouſly applied to the whole glans penis of a male for ſeveral days together, without giving either ulceration or bubo.

In mild caſes, the ſeat of the diſeaſe is in the urethra, not far from its orifice; but it frequently happens that the virus inſinuates itſelf much higher up, ſo as to affect Cowper's glands, the proſtate, and parts very near to the neck of the bladder.

In the generality of caſes, the inflammation goes on increaſing for ſeveral days, commonly for a week or a fortnight; after which the ſymptoms begin to abate; and the running, when left to itſelf, gradually leſſens in quantity, and becomes whiter and thicker, till at length it totally ſtops. The colour of the mucus, however, is by no means a certain guide in theſe caſes: for in many patients it is of a yellowiſh, and ſometimes of a greeniſh hue to the very laſt; but in general it becomes more conſiſtent towards the cloſe of the diſeaſe.

In women, the external parts of generation being fewer and more ſimple, the diſeaſe is leſs complicated than

Apocenoses than in men. Sometimes the vagina only is affected; and when this happens, the symptoms are very trifling: but in general it comes on with an itching and sensation of heat as in the other sex; and is attended with inflammation of the nymphæ, inside of the *labia*, *clitoris*, *carunculæ myrtiformes*, the orifice and sometimes the whole of the *meatus urinarius*. Very often the deep-seated glands of the vagina are affected, and it is sometimes difficult to distinguish the discharge of a gonorrhœa from that of the fluor albus.

Causes, &c. Many ingenious arguments have of late been advanced to prove, that the gonorrhœa and the lues venerea are different affections, originating from two distinct species of virus; and this controversy still, perhaps, remains to be decided by future facts. Certain it is, that in 19 of 20 cases of gonorrhœa, no symptom whatever of siphylis appears; and that the disease readily admits of cure without having recourse to those remedies which are universally requisite for combating the contagion of siphylis. It is by no means wonderful, that in some cases both contagious, supposing them different, should be communicated at the same time. Nay, cases are by no means rare, where the contagion of itch, though essentially different from both, has been communicated with either. But as undeniable proof that the contagion in both cases is precisely the same, it has been alleged by some, that the matter of a chancre introduced into the urethra will generate a gonorrhœa, and that the discharge from a gonorrhœa will produce chancre, bubo, and every other symptom of siphylis. On the other hand, however, it is contended, that when experiments of this nature are conducted with the greatest accuracy, the matter of siphylis uniformly produces siphylis, and that of gonorrhœa, gonorrhœa only. Without pretending to decide on which of these experiments the greatest dependence is to be put, we may only observe, that while an almost inconceivably small portion of siphylitic matter applied to the glans penis, from connection with an infected female, infallibly produces siphylis if it be not speedily removed, the matter of gonorrhœa, in every instance of that disease, is applied to the whole surface of the glans penis for many days together without producing almost any bad effect whatever. From this, therefore, there is ground for inferring, either that it is not capable of being absorbed, or that if absorbed it is innocent.

But while there have been disputes with regard to the peculiar nature of the matter in gonorrhœa, there have also been controversies with respect to the source from whence it is derived. While some suppose it to be principally purulent matter arising from ulcerations, others assert that no such ulceration is ever produced in the urethra by gonorrhœa. They contend that the increased secretion in these cases is exactly similar to what happens in the catarrh. But the comparison will by no means hold good in every particular: in the latter the whole membrane of the nose is equally irritated; whereas in the gonorrhœa, only particular parts of the urethra seem to be affected. The disease, in the generality of cases, seldom extends more than an inch and a half along that canal, and in many is confined (at least in the beginning) to a small spot about an inch from the extremity of the glans. The discharge is produced from that part of the urethra where Gonorrhœa. the pain is felt; and the patient, when he voids his urine, feels no smarting till it reaches the inflamed spot: but as the disorder increases, the inflammation affects a greater number of points, just in the same manner as chancres affect different parts of the glans. It might be supposed that dissection would at once clear up this matter, and put an end to the dispute; but this is far from being the case. Dr Simmons has seen several urethras opened in persons who had a gonorrhœa at the time of their death: in three of them the surface of the urethra, as in the cases related by Morgagni, appeared for some way down of a slight red colour, and in all of them was covered with mucus; but without any appearance of ulceration, except in two dissections at Paris, in which most of the gentlemen present were convinced that they saw evident marks of it: but Dr Simmons says that the appearances were to him not sufficiently satisfactory to enable him to decide with certainty on the subject. On the other hand, when we consider that the discharge in a gonorrhœa is sometimes tinged with blood, and that when this happens a little blood-vessel is no doubt ruptured, we can have no reason to doubt that an ulceration may, and sometimes does, happen in these cases; especially as we often observe an excoriation near the orifice of the urethra. It is certain, that wherever there is considerable inflammation, there will be danger of ulceration. Besides, from a neglected or badly-treated gonorrhœa, we often see fistulas *in perineo*, and other ulcers of the urethra, penetrating through its substance, and affording a passage to the urine. And there can be no doubt that slight ulcerations of this canal often occur, and are afterwards perfectly obliterated, in a similar manner to what happens in the papillæ of the tongue, the tonsils, &c. Such an obliteration will the more readily take place in a part like the urethra, defended with mucus, and not exposed to the air, which is known to have no little effect in hardening a cicatrix.

But whether ulcers take place or not, whether the virus of gonorrhœa be precisely of the same kind with that which gives siphylis, or of a different kind, there is reason from the phenomena of the disease to conclude, that the matter first acts by mixing with the mucus at the extremity of the urethra; and that from thence it is propagated upwards, particularly where the excretories of mucus are most numerous; and that on the parts to which it is applied, it operates as a peculiar irritating cause. The consequences of this irritation will be inflammation and an increased secretion of mucus; and so far the complaint will be local. In ninety-nine cases of an hundred a local affection of this kind constitutes the whole of the disease; and of this inflammation, ulcerations within the urethra, strictures, and other local affections, may be the consequence. But whether a disease of the habit ever takes place, unless when the contagion of siphylis is communicated with that of gonorrhœa, still remains to be determined by future observations and experiments.

Nothing can be more variable than the period at which the disease makes its appearance after infection. Perhaps, at a medium, we may place it between the 4th and 14th day: but in some cases it happens within

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Apocenofes. 24 hours; and in others, not before the end of five or even fix weeks: neither of thefe extremes, however, are common.

From what has been faid of the manner in which the contagious matter in gonorrhœa acts, and of the influence it exerts on thofe parts with which it comes in contact, it follows, that the prevention of gonorrhœa muft depend on the removal of the contagious matter, as foon as that can be done; and where this is either altogether neglected or not properly accomplifhed, that the cure muft depend on counteracting the inflammation which this contagious matter excites, and the confequences which refult from it.

The firft of thefe intentions may be moft certainly and moft eafily accomplifhed by careful lotion of all the parts to which the contagious matter has any chance of being applied. Thefe parts, at leaft on the firft application of the matter, are readily acceffible: for even in men there is no reafon to believe that it at firft penetrates to any extent in the urethra. This wafhing of the parts fhould be performed as foon as poffible; becaufe then the matter is both moft acceffible and leaft involved with mucus: but although wafhing cannot be accomplifhed at an early period, it fhould not be neglected afterwards; for from the difeafe uniformly commencing, even when it does not appear till a confiderable time after the application of the contagious matter, with a peculiar fenfe of titillation at the external parts, particularly in men at the extremity of the urethra, there is reafon to believe that the contagious matter attached to the mucus may remain latent there for a very confiderable time. For the purpofe of wafhing, with a view to the prevention of this difeafe, recourfe may be had to almoft any watery fluid, provided it be not fo ftimulant as to produce bad effects from injuring the parts. Pure water, properly applied, is perhaps one of the beft lotions; but there can be no doubt that its power in removing the contagious matter may be fomewhat increafed by fuch additions as render it a more powerful folvent of mucus. With this intention, one of the moft powerful additions is the vegetable alkali, either in its mild or cauftic ftate. In the latter ftate it is the moft active, but in the former it is moft fafe; and the *carbonas potaffæ* of the Edinburgh pharmacopœia, to the extent of half a dram, diffolved in fix or eight ounces of water, is one of the beft lotions that can be employed. The purpofe of removing the contagion may often alfo be effectually anfwered from wafhing with water impregnated with foap; for there the alkali, though in a cauftic ftate, is prevented from exerting any difagreeable effects, in confequence of its being combined with oily matters.

With the view of preventing gonorrhœa, fome have advifed, that the alkali either in its mild or cauftic ftate, properly diluted with water, fhould be injected into the urethra: and there can be no doubt, that by this means the contagious matter, when it has entered the urethra, may be removed. A removal may alfo be effected by the injection of a weak folution of corrofive fublimate, which feems to act not by diffolving the mucus but by producing an augmented fecretion. But at a very early period of the difeafe, injections are probably unneceffary; and if it has made any confiderable progrefs, they are dangerous: for from the augmented fenfibility of the part, even very gentle ones are Gonorrhœa. apt to excite a high degree of inflammation.

There are practitioners who, fuppofing that the body poffeffes powers to expel the virus, and that the difeafe has a certain period to run through its feveral ftages of progrefs, acmè, and decline, are for leaving the cure to nature; or at leaft content themfelves with affifting her by an antiphlogiftic regimen, gentle evacuations, and the like.

That in many cafes the diforder admits of a natural cure, there can be no doubt; the increafed fecretion of mucus carrying off the virus fafter than it is formed, till at length the infection is wholly removed: But it is equally certain, that in every cafe, by the application of fuitable remedies to the inflamed part, we may fhorten the duration of the complaint, and abridge the fufferings of the patient, with the fame certainty and fafety as we are enabled to remove the effects of an ophthalmia or any other local inflammation, by proper topical applications. General remedies, fuch as occafional blood-letting, a cooling diet, the liberal ufe of diluting liquors, and mild purges, are by all allowed to be ufeful, and even neceffary. Aftruc was of opinion that in thefe cafes blood-letting ought to be repeated five or fix times; and there are ftill many practitioners who depend much on repeated evacuations of this fort for a removal of the inflammation. But there is, perhaps, not one cafe in ten in which it is at all requifite; and this fmall number of cafes will confift only of the ftrong and plethoric: in fuch, when the chordee is frequent and painful, and the pulfe hard and full, the lofs of from eight to twelve ounces of blood will be beneficial, but it will be feldom neceffary to repeat the operation. The inflammation in thefe cafes is kept up by the local ftimulus of the virus and the urine; and all that we can expect from venefection is to moderate the pain and the frequency of erection. In perfons of a delicate habit, and of an irritable fibre, the evacuation will do no good; but if repeated will certainly be liable to do harm, by increafing irritability, and of courfe rendering the patient more fufceptible of ftimulus.

The utility, and even the neceffity, of a cooling regimen, are fufficiently obvious; wine and fpirituous liquors, fpiceries, a fifh-diet, much animal-food, and falted and high-feafoned difhes of every fort, will conftantly add to the complaint. The patient fhould eat meat only once a-day, and that fparingly. He fhould abftain from hot fuppers. Milk, mild vegetables, and fruit, fhould conftitute the principal part of his diet while the inflammatory fymptoms continue. Every thing that tends to excite the venereal imagination fhould be ftudioufly avoided; for whatever promotes erections of the penis will increafe the inflammation, and of courfe add fuel to the difeafe. For the fame reafons much walking or riding on horfeback will be hurtful, from the irritation kept up in the perinæum by fuch means. Violent exercife of any kind, or any thing that is liable to increafe the heat and the momentum of the blood, will of courfe be improper.

The drinking freely of mild, cooling, mucilaginous liquors, fuch as linfeed-tea, orgeat, whey, milk and water, almond emulfion, and the like, will be extremely ufeful, by diluting the urine, and preventing its falts from ftimulating the urethra. When the heat and pain in making water are very confiderable, mucilaginous fubftances

Apocenoses. substances are found to have the best effect, particularly the gum tragacanth. It is a common practice to give equal quantities of this gum or gum-arabic and nitre, and to dissolve nitre in the patient's drink, with a view to lessen the inflammation. But in these cases nitre is always improper: it is known to be a powerful diuretic, its chief action being upon the urinary passages; so that the stimulus it occasions will only serve to increase the evil it is intended to alleviate. Supertartrite of potass, on account of its diuretic quality, will be equally improper. Our view here is not to promote a preternatural flow of urine; for the virus, being insoluble in water, cannot easily be washed away by such means; but our object ought to be, to render the urine that is secreted as mild and as little stimulating as possible.

Mild purges, which constitute another material part of the general remedies, are no doubt extremely useful when exhibited with prudence; but it is well known that the abuse of purgative medicines in this disease has been productive of numerous evils. Formerly it was a pretty general practice to give a large dose of calomel at bed-time, three or four times a-week; and to work it off the next morning with a strong dose of the *pilulæ cocciæ*, or some other drastic purge. This method was persevered in for several weeks: in consequence of which the patient often found himself troubled with an obstinate gleet, and perhaps his constitution materially injured; the effect of such a method being (especially in irritable habits) to weaken the stomach and bowels, and lay the foundation of hypochondrial complaints. Violent purging likewise often occasions strangury, and other troublesome symptoms.

The cathartics employed in these cases should be gentle; such as Rochelle salt, manna, tartarised alkali, and the like. They should be given only in a dose sufficient to procure two or three stools, and be repeated only every two or three days. The daily use of the purgative electuaries that are still given by some practitioners, serves only to keep up a continual irritation on the bladder, and of course to prolong the inflammation.

The topical remedies that are used consist chiefly of different sorts of injections, the ingredients of which are extremely various; but their modes of operation may in general be referred to their mucilaginous and sedative, or to their detergent, stimulating, and astringent qualities. In the hands of skilful practitioners, great advantages may doubtless be derived from the use of these remedies; but, on the other hand, the improper and unseasonable administration of them may prove a source of irreparable mischief to the patient.

We know that mucilaginous and oily injections will tend to allay the local inflammation; and that a sedative injection, such as a solution of opium, will lessen the irritability of the parts, and of course produce a similar effect; the utility of such applications is therefore sufficiently obvious.

A detergent injection, or one that will act upon the mucus of the urethra, increase the discharge of it, wash it away, and with it the venereal virus that is blended with it, can only be used as a prophylactic before the symptoms of infection have made their appearance. But great circumspection is necessary in the use of this kind of injection. If it be too weak, it can be of no efficacy; and if it be too strong, it may prove dangerous to the patient. A suppression of urine has Gonorrhœa. been brought on by the improper use of an injection of this kind. When the symptoms of inflammation have once made their appearance, the stimulus of such an injection must be extremely hazardous. Excoriation of the urethra has but too often been produced by remedies of this sort in the hands of adventurous and unskilful practitioners.

While the inflammation of the urethra continues, every thing that stimulates it must be hurtful. If the injection excites a painful sensation in the urethra, as is but too often the case, it will be liable to produce swelled testicles, difficulty in making water, excoriation, and other effects of increased inflammation: if, by its astringency, the running be checked before the virus that excited the discharge be properly subdued, the patient will be exposed to fresh dangers; and perhaps to a variety of local complaints, such as obstructions in the urethra, and abscesses *in perinæo*, which are well known to be sometimes owing to applications of this sort improperly managed.

When the inflammation has subsided, gently stimulating and astringent injections may be used with safety, and with considerable advantage: for as the inflammation is at first excited by the stimulus of the venereal virus, so when the former begins to lessen, we may be assured that the activity of the latter has abated in proportion; and, in general, when the inflammatory symptoms are entirely removed, it will be found, that the mucus is no longer of an infectious nature, but is merely the effect of an increased secretion and of relaxation. Mild astringents will therefore serve to brace and strengthen the vessels secreting mucus, and in this way will lessen the discharge, and greatly promote the cure. It is certain, that in the greater number of cases, a gonorrhœa, which if treated by internal remedies alone, would continue for five or six weeks, or longer, may, when judiciously treated with injections, be cured in a fortnight, and very often in less time. The great aim, therefore, of the practitioner ought to be at first to make use of such injections only as will tend to lubricate the surface of the urethra, and to counteract and destroy the stimulus of the virus: as the inflammation abates, he may add some gently astringent preparation to a mucilaginous and sedative injection; taking care that its astringency be suited to the state of the disease, and to the irritability of the patient. Amongst a great variety of substances, mercury in different forms is one of those that is the most frequently employed in injections. All these mercurial injections have more or less of astringency; and, according to Dr Simmons, it is solely to this property that we are to ascribe their effects; for the idea of their correcting the venereal virus was originally introduced, and has, he thinks, been continued, upon mistaken principles.

Calomel, mixed with the mucus discharged in a gonorrhœa, has no more power in destroying the infectious properties of that mucus than ceruse or any other preparation would have. A diluted solution of sublimate injected into the urethra, will, like a solution of verdigrise, or blue vitriol, or any other styptic, constringe the mouths of the lacunæ; but this is all that it will do, for it will never lessen the infectious nature of the virus. The same thing may be observed of crude

crude mercury extinguished by means of mucilage, or of mercurial ointment, blended with the yolk of an egg, and which, when thrown up into the urethra, will act nearly in the same manner as balsam of copaiva, or any other stimulating injection. The stimulus of mercury, however, has often been found of considerable efficacy; and in women, when the vagina only was affected, after washing the parts well, the cure has been accomplished by rubbing them repeatedly with mercurial ointment.

As the gonorrhœa is only a local affection, it may be inferred, that the internal use of mercury is unnecessary towards the cure. Very often indeed this complaint may be removed without having recourse to mercurials. Sometimes patients have been met with whose general health has been greatly impaired by a long continued use of mercury in such cases, while the original disease, the gonorrhœa, was rendered much worse by it. In some it has degenerated into a gleet, that was cured with extreme difficulty; in others it has brought on a variety of distressing symptoms. In cases of gonorrhœas, therefore, whenever mercury is administered, it ought to be, not with a view to expedite the cure, but merely to obviate the dangers of syphilis. When the infection is apparently slight, and the inflammation and the symptoms trifling, we may proceed without the assistance of mercury, especially if the patient be of a weak, relaxed, and irritable habit, likely to be injured by mercurial medicines. On the other hand, when the discharge is violent, the inflammation considerable, or the seat of the disease high up in the urethra, it is perhaps the most prudent plan to give mercurials in small doses, and in such forms as seem the best adapted to the constitution of the patient.

The *pilulæ hydrargyri*, as prepared according to the receipts inserted in the last edition either of the London or Edinburgh Pharmacopœias, in both of which the mercury is rendered active merely by triture, may perhaps be considered as one of the mildest and most efficacious forms under which mercury can be exhibited by the mouth. Its efficacy will depend on its not irritating the bowels, and thus passing off by stool; care must likewise be taken to prevent its affecting the mouth. Of the chemical preparations of mercury, the mildest and least irritating is calomel. It may be given from gr. iss. to gr. iii. at bed-time, occasionally interposing a mild purgative to prevent it from salivating; but in general the mercurial pill just mentioned is to be preferred.

When there is no chancre nor bubo, no appearance in short of syphilitic infection, it would be improper to administer corrosive sublimate, the mercurius calcinatus, or any other of the more acrid preparations of mercury.

After a gonorrhœa proceeding from venereal causes has been removed, another kind of running without pain, called the *gonorrhœa mucosa*, or *gleet*, sometimes remains. Sometimes it arises from a constriction and excoriation of the urethra, and frequently it is the effect of an enlargement and diseased state of the prostate. In each of these cases, as the gleet is the effect of irritation, the cure will depend on the removal of the local disease that occasions it. But there is another species of gleet, that seems to depend chiefly on relaxation. It is in general free from infection, and is most common in those who have had long and frequent gonorrhœas. It is likewise often the effect of a debilitated habit, from severe purging, or a long continued use of mercurials. A discharge of this kind is more frequent in women than in men; or, at least, the fluor albus, after a gonorrhœa, will often be mistaken for a gleet.

When there is no reason to suspect remaining contagion, astringent injections will be of the greatest service. It will be necessary, at the same time, to attend to the health of the patient, by employing cinchona, chalybeate waters, cold bathing, and such other remedies as will tend to strengthen the system: and indeed by the use of these, particularly by the cinchona, such runnings are often successfully combated in those who from apprehension of dangerous consequences cannot be prevailed upon to employ injections. When there is no tendency to inflammation, the balsam of copaiva may be prescribed with advantage in large doses. Dr Simmons says he once saw a complaint of this sort removed by applying a blister to the perinæum, after it had resisted a variety of other remedies. In the Medical Observations also we have an account of a gleet and incontinence of urine removed at once by a blister to the os sacrum. In general, however, the other methods above mentioned will be sufficient to remove it, though sometimes it will continue for a long time in spite of all our endeavours to check it.—Other kinds of gonorrhœa, in which the semen itself is ejected, especially during sleep, may be cured by tonics and a mild cooling regimen.

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Genus CXXII. OBSTIPATIO. 393

Costiveness.

Obstipatio, *Lin.* 166. *Vog.* 128. *Sag.* 221.

Costiveness is sometimes occasioned by debility in dyspeptic persons, sometimes it is the effect of rigidity, and sometimes it is symptomatic of the colic. It may proceed from an affection of the liver; drinking rough red wines, or other astringent liquors; too much exercise, especially on horseback: it may likewise proceed from a long use of cold insipid food, which does not sufficiently stimulate the intestines. Sometimes it is owing to the bile not descending to the intestines, as in the jaundice; and at other times it proceeds from diseases of the intestines themselves, as a palsy, spasms, tumors, &c.

Excessive costiveness is apt to occasion pains of the head, vomiting, colics, and other complaints of the bowels. It is peculiarly hurtful to hypochondriac and hysteric persons, as it generates wind and other distressing symptoms.

Persons who are generally costive should live upon a moistening and laxative diet; as roasted or boiled apples, pears, stewed prunes, raisins, gruels with currants, butter, honey, sugar, and such like. Broths with spinage, leeks, and other soft pot-herbs, are likewise proper. Rye-bread, or that which is made of a mixture of wheat and rye together, ought to be eaten. No person troubled with costiveness should eat white bread alone, especially that which is made of fine flour.

Epischeses. flour. The best bread for keeping the belly soluble is what in some parts of England they call *meslin*. It is made of a mixture of wheat and rye, and is very agreeable to those who are accustomed to it.

Costiveness is increased by keeping the body too warm, and by every thing that promotes the perspiration; as wearing flannel, lying too long in bed, &c. Intense thought, and a sedentary life, are likewise hurtful. All the secretions and excretions are promoted by moderate exercise without doors, and by a gay, cheerful, sprightly temper of mind.

The drink should be of an opening quality. All ardent spirits, austere and astringent wines, as port, claret, &c. ought to be avoided. Malt liquor that is fine and of a moderate strength is very proper. Butter-milk, whey, and other watery liquors, are likewise proper, and may be drank in turns, as the patient's inclination directs.

Those who are troubled with costiveness ought, if possible, to remedy it by diet, as the constant use of medicines for that purpose is attended with many inconveniences, and often with bad consequences. In time the custom becomes necessary, and generally ends in a total relaxation of the bowels, indigestion, loss of appetite, wasting of the strength, and death.

The learned Dr Arbuthnot advises those who are troubled with costiveness to use animal oils, as fresh-butter, cream, marrow, fat broths, &c. He likewise recommends the expressed oils of mild vegetables, as olives, almonds, pistaches, and the fruits themselves; all oily and mild fruits, as figs; decoctions of mealy vegetables; these lubricate the intestines; some saponaceous substances which stimulate gently, as honey, hydromel, or boiled honey and water, unrefined sugar, &c. are useful.

The doctor observes, that such lenitive substances are proper for persons of dry atrabilarian constitutions, who are subject to astriction of the belly and the piles, and will operate when stronger medicinal substances are sometimes ineffectual; but that such lenitive diet hurts those whose bowels are weak and lax. He likewise observes, that all watery substances are lenitive; and that even common water, whey, sour milk, and butter-milk, have that effect:—That new milk, especially asses milk, stimulates still more when it sours on the stomach; and that whey, turned sour, will purge strongly:—That most part of fruits are likewise laxative; and that some of them, as grapes, will throw such as take them immoderately, into a cholera morbus, or incurable diarrhœa.

When the body cannot be kept open without medicine, gentle doses of rhubarb may be taken twice or thrice a-week. This is not near so injurious to the stomach as aloes, jalap, or the other drastic purgatives so much in use. Infusions of senna and manna may likewise be taken, or half an ounce of tartarised alkali dissolved in water gruel. About the size of a nutmeg of lenitive electuary taken twice or thrice a-day, generally answers the purpose very well.

394 Genus CXXIII. ISCHURIA.

Suppression of *Urine*.

Ischuria, *Sauv.* gen. 293. *Lin.* 167. *Vog.* 129. *Sag.* 212. *Home's* Clinical Experiments, sect. xv.

Ischuria. This disease is distinguished into various species, according as the seat of it is in the kidneys, the ureters, the bladder, or the urethra; and hence these species are named *renalis*, *ureterica*, *vesicalis*, and *urethralis*.

1. *Ischuria renalis*, or a suppression of urine from an affection of the kidneys, happens but rarely; however, 395
Dr Home in his Clinical Experiments describes such a case. In the end of December 1774, a man of a full habit, aged 35, was seized with shivering, coldness, and severe cough. Three days after, his urine appeared high-coloured, was passed with pain, and in small quantity. About the 8th of January 1775, he was attacked with violent pains in the small of his back, over the whole abdomen, and in the ankles, with pain in the region of the liver when pressed. A general swelling was afterwards observed all over the body, but chiefly in the ankles and abdomen, which last was tense and hard. These were attended with vomiting, bad appetite, and considerable thirst. When he entered the clinical ward (January 21st), the cough, sickness, and vomiting, had gone off, but the suppression of urine remained. The little which he made was passed with his stools, so that Dr Home saw it but once; and then it was pale, and had a white powder at bottom. The pains and swellings, which retained the impression of the finger, continued; he had a headach, and a very slow pulse, beating only 48 strokes in a minute. He had taken a great many diuretic medicines before his admission. The day after his reception, he was seized with a spontaneous diarrhœa, which continued during the remainder of his life. Crystals of tartar were exhibited in doses of half an ounce each morning; at bed-time he took 20 drops of tincture of opium with a scruple of nitre, and continued this course for eight days without any increase of urine. The stronger and heating diuretics were then tried, as an infusion of juniper berries and pills of garlic; but they were attended with no sensible advantage. Whenever the pulse became so strong that he could bear bleeding, eight ounces of blood were taken away, which was sizy. This was thrice repeated; he appeared easier after each bleeding, his pulse bore it well, and the swellings and other symptoms abated. The heating diuretics, in this state, were given up; and a mixture of vinegar and nitre was substituted in their place, in each dose of which, taken every two hours, there was a scruple of nitre. Fomentations were applied to the region of the kidneys, and camphorated oil was afterwards rubbed on the part. He was ordered the semicupium, which from a deficiency of water in the hospital at that time he got only once; and which then seemed to have a good effect, as he passed a gill of urine when he was in it. Notwithstanding this, however, the disease continually gained ground; he became comatose, delirious, and died ten days after his admission. On dissection, the kidneys were found of an irregular form; some watery vesicles appeared on their surface, containing black gritty particles like fine sand; and the lower part of the right kidney was considerably inflamed. The pylorus, part of the duodenum, and a considerable part of the small intestines, were much inflamed. In the abdomen were found about five pounds of fluid, and in the cavities of the thorax about half a pound. The

Epifchefes. The lungs were a little inflamed, and full of fmall tubercles on their furface and in their fubftance: the heart was large, and a polypus in each ventricle. About fix ounces of fluid were found in the pericardium: in the brain nothing preternatural appeared, except about an ounce of water in each ventricle.

Dr Home feems to have been at a lofs for the remote caufe of this fuppreffion of urine, which manifeftly had its immediate origin from the kidneys having loft the power of performing their functions. He thinks the inflammation which appeared in the right kidney was fcarce fufficient to have occafioned the diftemper, as the other would have fupplied its place: for which reafon alfo he thinks that the ifchuria was owing to a general affection of the fyftem; and that it was of an arthritic nature, the patient having been troubled with complaints of that kind for a long time before.

396 2. The *ifchuria ureterica* is alfo a rare difeafe, unlefs the obftruction proceeds from a ftone or clot of blood ftopping up the paffage. Gravel or ftones, indeed, are very frequently formed in the kidneys; and, by falling into the ureters, occafion an ifchuria, with violent pain, and fymptoms more or lefs urgent in proportion to the fize and fhape of the ftones. Sometimes it is attended with coldnefs of the extremities, naufea, vomiting, and fpaftic conftriction of the præcordia, a difficulty of making water, conftipation of the belly, difficulty of breathing, ftupor of the thigh, retraction of the tefticle, inquietude, lofs of ftrength, fyncope, and convulfion fits. When the violent pain has continued for feveral days and nights without intermiffion, and has brought the patient exceeding low, and the fuppreffion of urine is complete, with coldnefs of the extremities and convulfions of the tendons, death is at hand. Nor is it a good fign when the ftone continues long in the ureter; for then the appetite decays, a naufea and retching to vomit fupervene, and the patient is confumed with a hectic heat. Sometimes the pain is attended with an inflammation of the ftomach and inteftines; and fometimes the difeafe ends in a dropfy of the breaft, or lethargy, which foon carry off the patient.

The indications of cure are, to exclude the ftone as eafily as poffible, and prevent the breeding of others. If the patient be of a fanguineous temperament, Sydenham recommends to take away ten ounces of blood from the affected fide; and then to give the patient a gallon of poffet-drink in which two ounces of marfhmallow roots have been boiled, injecting at the fame time an emollient glyfter. After the poffet drink has been vomited up, and the clyfter returned, give a pretty large dofe of an opiate. But if the patient be old or weak, or fubject to nervous affections, bleeding may be omitted, efpecially if his urine at the beginning of the fit be coffee coloured, and mixed with gravel; but as to other things, the cure is the fame.—Huxham highly recommends an emollient bath prepared of a decoction of marfh-mallow root, lintfeed, fœnugreek feed, and flowers of chamomile, to which may be added a few white poppy feeds. By the ufe of this bath he fays he has feen the moft cruel fit of the gravel fuddenly ended, when neither copious bleeding nor opiates had the leaft effect. Mild diuretics are alfo of fervice. Hoffman recommends dulcified fpirit of nitre as proper to relax the fpaftic ftricture. It is to be taken with fuitable diftilled waters and fyrup of poppies; or in broth, with a few fpoonfuls of oil of fweet almonds. Turpentine glyfters are alfo accounted very ferviceable; and may be prepared with ten ounces of a decoction of chamomile, with half an ounce of turpentine diffolved in the yolk of an egg, and about as much honey. The *fal diureticus*, or *acetis potaffæ*, is much efteemed by fome, when taken along with an opiate. But when the ftone is too big to pafs, Arbuthnot recommends a cool and diluent diet to hinder the further growth of it. Whey, infufion of lintfeed, decoction of marfhmallows, and gently refolving diuretics, are alfo proper. To put a ftop to the vomiting, the compound tincture of benzoin, formerly named *balfamum traumaticum*, has fometimes been ufed with fuccefs, when almoft every other means have failed.

3. The *ifchuria veficalis* may arife from a ftone in the bladder; and this indeed is the moft common caufe of it: but there are certain cafes, in which, though the ufual quantity of urine, or perhaps more, be paffed, the patient dies from the retention of a ftill greater quantity in the bladder. Of this Dr Home gives the following inftances. A man of 58 years of age, of a ftrong fpare habit, and never fubject to the gravel, had, during the winter of 1777, a cough with expectoration, which went off in the beginning of 1778. About the 17th of February 1778 he felt fome difficulty in paffing his urine, and much pain about the region of the bladder. He continued in this way for ten days, after which he became eafier on application of fome medicines. The abdomen then fwelled, and he had pains in his loins and thighs. On the 3d of March he was admitted into the clinical ward: his abdomen was then fwelled and tenfe; and an evident fluctuation was felt, which fome that touched him thought was fonorous and produced by wind. A tumor was difcovered between the navel and fpine of the os ilium on the left fide, which gave him much pain, efpecially when preffed. This tumor became more eafily felt after the fwelling of the abdomen decreafed, feemed round, and very near as large as the head of a child. It appeared very much on the left fide, even when the patient lay on the right, and it then became dependent. He paffed urine frequently, and rather more than in health, as it was computed at four pints a-day. It was always clear, and of a light colour. His body had a ftrong difagreeable fmell; his fkin was dry, belly bound, and his appetite entirely gone, fo that he had hardly taken any food for 12 days. His legs fwelled flightly for fome days in the evening. His pulfe was generally regular, fometimes flower than natural, and fometimes a little quicker; being once felt at 64, and another time at 92. He was often feized, efpecially after eating or drinking, with hiccough; which increafed and lafted till his death. On the 20th day of his difeafe, after fome dofes of fquills, the general fwelling of his abdomen fell, became much fofter, and more diftinctly difcovered the fwelling of the left fide. The next day a vomiting came on; he became delirious, and died the day following. The body being opened, it appeared that the tumor which was fo diftinctly felt on the left fide of the abdomen, was owing to a diftenfion of the bladder with urine. Its fundus reached to about the divifion of the aorta into the

Ifchuria. 397

Epifchefes. the iliacs; it entirely filled the pelvis, and contained between five and fix pounds of urine of a pale colour. On examining the external furface, its neck, and the beginning of the urethra, were found to be furrounded with a fcirrhofity, which impeded the evacuation of the urine. The bladder itfelf was much thickened, but not more in one part than another. The ureters entered naturally; but were much thickened in their upper half near the kidney. The kidneys were fomewhat enlarged; particularly the left, which had feveral watery veficles on its external furface. Thefe organs were not in their ufual fituation; but lay clofe on each fide of the fpine, and very near the aorta; fo that the renal veffels were very fhort. What was very fingular, the lower end of each arofe over the fpine, and they were united together by their membranes, the aorta paffing beneath the union. The bladder had preffed confiderably on this part; and the peritoneum covering them was confiderably thicker than natural. The lungs adhered every where to the pleura, and in fome places very firmly: they were of a loofe texture and black colour; and the veins of the lower extremities were turgid with blood. It does not appear that this patient got any medicines farther than a few dried fquills, which diminifhed the fwellings and brought off much wind. He alfo got a mixture of mufk, and afterwards of opium, for his hiccough; but without fuccefs. His difeafe was miftaken for an afcites; and the catheter was not tried: but in another cafe the ufe of this inftrument was apparently of more fervice than any internal medicines. This laft patient was about 90 years of age, and laboured under fymptoms very fimilar to thofe already mentioned. When admitted into the clinical ward, he had the hypogaftric region fwelled, and difficulty of paffing his water; but without pain, vomiting, or hiccough. He had loft all appetite; was thirfty, and coftive. His pulfe was 110, and weak. In the evening about three Englifh pints of pale clear urine were drawn off by means of the catheter: the next day all the fymptoms were gone off or abated. After this he continued to pafs fome urine, fometimes voluntarily, fometimes involuntarily and infenfibly; but fo much always remained behind, that his bladder was conftantly full, unlefs when the urine was drawn off, which was done twice every day. The urine was fometimes pale, fometimes of a deep red colour; and once there was fome blood mixed with it, which perhaps might have been occafioned by the catheter. About the fixth day the urine was very putrid, with much purulent like matter at the bottom, and was paffed with more pain. About the 11th, the putrid fmell went off. The next day all the urine paffed infenfibly except what was drawn off; and an hiccough, though not very fevere, had come on. In this way he continued without fever, though frequently troubled with the hiccough, efpecially during thofe nights in which the urine had not been drawn off. A month after admiffion, the bladder, with the affiftance of the catheter, was almoft entirely, though infenfibly evacuated, and the hiccough had left him; he had no other complaint but that of voiding his urine infenfibly, the natural effect of a fcirrhous bladder, and which was probably incurable. With this patient the hot bath and mercurials were tried, in order to foften the fcirrhofity of the bladder, but without effect. Ifchuria.

398 4. The *ifchuria urethralis* arifes from fome tumor obftructing the paffage of the urethra, and thus hindering the flow of urine. It is no uncommon diftemper, and often follows a gonorrhœa. Dr Home gives us an example of this alfo.—The patient was a man of 60 years of age, who had laboured under a gonorrhœa fix months before, and which was ftopped by fome medicines in two or three days. He felt, foon afterwards, a difficulty in paffing his urine, which gradually increafed. About 10 days before his admiffion into the clinical ward, it was attended with pains in the glans, and *ardor urinæ;* he had paffed only about eight ounces the day before his admiffion, and that with very great difficulty; and the hypogaftric region was fwelled and pained. On introducing the catheter, three pounds of urine were drawn off, by which the pain and fwelling were removed. The inftrument required force to make it pafs the neck of the bladder, and blood followed the operation; and the finger, introduced into the anus, felt a hard tumor about its neck. He was treated with mercurial pills and ointment, by which the fwelling about the neck of the bladder foon began to decreafe; but at the fame time a fwelling of the right tefticle appeared. He was vomited with four grains of turbith-mineral, the *fubfulphas hydrargyri flavus* of the prefent pharmacopœia, which operated gently; and here Dr Home obferves, that though thefe vomits are little ufed, from a miftaken notion of their feverity, he never faw them operate with more violence than other vomits, or than he could have wifhed. The fwelling diminifhed in confequence of the emetic and fome external applications; and the cure was completed by bleeding and a decoction of mezereon root.

Genus CXXIV. DYSURIA. 399

Difficulty of discharging urine.

Dyfuria, *Sauv.* gen. 265. *Lin.* 57. *Vog.* 164. *Sag.* 213.
Stranguria *auctorum.*

A difficulty of making water may arife from many different caufes; as from fome acrid matter in the blood, cantharides, for inftance: and hence a ftrangury very often fucceeds the application of blifters. In many cafes it arifes from a compreffion of fome of the neighbouring parts; of the uterus, for inftance, in a ftate of pregnancy. Or it may arife from a fpafmodic affection of the bladder, or rather its fphincter; or from an inflammation of thefe parts, or others near them. Hence the difeafe is diftinguifhed into fo many fpecies, the cure of which is to be attempted by remedies indicated by their different caufes.

But the moft common, as well as the moft dangerous fpecies is that arifing from a calculous concretion, or

Stone in the Bladder. 400

Dyfuria calculofa, *Sauv.* fp. 12.

The figns of a ftone in the bladder are, pain, efpecially about the fphincter; and bloody urine, in confequence

Epischeses. quence of riding or being jolted in a carriage; a sense of weight in the *perinæum*; an itchiness of the *glans penis*; slimy sediment in the urine; and frequent stoppages in making water; a *tenesmus* also comes on while the urine is discharged: but the most certain sign is, when the stone is felt by the finger introduced into the anus, or by sounding.

Causes, &c. It is not easy to say what the particular causes are which occasion the apparently earthy particles of the fluids to run together, and form those calculous concretions which are found in different parts of the body, and especially in the organs for secreting and discharging the urine.

The gout and stone are generally supposed to have some affinity, because gouty people are for the most part afflicted with the gravel. But perhaps this is in part owing to their long confinement, and to lying on the back, which people who labour under the gout are often obliged to submit to; since the want of exercise, and this posture, will naturally favour the stagnation of gross matters in the kidneys: besides, there are many instances of people severely afflicted with the stone for the greatest part of a long life, who have never had the least attack of the gout.

There is, however, good reason for believing, that some farther connection takes place between the two diseases; and when treating of the gout we have already given some account of the opinion of an ingenious anonymous author, who has endeavoured to prove, that both the one and the other depend on a peculiar acid, the concreting, lithic, or uric acid, which is always present in blood; and which may be precipitated from thence by various causes, such as the introduction of other acids, or the like. When thus precipitated, he supposes it to produce the whole phenomena of both diseases. The objections we formerly stated to his theory of gout, do not equally militate against that of calculus; and it is at least certain, from the best chemical analysis, that what are commonly called *urinary calculi*, and have been considered as entirely an earthy matter, consist principally of acid in a solid state united only with a small proportion of earth or mucus. We may, therefore, whether this hypothesis be altogether well founded or not, justly view lithiasis as depending, in a great measure, on the separation of an acid from the blood.

Whatever may be the particular cause of the disposition to *lithiasis*, the kidneys appear to be the most likely places for particles to concrete or run together, because of the great quantity of blood which passes through the renal arteries, and which comes immediately from the heart, fraught with various newly-received matters, that have not undergone much of the action of the vessels, and therefore cannot as yet be supposed to be thoroughly assimilated.

Anatomists who have carefully examined the kidneys in the human subject, particularly M. Bertin, inform us, that there are two sets of *tubuli uriniferi*; the one continued directly from the extremities of the renal artery, and the other springing from that vesicular texture which is conspicuous in the kidneys.

It is in this vesicular part of the kidney that we presume the particles of the concreting matter first stagnate and coalesce: for it is hardly to be supposed, that such solid matters could be allowed to stop in the extremities of the renal arteries, since the blood, and the urine separated from it, must flow through these vessels with great degrees of force and velocity; but in the intermediate vesiculæ the particles may lie, and there attracting each other, soon come to acquire sensible degrees of magnitude, and thus become sand or gravel. As long as this sand or gravel formed in the vesicular part of the kidney lies quiet, there will be no pain or uneasiness, until the concretions become large enough to press either on the adjoining *tubuli*, or on the blood-vessels; then a sense of weight, and a kind of obtuse pain in the loins, will be felt. But when the small pieces of concreting matter shall be dislodged and washed off by the force of the circulating fluids, or loosened by some spasmodic action of the moving fibres in these parts, they will in their passage create pain, raise different degrees of inflammation, or perhaps lacerate some blood-vessels, and cause bloody urine. When these little concretions happen to be detained in the pelvis of the kidney, or any other place where a flow of urine continually passes, they soon increase in size, and become calculi, from the constant accession of particles, which are attracted by the original bit of sand, which thus becomes the nucleus of a stone.

Dysuria.

It is an opinion which Hippocrates first advanced, and which has been almost universally adopted by his followers, and has remained till lately uncontroverted, that the stone and gravel are generated by the use of hard water. From the quality, which the waters of certain springs possess, of depositing a large earthy sediment, either in the aquæducts through which they are conveyed, or in the vessels in which they are boiled or preserved, it was conjectured, that in passing through the kidneys, and especially whilst retained in the bladder, they would let fall their grosser particles, which by the continued apposition of fresh matter, connected by the animal gluten, and compacted by the muscular action of that organ, would in time form a calculus sufficiently large to produce a train of the most excruciating symptoms. And this reasoning *à priori* has been supposed to be confirmed by facts and experience; for not to mention the authority of Hippocrates, Dr Lister has observed, that the inhabitants of Paris are peculiarly subject to the stone in the bladder. Nicholas de Blegny has related the history of one who was dissected at Paris, in whom the pylorus, a great part of the duodenum, and the stomach itself, were found incrustated with a stony matter, to the thickness of a finger's breadth. And it is well known, that the water of the river Seine, with which that city is supplied, is so impregnated with calcareous matter, as to incrustate, and in a short time to choak up, the pipes through which it runs. But on the other hand it is objected, that the human calculus is of animal origin, and by chemical analysis appears to bear very little analogy to the stony concretions of water: and though it be allowed, that more persons are cut for the stone in the hospitals at Paris than in most other places; yet upon inquiry it is found, that many of those patients come from different provinces, and from towns and villages far distant from the Seine.

Dr Percival conjectures, that though this disease may chiefly depend upon a peculiar disposition to concrete in

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in the animal fluids, which in many inſtances is hereditary, and in no inſtance can with certainty be imputed to any particular cauſe; yet hard water is at leaſt negatively favourable to this diatheſis, by having no tendency to diminiſh it. The urine of the moſt healthy perſon is generally loaded with an apparently terreous matter, capable in favourable circumſtances of forming a calculus; as is evident from the thick cruſt which it depoſits on the ſides of the veſſels in which it is contained. And it ſeems as if nature intended by this excretion to diſcharge all the ſuperfluous ſalts of the blood, together with thoſe earthy particles, which are either derived from our aliment, and fine enough to paſs through the lacteals, though inſuperable by the powers of circulation, or which ariſe from the abraſion of the ſolids, or from the diſſolution of the red globular part of our fluids. Now water, whether uſed as nature preſents us with it, or mixed with wine, or taken under the form of beer or ale, is the great diluter, vehicle, and menſtruum, both of our food, and of the ſaline, earthy, and excrementitious parts of the animal juices. And it is more or leſs adapted to the performance of theſe offices, in proportion to its degree of purity. For it muſt appear evident to the moſt ordinary underſtanding, that a menſtruum already loaded, and perhaps ſaturated with different contents, cannot act ſo powerfully as one which is free from all ſenſible impregnation. Nor is this reaſoning founded upon theory alone; for it is obſerved, that Malvern water, which iſſues from a ſpring in Worceſterſhire remarkable for its uncommon purity, has the property of diſſolving the little ſabulous ſtones which are often voided in nephritic complaints. And the ſolution too, which is a proof of its being complete, is perfectly colourleſs. Hence this water is drunk with great advantage in diſorders of the urinary paſſages. And during the uſe of it, the patient's urine is generally limpid, and ſeldom depoſits any ſandy ſediment. Yet notwithſtanding this appearance of tranſparency, it is certainly at ſuch times loaded with impurities, which are ſo diluted and diſſolved as not to be viſible. For it is attended with a ſtrong and fetid ſmell, exactly reſembling that of aſparagus. Hoffman mentions a pure, light, ſimple water in the principality of Henneberg, in Germany, which is remarkable for its efficacy in the ſtone and gravel; and a water of ſimilar virtues was diſcovered not many years ago in the Black foreſt, near Oſterod, which upon examination did not afford a ſingle grain of mineral matter. Indeed it is worthy of obſervation, that moſt of the ſprings which were formerly held in great eſteem, and were called *holy wells*, are very pure, and yield little or no ſediment.

Dr Percival informs us that a gentleman of Mancheſter, who had been long ſubject to nephritic complaints, and often voided ſmall ſtones, was adviſed to refrain from his own pump-water, which is uncommonly hard, and to drink conſtantly the ſoft water of a neighbouring ſpring; and that this change alone, without the uſe of any medicine, has rendered the returns of his diſorder much leſs frequent and painful. A lady alſo, much affected with the gravel, was induced by the peruſal of the firſt edition of Dr Percival's Eſſay, to try the effect of ſoft water; and by the conſtant uſe of it remained two years entirely free from her diſorder.

Dyſuria.

In nephritic caſes, diſtilled water would be an excellent ſubſtitute for Malvern water, as the following experiment evinces.

Two fragments of the ſame calculus, nearly of equal weight, were immerſed, the one in three ounces of diſtilled water, the other in three ounces of hard pump-water. The phials were hung up cloſe together in a kitchen-chimney, at a convenient diſtance from the fire. After 14 days maceration, the calculi were taken out, and carefully dried by a very gentle heat. The former, viz. that which had been immerſed in diſtilled water, was diminiſhed in its weight a grain and a half; the latter had loſt only half a grain.

It is the paſſage of theſe calculi from the kidneys down into the bladder, which occaſions the pain, vomiting, and other ſymptoms, that conſtitute what is uſually termed a *fit of the gravel* or *ſtone*.

When an inflammation is actually raiſed, the diſeaſe is known by the name of *nephritis*, and has been already treated of.

As ſoon as the ſtone paſſes through the ureter, and falls into the bladder, the pain and other nephritic ſymptoms ceaſe; and every thing will remain quiet, either till the ſtone be carried into the urethra, or until it has remained long enough in the bladder to acquire weight ſufficient to create new diſtreſs.

If a ſtone happen to be ſmooth and of a roundiſh form, it may lie in the bladder and acquire conſiderable bulk before it can be perceived by the patient; but when it is angular, or has a rugged ſurface, even though it may be ſmall in ſize, yet it ſeldom fails to raiſe pain, and occaſion bloody urine, or the diſcharge of a ſlimy fluid, with teneſmus, and difficulty in making water.

There have been various attempts made to diſſolve the ſtone; and there are certainly ſome articles which have this effect when applied to them out of the body; but the almoſt total impoſſibility of getting theſe conveyed to the kidneys, renders it extremely doubtful whether a ſolvent ever will be diſcovered. Of all the articles employed for this purpoſe, no one perhaps has had greater reputation than fixed alkaline ſalt in its cauſtic ſtate, particularly under the form of the *lixivium cauſticum*, or *aqua potaſſæ*, as it is now called: but this being of a very acrid nature, it requires to be well ſheathed by means of ſome gelatinous or mucilaginous vehicle. Veal-broth is as convenient as any for this purpoſe; and accordingly it is uſed by thoſe who make a ſecret of the cauſtic alkali as a ſolvent of calculus.

Mr Blackrie, who has taken much pains in this inquiry, has proved very ſatisfactorily, that Chittrick's noſtrum is no other than ſoap-lees given in veal-broth, which the patients ſend every day to the doctor, who returns it mixed up with the medicine, in a cloſe veſſel ſecured by a lock.

It is not every caſe, however, that either requires or will bear a courſe of the cauſtic alkali. Some calculi are of that ſoft and friable nature, that they will diſſolve even in common water; and there are caſes wherein it appears that the conſtant uſe of ſome very ſimple decoction or infuſion of an inſignificant vegetable, has brought away large quantities of earthy matter, in flakes which apparently have been united together in layers to form a ſtone. Dr Macbride aſſures

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sures us, that a decoction of raw coffee, only 30 berries in a quart of water, boiled till it acquired a deep greenish colour, taken morning and evening to the quantity of eight or ten ounces, with ten drops of sweet spirit of nitre, had the powerful effect of bringing away, in the course of about two months, as much earthy matter in flakes as filled a large tea cup. The patient was far advanced in years; and, before he began this decoction, had been reduced to great extremities by the continuance of pain and other distressing symptoms: he was purged occasionally with *oleum ricini*.

Very lately the alkali in a mild state, and in a different form, has been much used by many calculous patients, and with great advantage, under the form of what is called *alkaline aërated water*, the aqua supercarbonatis potassæ of the present edition of the Edinburgh Pharmacopœia. For the introduction of this medicine, or at least for its extensive use, we are chiefly indebted to that ingenious physician Dr William Falconer of Bath. He has lately published an account of the *Aqua Mephitica Alkalina*, or solution of fixed alkaline salt, saturated with fixable air, in calculous disorders; which contains a number of cases strongly supporting the benefit to be derived from it. But whether the good effects obtained in these instances are to be explained from its operating as a solvent of calculus, seems to be extremely doubtful. There are indeed cases in Dr Falconer's treatise, of patients in whom, after using it for a considerable time, no stone could be detected by sounding, although it had been discovered in that way before they began the employment of it. But in many instances, the relief has been so sudden, that it may be concluded, that, notwithstanding the ease obtained, the calculus still remained. In such cases, it probably removed from the urine that quality by which it gives to the calculus fresh accretions, producing that roughness of its surface by which it is chiefly capable of acting as a stimulus. For the distressing symptoms resulting from stone are chiefly to be attributed to the inflammatory and spasmodic affections which it induces; and when its surface is least capable of operating as a stimulus, these of course will be least considerable. It is therefore not improbable, that this remedy produces relief, by preventing fresh additions being made to the calculus.

An infusion of the seeds of *daucus sylvestris* sweetened with honey, is another simple and much celebrated remedy; it has been found to give considerable ease in cases where the stomach could not bear any thing of an acrid nature. The leaves of the *uva ursi* were strongly recommended by the late celebrated De Haen; and this, whatever its way of operating may be, seems to have been productive of good effects in some instances. There is no reason to believe that it has any influence in dissolving calculus; and indeed it seems to be chiefly useful in these instances where ulcerations take place in the urinary passages.

In the Edinburgh Medical Commentaries, vol. iii. we have an account of a method used by the inhabitants of Arabia Petræa for curing the stone, to which they are very much subject, and which the author (an English gentleman of experience and candour) affirms he has seen frequently performed with success. By means of a catheter, they inject into the bladder a weak ley of alkali with the purified fat of a sheep's tail, and a proper quantity of opium, all put together. Their catheters are made of gold; and in performing the operation they introduce them quite into the bladder; so that the composition is safely conveyed to the stone without hurting any other part. But when a stone is situated in the kidney, they have no method of cure.

If this method of curing by injection could be safely practised, it would no doubt have the advantage over that of taking alkalies by the mouth, where the medicine is not only much weakened, but the constitution of the patient runs the risk of being greatly injured. But from some experiments mentioned in the second volume of the Medical Transactions, and still more from the chemical analysis of urinary concretions, lately published by Fourcroy and other modern chemists, it appears that the human calculi are very different from one another in their natures. Some, for instance, will easily yield to an alkaline menstruum, and very little to an acid; while others are found to resist the alkali, and yield to the acid; and some are of such a compact nature, that they yield neither to acids nor alkalies. An attention, however, to the fragments, scales, or films, which the stone may cast off, and also to the contents and sediment of the urine, may lead to the discovery of what solvent is proper, or whether the stone can be dissolved by any. To use either alkalies or acids improperly may be hurtful; though there may be such kinds of calculi as demand the alternate use of acids and alkalies; nay, there may be found calculi of opposite kinds in the same subject.

In such cases as will not allow us to think of dissolving the stony concretions, and where the only object is to palliate and procure ease from time to time, little more can be done than to keep the bowels open occasionally by some gentle cathartic, and wash off as much of the loose gravelly matter and slime as can be removed by such mild diuretic infusions and decoctions as shall be found to pass freely and sit well on the stomach. Persons afflicted with the stone should be careful in respect of their diet, and studiously avoid all heavy and flatulent food, as well as high sauces that are apt to turn rancid. For the same reason, butter and acids are to be shunned; for these often create heartburning, and every thing that offends the stomach raises the nephritic pain; such is the sympathy that obtains between the digestive and the uropoietic organs.

There have been surgeons bold enough to entertain an idea of cutting even into the kidney, in order to extract a stone: this, however, except in cases where an abscess has been formed, and nature points out the way, is both very uncertain and very hazardous. But cutting into the bladder for the same purpose, is an ancient and well-known operation, and often crowned with success. A description, however, of this operation belongs to the article SURGERY, to which we refer; and here shall only make this remark, that a surgeon should never begin his operation, until he and his assistants are perfectly satisfied, from actually feeling the stone, that there is one in the bladder; because it has sometimes happened, that when the incision has been made, no stone could be found: and the patient having died in consequence of the operation, and the body

body being opened, it has appeared that the ſymptoms which occaſioned the belief of a ſtone in the bladder aroſe from ſome other cauſe.

When a dyſuria proceeds from any acrimonious matter thrown into the blood, it may be readily cured by bleeding, emollient clyſters, cooling and diluting drinks with gum arabic or gum tragacanth, linſeed tea, or the warm bath. When it ariſes from inflammations of the bladder or parts adjoining to it, we are to regard it only as a ſymptomatic affection; and the remedies uſed to remove the primary diſeaſe will alſo remove the dyſuria. Sometimes it may ariſe from an ulcer of the bladder; in which caſe it is generally incurable; a mild nutritious diet will, however, protract the patient's life; and even render that life tolerable, by alleviating ſymptoms.

401 Genus CXXV. DYSPERMATISMUS.

Difficult Emission *of* Semen.

Dyſpermatiſmus, *Sauv.* gen. 260.
Sterilitas, *Lin.* 171. *Sag.* 211.
Ageneſia, *Vog.* 283.

This impediment proceeds generally from obſtructions in the urethra, either by tumors in itſelf, or in the cavernous bodies of the penis; in which caſe the treatment is the ſame as in the iſchuria urethralis; ſometimes it is owing to a kind of epileptic fit which ſeizes the man in the venereal act; and ſometimes the ſemen, when ejected from the proper receptacles, is again abſorbed, or flows into the bladder, and is expelled along with the urine. The laſt caſe it is very difficult, or even impoſſible, to cure; as proceeding from ſcirrhi, or other indiſſoluble tumors of the verumontanum, or the neighbouring parts. It is alſo, in general, incurable. In ſome it proceeds merely from too violent an erection; in which caſe emollient and relaxing medicines will be of ſervice; and we have an example of a cure performed by means of theſe in the firſt volume of the Edinburgh Medical Eſſays.

402 Genus CXXVI. AMENORRHOEA.

Suppression *of the* Menses.

Amenorrhœa, *Vog.* 130.
Dyſmenorrhœa, *Lin.* 168. *Sag.* 218.

This obſtruction, with many other ſymptoms, as dyſpepſia, yellowiſh or greeniſh colour of the ſkin, unuſual appetites, &c. conſtitutes the *chloroſis* already treated of, a diſeaſe which ſeldom or never appears without a ſuppreſſion of the menſes. In Dr Hume's Clinical Experiments we find the virtues of ſeveral emmenagogues ſet forth in the following manner. Chalybeates ſeldom or never ſucceeded: they were always found more uſeful in diminiſhing the evacuation when

too violent, than in reſtoring it when deficient. The tincture of black hellebore proved ſucceſsful only in one of nine or ten caſes, though given to the length of four tea-ſpoonfuls a-day, which is double the quantity recommended by Dr Mead. Compreſſion of the crural artery, recommended by Dr Hamilton in the Phyſical and Literary Eſſays, vol. ii. proved ſucceſsful only in one of ſix caſes. From the effects produced by this compreſſion, it has the ſtrongeſt appearance of loading the uterus with blood; from the ſenſations of the patient it produces the ſame effects as the approach of the menſes, and has every appearance in its favour; yet does not ſucceed. Dr Hume ſuppoſes that the uterus is moſt frequently in too plethoric and inflammatory a ſtate; in which caſe, this remedy will do more hurt than in a ſtate of inanition; however, he owns, that in the caſe in which it did ſucceed, the patient was plethoric and inflammatory. Veneſection is recommended as an excellent remedy; the doctor gives three inſtances of its ſucceſs, and ſays he could give many more. It acts by removing the plethoric ſtate of the uterus, relaxing the fibres, and giving the veſſels full play; ſo that their action overcomes all reſiſtance, and the evacuation takes place. It is of no great moment from whence the blood is taken: the ſaphænic vein has been ſuppoſed to empty the uterus moſt; but it is difficult to get the proper quantity from it, and the quantity of the diſcharge cannot be ſo well meaſured. The powder of ſavine is a moſt powerful remedy; and proved ſucceſsful in three caſes out of four in which it was tried. It was given to the quantity of half a dram twice a-day. It is a ſtrong topical ſtimulus, and ſeems improper in plethoric habits. Madder-root, according to Dr Hume, is a very powerful medicine in this diſeaſe; and proved ſucceſsful in 14 out of 19 caſes in which it was tried, being ſometimes exhibited in the quantity of two ſcruples, or a dram, four times a-day. It has ſcarcely any ſenſible effects; never quickens the pulſe, or excites inflammatory ſymptoms: on the contrary, the heat, thirſt, and other complaints abate; and ſometimes theſe ſymptoms are removed, though the diſeaſe be not cured; but when it ſucceeds, the menſes appear from the third to the 12th day.

We have now conſidered all thoſe diſeaſes enumerated in Dr Cullen's Noſology, the cure of which is to be attempted chiefly by internal medicines. The other genera either require particular manual operations, or a very conſiderable uſe of external applications; and therefore more properly fall under the article Surgery. To this, therefore, we ſhall refer the genera which fall under the three laſt orders of the claſs of locales, viz. the *tumores*, *ectopiæ*, and *dialyſes;* and we ſhall add, by way of Appendix, a few obſervations on ſome important affections to which Dr Cullen has not given a place in his ſyſtem, or which practitioners in general are not agreed in referring to any one particular genus which he has mentioned.

APPENDIX.

A P P E N D I X.

403 ANGINA PECTORIS.

Dr Heberden was the firſt who deſcribed this diſeaſe, though it is an extremely dangerous, and, by his account, not very rare affection. It ſeizes thoſe who are ſubject to it when they are walking, and particularly when they walk ſoon after eating, with a moſt diſagreeable and painful ſenſation in the breaſt, which ſeems to threaten immediate deſtruction: but the moment they ſtand ſtill, all the uneaſineſs vaniſhes. In all other reſpects the patients at the beginning of this diſorder are well, and have no ſhortneſs of breath; from which the *angina pectoris* is totally different. After it has continued ſome months, the fits will not ceaſe inſtantaneouſly on ſtanding ſtill; and it will come on not only when the patients are walking, but when they are lying down, and oblige them to riſe up out of bed every night for many months together. In one or two very inveterate caſes, it has been brought on by the motion of a horſe or carriage, and even by ſwallowing, coughing, going to ſtool, ſpeaking, or by any diſturbance of mind. The perſons affected were all men, almoſt all of whom were above 50 years of age, and moſt of them with a ſhort neck and inclining to be fat. Something like it, however, was obſerved in one woman, who was paralytic; and one or two young men complained of it in a ſlight degree. Other practitioners have obſerved it in very young perſons.

When a fit of this ſort comes on by walking, its duration is very ſhort, as it goes off almoſt immediately upon ſtopping. If it comes on in the night, it will laſt an hour or two. Dr Heberden met with one in whom it once continued for ſeveral days; during all which time the patient ſeemed to be in imminent danger of death. Moſt of thoſe attacked with the diſtemper died ſuddenly: though this rule was not without exceptions; and Dr Heberden obſerved one who ſunk under a lingering illneſs of a different nature.

The *os ſterni* is uſually pointed to as the ſeat of this malady. It ſeems as if it was under the lower part of that bone, and at other times under the middle or upper part, but always inclining more to the left ſide; and in many caſes there is joined with it a pain about the middle of the left arm, which appears to be ſeated in the biceps muſcle.

The appearance of Dr Heberden's paper in the Medical Tranſactions very ſoon raiſed the attention of the faculty, and produced other obſervations from phyſicians of eminence; particularly Dr Fothergill, Dr Wall of Worceſter, Dr Haygarth of Cheſter, and Dr Percival of Mancheſter. It alſo induced an unknown ſufferer under the diſeaſe to write Dr Heberden a very ſenſible letter, deſcribing his feelings in the moſt natural manner; which, unfortunately, in three weeks after the date of this anonymous epiſtle, terminated in a ſudden death, as the writer himſelf had apprehended.

The youngeſt ſubject that Dr Fothergill ever ſaw afflicted with this diſorder was about 30 years of age; and this perſon was cured. The method that ſucceeded with him was a courſe of pills, compoſed of the maſs of gum pill, ſoap, and native cinnabar; with a light chalybeate bitter: this was continued for ſome months, after which he went to Bath ſeveral ſucceſſive ſeaſons, and acquired his uſual health: he was ordered to be very ſparing in his diet; to keep the bowels open; and to uſe moderate exerciſe on horſeback, but not to take long or fatiguing walks.

The only ſymptom in this patient that is mentioned, was a ſtricture about the cheſt, which came on if he was walking up hill or a little faſter than ordinary, or if he was riding at a very briſk trot; for moderate exerciſe of any kind did not affect him: and this uneaſy ſenſation always obliged him to ſtop, as he felt himſelf threatened with immediate death if he had been obliged to go forward.

It is the ſharp conſtrictive pain acroſs the cheſt, which (according to Dr Fothergill's obſervation) particularly marks this ſingular diſeaſe; and which is apt to ſupervene upon a certain degree of muſcular motion, or whatever agitates the nervous ſyſtem.

In ſuch caſes as fell under the inſpection of Dr Fothergill, he very ſeldom met with one that was not attended with an irregular and intermitting pulſe; not only during the exacerbations, but often when the patient was free from pain and at reſt: but Dr Heberden obſerves, that the pulſe is, at leaſt ſometimes, not diſturbed; and mentions his having once had an opportunity of being convinced of this circumſtance, by feeling the pulſe during the paroxyſm.

But no doubt theſe varieties, as well as many other little circumſtances, will occur in this diſeaſe, as they do in every other, on account of the diverſity of the human frame; and if thoſe which in general are found to predominate and give the diſtinguiſhing character be preſent, they will always authoriſe us in giving the name to the diſeaſe: thus, when we find the conſtrictory pain acroſs the cheſt, accompanied with a ſenſe of ſtrangling or ſuffocation; and ſtill more, if this pain ſhould ſtrike acroſs the breaſt into one or both arms; we ſhould not heſitate to pronounce the caſe an *angina pectoris*.

As to the nature of this diſeaſe, it appears to be purely ſpaſmodic: and this opinion will readily preſent itſelf to any one who conſiders the ſudden manner of its coming on and going off; the long intervals of perfect eaſe; the relief afforded by wine, and ſpirituous cordials; the influence which paſſionate affections of the mind have over it; the eaſe which comes from varying the poſture of the head and ſhoulders, or from remaining quite motionleſs; the number of years for which it will continue, without otherwiſe diſordering health; its bearing ſo well the motion of a horſe or carriage, which circumſtance often diſtinguiſhes ſpaſmodic pains from thoſe which ariſe from ulcers; and, laſtly, its coming on for the moſt part after a full meal, and in certain patients at night, juſt after the firſt ſleep, at which time the incubus, convulſive aſthma, and other diſeaſes, juſtly attributed to the diſordered functions

Angina Pectoris.

tions of the nerves, are peculiarly apt to return or to be aggravated.

From all these circumstances taken together, there can be little doubt that this affection is of a spasmodic nature: but though it should be admitted, that the whole distress in these cases arise from spasm, it may not be so easy to ascertain the particular muscles which are thus affected.

The violent sense of strangling or choaking, which shows the circulation through the lungs to be interrupted during the height of the paroxysm; and the peculiar constrictive pain under the sternum, always inclining (according to Dr Heberden's observation) to the left-side; together with that most distressing and alarming sensation, which, if it were to increase or continue, threatens an immediate extinction of life; might authorise us to conclude that the heart itself is the muscle affected: the only objection to this idea is, that the pulse is not always interrupted during the paroxysm. The appearances in two of the dissections, favour the opinion that the spasm affects the heart; as in one subject the left ventricle was found as empty of blood as if it had been washed; and in another, the substance of the heart appeared whitish, not unlike a ligament; as it should seem, in both cases, from the force of the spasm squeezing the blood out from the vessels and cavities.

If this hypothesis be allowed, we must conclude that the spasm can only take place in an inferior degree, as long as the patient continues to survive the paroxysm; since an affection of this sort, and in this part, of any considerable duration or violence, must inevitably prove fatal: and accordingly, as far as could be traced, the persons who have been known to labour under this disease have in general died suddenly.

The dissections also show, that whatever may be the true seat of the spasm, it is not necessary for the bringing of it on, that the heart, or its immediate appendages, should be in a morbid state; for in three out of the six that have as yet been made public, these parts were found in a sound state.

On opening the body of the poor gentleman who wrote the letter to Dr Heberden, "upon the most careful examination, no manifest cause of his death could be discovered; the heart, in particular, with its vessels and valves, were all found in a natural condition."

In the case communicated by Dr Percival to the publishers of the Edinburgh Medical Commentaries, "the heart and aorta descendens were found in a sound state." And in Dr Haygarth's patient, "on opening the thorax, the lungs, pericardium, and heart, appeared perfectly sound." Not to mention Dr Fothergill's patient (R. M.), in whose body the only morbid appearance about the heart was a small white spot near the apex. Thus the cause, whatever its nature might have been, was at too great a distance, or of too subtile a nature, to come under the inspection of the anatomist. But there was a circumstance in two of the subjects that is worthy of remembrance; and which shows that the crasis of the blood, while they were living, must have been greatly injured, namely, its not coagulating, but remaining of a cream-like consistence, without any separation into serum and crassamentum.

From all that we have seen hitherto published, it does not appear that any considerable advances have been made towards the actual cure of this anomalous spasm.

Angina Pectoris.

The very judicious and attentive Dr Heberden (to whom the public are highly indebted for first making the disorder known) confesses, that bleedings, vomits, and other evacuations, have not appeared to do any good: wine and cordials taken at bed-time, will sometimes prevent or weaken the fits; but nothing does this so effectually as opiates: in short, the medicines usually called *nervous* or *cordial*, such as relieve and quiet convulsive motions, and invigorate the languishing principle of life, are what he recommends.

Dr Wall mentions one patient, out of the 12 or 13 that he had seen, who applied to him early in the disease, and was relieved considerably by the use of antimonial medicines joined with the fetid gums: he was still living at the time the doctor wrote his paper, (November 1772), and going about with tolerable ease. Two were carried off by other disorders; all the rest died suddenly.

Dr Fothergill's directions are chiefly calculated with the view to prevent the disorder from gaining ground, and to alleviate present distress. Accordingly he enjoins such a kind of diet as may be most likely to prevent irritability: in particular, not to eat voraciously: to be very abstemious in respect to every thing heating; spices, spirits, wines, and all fermented liquors: to guard most scrupulously against passion, or any vehement emotions; and to make use of all the usual means of establishing and preserving general health: to mitigate excesses of irritability by anodynes; or pains, if they quicken the circulation: to disperse flatulencies when they distend the stomach, by moderate doses of carminatives; amongst which, perhaps, simple peppermint water may be reckoned one of the safest. But since obesity is justly considered as a principal predisposing cause, he insists strongly on the necessity of preventing an increase of fat, by a vegetable diet, and using every other practicable method of augmenting the thinner secretions.

These were the only means recommended by the practitioners mentioned above for opposing this formidable disease: but Dr Smyth of Ireland has, we are told, discovered that it may be certainly cured by issues, of which Dr Macbride gives the following instance.

"*A. B.* a tall well-made man; rather large than otherwise; of healthy parents, except that there had been a little gout in the family; temperate; being very attentive to the business of his trade (that of a watchmaker), led a life uncommonly sedentary; had, from his boyhood upwards, been remarkably subject to alarming inflammations of his throat, which seized him, at least, once in the course of the year; in all other respects well.

"In 1767, (then 48 years of age), he was taken, without any evident cause, with a sudden and very dispiriting throbbing under the sternum. It soon afterwards increased, and returned upon him every third or fourth week, accompanied with great anxiety, very laborious breathing, choaking, a sensation of fulness and distension in the head, a bloated and flushed countenance, turgid and watery eyes, and a very irregular and unequal pulse. The paroxysm invaded, Angina Pectoris.

vaded, almost constantly, while he was sitting after dinner; now and then he was seized with it in the morning, when walking a little faster than usual: and was then obliged to stop, and rest on any object at hand. Once or twice it came on in bed; but did not oblige him to sit up, as it was then attended with no great difficulty in breathing. In the afternoon fits, his greatest ease was from a supine posture; in which he used to continue motionless for some hours, until, quite spent and worn out with anguish, he dropt into a slumber. In the intervals between these attacks, which at length grew so frequent as to return every fourth or fifth day, he was, to appearance, in perfect health.

"Thus matters continued for more than two years; and various antispasmodics were ineffectually tried for his relief. In 1769, there supervened a very sharp constrictory pain at the upper part of the sternum, stretching equally on each side, attended with the former symptoms of anxiety, dyspnœa, choaking, &c. and with an excruciating cramp, as he called it, that could be covered with a crown-piece, in each of his arms, between the elbow and the wrist, exactly at the insertion of the pronator teres; the rest of the limb was quite free. The fits were sometimes brought on, and always exasperated, by any agitation of mind or body. He once attempted to ride on horseback during the paroxysm; but the experiment was near proving fatal to him. The difference of season or weather made no impression upon him. Still, in the intervals, his health was perfectly good; except that his eyes, which before his illness were remarkably strong and clear, were now grown extremely tender: and that his sight was much impaired. He had no flatulency of stomach, and his bowels were regular.

"In this situation, February 22. 1770, he applied to me for assistance. I had seen, I believe, eight or ten of these frightful cases before. Two of the patients dropt dead suddenly. They were men between 40 and 50 years of age, and of a make somewhat fleshy. The fate of the others I was not informed of; or, at least cannot now recollect.

"Having found the total inefficacy of blisters and the whole class of nervous medicines in the treatment of this anomalous spasm, I thought it right to attempt the correcting or draining off of the irritating fluid in the case now before us. To this purpose, I ordered a mixture of lime-water with a little of the compound juniper-water, and an alterative proportion of Huxham's antimonial wine: I put the patient on a plain, light, perspirable diet; and restrained him from all viscid, flatulent, and acrimonious articles. By pursuing this course, he was soon apparently mended; but after he had persisted regularly in it for at least two months, he kept for some time at a stand. I then ordered a large issue to be opened on each of his thighs. Only one was made. However, as soon as it began to discharge, his amendment manifestly increased. The frequency and severity of the fits abated considerably: and he continued improving gradually, until, at the end of 18 months he was restored to perfect health: which he has enjoyed, without the least interruption, till now, except when he has been tempted (perhaps once in a twelvemonth) to transgress rules, by making a large meal on salted meat, or indulging himself in ale or rum-punch, each of which never failed to disorder him from the beginning of his illness: and even on these occasions, he has felt no more than the slightest motion of his former sufferings; insomuch that he would despise the attack, if it did not appear to be of the same stock with his old complaint. No other cause has had the least ill effect on him.

"Though rum was constantly hurtful, yet punch made with a maceration of black currants in our vulgar corn-spirit, is a liquor that agrees remarkably well with him.

"He never took any medicine after the issue began to discharge; and I have directed that it shall be kept open as long as he lives. The inflammations of his throat have disappeared for five years past; he has recovered the strength and clearness of his sight; and his health seems now to be entirely re-established."

Dr Macbride, in a letter to Dr Duncan, published in the Edinburgh Medical Commentaries, gives the following additional observations on this disease.

"Within these few weeks I have, at the desire of Dr Smyth, visited, three or four times, a very ingenious man who keeps an academy in this city, of about 34 years of age, who applied to the doctor for his advice in January last.

"I shall give you his symptoms as I had them from his own mouth, which appear to me to mark his case to be an angina pectoris, and as deplorable as any that I have read of. It was strongly distinguished by the exquisite constrictory pain of the sternum, extending to each of his arms as far as the insertion of the deltoid muscle, extreme anxiety, laborious breathing, strangling, and violent palpitation of the heart, with a most irregular pulse. The paroxysms were so frequent, that he scarcely ever escaped a day, for six or seven years, without one. They were usually excited by any agitation of mind or body, though slight. He had clear intervals of health between the fits. The distemper seems hereditary in him, as he says his father was affected in the same manner some years previous to his death. He has a strong gouty taint, which never showed itself in his limbs; and he has led a life of uncommon sedentariness, from intense application to mathematical studies, attention of mind, and passion, even from his boyish years. These circumstances may, perhaps, account for his having been taken with this disease at so early an age as 17.

"A large issue was immediately opened in each of his thighs. In a month afterwards he began to mend, and has gone on improving gradually. He can now run up stairs briskly, as I saw him do no later than yesterday, without hurt; can bear agitation of mind; and has no complaint, excepting a slight oppression of the breast, under the sternum, which he feels sometimes in a morning, immediately after dressing himself, and which he thinks is brought on by the motion used in putting on his clothes; though for a complete week preceding the day on which I saw him last, he told me that he had been entirely free from all uneasiness, and was exulting that he had not had such an interval of ease for these last seven years.

"Doctor Smyth also showed me, in his *adversaria*, the case of a gentleman who had been under his care in 1760, which he had forgotten when my book went

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went to the preſs, and which he was reminded of the other day by a viſit from his patient. It was a genuine angina pectoris, brought on by a very ſedentary life, and great vexation of mind, clearly marked by the exquiſite pain under the ſternum, that extended acutely to the upper extremities, particularly along the left arm, together with the other ſymptoms of dyſpnœa, anxiety, palpitation of the heart, &c. recited in the caſe above. The diſorder went off in 1762, by large ſpontaneous diſcharges from the piles, but returned upon him ſeverely in 1765. Iſſues in his thighs were then recommended to him, but not made. But, whether it was by the perſuaſion of ſome friend, or of his own accord, he went into a courſe of James's powder, in ſmall alterative doſes, combined with a little caſtor and aſafœtida. This he perſiſted in for about ſix weeks; in the meanwhile, he had large acrimonious gleetings from the ſcrotum and a plentiful diſcharge of ichor from the anus.—From this time he began to find his complaints grow leſs and leſs diſtreſſing, and he has now been totally free from them for ſix years paſt."

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This ſpecies of fever, as its name imports, is peculiar to women in childbed; and is uſually the moſt fatal of all the diſorders to which the ſex is liable. But, notwithſtandiug the prevalence of it in all ages, its real nature has remained, to the preſent time, a ſubject of much diſpute and uncertainty. The critical period of its invaſion, when febrile commotions are apt to be excited by various accidents, and the equivocal ſymptoms which accompany it, have even afforded room for queſtioning whether it be a primary or a ſecondary diſeaſe. Some writers have conſidered it as proceeding entirely from an inflammation of the uterus; others have imagined it to be the conſequence of an obſtruction to the ſecretion of the milk; while the greater number has been inclined, for reaſons equally if not more plauſible, to impute it to a ſuppreſſion of the lochia. If we examine this fever attentively, however, according to its natural courſe, and independently of all the accidental concomitant ſymptoms with which it is not eſſentially connected, we may ſafely pronounce it to be a primary diſeaſe of a particular nature, and perhaps not the neceſſary conſequence of any of the cauſes above mentioned.

This fever is moſt generally incident to women within 48 hours after delivery, though it may ſupervene on the fourth or fifth day, and ſometimes conſiderably later. It is preceded, like other fevers, by a rigor, which is commonly violent; and, when happening during the time of labour, may be confounded with the pains of parturiency. In its earlier ſtage it is attended with the ſigns of inflammation. A great pain is felt in the back, hips, and the region of the uterus; which, in the part laſt mentioned, is accompanied with the ſenſe of heat and throbbing. A ſudden cbange in the quality or quantity of the lochia now alſo takes place; the patient is frequently troubled with a teneſmus; and the urine, which is very high-coloured, is diſcharged in ſmall quantity and with pain. At the firſt attack of the fever, the woman is generally ſeized with a vomiting of porraceous matter, as in the *cholera morbus*, to which diſeaſe it then bears a ſtrong reſemblance.—But inſtead of this ſymptom, there is ſometimes only a nauſea, or loathing at the ſtomach, with a diſagreeable taſte in the mouth. The belly ſwells to a conſiderable bulk, and becomes ſuſceptible of painful ſenſations from the ſlighteſt impreſſion. The tongue is generally dry, though ſometimes moiſt, and covered with a thick browniſh fur. When the fever has continued a few days, the ſymptoms of inflammation uſually ſubſide, and the diſeaſe acquires a more putrid form. At this period, if not at the very beginning of the diſorder, a bilious or putrid diarrhœa, of a dangerous and obſtinate nature, ſupervenes, and accompanies it through all its future progreſs; each motion to ſtool being preceded by a temporary increaſe, and followed by an alleviation of pain. The patient uſually nauſeates all kind of food and drink, except what is cold and acidulated. A brown or blackiſh ſordes, the conſequence of putrid exhalations, adheres to the edges of the teeth; a troubleſome hiccough is at length produced, which greatly exaſperates the pains of the abdomen; petechiæ or vibices alſo appear, with ſometimes a miliary eruption, but which produces no mitigation of the diſeaſe. Through the whole courſe of the fever, the patient is affected with great anxiety and dejection of ſpirits.

Such in general is the courſe of the puerperal fever; the ſymptoms of which, however, may be often varied, according to the conſtitution of the patient, the degree of the diſeaſe, and its earlier or later invaſion. When the woman is naturally weak, or her ſtrength has been greatly reduced by immoderate evacuations after delivery; when the diſeaſe is violent, and immediately follows that period; its progreſs and termination are proportionably rapid and fatal. In ſuch unfortunate circumſtances, many have been known to expire within 24 hours from the firſt attack of the diſeaſe; nay, there are ſome inſtances where the rigor has concluded the ſcene. The cataſtrophe, however, is moſt generally ſuſpended for ſome days; and the number of theſe is variable, though the 11th from the commencement of the fever may juſtly be fixed as the period which is uſually deciſive. In whatever ſtage of the diſeaſe an unfavourable termination may happen, it would ſeem as if the commencement of the patient's recovery were not marked by any critical revolution of the fever, as depending on an alteration of the humours; but that the cure is gradually effected, either by a ſpontaneous vomiting, or a long-continued diſcharge by ſtool of that porraceous matter, the exiſtence of which in the ſtomach is uſually evinced at the firſt attack of the diſeaſe. The moſt unfavourable prognoſtic, therefore, ariſes from ſuch a weakneſs of the patient as renders her unable to ſupport ſo tedious an evacuation as that by which the fever is overcome. When the lochia return to their former ſtate, when the ſwelling and tenderneſs of the abdomen abate, and there is a moiſture on the ſkin, we have reaſon to hope for a happy termination of the diſeaſe.

Though the puerperal fever may generally be aſcertained from the deſcription which has been given, and chiefly by that remarkable tenderneſs of the abdomen which particularly diſtinguiſhes it: yet, as ſome of its ſymptoms may be confounded with thoſe ariſing from other diſeaſes, and which require a different method of

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of cure, it will be proper to mention here the circumſtances by which it may be known with greater certainty.

The pains of the abdomen, attending the childbed fever, may be diſtinguiſhed from thoſe called *after-pains*, by their uninterrupted continuance through the courſe of the diſeaſe, though ſometimes they ſuffer exacerbations; whereas, in the latter, they often totally intermit. They are alſo diſtinguiſhable by the abſence of fever with concomitant ſymptoms in the one, and their evident exiſtence in the other.

Many circumſtances evince a diſſimilarity between the puerperal and miliary fevers, notwithſtanding the ſymptoms of anxiety and oppreſſion are common to both; inſomuch that the nature of the approaching diſeaſe may be aſcertained at the very commencement of its attack. In the puerperal fever the rigor is more violent, of longer duration, and not interrupted, as it is in the other. The pulſe is fuller and ſtronger; the ſkin is more hot; and the tongue, whether moiſt or dry, though generally the latter, is not of a white, but browniſh appearance; and the urine is alſo higher coloured. Eruptions, which are critical in miliary fevers, procure no mitigation of the puerperal fever, and cordials generally increaſe it.

When the original attack of the puerperal fever happens to coincide with the febrile commotion which is excited in childbed women by the milk, the nature of it may at firſt be miſapprehended; but the concomitant ſymptoms, and greater violence of the diſeaſe, muſt in a ſhort time diſſipate ſuch an error.

From all the moſt accurate accounts of this diſeaſe, and from the period at which it generally commences, there ſeems reaſon to conclude, that it owes its riſe more immediately to accidents after delivery. For it is allowed that it may follow a labour under the beſt and moſt favourable circumſtances, though endeavours to dilate the os internum are ſuppoſed frequently to produce it. The more immediate cauſes generally aſſigned by authors are a ſtoppage of perſpiration, the too free uſe of ſpices, and the neglect of procuring ſtools after delivery; ſudden frights, too haſty a ſeparation of the placenta, and binding the abdomen too tight. The putrid appearance, however, which this diſeaſe ſo ſoon aſſumes, affords ground to ſuſpect that the prediſpoſing cauſe of it is a vitiated ſtate of the humours; for it is generally obſerved to be moſt prevalent in an unhealthy ſeaſon, and among women of a weakly and ſcorbutic conſtitution. But from its prevalence in ſome particular hoſpitals, while others in the ſame city are entirely free from it, there can be little doubt that it is often communicated by contagion from one female to another. This opinion is corroborated alſo by many other circumſtances; particularly by the means by which it has been removed from hoſpitals. It would ſeem, however, that this contagion does not act on the female ſyſtem without a certain prediſpoſition, and that this prediſpoſition is induced by thoſe changes to which the female habit is ſubjected in conſequence of delivery.

Within theſe few years this fever has been treated of by ſeveral writers, moſt of whom have differed from each other in their ſentiments of the nature of the diſeaſe. The firſt in the order of publication is Dr Denman, who ſeems to be of opinion, that it may derive its origin either from a redundancy or too great acrimony of the bile, the ſecretion of which appears to be much interrupted in the time of geſtation. In Dr Manning's treatiſe on this fever, he mentions its being highly probable that ſuch a cauſe contributes greatly to produce the diſeaſe, eſpecially where the putrid tendency of the humours is increaſed by unwholeſome air and diet.

It has likewiſe been the fate of the puerperal fever, that no diſeaſe has more divided the ſentiments of phyſicians in regard to the method of cure. The apparent indications and contra-indications of bleeding, and other remedies, ariſing from the complication of inflammatory and putrid ſymptoms; the equivocal appearance of the vomiting and purging, as whether they be critical or ſymptomatical; and the different cauſes whence ſymptoms ſimilar to each other may ariſe in pregnant women; all theſe circumſtances concur to involve the ſubject in great obſcurity and indeciſion. If we carefully attend to the ſeveral characteriſtics of the diſeaſe, however, ſo as to be able to diſtinguiſh it from every other puerperal complaint, and obſerve at the ſame time the uſual manner of its declenſion, our judgement may be guided in the method of cure by the ſalutary efforts of nature. But, in order to obtain a clearer view of the genuine indications, it will be proper to conſider them under the ſeveral lights in which they have been generally agitated by authors.

One of the moſt eſſential points to be aſcertained in the cure of the childbed fever, reſpects the propriety of bleeding. A free uſe of the lancet has been generally regarded as the moſt ſucceſsful expedient in practice; and there are ſome inſtances of critical hæmorrhagies which would ſeem to confirm its utility. But Dr Denman thinks we may ſafely affirm from experience, that for one who will be benefited by large bleeding, a much greater number will be injured, and that even almoſt irretrievably. Nor can this ſeem ſurpriſing, when we conſider the ſituation of childbed women. In moſt, the evacuations conſequent upon delivery are ſufficient to diminiſh any undue ſuperabundance of the fluids; and if, as frequently happens, the diſeaſe be produced by too haſty a ſeparation of the placenta, the conſequence of which is generally a very copious diſcharge of blood, we can never ſuppoſe that nature will be aſſiſted in overcoming the febrile commotion, by the farther evacuation of the vital fluid, through the defect of which ſhe is now rendered unequal even to the ordinary ſupport of the animal œconomy. We may appeal to every practical phyſician, how much he has known the pulſe to ſink, and what a train of nervous ſymptoms he has obſerved to ſucceed an exceſs of the diſcharge above mentioned. Beſides, it is an axiom in phyſic, that a remedy which cures any diſorder, will always prove ſufficient to prevent it; and therefore, if bleeding were the proper cure in the childbed fever, the diſeaſe ought to have been prevented by a large evacuation of blood, when that happened previous to its attack. Experience, however, in this, as in all other diſeaſes, is the only unerring guide we can follow; and whoever regulates his practice by fact and obſervation, will be convinced that bleeding, eſpecially in a larger quantity, is, in general, very far from being attended with ſucceſs. Bleeding is

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is feldom proper, except in women of plethoric conftitutions, and in whom the figns of inflammation rife high. Nor even in fuch patients ought it to be repeated without great caution, and the exiftence of ftrong indications. Bleeding, when ufed in proper circumftances, may unqueftionably palliate the fever; but that it often fhortens the duration of it, appears to be a matter of much doubt. On this account the practice becomes ftill more fufpicious and exceptionable, when we confider that by venefection improperly ufed the patient's ftrength may be fo far reduced as not to fupport the tedious loofenefs by which the difeafe is generally carried off. Though bleeding, however, ought in general to be ufed with great caution, there are certainly many cafes in which it is both neceffary and advantageous.

The genuine nature and effects of the loofenefs in this difeafe, is another controverted point of the higheft importance, and which merits the moft attentive inquiry. Phyficians, obferving that women who die of the puerperal fever are generally molefted with that evacuation, have been induced to confider this fymptom as of the moft dangerous and fatal tendency; and what, therefore, we fhould endeavour by every means to reftrain. In this opinion, however, they would feem to have been governed by too partial an obfervation of facts. For experience certainly authorifes the affertion, that more women appear to have recovered of the childbed fever, through the intervention of a diarrhœa, than have been deftroyed by that caufe. If it alfo be confidered, that purging is ufually almoft the only fenfible evacuation in the more advanced ftate of the difeafe, and is that which accompanies it to its lateft period, we fhall have the ftrongeft reafon to think that it is critical rather than fymptomatical, and ought therefore to be moderately fupported, inftead of being unwarily reftrained. Nay, the advantage which is found to attend vomiting as well as purging, in the earlier ftage of the difeafe, would feem to evince that the matter difcharged by thefe evacuations is what chiefly foments the difeafe. Emetics and purgatives, therefore, in the opinion of Dr Manning, are the only medicines on which any rational dependence is to be placed in this fever; at leaft, they are certainly fuch as are found the moft fuccefsful. It is an eftablifhed rule in practice, to prefcribe a vomit at the beginning of every fever attended with any naufea or loathing of the ftomach, and where there is not any reafon to apprehend an inflammation of that organ. Nor does the ftate of childbed women afford the fmalleft ground for prohibiting our recourfe to the fame expedient in anfwering a fimilar indication.

It is fo feldom a phyfician is called during the rigor preceding the puerperal fever, that he has few opportunities of trying the effects of remedies in that early ftate of the difeafe. When fuch occur, however, we fhould endeavour as much as poffible to abate and fhorten that period, as the fucceeding fever is generally found to bear a proportion to the violence and duration of it. For this purpofe, warm diluting drinks fhould be plentifully ufed, with a fmall quantity of volatile fpirits or brandy. When Dr Manning apprehended fuch an accident, he fometimes ordered the nurfe to give immediately a difh or two of warm fack-whey; taking care that it was not too ftrong, which is a caution that ought always to be remembered: for though a free ufe of the more cordial and fpirituous kinds of liquors might perhaps foon abate the rigor, there is danger to be feared from their influence on the approaching fever, efpecially in women of a ftrong and healthy conftitution. In all cafes, warm applications to the extremities, fuch as heated bricks, towels, or toafted grains in a linen bag, may be ufed with perfect fafety, and fome advantage.

When the hot fit is advanced, the firft thing Dr Manning orders is fome emollient injection, as chicken-water, or water and milk, which ought to be frequently repeated through the courfe of the difeafe. Thefe prove beneficial, not only by promoting the difcharge from the inteftines, which feems in fact to be the folution of the difeafe; but alfo by acting as a kindly fomentation to the uterus and adjacent parts. With this intention they are particularly ferviceable when the lochia are fuppreffed. Great care, however, is requifite in adminiftering them, on account of the tendernefs and inflammatory difpofition, which at that time render the parts in the pelvis extremely fufceptible of pain.

The next ftep in the method of cure ought to be to promote the difcharge of the morbid matter both by the ftomach and inteftines. This intention may be anfwered by a remedy prefcribed by Dr Denman—Two grains of tartrite of antimony rubbed up with a fcruple of the powder of lapilli cancrorum.

Of a powder thus prepared, Dr Denman gives from two to fix grains, and repeats it as circumftances require. If the firft dofe do not procure any fenfible operation, he repeats it in an increafed quantity at the end of two hours, and proceeds in that manner; not expecting any benefit but from its fenfible evacuation.

Should the difeafe be abated, but not removed, (which fometimes happens), by the effect of the firft dofe, the fame medicine muft be repeated, but in a lefs quantity, till all danger be over. But if any alarming fymptoms remain, he does not hefitate one moment to repeat the powder, in the fame quantity as firft given; though this be feldom neceffary, if the firft dofe operates properly.

It is to be obferved, fays Dr Denman, that as the certainty of cure depends upon the proper repetition of the medicine, the method of giving it at ftated hours does not appear eligible. If the firft dofe produce any confiderable effect by vomiting, procuring ftools, or plentifully fweating, a repetition of the medicine in a lefs quantity will feldom fail to anfwer our expectations; but great judgement is required in adapting the quantity firft given to the ftrength of the patient and other circumftances. We are not to expect that a difeafe which from the firft formation carries fo evident marks of danger, fhould inftantly ceafe, even though a great part of the caufe be removed.

Frequent dofes of the faline draughts ought alfo to be given, which not only promote the evacuation by the inteftines, but likewife increafe the falutary difcharges of urine and perfpiration. Thefe medicines are particularly ferviceable in fubduing the remains of the fever, after its violence has been broken by the more efficacious remedies above mentioned; but when they are ufed even in the decline of the difeafe, gentle laxatives of rhubarb and magnefia, as advifed by Dr Denman,

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Denman, ought to be frequently interpofed, fince, as he juftly obferves, without ftools we can do little fervice.

Although the difcharge by the inteftines appears to have the moft falutary effect in this difeafe; yet when the ftomach has not been properly unloaded of offenfive matter, though a great naufea and ficknefs had indicated the expediency of fuch an evacuation at the beginning of the fever, the continuance of the loofenefs is fometimes fo long protracted as in the end to prove fatal. In this alarming ftate of the difeafe, when the ftools are very frequent and involuntary, and all appearances threaten danger, Dr Denman fays, that a clyfter of chicken-water injected every one, two, or three hours, or as often as poffible without fatiguing the patient too much, with a cordial diaphoretic draught taken every fix hours, has produced better effects than could be expected.

While thefe medicines are employed, we fhould endeavour to mitigate the pains of the belly by relaxing applications. During the courfe of the difeafe, the patient ought to drink freely of diluting liquors, and abftain from every thing of a heating quality, unlefs great faintnefs fhould indicate the ufe of a fmall quantity of fome cordial medicine.

Such is the practice recommended in this difeafe by Dr Denman. We fhall now take a curfory view of the fentiments of fucceeding writers on this fubject.

According to Dr Hulme, the proximate caufe of the puerperal fever is an inflammation of the inteftines and omentum; for the confirmation of which opinion he appeals to diffections. He fuppofes the chief predifponent caufe of the difeafe to be the preffure of the gravid uterus againft the parts above mentioned. The omentum, fays he, in the latter ftage of pregnancy, muft either be flat, which is its natural fituation, or be rumpled or carried up by the gravid uterus in folds or doublings. When the latter is the cafe, which he obferves is probably not feldom, the danger of a ftrangulated circulation will be greater.

Mr White, who has alfo written on this difeafe, judicioufly remarks, that were Dr Hulme's hypothefis well founded, the diforder ought rather to take place before delivery, and be immediately removed at that period: That it would likewife moft generally happen to women at their firft labour, when the abdominal mufcles are lefs yielding, and the pains more violent; the contrary of which is moft frequently experienced to be the cafe.

It alfo deferves to be remarked, that, upon Dr Hulme's fuppofition, we cannot account for the difeafe being more common and fatal in large towns and in hofpitals, than in the country and private practice, while other inflammatory diforders are more endemic among thofe who live in the latter than the former fituation. Even admitting the friction of the inteftines and omentum againft the uterus to be as violent as Dr Hulme fuppofes, is it not highly improbable, that any inflammation could be occafioned by the preffure of fuch foft fubftances upon each other? Or, were this effect really produced, ought not the puerperal fever to be more common and fatal after the moft laborious deliveries? But this obfervation is not fupported by experience.

Dr Hulme, in favour of his own hypothefis, alleges that it gives a fatisfactory anfwer to the queftion, "Why all lying-in women have been, and ever will be, fubject to this difeafe?" In this propofition, however, the doctor fuppofes fuch an univerfality of the difeafe as is not confirmed by obfervation. It is affirmed upon undoubted authority, that in many parts of Britain the puerperal fever is hardly known; whereas, were it really produced by the caufes he affigns, it would be equally general and unavoidable.

But how peculiar foever this author's fentiments are in refpect of the proximate caufe of this difeafe, they have not led him to any method of cure different from the eftablifhed practice. On this fubject Dr Hulme divides his obfervations into two parts, comprehending under the former the more fimple method of treatment, and under the latter the more complex. He fets out with remarking, that the patient being generally coftive at the beginning of the difeafe, an emollient opening clyfter will often give immediate relief; but if this fhould not prove effectual, recourfe muft be had to cathartics. Thofe which he found anfwer his purpofe beft, were the *fal catharticus amarus*, the *oleum ricini*, emetic tartar, and antimonial wine. When the bowels have been fufficiently cleared and the pain abates, he advifes encouraging a gentle diaphorefis by medicines which neither bind the body nor are heating; fuch as fmall dofes of ipecacuan, emetic tartar, and antimonial wine, combined with an opiate in a moderate dofe, and given once or twice in the courfe of 24 hours; adminiftering the faline draughts in the intermediate fpaces. If, preceding or during this courfe, a ficknefs at ftomach or vomiting attend, he advifes affifting the efforts of nature, by drinking, plentifully of chamomile tea, warm water, or any other diluting liquor. He concludes with recommending a cooling regimen, reft of body, and tranquillity of mind; prohibiting all kinds of bandage upon the abdomen, and enjoining particular attention to the ftate of the bowels, which ought to be kept gently open for fome time, even after the diforder feems to be gone off, till the patient be quite out of danger.

So much for the fimple treatment: we now proceed to the fecond part, where he defcribes the method of practice when the difeafe is in its more irregular and complicated ftate.

When a diarrhœa accompanies the difeafe, he obferves that it ought by no means to be checked, but fupported, by ordering the patient to drink plentifully of mild aperient liquors. If the pain of the hypogaftric region be attended with ftitches in the fides or over the pit of the ftomach, and a pulfe that refifts the finger pretty ftrongly, he remarks that bleeding would then be highly neceffary: declaring, however, his opinion, that, in the puerperal fever, bleeding is to be confidered only as a fecondary means of relief, though the firft in point of time; that it ought to be advifed with great caution; and that the greateft dependence is always to be placed upon evacuations by ftool.

Mr White imputes the puerperal fever to a putrefcent difpofition of the humours, contracted during pregnancy, and fomented by the hot regimen commonly ufed by women in childbed. In conformity to this opinion, the chief means which he recommends for preventing the difeafe is a cool regimen and free circulation

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tion of air, which he evinces to be of the greateſt importance. In reſpect of bleeding, he informs us, that, upon the ſtricteſt inquiry, he cannot find that thoſe who have bled the moſt copiouſly have had the greateſt ſucceſs, either in private or hoſpital practice. He even ſeems to queſtion the propriety of this evacuation in any caſe; but approves of emetics, cathartics, and clyſters, for cleanſing the *primæ viæ*, and likewiſe of ſuch medicines and diet as will correct the putrid humours: adding, that an upright poſture and free ventilation are at all times uſeful, and abſolutely neceſſary, both for the the prevention and cure of the diſeaſe.

Another writer who treats of the childbed fever is Dr Leake, who has publiſhed the reſult of his obſervations on this diſeaſe from April 1768 to the autumn of the year 1770; but chiefly from December 1769 to May 1770, during which period the childbed fever prevailed much about London.

Dr Leake tells us that this fever generally commenced the evening of the ſecond or morning of the third day after delivery, with a rigor or ſhivering fit. Sometimes it invaded ſoon after delivery; and at other times, though rarely, it has ſeized ſo late as the fifth or ſixth day. Now and then it ſeemed to be occaſioned by catching cold, or by errors in diet; but oftener by anxiety of mind. Sometimes the thirſt was great; though the tongue had, in general, a better appearance at the beginning than is common in other fevers. It was ſeldom ever black or very foul: but, as the diſeaſe advanced, became white and dry, with an increaſe of thirſt; and at laſt was of a browniſh colour towards the root, where it was ſlightly covered with an inſpiſſated mucus. The loſs of ſtrength was ſo great and ſudden, that few of the patients could turn in bed without aſſiſtance, even ſo early as the firſt or ſecond day after the attack. The lochia, from firſt to laſt, were not obſtructed, nor deficient in quantity; neither did the quality of this diſcharge ſeem to be in the leaſt altered from its natural ſtate; a preſumption, ſays the author, that the uterus was not at all affected. Of this he was convinced by making a conſiderable preſſure above the pubes with the hand, which did not occaſion pain; but when the ſame degree of preſſure was applied higher, between the ſtomach and umbilical region, it became almoſt intolerable. A perfect criſis ſeldom if ever happened in this fever, which he imputes to the great oppreſſion of the vital powers, whereby they were rendered unable to produce ſuch an event. When the diſeaſe proved mortal, the patient generally died on the 10th or 11th day from the firſt attack. In thoſe who died of the fever, the omentum was found ſuppurated; an inflammation of which part, or of the inteſtines, Dr Leake concludes to be the proximate cauſe of the diſeaſe.

In conſequence of this idea of the cauſe of the diſeaſe, Dr Leake affirms that veneſection is the only remedy which can give the patient a chance for life. But, though it be the principal reſource to be depended upon at the beginning of the fever, he obſerves that it will ſeldom prove of ſervice after the ſecond or third day; and, if directed yet later, will only weaken and exhauſt the patient; when, matter having begun to form in the omentum, the progreſs of the diſeaſe can no longer be prevented by that evacuation. At this period the blood begins to be tainted by the abſorption of the purulent fluid; and the fever, from being inflammatory, is changed into a putrid nature.

After bleeding in ſuch a quantity as the ſymptoms require, he adviſes that the corrupted bile be evacuated and corrected as ſoon as poſſible; that the diarrhœa, when exceſſive, be reſtrained by emollient anodyne clyſters and gentle ſudorifics, or even by opiates and mild aſtringents, when the patient's ſtrength begins to ſink under the diſcharge; and, laſtly, that where the ſigns of the putrefaction or intermiſſion take place, antiſeptics and the cinchona may be adminiſtered.

The great uniformity of the ſymptoms in all Dr Leake's patients might authoriſe an opinion, that the fever which he deſcribes was in a great meaſure a diſeaſe *ſui generis*, and depended much upon the conſtitution of the air preceding and during the period in which the fever prevailed.

Dr Kirkland has alſo made judicious obſervations on this ſubject. He rejects the opinion that the puerperal fever is a diſeaſe *ſui generis*, and ariſes always from the ſame cauſe. The particular ſituation of childbed women, he acknowledges, occaſions a ſimilarity in the appearance of all the febrile ſymptoms: but he affirms that the ſame kind of fever may be produced by various cauſes; for inſtance, by an inflammation of the uterus or abdomen, by putrid blood or other matter, and putrid miaſms. The ſymptoms, he obſerves, will vary according to the time of ſeizure. If the fever happen in three or four days after delivery, all the ſymptoms uſual to the ſituation of the patient will make their appearance; but if it do not invade till the milk has been ſecreted, and the lochial diſcharge be nearly finiſhed, the ſymptoms, if the breaſts are properly drawn, will, for the moſt part, be thoſe only which are common to that kind of diſorder by which the fever has been produced.

With reſpect to the cure of puerperal fevers, Dr Kirkland adviſes the antiphlogiſtic method when they ariſe from inflammation; but when this method fails of ſucceſs, and a diarrhœa ſupervenes, the diſeaſe has changed its nature, having become more or leſs putrid, and requires a very different treatment.

His obſervations relative to the management of the diarrhœa merit attention. No one, ſays he, would purge and bleed to cure the colliquative fever ariſing from the abſorption of matter in large wounds; and yet the only difference is, that in the puerperal fever the matter abſorbed from the uterus, &c. acts with more violence, becauſe the blood is commonly thinner and the habit in a more irritable ſtate. We ſee, continues he, that abſorbed matter purges as effectually as if any purging medicine had been given by the mouth; and may we not therefore do harm by additional purging, when there has been a large evacuation, eſpecially as purges in this caſe are incapable of entirely removing the *fomes morbi*?

He conſiders cinchona as the principal remedy, as ſoon as the pulſe ſinks, the heat is leſſened, and the ſtomach will bear it. If this increaſe the diarrhœa beyond moderation, he joins with it ſmall doſes of laudanum; but if the diarrhœa ſhould entirely ſtop without the fever going off, in place of laudanum he adviſes a proper quantity of rhubarb. Should the diarrhœa, notwithſtanding the uſe of the medicines propoſed, become

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come ſo violent as to endanger the patient, he agrees with Mr White in recommending the columbo root, which is a warm cordial, and removes the irritability of the ſtomach and inteſtines more powerfully than any other bitter he knows.

Of this diſeaſe alſo, as it appeared in Derbyſhire and ſome of the adjacent provinces, an account has been publiſhed by Dr Butter. Concerning the cauſes and nature of the diſeaſe, he obſerves, that pregnancy ſeems to add much to the natural ſenſibility of the female conſtitution; becauſe at this period women are often ſubject to a train of nervous ſymptoms, which never moleſt them at other times. During geſtation likewiſe, the appetite is for the moſt part keen, while the digeſtion appears to be impaired; and this weakneſs is increaſed not only by improper food, of which the woman is frequently deſirous, but alſo by the inactivity attending her ſituation. To theſe circumſtances, it is added, that the inteſtinal paſſage being interrupted by the uterine preſſure, coſtiveneſs generally prevails. From the ſeveral obſervations here enumerated, Dr Butter concludes, that the proximate cauſe of the puerperal fever is a ſpaſmodic affection of the firſt paſſages, with a morbid accumulation in their cavity; and upon this ſuppoſition he endeavours to account for the various ſymptoms of the diſeaſe.

In treating of the method of cure, he lays down two indications; the former of which is to promote two, three, or four ſtools daily, in a manner ſuited to the ſtrength of the patient, till ſuch time as they reſume a natural appearance. The ſecond indication is to relieve all uneaſy ſymptoms, ſuch as heat, thirſt, headach, &c.

With reſpect to the opinion entertained by Dr Butter of the cauſe of the puerperal fever, it nearly coincides with that of Mr White. But however plauſible it may appear, we are not entirely ſatisfied that a diſeaſe attended with ſo peculiar ſymptoms as the puerperal fever can depend principally upon an irritability, which is not reſtricted either to the pregnant or puerperal ſtate.

The late Dr Thomas Young profeſſor of midwifery in the univerſity of Edinburgh, although he publiſhed nothing on the ſubject of the puerperal fever, wrote a very ingenious diſſertation reſpecting it, which was read in the Philoſophical Society of Edinburgh. In that diſſertation, after giving a very accurate account of the ſymptoms of the diſeaſe, which coincides very nearly with the account given by others, he endeavours to ſhow, that the *puerperal fever*, ſtrictly ſo called, is in every inſtance the conſequence of contagion; but he contends, that the contagious matter of this diſeaſe is capable only of producing its effect, in conſequence of a peculiar prediſpoſition given by delivery and its conſequences. In ſupport of this doctrine, he remarks, that for many years the diſeaſe was altogether unknown in the lying-in ward of the Royal Infirmary at Edinburgh; but that after it was once accidentally introduced into the hoſpital, almoſt every woman was in a ſhort time after delivery attacked with it; although prior to her delivery, ſhe may have lain, even for weeks together, not only in the ſame ward with the infected, but even in the very next bed. He remarks, that it was only eradicated from the hoſpital in conſequence of the wards being entirely emptied, thoroughly ventilated, and new painted. After theſe proceſſes, puerperal females in the hoſpital remained as free from this diſeaſe as formerly. The puerperal fever, according to Dr Young, has very generally a ſtrong tendency to the typhoid type; although he allows, that in the beginning it is not unfrequently attended with inflammatory ſymptoms, and even with topical inflammation, particularly in the inteſtinal canal. On this idea, he conſiders the puerperal fever as admitting of the ſame variety of treatment with other affections depending on contagion, in which ſometimes an inflammatory, ſometimes a putreſcent tendency, prevails; ſuch, for example, as ſmallpox or eryſipelas. But from the prevailing putreſcent tendency in this affection, he conſiders the free acceſs of cool air, with the liberal uſe of antiſeptics, as being very generally requiſite.

It deſerves to be remarked, that though the ſeveral writers who treat of this ſubject have conducted their method of cure conformably to their particular idea of the cauſe of the diſeaſe, reſpecting which their ſentiments are very different, they ſeem to have been equally ſucceſsful in the treatment of their patients. Indeed the ſeveral writers differ leſs from each other in their method of cure than might be expected, where ſo great an oppoſition of theoretical ſentiment prevails. For after endeavouring to eſtabliſh indications correſpondent to their particular ſyſtems, thoſe who contend for the expediency of promoting the inteſtinal diſcharge, diſſuade not from having recourſe to phlebotomy when the diſeaſe is attended with inflammatory ſymptoms; while, on the other hand, the moſt ſtrenuous advocates for bleeding admit the utility of the former evacuation. It appears, therefore, that a due regulation of the alvine diſcharge is neceſſary through the whole courſe of the fever, but veneſection only ſometimes.

Worms.

WORMS.

Thoſe infeſting the human body are chiefly of three 405
kinds: the *aſcarides*, or ſmall round and ſhort white worms; the *teres*, or round and long worm; and the *tænia*, or tape worm.

The *aſcarides* have uſually their ſeat in the rectum.— 406
The *teretes* or *lumbrici* are about a ſpan long, round and ſmooth: they are ſeated for the moſt part in the upper ſmall inteſtines; but ſometimes they are lodged alſo in the ſtomach, and in any part of the inteſtines, even to
the rectum.—The tape-worms are from two to forty 407
feet long, according to the teſtimony of Platerus; they generally poſſeſs the whole tract of the inteſtines, but eſpecially the ileum: they very much reſemble a tape in their appearance, whence the name of *tape-worm:* but another ſpecies of this genus, from the reſemblance of each joint to a gourd ſeed, has the name of the *gourd-worm.*

In the Medical Tranſactions, vol. 1ſt. Dr Heberden gives a very accurate account of the ſymptoms produced by the *aſcarides*, from an eminent phyſician who was troubled with them all his life. They brought on an uneaſineſs in the rectum, and an almoſt intolerable itching in the anus; which ſenſations moſt uſually came on in the evening, and prevented ſleep for ſeveral hours. They were attended with heat, ſometimes ſo conſiderable as to produce a ſwelling in the rectum both

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both internally and externally; and if these symptoms were not soon relieved, a tenesmus was brought on, with a mucous dejection. Sometimes there was a griping pain in the lower part of the abdomen, a little above the *os pubis*. If this pain was very severe, a bloody mucus followed, in which there were often found ascarides alive. They were also sometimes suspected of occasioning disturbed sleep, and some degree of headach.

On this case Dr Heberden observes, that the general health of the patient did not seem to have suffered from the long continuance of the disease, nor the immediate inconveniences of the disorder itself to have increased. "It is (says he) perhaps universally true, that this kind of worms, though as difficult to be cured as any, yet is the least dangerous of all. They have been known to accompany a person through the whole of a long life, without any reason to suspect that they had hastened its end. As in this case there was no remarkable sickness, indigestion, giddiness, pain of the stomach, nor itching of the nose, possibly these symptoms, where they have happened to be joined with the ascarides, did not properly belong to them, but arose from some other causes. There is indeed no one sign of these worms, but what in some patients will be wanting."

The above mentioned patient used purging and irritating clysters with very little success. One dram and an half of tobacco was infused in six ounces of boiling water; and the strained liquor being given as a clyster, occasioned a violent pain in the lower part of the abdomen, with faintness and a cold sweat: this injection, though retained only one minute, acted as a smart purge, but did little or no good. Lime-water was also used as a clyster; which brought on a costiveness, but had no good effect. Six grains of salt of steel were dissolved in six ounces of water, and injected. This clyster in a few minutes occasioned an aching in the rectum, griped a little without purging, and excited a tenesmus. Some few ascarides were brought off with it; but all of them were alive. The uneasy sensation in the rectum did not abate till some warm milk was thrown up. Whenever the tenesmus or mucous stools were thought worth the taking notice of, warm milk and oil generally gave immediate relief. If purging was necessary, the lenient purges, such as manna with oil, were, in this particular case, made use of: rhubarb was found too stimulating.—But, in general, the most useful purge, and which therefore was most usually taken, was cinnabar and rhubarb, of each half a drachm: this powder seldom failed to bring away a mucus as transparent as the white of an egg, and in this many ascarides were moving about. The cinnabar frequently adhered to this mucus, which did not come off in large quantities, when a purge was taken without cinnabar. Calomel did no more than any other purge which operates briskly would have done; that is, it brought away ascarides, with a great deal of mucus. Oil given as a clyster sometimes brought off these animalcules: the oil swam on the surface of the mucus, and the ascarides were alive and moving in the mucus itself, which probably hindered the oil from coming in contact with them and killing them.

Dr Heberden also observes, that mucus or slime is the proper nest of the ascarides, in which they live, and is perhaps the food by which they are nourished; and it is this mucus which preserves them unhurt, though surrounded with many other liquors, the immediate touch of which would be fatal. It is hard to satisfy ourselves by what instinct they find it out in the human body, and by what means they get at it; but it is observable in many other parts of nature, as well as here, that where there is a fit soil for the hatching and growth of animals and vegetables, nature has taken sufficient care that their seeds should find the way thither. Worms are said to have been found in the intestines of still-born infants. Purges, by lessening this slime, never fail to relieve the patient: and it is not unlikely, that the worms which are not forced away by this quickened motion of the intestines, may, for want of a proper quantity of it, languish, and at last die; for if the ascarides are taken out of their mucus, and exposed to the open air, they become motionless, and apparently die in a very short time. Dr Heberden supposes that the kind of purge made use of is of some consequence in the cure of all other worms as well as ascarides; the animals being always defended by the mucus from the immediate action of medicines; and that therefore those purges are the best which act briskly, and of which a repetition can be most easily borne. Purging waters are of this sort, and jalap especially for children; two or more grains of which, mixed with sugar, are most easily taken, and may be repeated daily.

From Dr Heberden's observations, we may easily see why it is so difficult to destroy these animals; and why anthelmintics, greatly celebrated for some kinds, are yet so far from being specifics in the disease. As the worms which reside in the cavities of the human body are never exposed to the air, by which all living creatures are invigorated, it is evident, that in themselves they must be the most tender and easily destructible creatures imaginable, and much less will be requisite to kill them than any of our common insects. The most pernicious substances to any of the common insects are oil, caustic fixed alkali, lime, and lime-water. The oil operates upon them by shutting up the pores of their bodies; the lime-water, lime, and caustic alkali, by dissolving their very substance. In the case of intestinal worms, however, the oil can have very little effect upon them, as they are defended from it by the moisture and mucus of the intestines; the like happens with lime-water: and therefore it is necessary that the medicine should be of such a nature as to destroy both mucus and insects together; for which purpose the caustic fixed alkali is at once safe and efficacious; nor is it probable that any case of worms whatever could resist the proper use of this medicine. A very large dose of any salt indeed will also destroy the mucus and destroy the worms; but it is apt to inflame and excoriate the stomach and intestines, and thus to produce worse distempers than that which it was intended to cure. Dr Heberden gives the following remarkable case of a patient cured of worms by enormous doses of common salt, after trying many other remedies in vain. In February 1757, the patient was seized with uncommon pains in his stomach, attended with nausea, vomiting, and constipation of bowels, and an almost total loss of sleep and appetite: He

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He foon became much emaciated, and could neither ftand nor walk upright; his belly grew fmall and hard, and clofely retracted, infomuch that the fternum covered the navel, and the latter could fcarce be difcovered or felt by the finger: his urine was always milky, and foon depofited a thick white fediment; his excrements were very hard and lumpy, refembling thofe of fheep, only of a brown colour; nor had he ever a ftool without fome medicine or other to procure it. In this fituation he continued four years; during which time he had been in an infirmary, attended by eminent phyficians, but was difmiffed as incurable. At laft he was advifed by a neighbour to drink falt and water, as he faid he knew one cured by it who had for many years been afflicted with the fame kind of pains in the belly and ftomach. As his diftemper was now almoft infupportable, he willingly tried the experiment. Two pounds of common falt were diffolved in as little water as poffible, all which he drank in lefs than an hour. Soon afterwards he found himfelf greatly oppreffed at the ftomach, grew extremely fick, and vomited violently; on the fourth ftraining he brought up about half a pint of fmall worms, part afcarides, and the reft refembling thofe worms which are called the *botts*, and frequently met with in the ftomach of horfes, but much fmaller, and about the fize of a grain of wheat. The falt foon began to operate downwards, and he had five or fix very copious fetid ftools, tinged with blood; and in them difcharged near an equal quantity of the fame kind of worms he had vomited. Being greatly fatigued with the violence of the operations, he fell into a calm fleep, which lafted two hours, during which he fweated profufely, and awoke much refrefhed. Inftead of his ufual pains, he now only complained of a rawnefs and forenefs of his gullet, ftomach, and bowels, with an almoft unquenchable thirft; to allay which, he drank large quantities of cold water, whey, butter-milk, or whatever he could get. The urine he now paffed was fmall in quantity, and rendered with very great difficulty, being highly faturated with the falt, from whence arofe a moft troublefome dyfuria and ftrangury. However, thefe fymptoms gradually abated by a free ufe of the liquors above-mentioned; and on the third morning he was fo well recovered, that he took two pounds more of falt, diffolved in the like quantity of water. The effects were nearly fimilar to the former; only that moft of the worms were now burft, and came away with a confiderable quantity of flime and mucus. The drought, ftrangury, &c. returned with their former violence, but foon yielded to the old treatment. He fweated very copioufly for three days, flept eafily, and by that time could extend his body freely: on the fifth day he left his bed, and, though very weak, could walk upright; his ftrength and appetite foon returned, and he became robuft and well.

The anthelmintic medicines which have been recommended by one perfon or other, are in a manner innumerable; but the principal are,

1. *Quickfilver*. This is very efficacious againft all kinds of worms, either taken in the form of calomel or corrofive fublimate. Even the crude metal boiled in water, and the water drunk, has been recommended as an almoft certain cure. But this, it is evident, can receive no impregnation from the mercury. If, therefore, it have any effect, it muft be from fome foreign and accidental impregnation. In moft inftances there can be no objection to mercury, but only that it is not endowed with any attenuating quality whereby the mucus in which thefe infects refides can be diffolved. It therefore fails in many cafes, though it will moft certainly deftroy worms where it can get at them.

2. *Powder of tin*. This was for fome time celebrated as a fpecific, and indeed we may reafonably expect good effects from it; as by its weight and grittinefs it rubs off the mucus and worms it contains from the coats of the inteftinal canal, in which cafe they are eafily evacuated by purgatives. In order to produce any confiderable effects, it muft be given in a large dofe.

3. *Geoffræa inermis*, or *cabbage bark*. This remedy is ufed by the inhabitants of Jamaica. The firft account of it which appeared in this country was publifhed in the Phyfical and Literary Effays, vol. ii. by Mr Duguid furgeon in that ifland. He acquaints us, that the inhabitants of Jamaica, young and old, white and black, are much infefted with worms, efpecially the long round fort; the reafon of which, he thinks, is the quantity of fweet vifcid vegetables which they eat. On diffecting a child of feven months old, who died of vomiting and convulfions, twelve large worms were found; one of them filled the *appendix vermiformis*, and three of them were entwifted in fuch a manner as to block up the *valvula Tulpii*, fo that nothing could pafs from the fmall to the great guts.—The cabbage bark, however, he tells us, is a fafe and effectual remedy, and the moft powerful vermifuge yet known; and that it frequently brings away as many worms by ftool as would fill a large hat. He owns that it has fometimes violent effects; but this he afcribes to the negroes who make the decoction (in which form the bark is ufed) too ftrong, and not to the remedy itfelf.

Mr Anderfon, furgeon in Edinburgh, has alfo given an account of this bark and its operation, in a letter to Dr Duncan, publifhed in the Edinburgh Medical Commentaries, volume iv. p. 84. From this account it appears, that there are two different kinds of cabbage bark; the one much paler than the other: the pale kind operates much more violently than the other. It often occafions loofe ftools, great naufea, and fuch like fymptoms, attended with great uneafinefs in the belly: in one or two inftances it was fufpected of inducing fyncope. The darker coloured kind refembles the caffia lignea, though it is of a much coarfer texture. This kind, Mr Anderfon thinks, may be exhibited in any cafe where an anthelmintic is neceffary; the dangerous fymptoms might have followed either from the ufe of the firft kind, or from an over-dofe of the fecond. The ufual method of preparing the medicine is by boiling two ounces and a half of the bark in two quarts of water to a pint and a half. Of this a tea-fpoonful may be given at firft in the morning, gradually increafing the quantity till we come to four or five table-fpoonfuls in a day. When exhibited in this manner, Mr Anderfon informs us, that he never faw it produce any violent fymptoms, and has experienced the beft effects from it as an anthelmintic. After the ufe of this decoction for eight or

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or nine mornings successively, a dose of jalap with calomel must be given, which seldom fails to bring away the worms, some dead, some alive. If at any time the decoction produce more than one or two loose stools, a few drops of liquid laudanum may be given; and, in general, Mr Anderson gave 15 or 20 drops of the spirit of lavender with each dose.

In a letter from Dr Rush, professor of chemistry at Philadelphia, to Dr Duncan of Edinburgh, the following account is given of another preparation of this medicine. "It has long (says he) been a complaint among physicians, that we have no *vermifuge* medicine which can be depended upon. Even calomel fails in many cases where there are the most pathognomonic signs of worms in the bowels. But this complaint, it is hoped, is now at an end. The physicians of Jamaica have lately found, that the *cabbage bark*, as it is called in the West Indies, made into a syrup with brown sugar, is an infallible antidote to them. I have used above 30 pounds of it, and have never found it fail in one instance. The syrup is pleasant; it sometimes pukes, and always purges, the first or second time it is given."

The most accurate botanical description of the geoffrœa inermis, or the tree furnishing the worm bark, as it has often been called, is that which was published some years ago in the Philosophical Transactions by Dr Wright, formerly physician at Jamaica, now of Edinburgh, who also highly extolls this remedy as an anthelmintic.

Notwithstanding these encomiums, however, the cabbage bark has not come into general use in Britain. But diseases from the *teretes*, or *lumbrici* as they are often called, the species of worm against which this bark is employed, much less frequently occur in Britain than in some other countries. When they do occur, in almost every instance they readily yield to more gentle and safe anthelmintics; and the worms may not only be expelled by calomel, but by the vegetable bitters; as the powder of the artemisia santonica, or the like.

4. *Couhage*, or *cow itch*. This is the *Dolichos urens* or *pruriens* of Linnæus; and the principles on which it acts have been already explained under the article DOLICHOS. It is somewhat similar to the powder of tin, but bids fair for being more efficacious. It might at first appear to occur as objections to this medicine, that by the hairs of it entangling themselves with one another, calculi might be formed in the intestines, or obstructions equally bad; or if the sharp points and hooks with which it abounds were to adhere to the nervous coats of the intestines themselves, they might occasion a fatal irritation, which could not be removed by any means whatever. But from the experience of those who have employed it extensively in practice, it would appear, that these objections are entirely theoretical: and that it may be employed with perfect safety. The spiculæ, gently scraped off from a single pod, and mixed with syrup or melasses, are taken for a dose in the morning fasting. This dose is repeated in this manner for two or three days without any sensible operation; but even a very slight purgative taken afterwards has been found to discharge an almost incredible quantity of worms. And according to Dr Bancroft, who has given a very particular account of its use in his Natural History of Guiana, it is one of the safest and most certain anthelmintics yet discovered; but, as well as the bark of the *Geoffræa*, it has hitherto been very little used in Britain, probably from its not being necessary.

5. *Indian pink*. This plant, which is the *Spigelia marilandica* of Linnæus, is also an American plant, and was first recommended in the Edinburgh Physical and Literary Essays by Dr Garden of Charlestown in South Carolina. He is of opinion that a vomit ought always to precede the use of it; and informs us, that half a dram of it purges as briskly as the same quantity of rhubarb. At other times he has known it produce no effect on the belly though given in very large quantity: In such cases it becomes necessary to add a grain or two of sweet mercury, or some grains of rhubarb; but then it is less efficacious than when it proves purgative without addition. The use of it, however, in small doses, is by no means safe; as it frequently produces giddiness, dimness of sight, convulsions, &c. The addition of a purgative, indeed, prevents these effects; but at the same time, as already observed, it diminishes the virtue of the medicine. The doctor therefore recommends large doses, as from them he never knew any other effect than the medicine's proving emetic or violently cathartic. The dose is from 12 to 60 or 70 grains of the root in substance, or two, three, or four drams of the infusion, twice a day. This medicine has also had its day, and is now very far from being considered as a specific.

The long round worms seem to be the most dangerous which infest the human body, as they often pierce through the stomach and intestines, and thus bring on a miserable death. The common symptoms of them are nausea, vomiting, looseness, fainting, slender intermitting pulse, itching of the nose, and epileptic fits. By the consumption of the chyle they produce hunger, paleness, weakness, costiveness, tumor of the abdomen, eructations, and rumbling of the intestines; but it is from the perforation of the intestines that the disease proves so frequently fatal. A child may be known to have worms from his cold temperament, paleness of the countenance, livid eyelids, hollow eyes, itching of the nose, voracity, startings, and grinding of the teeth, in sleep; and more especially by a very fetid breath. Very frequently, however, they are voided by the mouth and anus, in which case there is no room for doubt. In the Medical Commentaries, vol. ii. we have an account of the intestines being perforated by a worm, and yet the patient recovered. The patient was a woman troubled with an inflammation in the lower part of the abdomen. The pain was so violent, that for six days she slept none at all; the tumor then broke, discharged upwards of a pound of thin watery sanies, immediately after which the excrements followed. The next day she was extremely low; her pulse could scarcely be felt; the extremities were cold; and there was a considerable discharge from the wound, which had already begun to mortify. She got a decoction of cinchona with wine, which alleviated the symptoms; but in removing the mortified parts a worm was found among them nine inches long, and as thick as an eagle's quill. By proper applications, the discharge of excrements ceased, and she recovered perfect health. She was sensible of no accident giving rise to the

Worms. the inflammation; so that in all probability it arose entirely from the worm itself.

The *tænia*, or *tape worm* as it is called, is one of those most difficult to be removed from the human body. It is of two kinds, *tænia solium* and *tænia lata*; for a description of which see the article TÆNIA.—The reason of its being so difficult to cure is, that though portions of it are apt to break off and be discharged, it is endowed with a power of reproduction, so that the patient is little or nothing better. The symptoms occasioned by it are not different from those above described. A specific against the *tænia lata* has been lately so much celebrated in France, that the king thought proper to purchase it from the proprietor (Madame Nouffer), and the account of it has been translated into English by Dr Simmons. The patients are required to observe no particular regimen till the day before they take the specific. That day they are to take nothing after dinner till about 7 o'clock; after which, they are to take the following soup: "Take a pint and an half of water, two or three ounces of good fresh butter, and two ounces of bread cut into thin slices; add to this salt enough to season it, and then boil it to the consistence of panada." About a quarter of an hour after this, they take a biscuit and a glass of white wine, either pure or mixed with water; or even water alone, if they have not been accustomed to wine. If the patient has not been to stool that day, (which, however, is not usual with patients in this way), the following clyster is to be injected. "Take a small quantity of the leaves of mallows, and boil them in a sufficient quantity of water, mixing with it a little salt, and when strained off add two ounces of olive oil." Next morning, about eight or nine hours after the supper above mentioned, the specific is to be taken. This is no other than two or three drams of the root of male fern, *polypodium filix mas* of Linnæus, gathered in autumn, and reduced to fine powder. It is to be taken in any distilled water, or in common water. This medicine is apt to occasion a nausea: to avoid which, Madame Nouffer allows her patients to chew any thing that is agreeable, but forbids any thing to be swallowed; or they may smell to vinegar, to check the sickness: but if, notwithstanding this, the specific be thrown up, a fresh dose must be swallowed as soon as the sickness is gone off, and then they must try to sleep. About two hours after this the following bolus is to be taken. "Take of the panacea of mercury 14 times sublimed, and select resin of scammony, each ten grains: of fresh and good gamboge six or seven grains: reduce each of these substances separately into powder, and then mix them with some conserve into a bolus." This composition is to be swallowed at two different times, washing it down with one or two dishes of weak green-tea, after which the patient must walk about his chamber. When the bolus begins to operate, he is to take a dish of the same tea occasionally, until the worm be expelled; then, and not before, Madame Nouffer gives him broth or soup, and he is directed to dine as is usual after taking physic. After dinner he may either lie down or walk out, taking care to conduct himself discreetly, to eat but little supper, and to avoid every thing that is not of easy digestion.

The cure then is complete; but it is not always effected with the same quickness in every subject. He who has not kept down the whole bolus, or who is not sufficiently purged by it, ought to take, four hours after it, from two to eight drams of Epsom salt dissolved in boiling water. The dose of this salt may be varied according to the temperament and other circumstances of the patient.

If the worm should not come away in a bundle, but in the form of a thread (which particularly happens when the worm is involved in much tenacious mucus), the patient must continue to sit upon the close stool without attempting to draw it away, drinking at the same time warm weak tea: sometimes this alone is not sufficient, and the patient is obliged to take another dose of purging salt, but without varying his position till the worm be wholly expelled.

It is unusual for patients who have kept down both the specific and purging dose, not to discharge the worm before dinner-time. This, however, sometimes happens when the dead worm remains in large bundles in the intestines, so that the fæces becoming more limpid towards the end of the purging, pass by it without drawing it with them. The patient may in this case eat his dinner; and it has been observed, that the food, joined to the use of a clyster, has brought about the expulsion of the worm.

Sometimes the worm is brought away by the action of the specific alone, before the patient has taken the purging bolus: when this happens, Madame Nouffer gives only two thirds of it, or substitutes the salt in its stead.

Patients must not be alarmed by any sensation of heat or uneasiness they may feel during the action of the remedy, either before or after a copious evacuation, or just as they are about to void the worm. These sensations are transitory, and go off spontaneously, or by the assistance of the vapour of vinegar drawn in at the nose.

They who have vomited both the specific and bolus, or who have kept down only a part of them, sometimes do not void the worm that day. Madame Nouffer therefore directs them to take again that night the soup, the wine and biscuit; and if circumstances require it, the clyster. If the worm do not come away during the night, she gives them early the next morning another dose of the specific, and, two hours afterwards, six drams or an ounce of purging salt, repeating the whole process of the preceding day; excepting the bolus, which she suppresses.

She observes, that very hot weather diminishes in some degree the action of her remedy; she therefore prefers the month of September for administering it; but as she has not been always able to choose the season, and has been sometimes obliged to undertake the cure of patients in the hottest days of summer, she then gave her specific very early in the morning; and with this precaution she saw no difference in its effects.

On the day appointed for the trial of this medicine before the commissioners nominated by the king of France, it was exhibited to five different persons; but only one of them was certainly known to have the *tænia lata* by having discharged parts of it before. That person was cured; the second voided a portion of the *tænia solium*; the third some *ascarides*, with a part of the *tænia solium*; the fourth and fifth voided no worms; but

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but the laſt conſidered much of the viſcid ſlime he voided to be worms in a diſſolved ſtate.

This trial was thought ſufficient to aſcertain the efficacy of the medicine, and further trials were made by thoſe to whom the ſecret was communicated. The firſt voided two tænia, after much vomiting and 18 or 20 ſtools; the ſecond had no vomiting, but was as violently purged, and diſcharged two worms; the third had 20 copious ſtools during the night, and diſcharged the worm in the morning; and the fifth was affected in much the ſame manner. Some others who were not relieved, were ſuppoſed not to have a tænia.

This ſpecific, however, is not to be conſidered as a new diſcovery; the efficacy of fern in caſes of tænia having been known long ago. Theophraſtus preſcribes its root, in doſes of four drams, given in water ſweetened with honey, as uſeful in expelling flat worms.—Dioſcorides orders it in the ſame doſe, and adds, that its effects are more certain when it is mixed with four oboli (40 grains) of ſcammony or black hellebore; he particularly requires that garlic ſhould be taken before hand. Pliny, Galen, Oribaſius, and Aëtius, aſcribe this ſame virtue to fern; and are followed in this by Avicenna, and the other Arabian phyſicians. Dorſtenius, Valerius Cordus, Dodonæus, Mathiolus, Dalechampius, who commented on Dioſcorides, or copied him in many things, all mention the fern-root as a ſpecific againſt the tænia. Sennertus, and Burnet after him, recommended in ſimilar caſes an infuſion of this plant, or a dram of its powder, for young perſons, and three drams for adults. Simon Paulus, quoted by Ray and Geoffroy, conſiders it as the moſt efficacious of all poiſons againſt the flat worm, and as being the baſis of all the ſecret remedies extolled by empirics in that diſeaſe. Andry prefers diſtilled fern-water to the root in powder, or he employs it only in the form of an opiate, or mixed with other ſubſtances.

Theſe are not the only authors who have mentioned the tænia; many others have deſcribed this worm, the ſymptoms it excites, and the treatment proper to expel it. Almoſt all of them mention the fern-root, but at the ſame time they point out other remedies as poſſeſſing equal efficacy. Amongſt theſe we find the bark of the root of the mulberry-tree, the juice of the *auricula murus*, the roots of *chamæleon niger*, ginger, zedoary; decoctions of mugwort, ſouthernwood, wormwood, penny-royal, origanum, hyſſop, and in general all bitter and aromatic plants, &c. Some of them direct the ſpecific to be ſimply mixed and taken in wine or honey and water; others join to it the uſe of ſome purgative remedy, which they ſay adds to its efficacy. Oribaſius, Sylvius, &c. diſtinguiſh the ſpecific that kills the worm, from the purgative that evacuates it, and direct them to be given at different times. Sennertus gives a very ſatisfactory reaſon for adopting this method. If we give, ſays he, the purgative medicine and the ſpecific at the ſame time, the latter will be haſtily carried off before it can have exerted its powers on the worm: whereas, if we give the ſpecific firſt, and thus weaken the worm, it will collect itſelf into a bundle, and, being brought away by means of the purge, the patient will be cured. The cure will be more ſpeedy if the *primæ viæ* have been previouſly lubricated. Theſe precautions are all of them eſſential to the ſucceſs of the remedy, nor are they neglected by Madame Nouffer in her method of treatment. The panada and injection ſhe preſcribes the night before, to lubricate the inteſtines, and prepare the *primæ viæ*. The fern root, taken in the morning, kills and detaches the worm; of this the patients are ſenſible by the ceſſation of the pain in the ſtomach, and by the weight that is felt in the lower belly. The purgative bolus adminiſtered two hours after this, procures a complete evacuation; it is compoſed of ſubſtances that are at once purgative and vermifuge, and which, even when adminiſtered alone, by different phyſicians, ſometimes ſucceeded in expelling the worm. If this purgative appear to be too ſtrong, the reader is deſired to recollect, that it produced no ill effects in either of the caſes that came under the obſervation of the phyſicians appointed to make the trials; and that in one of thoſe caſes, by diminiſhing the doſe, they evidently retarded the evacuations.—Regard however, they obſerve, is to be had both to the age and the temperament of the patient, and the treatment ſhould always be directed by a prudent and experienced phyſician, who may know how to vary the proportions of the doſe as circumſtances may require. If the purgative be not of ſufficient ſtrength, the worm, after being detached by the ſpecific, remains too long a time in the inteſtines, and becoming ſoon corrupted, is brought away only in detached portions: on the other hand, if the purgative be too ſtrong, it occaſions too much irritation, and evacuations that cannot fail to be inconvenient.

Madame Nouffer's long experience has taught her to diſtinguiſh all theſe circumſtances with ſingular adroitneſs.

This method of cure is, as we have ſeen, copied in a great meaſure from the ancients: it may be poſſible to produce the ſame effects by varying the remedies; but the manner of applying them is by no means indifferent: we ſhall be always more certain of ſucceſs, if the inteſtines be previouſly evacuated, and if the ſpecific be given ſome time before the purgative bolus. It is to this method that Madame Nouffer's conſtant ſucceſs is attributed.

Her remedy has likewiſe ſome power over the *tænia ſolium*; but as the rings of this worm ſeparate from each other more eaſily than thoſe of the *tænia lata*, it is almoſt impoſſible for it to be expelled entire. It will be neceſſary therefore to repeat the treatment ſeveral times, till the patient ceaſe to void any portions of worms. It muſt likewiſe be repeated, if, after the expulſion of one *tænia ſolium*, another ſhould be generated in the inteſtinal canal. This laſt caſe is ſo rare, that it has been ſuppoſed that no perſon can have more than one of theſe worms; and for this reaſon it has been named *ſolitary worm*, which, being once removed, could never be renewed or replaced by a ſecond: but experience has proved, that this notion is an ill-founded prejudice; and we know that ſometimes theſe worms ſucceed each other, and that ſometimes ſeveral of them exiſt together. Two living tæniæ have frequently been expelled from the ſame patient. Dr De Haen relates an inſtance of a woman who voided 18 tæniæ at once. In theſe caſes the ſymptoms are uſually more alarming; and the appetite becomes exceſſive, becauſe theſe worms derive all their nouriſhment from the chyle. If too auſtere and ill-judged a regimen deprives

Worms. deprives them of this, they may be expected to attack even the membranes of the inteſtines themſelves. This evil is to be avoided by eating frequently.

Such are the precautions indicated in this diſeaſe. The ordinary vermifuge remedies commonly procured only a palliative cure, perhaps becauſe they were too often improperly adminiſtered. But the efficacy of the preſent remedy, in the opinion of the French phyſicians, ſeems to be ſufficiently confirmed by experience. To the above account, however, it ſeems proper to ſubjoin the following obſervations by Dr Simmons.

"A Swiſs phyſician, of the name of *Herrenſchwand*, more than 20 years ago, acquired no little celebrity by diſtributing a compoſition of which he ſtyled himſelf the *inventor*, and which was probably of the ſame nature as Madame Nouffer's. Several very eminent men, as Tronchin, Hovius, Bonnet, Cramer, and others, have written concerning the effects of this remedy. It ſeems that Dr Herrenſchwand uſed to give a powder by way of preparation, the night before he adminiſtered his ſpecific. Nothing could be ſaid with certainty concerning the compoſition either of one or the other. The treatment was ſaid ſometimes to produce moſt violent effects, and to leave the patients in a valetudinary ſtate. Dr De Haen was diſſuaded by his friends from uſing it, becauſe it diſordered the patients too much. It will be readily conceived, now that we are acquainted with Madame Nouffer's method, that theſe effects were occaſioned wholly by the purgative bolus. It is not ſtrange, that reſin of ſcammony or jalap, combined with *mercurius dulcis* and gamboge, all of them in ſtrong doſes, ſhould in many ſubjects occaſion the greateſt diſorders. It ſeems likely, however, that much of the ſucceſs of the remedy depends on the uſe of a draſtic purge. Some of the ancients who were acquainted with the virtues of the fern root, obſerved that its efficacy was increaſed by ſcammony. Reſinous purges, eſpecially when combined with mercury, have often been given with ſucceſs in caſes of *tænia*. Dr De Haen ſaw a worm of this ſort five ells long expelled by the reſin of jalap alone. Dr Gaubius knew a woman who had taken a variety of anthelmintic remedies without any effect, though ſhe had voided a portion of *tænia* an ell and a half long previous to the uſe of theſe medicines: but at length, after taking a purge of ſingular ſtrength, ſhe voided the worm entire. Many other inſtances of the ſame kind are to be met with in authors. Other remedies have occaſionally been given with ſucceſs. In Sweden, it has been a practice to drink ſeveral gallons of cold water, and then to take ſome draſtic purge. Boerhaave ſays, that he himſelf ſaw a *tænia* meaſuring 300 ells expelled from a Ruſſian by means of the ſulphate of iron.

From ſome late accounts, there is reaſon to believe that Dr Herrenſchwand's remedy for *tænia* does not ſo exactly agree with that of Madame Nouffer as Dr Simmons ſeems to imagine. According to the account given us by a gentleman who had his information from Dr Herrenſchwand himſelf, it conſiſts entirely of gamboge and fixed vegetable alkali.

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Of many poiſons we have already treated, but there are ſome of which nothing has hitherto been ſaid. Among the moſt fatal of theſe are the bites and ſtings of ſerpents, ſcorpions, &c. According to Dr Mead, the ſymptoms which follow the bite of a viper are, an acute pain in the place wounded, with a ſwelling, at firſt red, but afterwards livid, which by degrees ſpreads farther to the neighbouring parts; with great faintneſs, and a quick, low, and ſometimes interrupted pulſe; great ſickneſs at ſtomach, with bilious convulſive vomitings, cold ſweats, and ſometimes pains about the navel. Frequently a ſanious liquor runs from the ſmall wound, and little puſtules are raiſed about it: the colour of the whole ſkin in leſs than an hour is changed yellow, as if the patient had the jaundice. Theſe ſymptoms are very frequently followed by death, eſpecially if the climate be hot, and the animal of a large ſize. This is not, however, the caſe with all kinds of ſerpents. Some, we are aſſured, kill by a fatal ſleep; others are ſaid to produce an univerſal hæmorrhage and diſſolution of the blood; and others an unquenchable thirſt. But of all the ſpecies of ſerpents hitherto known, there is none whoſe bite is more expeditiouſly fatal than that of the rattleſnake. Dr Mead tells us, that the bite of a large ſerpent of this kind killed a dog in a quarter of a minute; and to the human ſpecies they are almoſt equally fatal. Of this ſerpent it is ſaid, that the bite makes the perſon's ſkin become ſpotted all over like the ſkin of the ſerpent; and that it has ſuch a motion as if there were innumerable living ſerpents below it. But this is probably nothing more than a diſſolution of the blood, by which the ſkin becomes ſpotted as in petechial fevers, at the ſame time that the muſcles may be convulſed as in the diſtemper called *hieranoſos*, which was formerly thought to be the effect of evil ſpirits: but it is even not improbable that obſervers have been ſomewhat aided by fancy and ſuperſtition when they thought that they detected ſuch appearances. Poiſons.

It has juſtly appeared ſurpriſing to philoſophers, how ſuch an inconſiderable quantity of matter as the poiſon emitted by a viper at the time of biting ſhould produce ſuch violent effects. But all inquiries into this matter muſt neceſſarily be uncertain; neither can they contribute any thing towards the cure. It is certain that the poiſon produces a gangrenous diſpoſition of the part itſelf, and likewiſe ſeemingly of the reſt of the body; and that the original quantity of poiſon continues ſome time before it exerts all its power on the patient, as it is known that removing part of the poiſonous matter by ſuction will alleviate the ſymptoms. The indications of cure then are three: 1. To remove the poiſonous matter from the body: Or, 2. If this cannot be done, to change its deſtructive nature by ſome powerful and penetrating application to the wound: And, 3. To counteract the effects of that portion already received into the ſyſtem.

The poiſonous matter can only be removed from the body by ſucking the wound either by the mouth, or by means of a cupping glaſs; but the former is probably the more efficacious, as the ſaliva will in ſome meaſure dilute and perhaps obtund the poiſon. Dr Mead directs the perſon who ſucks the wound to hold warm oil in his mouth, to prevent inflammation of the lips and tongue: but as bites of this kind are moſt likely to happen in the fields, and at a diſtance from houſes, the want of oil ought by no means to retard the

Poiſons. the operation, as the delay of a few minutes might prove of the moſt fatal conſequence; and it appears from Dr Mead's experiments, that the taking the poiſon of a viper into the mouth undiluted, is attended with no worſe conſequences than that of raiſing a ſlight inflammation. A quick exciſion of the part might alſo be of very great ſervice.

The only way of anſwering the ſecond indication is, by deſtroying the poiſoned part by a red-hot iron, or the application of alkaline ſalts, which have the power of immediately altering the texture of all animal ſubſtances to which they are applied, provided they are not covered by the ſkin; and as long as the poiſon is not totally abſorbed into the ſyſtem, theſe muſt certainly be of uſe.

To anſwer the third indication, Dr Mead recommends a vomit of ipecacuanha, encouraged in the working with oil and warm water. The good effects of this, he ſays, are owing to the ſhake which it gives to the nerves, whereby the irregular ſpaſms into which their whole ſyſtem might be drawn are prevented. After this the patient muſt go to bed, and a ſweat muſt be procured by cordial medicines; by which the remaining effects of the poiſon will be carried off.

It has been confidently aſſerted by many, that the American Indians are poſſeſſed of ſome ſpecific remedy by which they can eaſily cure the bite of a rattleſnake. But Mr Cateſby, who muſt have had many opportunities of knowing this, poſitively denies that they have any ſuch medicine. They make applications indeed, and ſometimes the patient recovers; but theſe recoveries he aſcribes to the ſtrength of nature overcoming the poiſon, more than to the remedies made uſe of. He ſays, they are very acute in their prognoſtics whether a perſon that is bit will die or not; and when they happen to receive a bite in certain parts of the body, when the teeth of the animal enter a large vein, for inſtance, they quietly reſign themſelves to their fate, without attempting any thing for their own relief. Indeed, ſo violent and quick is the operation of this poiſon, that unleſs the antidote be inſtantly applied, the perſon will die before he can get to a houſe. It would ſeem therefore eligible for thoſe who are in danger of ſuch bites, to carry along with them ſome ſtrong alkaline ley, or dry alkaline ſalt, or both, which could be inſtantly clapt on the wound, and by its diſſolving power would deſtroy both the poiſon and the infected parts. Strong cordials alſo, ſuch as ardent ſpirits, volatile alkali, &c. might poſſibly excite the languid powers of nature, and enable her to expel the enemy, which would otherwiſe prove too powerful. This ſeems to be ſomewhat confirmed from the account we have in the Philoſophical Tranſactions of a gentleman bit by a rattleſnake, who was more relieved by a poultice of vinegar and vine-aſhes put to his wound than any thing elſe. The vine aſhes being of an alkaline nature, muſt have ſaturated the vinegar, ſo that no part of the cure could be attributed to it: on the other hand, the aſhes themſelves could not have been ſaturated by the ſmall quantity of acid neceſſary to form them into a poultice; of conſequence they muſt have operated by their alkaline quality.—Soap ley, therefore, or very ſtrong ſalt of tartar, may reaſonably be thought to be the beſt external application, not only for the bites of vipers, but of every venomous creature; and in fact we find *dry ſalt* univerſally recommended both in the bites of ſerpents and of mad dogs. Dr Mead recommends the fat of vipers immediately rubbed into the wound; but owns that it is not ſafe to truſt to this remedy alone.

Diſeaſes of Children.

Some years ago the volatile alkali was ſtrongly recommended by M. Sage of the French academy, as a powerful remedy againſt the bite of the viper: and, by a letter from a gentleman in Bengal to Dr Wright, it would appear that this article, under the form of the *eau de luce*, which is very little if any thing different from the *ſpiritus ammoniæ ſuccinatus* of the London Pharmacopœia, has been employed with very great ſucceſs againſt this affection in the Eaſt Indies: but from the trials made with it by the abbé Fontana, publiſhed in his Treatiſe on the Poiſon of the Viper, it would appear that it by no means anſwered his expectation; and the efficacy of this, as well as of the ſnake pills mentioned under the article HYDROPHOBIA, ſtill requires to be confirmed by further experience.

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This is a diſtemper not very common, but it has been obſerved by the ancient phyſicians, and is deſcribed by Hippocrates under the name of *morbus niger*. It ſhows itſelf by a vomiting and purging of black tar-like matter, which Hippocrates, Boerhaave, and Van Swieten, ſuppoſed to be occaſioned by atra bilis. But Dr Home, in his Clinical Experiments, endeavours to ſhew that it is owing to an effuſion of blood from the meſeraic veſſels, which, by its ſtagnation and corruption, aſſumes that ſtrange appearance. The diſeaſe, he ſays, frequently follows hæmorrhage; and thoſe of a ſcorbutic habit are moſt ſubject to it. It is an acute diſeaſe, and terminates ſoon; yet it is not attended with any great degree of fever. In one of Dr Home's patients the criſis happened on the eighth day by diarrhœa; in another, on the 14th, by ſweat and urine; and a third had no evident critical evacuation.

As to the cure, Dr Home obſerves, that bleeding is always neceſſary where the pulſe can bear it; nor are we to be deterred from it by a little weakneſs of the pulſe, more than in the enteritis. Emetics are hurtful, but purgatives are uſeful. But the moſt powerful medicine for checking this hæmorrhage is the ſulphuric acid: and, that this might be given in greater quantity, he mixed it with mucilage of gum arabic; by which means he was enabled to give double the quantity he could otherwiſe have done. The cold bath was tried in one inſtance, but he could not determine whether it was of any ſervice or not. The cure was completed by exerciſe and cinchona.

Of the DISEASES *of* CHILDREN. 410

Dr Buchan obſerves, that from the annual regiſters of the dead, it appears that about one half of the children born in Great Britain die under twelve years of age; and this very great mortality he attributes in a great meaſure to wrong management. The particulars of this wrong management enumerated by him are,

1. Mothers not ſuckling their own children. This, he owns, it is ſometimes impoſſible for them to do; but

but where it can be done, he affirms that it ought never to be omitted. This, he says, would prevent the unnatural custom of mothers leaving their own children to suckle those of others; on which he passes a most severe censure, and indeed scarce any censure can be severe enough upon such inhumanity. Dr Buchan informs us, "He is sure he speaks within bounds, when he says not one in a hundred of these children live who are thus abandoned by their mothers." For this reason he adds, that no mother should be allowed to suckle another's child till her own be fit to be weaned. A regulation of this kind would save many lives among the poorer sort, and would do no harm to the rich; as most women who make good nurses are able to suckle two children in succession upon the same milk.

2. Another source of the diseases of children is the unhealthiness of parents: and our author insists that no person who labours under an incurable malady ought to marry.

3. The manner of clothing children tends to produce diseases. All that is necessary here, he says, is to wrap the child in a soft loose covering; and the softness of every part of the infant's body sufficiently shows the injury which must necessarily ensue by pursuing a contrary method.

4. A new-born infant, instead of being treated with syrups, oils, &c. ought to be allowed to suck the mother's milk almost as soon as it comes into the world. He condemns the practice of giving wines and spirituous liquors along with the food soon after birth; and says, that if the mother or nurse has a sufficient quantity of milk, the child will need little or no other food before the third or fourth month. But to this it may reasonably be objected, not only that the nursing would thus be very severe on the mother; but if the child be left thus long without other food, it will not easily relish that food for some time, and its stomach is apt to be easily hurt by a slight change of diet after it has been long accustomed to one thing. The human species are unquestionably fitted by nature for a mixed aliment, both from the vegetable and animal kingdom. And the analogy of other animals belonging to the class of mammalia for whom milk is equally provided at the earliest periods of life, would lead us to the conclusion, that mixed aliment is well fitted for the human species even in the earliest periods of infancy. The lamb is no sooner dropt than, by natural instinct, it crops the grass as well as it sucks its mother. And the stomach in the human species, immediately after birth, can digest other food as well as milk. Neither can it be shown, that the strongest and most healthy infants are those which get no other food but the mother's milk during the first months of their life. In fact, children are evidently of a weak and lax habit of body, so that many of their diseases must arise from that cause; all directions which indiscriminately advise an antiphlogistic regimen for infants as soon as they come into the world, must of necessity be wrong. Many instances in fact might be brought to show, that by the preposterous method of starving infants, and at the same time treating them with vomits and purges, they are often hurried out of the world. Animal food indeed, particularly under the form of broths, is excessively agreeable to children, and they ought to be indulged with it in moderation. This will prove a much better remedy for those acidities with which children are often troubled, than magnesia alba, crabs eyes, or other absorbents, which have the most pernicious effects on the stomachs of these tender creatures, and pall the appetite to a surprising degree. The natural appetites of children are indeed the best rule by which we can judge of what is proper or improper for them. They must no doubt be regulated as to the quantity; but we may be assured that what a child is very fond of will not hurt it, if taken in moderation. When children are sick, they refuse every thing but the breast; and if their distemper be very severe, they will refuse it also, and in this case they ought not to be pressed to take food of any kind; but when the sickness goes off, their appetite also returns, and they will require the usual quantity of food.

According to Dr Armstrong, *inward fits*, as they are called, are in general the first complaint that appears in children; and as far as he has observed, most, if not all infants, during the first months, are more or less liable to them. The symptoms are these: The child appears as if it was asleep, only the eyelids are not quite closed; and if you observe them narrowly, you will see the eyes frequently twinkle, with the white of them turned up. There is a kind of tremulous motion in the muscles of the face and lips, which produces something like a simper or a smile, and sometimes almost the appearance of a laugh. As the disorder increases, the infant's breath seems now and then to stop for a little; the nose becomes pinched; there is a pale circle about the eyes and mouth, which sometimes changes to livid, and comes and goes by turns; the child starts, especially if you attempt to stir it though ever so gently, or if you make any noise near it. Thus disturbed, it sighs, or breaks wind, which gives relief for a little, but presently it relapses into the dozing. Sometimes it struggles hard before it can break wind, and seems as if falling into convulsions; but a violent burst of wind from the stomach, or vomiting, or a loud fit of crying, sets all to rights again. As the child increases in strength, these fits are the more apt to go off spontaneously and by degrees; but in case they do not, and if there is nothing done to remove them, they either degenerate into an almost constant drowsiness, (which is succeeded by a fever and the thrush), or else they terminate in vomitings, sour, curdled, or green stools, the watery gripes, and convulsions. The thrush indeed very often terminates in these last symptoms. As these complaints naturally run into one another, or succeed one another, they may be considered, in a manner, as only different stages of the same disease, and which derive their origin from the same cause. Thus, the inward fits may be looked upon as the first stage of the disorder; the fever, and thrush (when it happens), as the second; the vomitings, sour, curdled, green or watery stools, as the third; and convulsions, as the last.

As to the cause of these complaints, he observes, that in infants the glandular secretions, which are all more or less glutinous, are much more copious than in adults. During the time of sucking, the glands of the mouth and fauces being squeezed by the contraction of the muscles, pour forth their contents plentifully; which afterwards mixing with the mucus of the gullet and

and stomach, render the milk of a slimy consistence, by which means it is not so readily absorbed into the lacteals; and as in most infants there is too great an acidity in the stomach, the milk is thereby curdled, which adds to the load; hence sickness and spasms, which, being communicated by sympathy to the nerves of the gullet and fauces, produce the convulsive motions above described, which go commonly by the name of *inward fits*. The air, likewise, which is drawn in during suction, mixing with the milk, &c. in the stomach, perhaps contributes towards increasing the spasms above mentioned. Dr Armstrong is the more induced to attribute these fits to the causes now assigned, that they always appear immediately after sucking or feeding; especially if the child has been long at the breast, or fed heartily, and has been laid down to sleep without having first broken wind. Another reason is, that nothing relieves them so soon as belching or vomiting; and the milk or food they throw up is generally either curdled, or mixed with a large quantity of heavy phlegm. If they be not relieved by belching or vomiting, the fits sometimes continue a good while, and gradually abate, according as the contents of the stomach are pushed into the intestines; and as soon as the former is pretty well emptied, the child is waked by hunger, cries, and wants the breast; he sucks, and the same process is repeated.—Thus, some children for the first weeks are kept almost always in a dose, or seemingly so; especially if the nurses, either through laziness or want of skill, do not take care to rouse them when they perceive that it is not a right sleep, and keep them awake at proper intervals. This dozing is reckoned a bad sign amongst experienced nurses; who look upon it as a forerunner of the thrush, as indeed it often is; and therefore, when it happens, we ought to be upon our guard to use the necessary precautions for preventing that disorder.

For these disorders, the only remedy recommended by Dr Armstrong is antimonial wine, given in a few drops, according to the age of the infant. By this means the superabundant mucus will no doubt be evacuated; but at the same time we must remember, that this evacuation can only *palliate*, and not cure the disease. This can only be effected by tonics; and, when from inward fits and other symptoms it appears that the tone of the stomach is very weak, a decoction of cinchona, made into a syrup, will readily be taken by infants, and may be safely exhibited from the very day they come into the world, or as soon as their bowels are emptied of the meconium by the mother's milk or any other means.

Dr Clarke observes, that *fractures* of the *limbs*, and *compressions* of the *brain*, often happen in difficult labours; and that the latter are often followed by convulsions soon after delivery. In these cases, he says, it will be advisable to let the navel-string bleed two or three spoonfuls before it be tied. Thus the oppression of the brain will be relieved, and the disagreeable consequences just mentioned will be prevented. But if this has been neglected, and fits have actually come on, we must endeavour to make a revulsion by all the means in our power; as by opening the jugular vein, procuring an immediate discharge of the urine and meconium, and applying small blisters to the back, legs, or behind the ears. The semicupium, too, would seem to be useful in this case, by driving the oppressive load of fluids from the head and upper parts.

It sometimes happens after a tedious labour, that the child is so faint and weak as to discover little or no signs of life. In such a case, after the usual cleansing, the body should be immediately wrapped in warm flannel, and briskly tossed about in the nurse's arms, in order, if possible, to excite the languid circulation. If this fail, the breast and temples may be rubbed with brandy or other spirits; or the child may be provoked to cry, by whipping, or other stimulating methods, as the application of onion, or salt and spirit of hartshorn, to the mouth and nostrils. But after all these expedients have been tried in vain, and the recovery of the child absolutely despaired of, it has sometimes been happily revived by introducing a short catheter or blowpipe into the mouth, and gently blowing into the lungs at different intervals. Such children, however, are apt to remain weak for a considerable time, so that it is often no easy matter to rear them; and therefore particular care and tenderness will be required in their management, that nothing may be omitted which can contribute either to their preservation or the improvement of their strength and vigour.

All the disorders which arise from a *retention* of the *meconium*, such as the *red gum*, may easily be removed by the use of gentle laxatives; but the great source of mortality among children is the *breeding* of their *teeth*. The usual symptoms produced by this are fretting; restlessness; frequent and sudden startings, especially in sleep; costiveness; and sometimes a violent diarrhœa, fever, or convulsions. In general, those children breed their teeth with the greatest ease, who have a moderate laxity of the bowels, or a plentiful flow of saliva during that time.

In mild cases, we need only, when necessary, endeavour to promote the means by which nature is observed to carry on the business of dentition in the easiest manner. For this purpose, if a costiveness be threatened, it must be prevented, and the body kept always gently open; the gums should be relaxed by rubbing them frequently with sweet oils, or other softening remedies of that kind, which will greatly diminish the tension and pain. At the same time, as children about this period are generally disposed to chew whatever they get into their hands, they ought never to be without something that will yield a little to the pressure of their gums, as a crust of bread, a wax candle, a bit of liquorice root, or such like; for the repeated muscular action, occasioned by the constant biting and gnawing at such a substance, will increase the discharge from the salivary glands, while the gums will be so forcibly pressed against the advancing teeth, as to make them break out much sooner, and with less uneasiness, than would otherwise happen. Some likewise recommend a slice of the rind of fresh bacon, as a proper masticatory for the child, in order to bring moisture into its mouth, and facilitate the eruption of the teeth by exercising the gums. If these means, however, prove ineffectual, and bad symptoms begin to appear, the patient will often be relieved immediately by cutting the inflamed gum down to the tooth, where a small white point shows the latter to be coming forward. When the pulse is quick, the skin hot and dry, and the child of a sufficient age and strength, emptying the vessels by bleeding,

ing, efpecially at the jugular, will frequently be neceffary here, as well as in all other inflammatory cafes; and the belly fhould be opened from time to time by emollient, oily, or mucilaginous clyfters. But, on the contrary, if the child be low, funk, and much weakened, repeated dofes of the fpirit of hartfhorn, and the like reviving medicines, ought to be prefcribed. Blifters applied to the back, or behind the ears, will often be proper in both cafes. A prudent adminiftration of opiates, when their ufe is not forbid by coftivenefs or otherwife, is fometimes of great fervice in difficult teething, as, by mitigating pain, they have a tendency to prevent its bad effects, fuch as a fever, convulfions, or other violent fymptoms; and often they are abfolutely neceffary, along with the teftaceous powders, for checking an immoderate diarrhœa.

When cathartics are neceffary, if the child feems too tender and weak to bear their immediate operation, they fhould be given to the nurfe; in which cafe they will communicate fo much of their active powers to the milk as will be fufficient to purge the infant. This at leaft certainly holds with regard to fome cathartics; fuch, for example, as the infufion of fenna, particularly if a very weak infufion be employed, and not ufed to fuch an extent as to operate as a purgative to the nurfe.

As moft young children, if in health, naturally fleep much, and pretty foundly, we may always be apt to fufpect that fomething is amifs when they begin to be fubject to *watching* and *frights*; fymptoms which feldom or never occur but either in confequence of fome prefent diforder not perceived, or as the certain forerunners of an approaching indifpofition. We fhould immediately, therefore, endeavour to find out the caufe of watchfulnefs, that we may ufe every poffible means to remove or prevent it; otherwife the want of natural reft, which is fo very prejudicial to perfons of all ages, will foon reduce the infant to a low and emaciated ftate, which may be followed by a hectic fever, diarrhœa, and all the other confequences of weaknefs. Thefe fymptoms, being always the effects of irritation and pain, may proceed, in very young infants, from crudities or other affections of the *primæ viæ* producing flatulencies or gripes; about the fixth or feventh month, they may be owing to that uneafinefs which commonly accompanies the breeding of the teeth; and after a child is weaned, and begins to ufe a different kind of food, worms become frequently an additional caufe of watchings and difturbed fleep. Hence, to give the neceffary relief on thefe occafions, the original complaint muft firft be afcertained from the child's age and other concomitant circumftances, and afterwards treated according to the nature of the cafe. Women and nurfes are too apt to have recourfe to opiates in the watchings of children, efpecially when their own reft happens to be much difturbed by their continual noife and clamour. But this practice is often prejudicial, and never ought to have place when the belly is in the leaft obftructed.

There is no complaint more frequent among children than that of worms, the general fymptoms of which have been already enumerated; but it muft be obferved, that all the fymptoms commonly attributed to worms, may be produced by a foulnefs of the bowels. Hence practitioners ought never to reft fatisfied with adminiftering to their patients fuch medicines as are poffeffed only of an anthelmintic quality, but to join them with thofe which are particularly adapted for cleanfing the *primæ viæ*; as it is uncertain whether a foulnefs of the bowels may not be the caufe of all the complaints. This practice is ftill the more advifable, on account of vifcid humours in the inteftines affording lodgement to the ova of worms; which, without the convenience of fuch a receptacle, would be more fpeedily difcharged from the body.

The difficulty of curing what is called a *worm fever*, arifes, according to Dr Mufgrave, from its being frequently attributed to worms, when the caufe of the diforder is of a quite different nature. He does not mean to deny that worms do fometimes abound in the human body, nor that the irritation caufed by them does fometimes produce a fever; but he apprehends thefe cafes to be much more uncommon than is generally imagined, and that great mifchief is done by treating fome of the diforders of children as worm cafes, which really are not fo. Dr Hunter is of the fame opinion on this point. He has, we are told, diffected great numbers of children who have been fuppofed to die of worm fevers, and whofe complaints were of courfe treated as proceeding from worms, in whom, however, there appeared, upon diffection, to be not only no worms, but evident proofs of the diforder's having been of a very different nature.

The *fpurious worm fever*, as Dr Mufgrave terms it, has, in all the inftances he has feen of it, arifen evidently from the children having been indulged with too great quantities of fruit. Every fort of fruit eaten in excefs will probably produce it; but an immoderate ufe of cherries feems to be the moft common caufe of it. The approach of this diforder has a different appearance, according as it arifes from a habit of eating fruit in rather too large quantities, or from an exceffive quantity eaten at one time. In the former cafe, the patient gradually grows weak and languid: his colour becomes pale and livid; his belly fwells and grows hard; his appetite and digeftion are deftroyed; his nights grow reftlefs, or at leaft his fleep is much difturbed with ftartings, and then the fever foon follows, in the progrefs of which, the patient grows comatofe, and at times convulfed; in which ftate, when it takes place to a high degree, he often dies. The pulfe at the wrift, though quick, is never ftrong or hard; the carotids, however, beat with great violence, and elevate the fkin fo as to be diftinctly feen at a diftance. The heat is at times confiderable, efpecially in the trunk; though at other times, when the brain is much oppreffed, it is little more than natural. It is fometimes accompanied by a violent pain of the epigaftric region, though more commonly the pain is flight, and terminates in a coma; fome degree of pain, however, feems to be infeparable from it, fo as clearly to diftinguifh this diforder from other comatofe affections.

When a large quantity of fruit has been eaten at once, the attack of the diforder is inftantaneous, and its progrefs rapid; the patient often paffing, in the fpace of a few hours, from apparently perfect health, to a ftupid, comatofe, and almoft dying ftate. The fymptoms of the fever, when formed, are in both cafes nearly the fame; except that, in this latter fort, a little purulent matter is fometimes difcharged, both by vomit

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mit and ſtool, from the very firſt day. The ſtools, in both caſes, exhibit ſometimes a kind of curd reſembling curdled milk, at other times a floating ſubſtance is obſerved in them; and ſometimes a number of little threads and pellicles, and now and then a ſingle worm.

Strong purgatives, or purges frequently repeated, in this diſorder, are greatly condemned by Dr Armſtrong, as they in general not only aggravate the ſymptoms already preſent, but are ſometimes the origin of convulſions. Bloodletting is not to be thought of in any ſtage of the diſorder.

Although frequent purging, however, be not recommended, yet a ſingle vomit and purge are adviſed in the beginning of the diſorder, with a view to evacuate ſuch indigeſted matter and mucus as happens to remain in the ſtomach and bowels. Theſe having operated properly, there is ſeldom occaſion for repeating them; and it is ſufficient, if the body be coſtive, to throw up, every ſecond or third day, a clyſter, compoſed of ſome grains of aloes, diſſolved in five or ſix ounces of infuſion of chamomile.

The principal part of the cure, however, depends upon external applications to the bowels and ſtomach; and as the cauſe of the diſorder is of a cold nature, the applications muſt be warm, cordial, and invigorating; and their action muſt be promoted by conſtant actual heat.

When any nervous ſymptoms come on, or remain after the diſorder is abated, they are eaſily removed by giving a pill with a grain or two of aſafœtida once or twice a day.

The diagnoſtics of worms are very uncertain; but, even in real worm caſes, the treatment above recommended would, it is imagined, be much more efficacious than the practice commonly had recourſe to. As worms either find the conſtitution weakly, or very ſoon make it ſo, the frequent repetition of purges, particularly mercurials, cannot but have a pernicious effect. Bear's-foot is ſtill more exceptionable, being in truth to be ranked rather among poiſons than medicines. Worm ſeed and bitters are too offenſive to the palate and ſtomach to be long perſiſted in, though ſometimes very uſeful. The powder of coralline creates diſguſt by its quantity; and the infuſion of pink root is well known to occaſion now and then vertiginous complaints and fits.

Fomenting the belly night and morning with a ſtrong decoction of rue and wormwood, is much recommended. It is a perfectly ſafe remedy, and, by invigorating the bowels, may thereby have ſome influence in rendering them capable of expelling ſuch worms as they happen to contain. After the fomentation, it is adviſed to anoint the belly with a liniment, compoſed of one part of eſſential oil of rue, and two parts of a decoction of rue in ſweet oil. It is, however, a matter of great doubt whether theſe external applications, in conſequence of the articles with which they are impregnated, exert any influence on the worms themſelves.

The diet of children diſpoſed to worms ſhould be warm and nouriſhing, conſiſting in part at leaſt of animal food, which is not the worſe for being a little ſeaſoned. Their drink may be any kind of beer that is well hopped, with now and then a ſmall draught of porter or negus. A total abſtinence from butter is not ſo neceſſary, perhaps, as is generally imagined. Poor cheeſe muſt by all means be avoided; but ſuch as is rich and pungent, in a moderate quantity, is particularly ſerviceable. In the ſpurious worm fever, the patient ſhould be ſupported occaſionally by ſmall quantities of broth; and, at the cloſe of it, when the appetite returns, the firſt food given ſhould be of the kinds above recommended.

The diet here recommended will, perhaps, be thought extraordinary, as the general idea is at preſent, that, in the management of children, nothing is ſo much to be avoided as repletion and rich food. It is no doubt an error to feed children too well, or to indulge them with wine and rich ſauces; but it is equally an error to confine them to too ſtrict or too poor a diet, which weakens their digeſtion, and renders them much more ſubject to diſorders of every kind, but particularly to diſorders of the bowels. In regard to the ſpurious worm fever, if it be true that acid fruits too plentifully eaten are the general cauſe of it, it follows as a conſequence, that a warm nutritious diet, moderately uſed, will moſt effectually counteract the miſchief, and ſooneſt reſtore the natural powers of the ſtomach. Beſides, if the diſorder does not readily yield to the methods here directed, as there are many examples of its terminating by an inflammation and ſuppuration of the navel, it is highly adviſeable to keep this probability in view, and, by a moderate allowance of animal food, to ſupport thoſe powers of nature, from which only ſuch a happy criſis is to be expected.

Beſides theſe, many other diſeaſes might here be mentioned, which, if not peculiar to infants, are at leaſt peculiarly modified by the infant ſtate. But into details reſpecting theſe we cannot propoſe to enter. It is ſufficient to ſay, that due regard being paid to age and conſtitution, the cure is to be conducted on the ſame general principles as in the adult ſtate.

Medical Juriſprudence.

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During the progreſs of ſcience in Europe this ſubject has not been altogether neglected. But we may ſafely venture to aſſert, that even from many enlightened governments it has hitherto claimed much leſs attention than its importance merits. At the Britiſh univerſities this has been two much the caſe. It is indeed true, that for near 20 years a few lectures on this ſubject have been delivered at the univerſity of Edinburgh, by the profeſſor of the inſtitutions of medicine. But he could by no means conſider the ſubject on that extenſive ſcale which its importance merited. And he had often expreſſed his regret, that, as in ſeveral of the foreign univerſities, a profeſſorſhip had not been inſtituted for the expreſs purpoſe of giving a courſe of lectures on medical juriſprudence. That defect, however, in medical education at Edinburgh is now ſupplied. When that able and upright ſtateſman Lord Grenville, to whom every thing that regarded the laws of his country was an object of peculiar attention, was at the head of his majeſty's councils, a regius profeſſorſhip of juridical and political medicine was eſtabliſhed in the univerſity of Edinburgh by a royal warrant. And

And there is every reason to hope, that this appointment will be attended with many effects highly beneficial to the nation.

A short view of the extent and importance of this subject will, we presume, not be unacceptable to the intelligent reader.

Whatever aid the science of medicine can contribute towards the good of the state, and the execution of its laws, has been by the Germans denominated State Medicine; a new, but not improper, appellation, for that branch of knowledge which many writers have termed Medical Jurisprudence.

It comprehends both medical police and juridical medicine. The former consists of the medical precepts which may be of use to the legislature or to the magistracy. The latter is the aggregate of all the information, afforded by the different branches of medicine, which is necessary for elucidating doubtful questions in courts of law.

Although there are some traces of juridical medicine in the Justinian code; such as determining the real period of birth, with a view to prevent the imposition of spurious children: it properly originated with the code of laws enacted by the emperor Charles V. under the name of *Constitutio criminalis Carolina;* in which it is ordained, that the opinions of physicians should be taken, with regard to the danger of wounds, child-murder, murder, poisoning, procured abortion, concealed pregnancy, &c. These directions, and the impossibility which was found of determinating many questions by simply legal means, induced some legislators to enjoin, that all tribunals and judges should procure from sworn physicians, appointed to this office, their opinions concerning all the subjects to be mentioned hereafter.

Since that time, it has been treated systematically by many learned men; such as Fortunatus Fidelis, Zacchias, Alberti, Hebenstreit, Haller, Ludwig, Plenck; and lastly, in the most masterly manner, by Metzger. Numberless dissertations have been written on all its parts; and among those who contributed to its advancement, we may reckon Ambrose Parry, Bohn, Butener, Morgagni, Camper, and Gruner. Collections of cases, illustrating its principles, have been made by Amman, Daniel, Bucholz, Pyl, Scherf and Metzger. These are only a few of the principal writers, who have attended to this science: to enumerate more would be unnecessary.

From its very nature, it is evident how necessary a knowledge of this science must be to every medical practitioner, who is liable to be called upon to illustrate any question comprehended under it before a court of justice. On his answers, the fate of the accused person must often depend; both judge and jury regulating their decision by his opinion. On the other hand, while he is delivering his sentiments, his own reputation is before the bar of the public. The acuteness of the gentlemen of the law is universally acknowledged; the versatility of their genius, and the quickness of their apprehension, are rendered almost inconceivable, by constant exercise. It is their duty to make every possible exertion for the interest of their client, and they seldom leave unnoticed any inaccurate or contradictory evidence. How cautious must, then, a medical practitioner be, when examined before such men, when it is their duty to expose his errors, and magnify his uncertainties, till his evidence seem contradictory and absurd? How often must he expose himself to such severe criticism, if he be not master of the subject on which he is giving evidence, and have not arranged his thoughts on it according to just principles? On the other hand, he may deserve and gain much credit, by so public a display of judgement and professional knowledge.

Some acquaintance with this part of medical science must be useful at least, and sometimes necessary, to judges and lawyers. They will thus be enabled to estimate how much they may depend on the opinion of any physician, and will know how to direct their questions, so as to arrive at the truth, and avoid being misled by his partiality or favourite opinions. To the lawyer who conducts the defence of an accused person, in a criminal case, it is almost indispensable; without it, he cannot do justice to the cause of his client.

Before criminal courts, the questions which occur most generally are, respecting

1. The cause of death, as ascertained from the examination of the body.
2. The sufficiency of the supposed cause to have produced death.
3. Probable event of wounds, contusions, &c.
4. The importance of the part injured.
5. Supposed child-murder; whether still-born or not.
6. Whether death accidental or intended.
7. Abortion; its having occurred,
8. Spontaneously, from habit; accidentally, from external violence or passions of the mind; or intentionally, from the introduction of a sharp instrument, use of certain drugs, &c.
. Rape; its being attempted or consummated; recent or previous defloration.
10. The responsibility of the accused for his actions.

Before civil courts the questions generally regard,

1. The state of mind; madness, melancholy, idiotism.
2. Pregnancy; concealed, pretended.
3. Parturition; concealed, pretended, retarded, premature.
4. The first-born of twins.
5. Diseases; concealed, pretended, imputed.
6. Age and duration of life.

Before consistorial courts, the subjects investigated are,

1. Impotence; general, relative, curable, incurable.
2. Sterility; curable, relatively incurable, absolutely incurable.
3. Uncertainty of sex; hermaphrodites.
4. Diseases preventing cohabitation; venereal disease, leprosy, &c.

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Of incomparably greater consequence, and more widely extended influence, is the second division of this subject. It regards not merely the welfare of individuals, but the prosperity and security of nations. It is perhaps the most important branch of general police; for its influence is not confined to those whom accidental circumstances bring within its sphere, but extends over the whole population of the state.

Many

Medical Police.

Many of its principles have been long acknowledged, and confidered as neceffary confequences of medical and political truths; and fome few of them have acquired the authority of laws. But it was referved for the philanthropic Frank, to collect the whole into one vaft and beneficent fyftem, and to feparate it from juridical medicine; in the old fyftems of which, it was neglected, or mentioned only in a few fhort paragraphs. His enlarged mind perceived at once, and fully vindicated its importance. The very name of Medical Police, is now fufficient to attract the attention of legiflators and of magiftrates, and to make them defirous of becoming acquainted with its principles, and anxious to fee them carried into execution. In fact, its influence is already vifible in the countries where it is cultivated. If the principles of medical police were feparated from the profeffional part of medicine, and communicated in a form generally intelligible, in what country have we reafon to expect more beneficial effects from its influence than this? Where is the fpirit of patriotifm and benevolence fo prevalent? What nation is more generous in its public inftitutions? Where does the individual facrifice a part of his wealth fo willingly for the benefit of the community? It feems only neceffary to prove that an undertaking will be of advantage to the ftate, to have it carried into inftant execution. But, can medical knowledge be more ufefully employed than in pointing out the means of preferving or improving health; of fupplying healthy nourifhment to the poor, efpecially in times of fcarcity; of oppofing the introduction of contagious difeafes, and of checking their progrefs; of fecuring to the indigent the advantages intended by their benefactors; of rearing the orphan to be the fupport of the nation which has adopted him; and of diminifhing the horrors of confinement to the poor maniac and the criminal? Thefe good effects are not to be promoted fo much by rigid laws, as by recommendation and example. Nor can it be reafonably objected to a fyftem of medical police, that it is a pleafing dream, which flatters the imagination, but the execution of which is in reality impracticable. As well might we entirely throw afide the rules of humanity, becaufe no one is able to obferve them all; or live without laws, becaufe no exifting code is unexceptionable.

Medical police may be defined,—The application of the principles deduced from the different branches of medical knowledge, for the promotion, prefervation and reftoration of general health.

The effects to be expected from it are the general welfare of the ftate, and increafe of healthy population; and are to be attained by means of public inftitutions, exprefs laws, and popular inftruction. Inftructing the people, and convincing them of the propriety of certain precautions and attentions, in regard to their own and the general ftate of health, are neceffary to fecure the good effects of our public inftitutions and regulations; to obtain refpect and obedience in many things, to which no exprefs law can be adapted; and, to induce them to forego what may be prejudicial to the fafety of the community, and of themfelves.

Public medical inftitutions and laws, muft be adapted to the country for which they are intended. Many local circumftances, national character, habits of life, prevalent cuftoms and profeffions, fituation, climate, &c, make confiderable varieties neceffary. And many inftitutions, many a law which would be highly beneficial to the public health, in fome circumftances, would be ufelefs, impracticable, and even hurtful, in others. Thefe caufes and their effects, muft, therefore, be particularly attended to.

The principal authors who have written on this fubject, are Alberti, Heifter, Plaz, Frank, Hufty, Metzger, and Hebenftreit; to whom we may add Howard and Rumford.

The fubjects which it comprehends, cannot be claffed very regularly or fyftematically. Its views will be different, according to occafional and temporary caufes; and its interference may fometimes be advantageoufly extended beyond what may feem the ftrict limits of a branch of the medical profeffion.

Medical Police relates to

The Situation of places of Abode. Conftruction of houfes.

Air. Means of counteracting its impurity—Its various impregnations.

Water. Its neceffity and purity.

Food. Its various kinds—Comparative quantities of nourifhment afforded by them—Cheaper kinds, which may be fafely fubftituted in times of fcarcity—Bread—Animal food—Butcher meat—Fifh—Vegetables—Veffels—Cookery; Healthy; Œconomical.

Drink. Beer—Ale—Porter—Cyder—Spirituous liquors—Wine—Warm drinks—Adulterations of thefe liquors—Hurtful additions—Veffels.

Fire and Light.

Clothing.

Cleanliness.

Professions. Manufacturers—Mechanics—Soldiers Sailors—Men of letters.

Healthy Propagation.

Pregnant and Puerperal Women.

New-born Infants. Regifters of birth.

Physical Education.

Prevention of Accidents. From poifon—Hurtful Effluvia—Maniacs—Rabid animals.

Restoration of the Apparently dead. Humane Societies—Care of the dying—Danger of too early—too late burial—Places of interment—manner of conducting it—Bills of mortality.

Contagious and Epidemic Diseases. Plague—Putrid fever—Dyfentery—Smallpox—Inoculation—Extirpation of them—Leprofy—Itch and pox—Precautions to be taken, to prevent their introduction, to diminifh their violence, to deftroy their caufe, and to counteract their effects.

Management of Public Institutions, in which many people are collected under the care of the public.

Hofpitals for the Indigent:

1. Lying-in Hofpitals.
2. Foundling ditto.
3. Orphan ditto.
4. Hofpitals for Education.

5. Aged.

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5. Aged.
6. Blind.
7. Maimed.

Military Hoſpitals:
Priſoners of War.
Lazarettoes.
Work-houſes.
Priſons.

Hoſpitals for the Sick.
Maniacs.
Convaleſcents.
Incurables.

Obſervations on the MEANS *of preſerving* HEALTH.

Having now treated of all the moſt important diſeaſes to which the human body is ſubjected, we ſhall conclude the article MEDICINE, with a few obſervations on the means of preſerving health, both for the general management of valetudinarians, and of thoſe alſo who wiſh to obtain long life and good health by avoiding the cauſes of thoſe diſeaſes which the human ſpecies often bring upon themſelves. On this ſubject much has been written at almoſt every period of medicine. And we may refer thoſe readers who wiſh for a full and extenſive view of this intereſting ſubject to a very elaborate work lately publiſhed by Sir John Sinclair Bart. entitled the Code of Health and Longevity. Here we cannot propoſe to give even an abridged view of this extenſive inquiry; but muſt content ourſelves with offering only a very few general obſervations.

I. RULES *for the Management of* VALETUDINARIANS.

413 THAT part of the medical ſyſtem which lays down rules for the preſervation of health, and prevention of diſeaſes, termed *Hygieina*, is not to be ſtrictly underſtood as if it reſpected only thoſe people who enjoy perfect health, and who are under no apprehenſions of diſeaſe, for ſuch ſeldom either deſire or attend to medical advice; but is rather conſidered as relating to valetudinarians, or ſuch as, though not actually ſick, may yet have ſufficient reaſon to fear that they will ſoon become ſo: hence it is that the rules muſt be applied to correct morbific diſpoſitions, and to obviate various particulars which were ſhown to be the remote or poſſible cauſes of diſeaſes.

From the way in which the ſeveral temperaments are commonly mentioned by ſyſtematic writers, it ſhould ſeem as if they meant that every particular conſtitution might be referred to one or other of the four; but this is far from being the caſe, ſince by much the greater number of people have temperaments ſo indiſtinctly marked, that it is hard to ſay to which of the temperaments they belong.

When we actually meet with particular perſons who have evidently either,

1. Too much ſtrength and rigidity of fibre, and too much ſenſibility;
2. Too little ſtrength, and yet too much ſenſibility;
3. Too much ſtrength, and but little ſenſibility; or,
4. But little ſenſibility joined to weakneſs;

we ſhould look on ſuch perſons as more or leſs in the valetudinary ſtate, who require that theſe morbific diſpoſitions be particularly watched, leſt they fall into thoſe diſeaſes which are connected with the different temperaments.

People of the firſt mentioned temperament being liable to ſuffer from continued fevers, eſpecially of the inflammatory ſpecies, their ſcheme of preſerving health ſhould conſiſt in temperate living, with reſpect both to diet and exerciſe; they ſhould ſtudiouſly avoid immoderate drinking, and be remarkably cautious leſt any of the natural diſcharges be checked. People of this habit bear evacuations well, eſpecially bleeding: they ought not, however, to loſe blood but when they really require to have the quantity leſſened; becauſe too much of this evacuation would be apt to reduce the conſtitution to the ſecond-mentioned temperament, in which ſtrength is deficient, but ſenſibility redundant.

Perſons of the ſecond temperament are remarkably prone to ſuffer from painful and ſpaſmodic diſeaſes, and are eaſily ruffled; and thoſe of the ſofter ſex who have this delicacy of habit, are very much diſpoſed to hyſterical complaints. The ſcheme here ſhould be, to ſtrengthen the ſolids by moderate exerciſe, cold bathing, cinchona, and chalybeate waters; particular attention ſhould conſtantly be had to the ſtate of the digeſtive organs, to prevent them from being overloaded with any ſpecies of ſaburra which might engender flatus, or irritate the ſenſible membranes of the ſtomach and inteſtines, from whence the diſorder would ſoon be communicated to the whole nervous ſyſtem. Perſons of this conſtitution ſhould never take any of the draſtic purges, or ſtrong emetics; neither ſhould they loſe blood but in caſes of urgent neceſſity. But a principal ſhare of management, in theſe extremely irritable conſtitutions, conſiſts in avoiding all ſudden changes of every ſort, eſpecially thoſe with reſpect to diet and clothing, and in keeping the mind as much as poſſible in a ſtate of tranquillity: hence the great advantages which people of this frame derive from the uſe of medicinal waters drank on the ſpot, on account of that freedom from care and ſerious buſineſs of every kind, which generally obtains in all the places planned for the reception of valetudinarians.

The third-mentioned temperament, where there is an exceſs of ſtrength and but little ſenſibility, does not ſeem remarkably prone to any diſtreſſing or dangerous ſpecies of diſeaſe; and therefore it can hardly be ſuppoſed that perſons ſo circumſtanced will either of themſelves think of any particular ſcheme of management, or have recourſe to the faculty for their inſtructions: ſuch conſtitutions, however, we may obſerve, bear all kinds of evacuations well, and ſometimes require them to prevent an over-fulneſs, which might end in an oppreſſion of the brain or ſome other organ of importance.

But the fourth temperament, where we have weakneſs joined to want of ſenſibility, is exceedingly apt to fall into tedious and dangerous diſeaſes, ariſing from a defect of abſorbent power in the proper ſets of veſſels, and from languor of the circulation in general: whence corpulency, dropſy, jaundice, and different degrees of ſcorbutic affection. In order to prevent theſe, or any other ſpecies of accumulation and depravation of the animal fluids, the people of this conſtitution ſhould uſe a generous courſe of diet, with briſk

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exercise, and be careful that none of the secretions be interrupted, nor any of the natural discharges suppressed. These constitutions bear purging well, and often require it; as also the use of emetics, which are frequently found necessary to supply the place of exercise, by agitating the abdominal viscera, and are of service to prevent the stagnation of bile, or the accumulation of mucous humours, which hinder digestion, and clog the first passages. The free use of mustard, horse-radish, and the like sort of stimulating dietetics, is serviceable in these torpid habits.

When the general mass of fluids is increased beyond what is conducive to the perfection of health, there arises what the writers term a *plethora*, which may prove the source of different diseases; and therefore, when this overfulness begins to produce languor and oppression, care should be taken in time to reduce the body to a proper standard, by abridging the food and increasing the natural discharges, using more exercise, and indulging less in sleep.

But in opposite circumstances, where the fluids have been exhausted, we are to attempt the prevention of further waste by the use of strengthening stomachics, nourishing diet, and indulgence from fatigue of body or mind.

Vitiated fluids are to be considered as tainted either with the different kinds of general acrimony, or as betraying signs of some of the species of morbific matter which give rise to particular diseases, such as calculus, scurvy, &c.

During the state of infancy, we may sometimes observe a remarkable acidity, which not only shows itself in the first passages, but also seems to contaminate the general mass of fluids. As it takes its rise, however, from weak bowels, our views, when we mean to prevent the ill consequences, must be chiefly directed to strengthen the digestive organs, as on their soundness the preparation of good chyle depends; and hence small doses of rhubarb and chalybeates (either the natural chalybeate waters mixed with milk, or the *murias ammoniæ et ferri* in doses of a few grains, according to the age of the child), are to be administered; and the diet is to be so regulated as not to add to this acid tendency: brisk exercise is likewise to be enjoined, with frictions on the stomach, belly, and lower extremities.

Where the fluids tend to the putrescent state, which shows itself by fetid breath, sponginess and bleeding of the gums, a bloated look and livid cast, the diet then should be chiefly of fresh vegetables and ripe fruits, with wine in moderation, due exercise, and strengthening bitters.

Where acrimony shows itself by itching eruptions, uncommon thirst, and flushing heats, nothing will answer better than such sulphureous waters as the Harrowgate and Moffat, at the same time using a course of diet that shall be neither acrid nor heating.

So far with respect to those kinds of morbific matter which do not invariably produce a particular species of disease: but there are others of a specific nature, some of which are generated in the body spontaneously, and seem to arise from errors in diet, or other circumstances of ill management with respect to the animal economy; and hence it is sometimes possible, to a certain degree if not altogether, to prevent the ill consequences. Thus, there are instances where returns of the gout have been prevented by adhering strictly to a milk diet.

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The rheumatism has also been sometimes warded off by wearing a flannel shirt, or by using the cold bath without interruption.

Calculus may be retarded in its progress, and prevented from creating much distress, by the internal use of soap and lime-water, by soap-lees taken in milk or in veal-broth, or by the use of aërated alkaline water, which may perhaps be considered as being both more safe and more efficacious, and at the same time more pleasant, than any of the other practices.

The scurvy may be prevented by warm clothing and perseverance in brisk exercise, by drinking wine or cyder, and eating freely of such vegetable substances as can be had in those situations where this disease is most apt to show itself.

In constitutions where there is an hereditary disposition to the scrophula, if early precautions be taken to strengthen the solids by cold bathing, a nourishing course of diet, and moderate use of wine, the constitution which gives rise to the disease will probably be prevented from producing any very bad effects.

The other kinds of morbific matter, which are of the specific nature, are received into the body by infection or contagion.

The infection of a putrid fever or dysentery is best prevented by immediately taking an emetic on the first attack of the sickness or shivering; and if that do not completely answer, let a large blister be applied between the shoulders: by this method the nurses and other attendants on the sick in the naval hospitals have often been preserved. As to other infectious morbific matter, we must refer to what has already been said when treating of hydrophobia, poisons, gonorrhœa, &c.

The ill effects which may arise from the different species of saburra, are to be obviated, in general, by the prudent administration of emetics, and carefully abstaining from such kinds of food as are known to cause the accumulation of noxious matters in the first passages.

Crude vegetables, milk, butter, and other oily substances, are to be avoided by persons troubled with a sourness in the stomach; brisk exercise, especially riding, is to be used, and they are to refrain from fermented liquors: the common drink should be pure water; or water with a very little of some ardent spirit, such as rum or brandy. Seltzer and Pyrmont waters are to be drunk medicinally; and aromatic bitters, infusions, or tinctures, acidulated with sulphuric acid, will be found serviceable, in order to strengthen the fibres of the stomach, and promote the expulsion of its contents, thereby preventing the too hasty fermentation of the alimentary mixture. In order to procure immediate relief, magnesia alba, or *creta præparata*, will seldom fail; the magnesia, as well as the chalk, may be made into lozenges, with a little sugar and mucilage; and in that form may be carried about and taken occasionally by people afflicted with the acid saburra.

In constitutions where there is an exuberance or stagnation of bile, and a troublesome bitterness in the mouth, it is necessary to keep the bowels always free, by taking occasionally small doses of pure aloes, *oleum ricini*,

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ricini, ſupertartrite of potaſs, ſome of the common purging ſalts, or the natural purging waters.

When there is a tendency to the empyreumatic and rancid ſaburra, people ſhould carefully avoid all the various kinds of thoſe oily and high-ſeaſoned articles of diet generally termed *made-diſhes*, and eat ſparingly of plain meat, without rich ſauces or much gravy; and in theſe caſes the moſt proper drink is pure water.

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THERE can be no doubt, that, in general, temperance is the true foundation of health; and yet the ancient phyſicians, as we may ſee in the rules laid down by Celſus, did not ſcruple to recommend indulgence now and then, and allowed people to exceed both in eating and drinking: but it is ſafer to proceed to exceſs in drink than in meat; and if the debauch ſhould create any extraordinary or diſtreſſing degree of pain or ſickneſs, and a temporary fever ſhould enſue, there are two ways of ſhaking it off, either to lie in bed and encourage perſpiration, or to get on horſe-back and by briſk exerciſe reſtore the body to its natural ſtate. The choice of theſe two methods muſt always be determined by the peculiar circumſtances of the parties concerned, and from the experience which they may before have had which agrees beſt with them.

If a perſon ſhould commit exceſs in eating, eſpecially of high-ſeaſoned things, with rich ſauces, a draught of cold water, acidulated with ſulphuric acid, will take off the ſenſe of weight at the ſtomach, and aſſiſt digeſtion by moderating and keeping within bounds the alimentary fermentation, and thus preventing the generation of too much flatus. The luxury of ices may be here of real ſervice at the tables of the great, as producing ſimilar effects with the cold water acidulated. Perſons in theſe circumſtances ought not to lay themſelves down to ſleep, but ſhould keep up and uſe gentle exerciſe until they are ſenſible that the ſtomach is unloaded, and that they no longer feel any oppreſſive weight about the præcordia.

If a man be obliged to faſt, he ought, if poſſible, during that time, to avoid laborious work: after ſuffering ſevere hunger, people ought not at once to gorge and fill themſelves; nor is it proper, after being overfilled, to enjoin an abſolute faſt: neither is it ſafe to indulge in a ſtate of total reſt immediately after exceſſive labour, nor ſuddenly fall hard to work after having been long without motion: in a word, all changes ſhould be made by gentle degrees; for though the conſtitution of the human body be ſuch that it can bear many alterations and irregularities without much danger, yet, when the tranſitions are extremely ſudden, there is a great riſk of producing ſome degree of diſorder.

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It is alſo the advice of Celſus to vary the ſcenes of life, and not confine ourſelves to any ſettled rules: but as inaction renders the body weak and liſtleſs, and exerciſe gives vigour and ſtrength, people ſhould never long omit riding, walking, or going abroad in a carriage. Fencing, playing at tennis, dancing, or other ſimilar engagements, which afford both exerciſe and amuſement, as each ſhall be found moſt agreeable or convenient, are to be uſed in turn, according to the circumſtances and tendency to any particular ſpecies of diſeaſe. But when the weakneſs of old age ſhall have rendered the body incapable of all theſe, then dry frictions with the fleſh-bruſh will be very requiſite to preſerve health, by accelerating the flow of humours through the ſmalleſt orders of veſſels, and preventing the fluids from ſtagnating too long in the cellular interſtices of the fleſhy parts.

Sleep is the great reſtorer of ſtrength; for, during this time, the nutritious particles appear to be chiefly applied to repair the waſte, and replace thoſe that have been abraded and waſhed off by the labour and exerciſe of the day; but too much indulgence in ſleep has many inconveniencies, both with reſpect to body and mind, as it blunts the ſenſes, and encourages the fluids to ſtagnate in the cellular membrane; whence corpulency, and its neceſſary conſequences languor and weakneſs.

The proper time for ſleep is the night, when darkneſs and ſilence naturally bring it on: ſleep in the day time, from noiſe and other circumſtances, is in general not ſo ſound or refreſhing; and to ſome people is really diſtreſſful, as creating an unuſual giddineſs and languor, eſpecially in perſons addicted to literary purſuits. Cuſtom, however, frequently renders ſleep in the day neceſſary; and in thoſe conſtitutions where it is found to give real refreſhment, the propenſity to it ought to be indulged, particularly in very advanced age.

With regard to the general regimen of diet, it has always been held as a rule, that the ſofter and milder kinds of aliment are moſt proper for children and younger ſubjects: that grown perſons ſhould eat what is more ſubſtantial; and old people leſſen their quantity of ſolid food, and increaſe that of their drink both of the diluent and cordial kind.

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MEDICIS, COSMO DE, was born in the year 1389, and was in the prime of life, at the death of his father, Giovanni. His conduct was distinguished for urbanity and kindness to the superior ranks of his fellow citizens, and by a constant attention to the wants of the lower class, whom his munificence abundantly relieved. His prudence and moderation, however, could not repress the ambitious designs of the rival families, the Florentines and Medici; for in 1433, Rinaldo de Albizi, at the head of a formidable party, carried the appointment of the magistracy. On returning from his country seat he was seized upon by his adversaries, and committed to prison. The conspirators not agreeing as to the proper method of dispatching their prisoner, one Peruzzi recommended poison, which was heard by Cosmo, who refused to take any other sustenance than a small portion of bread. In this dismal situation he remained four days, shut up from all his kindred and friends, where he soon expected to be numbered with the dead. But the man employed to take him off, unexpectedly proved his friend. Malavolta, the keeper of the prison, relented, and declared that he had no just reason to be alarmed, as he hesitated not to eat of every thing that was brought him.

His brother Lorenzo, and his cousin Averardo, raised a considerable body of men in Romagna and other districts; and being joined by the commander of the republican forces, they marched to Florence to relieve him. A decree was obtained from the magistracy, by which he was banished to Padua for ten years, his brother to Venice for five, and several of their relations shared a similar fate. Padua was in the dominions of Venice, and he received a deputation from the senate before he reached it, promising him their protection and assistance in whatever he should desire. He rather experienced the treatment of a prince than of an exile, as they entertained the highest expectations from his great commercial knowledge. From this period his life may be considered as one continued scene of uninterrupted prosperity, and his family received education equal to that of the greatest potentates. In his public and private charities he was almost unbounded, and perhaps possessed more wealth than any single individual in Europe at that period. In his promotion of science and encouragement of learned men he was truly exemplary, and from this source he acquired the greatest honour and esteem.

His fostering hand protected the arts as well as the sciences; and architecture, sculpture, and painting, all flourished under his powerful protection. The countenance he shewed to these arts was not such as their professors generally receive from the great; for the sums of money which he expended on pictures, statues, and public buildings, appear almost incredible. When he approached the period of his mortal existence, his faculties were still unimpaired; and 20 days before he died, he requested Ficino to translate from the Greek the treatise of Xenocrates on death. He died on the 1st of August 1464, at the age of 75, and gave strict injunctions, that his funeral should be conducted with as much privacy as possible. By public decree he was honoured with the title of *Pater Patriæ*, an appellation which was inscribed on his tomb, and was declared by competent judges, to be founded in real merit.

MEDICI, *Lorenzo de*, stiled, with great propriety, the Magnificent, was the grandson of Cosmo, and about 16 years of age at his decease. In 1469 his father died, and he succeeded to his authority as if it had constituted a part of his fortune. In the year 1474, Lorenzo incurred the displeasure of the pope for the opposition he

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he made to ſome of his encroachments on the petty princes of Italy, and for this reaſon he deprived him of the office of treaſurer of the Roman ſee, which he conferred on one Pazzi, connected with a Florentine family, the intereſt of which he thus ſecured, and intended to ſacrifice Lorenzo and Juliano to his private revenge. Their aſſaſſination was fixed for Sunday, April 26. 1478, and the cathedral was the place in which a monſter of an archbiſhop had reſolved to murder them by the inſtigation of the pope. When the people ſaw one of their favourites (Juliano) expiring, and the other (Lorenzo) covered with blood, their rage was not to be expreſſed in language. The interference of the magiſtrates was finally victorious, who had the courage and virtue to hang the archbiſhop from one of the windows, arrayed in his pontifical robes, which made Florence reſound with the acclamation—Medici, Medici! down with their enemies!

Lorenzo was delivered from that part of the cathedral to which he had fled for refuge, and was triumphantly carried home, where his wounds were attended to by men of ability. His friends in the mean time purſued the conſpirators, and ſpared none who happened to fall in their way. In a word, the generality of them were either hanged or decapitated, and very few had the good fortune to eſcape their uncommon vigilance. Much to the honour of Lorenzo, he exerted all his influence to prevent the indiſcriminate maſſacre of his cruel enemies, and reſtrain the juſt indignation of the people, begging that they would truſt the magiſtrates with the puniſhment of the guilty; and the reſpect in which he was held had the moſt aſtoniſhing effect in reſtraining the vengeance of popular indignation.

No ſooner had hoſtilities ceaſed between Pope Sextus and the Florentine republic, then Lorenzo began to develope plans for ſecuring the internal peace and tranquillity of Italy, by which the higheſt honour has been conferred on his political life. But the life of this great man was again brought into imminent danger by the intrigues of Cardinal Riario, and ſome Florentine exiles, who determined to aſſaſſinate him in the church of the Carmeli, on the feſtival of the Aſcenſion 1481; but the plot was happily diſcovered, the conſpirators were executed, and after this Lorenzo very ſeldom went abroad without being ſurrounded by a number of friends in whom he could ſecurely confide.

When we attentively examine the character of Lorenzo, it will not perhaps appear aſtoniſhing, that Italy, Chriſtendom, and even the Mahometans themſelves, conferred upon him the moſt flattering approbation. Even Prince Mirandola choſe Florence as the place of his reſidence entirely upon his account, and there ended his mortal career. To a moſt engaging perſon Lorenzo added almoſt every other accompliſhment. He was the favourite of the ladies, the envy of his own ſex, and the admiration of all. He was declared to be unrivalled in chivalry, and one of the moſt eminent orators that the world in any age has produced. According to the opinion of his contemporaries, he was even ſuperior to Julius Cæſar himſelf, except as a general, yet he would alſo have proved a moſt conſummate commander had not peace been always the darling of his ſoul. We recollect a memorable paſſage in the Rambler, which may here be appoſitely introduced. A great man condeſcending to do little things, is like the ſun in his weſtern declination; he remits his ſplendor, but retains his magnitude, and pleaſes more though he dazzles leſs. To ſuch little things did Lorenzo frequently ſubmit, often ſeeking pleaſure in his nurſery, and ſpending hours there in all the frivolous pranks of childiſh diverſion. The gravity of his life, if contraſted with its levity, muſt make him appear as a compoſition of two different perſons, incompatible, and, as it were, impoſſible to be joined the one with the other.

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Such were the love and veneration of the citizens for Lorenzo, that the phyſician who attended him on his deathbed, terrified to return to Florence, left the houſe in a ſtate of diſtraction, and plunged himſelf into a well. When Ferdinand king of Naples was informed of his death, he cried out, "This man has lived long enough for his own glory, but too ſhort a time for Italy." He died on the 8th of April 1492, amidſt a number of his weeping friends, who appeared deeply conſcious of ſuch an irreparable loſs.

Medicis, *John de*, on account of his bravery and knowledge in military affairs, was ſurnamed the *Invincible*. He was the ſon of John, otherwiſe called *Jourdain*, de Medicis. His only ſon Coſmo I. ſtyled the *Great*, was choſen duke of Florence after the murder of Alexander de Medicis, A. D. 1537. He firſt carried arms under Laurence de Medicis againſt the duke of Urbino, afterwards under Pope Leo X. Upon the death of Leo, he entered into the ſervice of Francis I. which he quitted to follow the fortune of Francis Sforza duke of Milan. When Francis I. formed an alliance with the pope and the Venetians againſt the emperor, he returned to his ſervice. He was wounded in the knee at Governola, a ſmall town in the Mantuan territory, by a muſket ball; and being carried to Mantua, he died the 29th of November 1526, aged 28. Brantome relates, that when his leg was to be cut off, and when he was informed that he needed ſome perſon to ſupport him, "Proceed without fear (ſaid he), I need nobody!" and he held the candle himſelf during the operation. This anecdote is alſo mentioned by Varchi. John de Medicis was above the middle ſtature, ſtrong, and nervous. His ſoldiers, to expreſs their affection for him and their concern for his loſs, aſſumed a mourning dreſs and ſtandards, which gave the name of *the black band* to the Tuſcan troops whom he commanded.

Medicis, *Laurence*, or *Laurenein de*, was deſcended from a brother of Coſmo the Great, and affected the name of *popular*. In 1537, he killed Alexander de Medicis, whom Charles V. had made duke of Florence, and who was believed to be the natural ſon of Laurence de Medicis duke of Urbino. He was jealous of Alexander's power, and diſguiſed this jealouſy under the ſpecious pretext of love to his country. He loved men of learning, and cultivated literature. His works are, 1. *Lamenti*, Modena, 12mo. 2. *Acidoſio Commedia*, Florence 1595, 12mo. He died without iſſue.

Medicis, *Hypolitus de*, natural ſon of Julian de Medicis and a lady of Urbino, was early remarkable for the brilliancy of his wit and the graces of his perſon. Pope Clement VII. his couſin, made him cardinal in 1529, and ſent him as legate into Germany to the court of Charles V. When that prince went into Italy, Medicis, yielding to his warlike diſpoſition,

appeared

appeared in the drefs of an officer, and advanced before the emperor, followed by feveral refpectable gentlemen of the court. Charles, natually fufpicious, and afraid that the legate intended to do him fome ill offices with the pope, fent after him and caufed him to be apprehended. But when he underftood that it was a mere fally of humour in the young cardinal, he fet him at liberty in a few days. The character which Medicis obtained by the happy fuccefs of this appointment was of effential fervice to him. He was confidered as one of the fupports of the Holy See; and a little before Clement's death, when the corfair Barbaroffa made a defcent into Italy to the great terror of Rome, which was only defended by 200 of the pope's guards, Medicis was defpatched to protect the coafts from the fury of the barbarians. On his arrival at the place of deftination, he was fortunate enough to find that Barbaroffa had withdrawn himfelf at that critical moment; which allowed him to claim the honour of the retreat without expofing his perfon or his army. When he returned to Rome, he was of great fervice in the election of Paul III. who neverthelefs refufed to make him legate to Ancona, though that office had been promifed to him in the conclave. Enraged alfo that the pope had beftowed the principality of Florence on Alexander de Medicis, fuppofed to be the natural fon of Laurence duke of Urbino, he was prompted by his ambition to believe that he might fucceed to that dignity by the deftruction of Alexander. He entered into a confpiracy againft him, and determined to carry him off by a mine; but the plot was difcovered before he had accomplifhed his purpofe. Octavian Zanga, one of his guards, was arrefted as his chief accomplice. Hypolitus de Medicis, apprehenfive for his own fafety, retired to a caftle near Tivoli. On his road to Naples, he fell fick at Itri in the territory of Fondi, and died Auguft 13. 1535, in his 24th year, not without fufpicion of being poifoned. His houfe was an afylum for the unfortunate, and frequently for thofe who were guilty of the blackeft crimes. It was open to men of all nations; and he was frequently addreffed in twenty different languages. He had a natural fon named *Afdrubal de Medicis*, who was a knight of Malta. This anecdote proves that his manners were more military than ecclefiaftic. He wore a fword, and never put on the habit of cardinal except on occafions of public ceremony. He was wholly devoted to the theatre, hunting, and poetry.

Medicis, *Alexander de*, firft duke of Florence in 1530, was natural fon of Laurence de Medicis furnamed the *Younger*, and nephew of Pope Clement VII. He owed his elevation to the intrigues of his uncle and to the arms of Charles V. This prince having made himfelf mafter of Florence after an obftinate fiege, conferred the fovereignty of this city on Alexander, and afterwards gave him in marriage Margaret of Auftria his natural daughter. According to the terms of capitulation granted to the Florentines, the new duke was to be only hereditary doge, and his authority was tempered by councils; which left them at leaft a fhadow of their ancient liberty. But Alexander, who felt himfelf fupported by the emperor and the pope, was no fooner in poffeffion of his new dignity, than he began to govern like a tyrant; being guided by no law but his own caprice, indulging the moft brutal paffions, and making light of difhonouring families, and of violating even the afylum of the cloifters to gratify his luft. Among the confidants of his debauchery was a relation of his own, Laurence de Medicis. This young man, who was only 22 years of age, at the inftigation of Philip Strozzi, a zealous republican, conceived the defign of affaffinating Alexander, and thereby of delivering his country from oppreffion. From the moment when he firft became attached to him, he tried to gain his confidence, for no other reafon but that he might the better have it in his power to take away his life. A confiderable time elapfed before he found fuch an opportunity as he defired. At length, under pretence of procuring the duke a *tête à tête* with a lady of whom he was deeply enamoured, he brought him alone and unattended into his chamber, and put him under his bed. He went out, under pretence of introducing the object of his paffion; and returned along with an affaffin by profeffion, to whom alone he had entrufted his defign, only to ftab him. This cruel fcene happened on the night betwixt the 5th and 6th of January 1537. Alexander was only 26 years of age. The Florentines derived no advantage from this crime of Laurence, for they failed in their attempt to recover their liberty. The party of the Medicis prevailed, and Alexander was fucceeded by Cofmo; whofe government, it muft be confeffed, was as juft and moderate, as that of his predeceffor had been violent and tyrannical. Laurence de Medicis fled to Venice, to fome of the leaders of the malecontents at Florence, who had taken refuge there; but not thinking himfelf in fufficient fecurity, he went to Conftantinople, whence he returned fome time after to Venice. He was there affaffinated in 1547, ten years after the duke's murder, by two foldiers, one of whom had formerly been in Alexander's guards: And thefe foldiers were generous enough to refufe a confiderable fum of money, which was the price put upon his head.

Medicis, *Cofmo de*, grand duke of Tufcany, joined Charles V. againft the French, after trying in vain to continue neutral. As a reward for his fervices, the emperor added to the duchy of Tufcany Piombino, the ifle of Elba, and other ftates. Cofmo foon after received from Pope Pius IV. the title of *grand duke;* and had it not been oppofed by all the princes of Italy, this pontiff, who was entirely devoted to Cofmo, becaufe he had thought proper to acknowledge him to be of his houfe, would have conferred on him the title of *king*. There never was a more zealous patron of learning. Ambitious of imitating the fecond Cæfar, he like him, was fond of learned men, kept them near his perfon, and founded for them the univerfity of Pifa. He died in 1574, at the age of 55, after governing with equal wifdom and glory. In 1562 he inftituted the military order of St Stephen. His fon, Francis Mary who died in 1587, was the father of Mary of Medicis, the wife of Henry the Great and of Ferdinand I. who died in 1608.

MEDIETAS linguæ, in *Law*, fignifies a jury, or inqueft impanelled, of which the one half are natives of this land and the other foreigners. This jury is never ufed except where one of the parties in a plea is a ftranger and the other a denizen. In petit treafon, murder, Medimnus || Medina.

murder, and felony, foreigners are allowed this privilege; but not in high treason, because an alien in that case shall be tried according to the rules of the common law, and not by a *medietas linguæ*. A grand jury ought not in any case to be of a *medietas linguæ*; and the person that would have the advantage of a trial in this way, is to pray the same, otherwise it will not be permitted on a challenge of the jurors.

MEDIMNUS, in Grecian antiquity, a measure of capacity. See MEASURE.

MEDINA-TALNARI, a famous town of Arabia Petræa, between Arabia Deserta and Arabia the Happy; celebrated for being the burial-place of Mahomet. It stands at a day's journey from the port of Iambo. It is of moderate size, surrounded by wretched walls, and situated in the midst of a sandy plain. It belongs to the scherif of Mecca, although it had of late times a particular sovereign of the family of Dacii Barkad. At present, the government is confided by the scherif to a vizir, who must be taken from the family of the sovereign. Before Mahomet, this city was called *Iathreb*; but it got the name of *Medinet en Nebbi*, "the City of the Prophet," after Mahomet, being driven from Mecca by the Koreischites, had taken refuge there, and passed in it the rest of his days. The tomb of Mahomet at Medina is respected by Mussulmans, but they are under no obligation to visit it for the purposes of devotion. The caravans of Syria and Egypt alone, which on their return from Mecca pass near Medina, go a little out of their way to see the tomb. It stands in a corner of the great square, whereas the Kaba is situated in the middle of that at Mecca. That the people may not perform some superstitious worship to the relics of the prophet, they are prevented from approaching the tomb by grates, through which they may look at it. It consists of a piece of plain mason work in the form of a chest, without any other monument. The tomb is placed between two others, where the ashes of the two first caliphs repose. Although it is not more magnificent than the tombs of the greater part of the founders of mosques, the building that covers it is decorated with a piece of green silk stuff embroidered with gold, which the pacha of Damascus renews every seven years. It is guarded by 40 eunuchs, who watch the treasure said to be deposited there. It is seated in a plain abounding with palm trees, in E. Long. 39. 53. N. Lat. 25. See (*History of*) ARABIA.

MEDINA Celi, an ancient town of Spain, in Old Castile, and capital of a considerable duchy of the same name; seated near the river Xalon, in W. Long. 2. 9. N. Lat. 41. 15.

MEDINA de-las-Torres, a very ancient town of Spain, in Estremadura, with an old castle, and the title of a duchy. It is seated on the confines of Andalusia, at the foot of a mountain near Bajadoz.

MEDINA-del-Campo, a large, rich, and ancient town of Spain, in the kingdom of Leon. The great square is very fine, and adorned with a superb fountain. It is a trading place, enjoys great privileges, and is seated in a country abounding with corn and wine. W. Long. 4. 20. N. Lat. 41. 22.

MEDINA-del-rio-Secco, an ancient and rich town of Spain, in the kingdom of Leon, with the title of a duchy: seated on a plain, remarkable for its fine pastures. E. Long. 4. 33. N. Lat. 42. 8.

Medina || Mediolanum.

MEDINA, SIR JOHN, an eminent painter, was son of Medina de l'Asturias, a Spanish captain who settled at Brussels, where the son was born in 1660. He was instructed in painting by Du Chatel; under whose direction he made great progress; and applying himself to the study of Rubens, made that eminent master his principal model. He painted both history and portrait; and was held in extraordinary esteem by most of the princes of Germany, who distinguished his merit by several marks of honour. He married young, and came into England in 1686, where he drew portraits for several years with great reputation; as he painted those subjects with remarkable freedom of touch, a delicate management of tints, and strong resemblance of the persons. The earl of Leven encouraged him go to Scotland, and procured him a subscription of 500l. worth of business. He went, carrying a large number of bodies and postures, to which he painted heads. He returned to England for a short time; but went back to Scotland, where he died, and was buried in the churchyard of the Grayfriars at Edinburgh in 1711, aged 52. He painted most of the Scotch nobility. Two small history pieces, and the portraits of the professors, in the Surgeons Hall at Edinburgh, were also painted by him. At Wentworth castle is a large piece containing the first duke of Argyll and his sons, the two late dukes John and Archibald, in Roman habits; the style Italian, and superior to most modern performers. The duke of Gordon presented Sir John Medina's head to the great duke of Tuscany for his collection of portraits done by the painters themselves; the duke of Gordon too was drawn by him, with his son the marquis of Huntley and his daughter Lady Jane, in one piece. Medina was knighted by the duke of Queensberry, lord high commissioner; and was the last knight made in Scotland before the union. The prints in the octavo edition of Milton were designed by him; and he composed another set for Ovid's Metamorphoses, but they were never engraved.

MEDINE, an Egyptian piece of money, of iron silvered over, and about the size of a silver threepenee.

MEDIOLANUM, an ancient city, the capital of the Insubres, built by the Gauls on their settlement in that part of Italy; a *municipium*, and a place of great strength; and a seat of the liberal arts; whence it had the name of *Novæ Athenæ*. Now *Milan*, capital of the Milanese, situated on the rivers Olana and Lombro, E. Long. 9. 30. N. Lat. 45. 25.

MEDIOLANUM Aulercorum, in *Ancient Geography*, a town of Gallia Celtica, which afterwards took the name of the *Eburovicum Civitas* (Antonine); corrupted to *Civitas Ebroicorum*, and this last to *Ebroica*; whence the modern appellation *Evreux*, a city of Normandy. E. Long. 1. 12. N. Lat. 49. 21.

MEDIOLANUM Gugernorum, in *Ancient Geography*, a town of Gallia Belgica; now the village *Moyland*, not far from Cologne.

MEDIOLANUM Ordovicum, in *Ancient Geography*, a town of Britain, now *Llan Vethlin*, a market town of Montgomeryshire in Wales.

MEDIOLANUM Santonum, in *Ancient Geography*, which afterwards taking the name of the people, was called

called *Santonica Urbs;* alſo *Santones* and *Santoni:* A town of Aquitaine. Now *Saintes*, capital of Saintonge in Guienne, on the river Charente.

MEDIOMATRICI, anciently a territory of Belgica. Now the dioceſe of Metz.

MEDITATION, an act by which we conſider any thing cloſely, or wherein the ſoul is employed in the ſearch or conſideration of any truth. In our religion, it is uſed to ſignify a conſideration of the objects and grand truths of the Chriſtian faith.

Myſtic divines make a great difference between *meditation* and *contemplation:* the former conſiſts in diſcurſive acts of the ſoul, conſidering methodically and with attention the myſteries of faith and the precepts of morality; and is performed by reflections and reaſonings, which leave behind them manifeſt impreſſions on the brain. The pure contemplative have no need of meditation, as ſeeing all things in God at a glance, and without any reflection. When a man, therefore, has once quitted meditation, and is arrived at contemplation, he returns no more; and, according to Alvarez, never reſumes the oar of meditation, except when the wind of contemplation is too weak to fill his ſails.

MEDITERRANEAN, ſomething encloſed within land; or that is remote from the ocean.

MEDITERRANEAN is more particularly uſed to ſignify that large ſea which flows between the continents of Europe and Africa, entering by the ſtraits of Gibraltar, and reaching into Aſia, as far as the Euxine ſea and the Palus Mæotis.

The Mediterranean was anciently called the *Grecian ſea* and the *Great ſea.* It is now cantoned out into ſeveral diviſions, which bear ſeveral names. To the weſt of Italy it is called the *Liguſtic* or *Tuſcan ſea;* near Venice, the *Adriatic;* towards Greece, the *Ionic* and *Ægean;* between the Helleſpont and the Boſphorus, the *White ſea*, as being very ſafe; and beyond, the *Black ſea*, its navigation being dangerous.

The Britiſh trade carried on by means of the Mediterranean ſea is of the laſt conſequence to Great Britain; and the permanent preſervation thereof depends on the poſſeſſion of the town and fortification of Gibraltar.

The counterfeiting of Mediterranean paſſes for ſhips to the coaſt of Barbary, &c. or the ſeal of the admiralty office to ſuch paſſes, is felony without benefit of clergy. Stat. 4. Geo. II. c. 18.

MEDITRINALIA, a Roman feſtival in honour of the goddeſs Meditrina, kept on the 30th of September. Both the deity and the feſtival were ſo called *à medendo*, becauſe on this day they began to drink new wine mixed with old by way of medicine. The mixture of wines, on this feſtival, was drank with much form and ſolemn ceremony.

MEDITULLIUM, is uſed by anatomiſts for that ſpongy ſubſtance between the two plates of the *cranium*, and in the interſtices of all laminated bones. See ANATOMY, N° I. II.

MEDIUM, in *Logic*, the mean or middle term of a ſyllogiſm, being an argument, reaſon, or conſideration, for which we affirm or deny any thing; or, it is the cauſe why the greater extreme is affirmed or denied of the leſs in the concluſion.

MEDIUM, in *Arithmetic*, or *arithmetical medium* or *mean*, called in the ſchools *medium rei;* that which is equally diſtant from each extreme, or which exceeds the leſſer extreme as much as it is exceeded by the greater, in reſpect of quantity, not of proportion; thus 9 is a medium betwixt 6 and 12.

Geometrical MEDIUM, called in the ſchools *medium perſonæ*, is that where the ſame ratio is preſerved between the firſt and ſecond as between the ſecond and third terms; or that which exceeds in the ſame ratio or quota of itſelf, as it is exceeded: thus 6 is a geometrical medium between 4 and 9.

MEDIUM, in *Philoſophy*, that ſpace or region through which a body in motion paſſes to any point: thus æther is ſuppoſed to be the medium through which the heavenly bodies move; air, the medium wherein bodies move near our earth; water, the medium wherein fiſhes live and move; and glaſs is alſo a medium of light, as it affords it a free paſſage. That denſity or conſiſtency in the parts of the medium, whereby the motion of bodies in it is retarded, is called the *reſiſtance of the medium;* which, together with the force of gravity, is the cauſe of the ceſſation of the motion of projectiles.

Subtle or *Ætherial* MEDIUM. Sir Iſaac Newton conſiders it probable, that, beſide the particular aëreal medium, wherein we live and breathe, there is another more univerſal one, which he calls an *æthereal medium;* vaſtly more rare, ſubtle, elaſtic, and active, than air, and by that means freely permeating the pores and interſtices of all other mediums, and diffuſing itſelf through the whole creation; and by the intervention hereof he thinks it is that moſt of the great phenomena of nature are effected. See ÆTHER, ELECTRICITY, FIRE, &c.

MEDIUM, in optics, any ſubſtance through which light is tranſmitted.

MEDLAR, See MESPILUS, BOTANY *Index.*

MEDULLA OSSIUM, or *Marrow of the bones.* See ANATOMY, N° 5.

MEDULLA *cerebri* and *cerebelli*, denotes the white ſoft part of the brain and cerebellum, covered on the outſide with the cortical ſubſtance, which is of a more dark or aſhy colour. See ANATOMY, N° 131—133.

MEDULLA *oblongata*, is the medullary part of the brain and cerebellum, joined in one; the fore part of it coming from the brain, and the hind part from the cerebellum. See ANATOMY, N° 134.

It lies on the baſis of the ſkull, and is continued through the great perforation thereof into the hollow of the vertebræ of the neck, back, and loins; though only ſo much of it retains the name *oblongata* as is included within the ſkull. After its exit thence it is diſtinguiſhed by the name of *medulla ſpinalis. Ibid.* N° 135.

MEDUSA, in fabulous hiſtory, one of the three Gorgons, daughter of Phorcys and Ceto. She was the only one of the Gorgons who was ſubject to mortality. She is celebrated for her perſonal charms and the beauty of her locks. Neptune became enamoured of her, and obtained her favours in the temple of Minerva. This violation of the ſanctity of the temple provoked Minerva; and ſhe changed the beautiful locks of Meduſa, which had inſpired Neptune's love, into ſerpents, the ſight of which turned the beholders into ſtones: but Perſeus, armed with Mercury's axe, with which he killed Argus, cut off Meduſa's head, from whoſe blood ſprang Pegaſus and Chryſaor, together with the innumerable

Medusa ‖ Meeren.

serpents that infest Africa. The conqueror placed Medusa's head on the ægis of Minerva, which he had used in his expedition; and the head still retained the same petrifyng powers as before.

MEDUSA, a genus of vermes, belonging to the order of mollusca. See HELMINTHOLOGY *Index*.

MEDWAY, a river of England, rises in the Weald of Sussex, and entering Kent near Ashurst, runs by Tunbridge, and thence continues its course towards Maidstone. It is navigable for large ships to Rochester bridge, and thence for vessels and barges to Maidstone, the tide flowing up to that town. The distance between the mouth of this river, where the fort at Sheerness is erected, and Rochester bridge, is between 16 and 18 miles. In this part of the river, the channel is so deep, the banks so soft, and the reaches so short, that it is one of the best and safest harbours in the world; and ships of 80 guns ride afloat at low water, within musket shot of Rochester bridge. Nor is there a single instance upon record, that any of the royal navy ever suffered here by storms, except in the dreadful tempest which happened in November 1703, when the Royal Catharine was sunk and lost. On the shore of this river are two castles, one at Upnor, which guards two reaches of the river, and is supposed to defend all the ships which ride above, between that and the bridge; on the other side of the river is Gillingham castle, built for the same purpose, and well furnished with cannon, which commands the river. Besides these, there is a platform of guns at a place called the Swam, and another at Cockhamwood. But the principal fortification on this river is the castle at Sheerness.

MEEREN, or MEER, JOHN VANDER, called the *Old*, an esteemed painter, was born in 1627. He chose for his subjects sea-pieces, landscapes, and views of the sea and its shores; which he painted with great truth, as he had accustomed himself to sketch every scene after nature. The situations of his landscapes are agreeably chosen, frequently they are solemn, and generally pleasing. The forms of his trees are easy and natural, his distances well observed, and the whole scenery has a striking effect, by a happy opposition of his lights and shadows. He also painted battles in an agreeable style, as they showed good composition, were touched with spirit, and had a great deal of transparence in the colouring. He died in 1690.

MEEREN, or MEER, *John Vander*, called *De Jonghe*, an eminent landscape painter, is supposed to have been the son of the old John Vander Meer, and of whom he learned the first rudiments of the art; but being in his youth deprived of his instructor before he had made any great progress, he became a disciple of Nicholas Berghem, and was accounted the best of those who were educated in the school of that admired master. In the manner of his master, he painted landscapes and cattle; and his usual subjects are cottages, with peasants at their rural occupations and diversions. It is observed of him, that he very rarely introduced cows, horses, or any other species of animals, except goats and sheep; the latter of which are so highly finished, that one would imagine the wool might be felt by the softness of its appearance. His touch is scarce perceptible, and yet the colours are admirably united. He died in 1688. The genuine works of this Vander Meer bear a very high price, and are esteemed even in Italy, where they are admitted into the best collections; but the scarcity of them has occasioned many moderate copies after his works to be passed on the undiscerning for real originals.

Megale ‖ Megara.

MEGALE POLIS, in *Ancient Geography*, dividedly (Ptolemy, Pausanius); or conjunctly *Megalopolis*, (Strabo): A town of Arcadia, built under the auspices of Epaminondas, after the battle of Leuctra; many inconsiderable towns being joined together in one great city, the better to withstand the Spartans. It was the greatest city of Arcadia, according to Strabo.

MEGALESIA, and MEGALENSES LUDI, feasts and games in honour of Cybele or Rhea the mother of the gods, kept on the 12th of April by the Romans, and famous for great rejoicings and diversions of various sorts. The Galli carried the image of the goddess along the city, with sound of drums and other music, in imitation of the noise they made to prevent Saturn from hearing the cries of his infant son Jupiter, when he was disposed to devour him.

MEGARA, *Ancient Geography*, a noble city, and the capital of the teritory of Megaris, which for many years carried on war with the Corinthians and Athenians. It had for some time a school of philosophers, called the *Megarici*, successors of Euclid the Socratic, a native of Megara. Their dialect was the Doric; changed from the Attic, which it formerly had been, because of Peloponnesian colonists who settled there.

Megara was situated at a distance from the sea. Its port was called *Nisæa*, from Nisus son of Pandion the second, who obtained Megaris for his portion, when the kingdom of Athens was divided into four lots by his father. He founded the town, which was eighteen stadia or two miles and a quarter from the city, but united with it, as the Piræus with Athens, by long walls. It had a temple of Ceres. "The roof (says Pausanias) may be supposed to have fallen through age." The site (as Dr Chandler informs us *) is now covered with rubbish, among which are standing some ruinous churches. The place has been named from them *Dode Ecclesiais*, "The Twelve Churches;" but the number is reduced to seven. The acropolis or citadel, called also *Nisæa*, was on a rock by the sea side. Some pieces of the wall remain, and a modern fortress has been erected on it, and also on a lesser rock near it.

* *Travels in Greece*, p. 192.

The village Megara (continues the doctor) consist of low mean cottages pleasantly situated on the slop of a brow or eminence indented in the middle. On each side of this vale was an acropolis or citadel; one named Caria; the other from Alcathous, the builder of the wall. They related, that he was assisted by Apollo, who laid his harp aside on a stone, which, as Pausanias testifies, if struck with a pebble returned a musical sound. An angle of the wall of one citadel is seen by a windmill. The masonry is of the species called Incertum. In 1676 the city wall was not entirely demolished, but comprehended the two summits, on which are some churches, with a portion of the plain toward the south. The whole site, except the hills, was now green with corn, and marked by many heaps of stones, the collected rubbish of buildings. A few inscriptions are found, with pedestals fixed in the walls and inverted; and also some maimed or mutilated

mutilated ſtatues. One of the former relates to Atticus Herodes, and is on a pedeſtal which ſupported a ſtatue erected to him when conſul, A. D. 143. by the council and people of Megara, in return for his benefactions and good will toward the city. In the plain behind the ſummits, on one of which was a temple of Minerva, is a large baſin of water, with ſcattered fragments of marble, the remains of a bath or of a fountain, which is recorded as in the city, and remarkable for its ſize and ornaments, and for the number of its columns. The ſpring was named from the local nymphs called Sithnides.

The ſtone of Megara was of a kind not diſcovered any where elſe in Hellas; very white, uncommonly ſoft, and conſiſting entirely of cockle ſhells. This was chiefly uſed; and, not being durable, may be reckoned among the cauſes of the deſolation at Megara, which is ſo complete, that one ſearches in vain for veſtiges of the many public edifices, temples, and ſepulchres, which once adorned the city.

Megara was engaged in various wars with Athens and Corinth, and experienced many viciſſitudes of fortune. It was the only one of the Greek cities which did not reflouriſh under their common benefactor Hadrian; and the reaſon aſſigned is, that the avenging anger of the gods purſued the people for their impiety in killing Anthemocritus, a herald, who had been ſent to them in the time of Pericles. The Athenian generals were ſworn on his account to invade them twice a-year. Hadrian and Atticus were followed by another friend, whoſe memory is preſerved by an inſcription on a ſtone lying near a church in the village:—"This too is the work of the moſt magnificent count Diogenes ſon of Archelaus, who regarding the Grecian cities as his own family, has beſtowed on that of the Megarenſians one hundred pieces of gold towards the building of their towers, and alſo one hundred and fifty more, with two thouſand two hundred feet of marble toward re-edifying the bath; deeming nothing more honourable than to do good to the Greeks, and to reſtore their cities." This perſon is not quite unnoticed in hiſtory. He was one of the generals employed by the emperor Anaſtaſius on a rebellion in Iſauria. He ſurpriſed the capital Claudiopolis, and ſuſtained a ſiege with great bravery, A. D. 494.

Megara retains its original name. It has been much infeſted by corſairs; and in 1676 the inhabitants were accuſtomed, on ſeeing a boat approach in the day time or hearing their dogs bark at night, immediately to ſecrete their effects and run away. The vaiwode or Turkiſh governor, who reſided in a forſaken tower above the village, was once carried off. It is no wonder, therefore, that Niſæa has been long abandoned. The place was burned by the Venetians in 1687.

Megara, in *Ancient Geography*, formerly called *Hybla*, a town towards the eaſt coaſt of Sicily; extinct in Strabo's time, though the name Hybla remained on account of the excellence of its honey. It was a colony of Megareans from Greece. *Riſus Megaricus* denotes a horſe laugh.

MEGARIS, in *Ancient Geography*, the country of the Megareans, is deſcribed as a rough region, like Attica; the mountain called *Oneian* or the Aſinine, now *Macriplayi* or "the long Mountain," extending through it towards Bœotia and Mount Cithæron. It belonged to Ionia or Attica, until it was taken by the Peloponneſians in the reign of Codrus, when a colony of Dorians ſettled in it. This territory had Attica to the eaſt, Bœotia to the north and weſt, and the iſthmus of Corinth to the ſouth.

Megaris, a ſmall iſland in the Tuſcan ſea, joined to Naples by a bridge, now called *Caſtello dell'Ovo*.

MEGASTHENES, a Greek hiſtorian in the age of Seleucus Nicanor, about 300 years before Chriſt. He wrote about the oriental nations, and particularly the Indians. His hiſtory is often quoted by the ancients. What now paſſes as his compoſition is ſpurious.

MEGIDDO, in *Ancient Geography*, a town of Galilee, recited (Joſhua xvii. 11.) among the cities of Manaſſeh, in the tribe of Iſſachar or Aſſer, on the weſt ſide of Jordan; famous for the defeat of Ahaziah and Joſiah, who periſhed there (2 Kings xxiii. 29.): near it was an open plain, fit for drawing up an army in battle array. It was ſituated to the north, contrary to its poſition in the common maps. The Canaanites, being tributary to the Iſraelites, dwelt in it, Joſhua xvii.—It was rebuilt by Solomon, 1 Kings ix.

MEIBOMIUS, the name of ſeveral learned Germans.—*John Henry Meibomius* was profeſſor of phyſic at Helmſtadt, where he was born, and at Lubec; he wrote the Life of Mæcenas, publiſhed at Leyden in 4to, 1653, with ſeveral other learned works. *Henry*, his ſon, was born at Lubec in 1638; became profeſſor of phyſic at Helmſtadt; and, beſides works in his own profeſſion, publiſhed *Scriptores rerum Germanicarum*, 3 vols. folio, 1688; a very uſeful collection, firſt begun by his father.—*Marcus Meibomius*, of the ſame family, publiſhed a collection of ſeven Greek authors who had written upon ancient muſic, with a Latin verſion by himſelf, dedicated to Queen Chriſtina of Sweden, who invited him to her court. But ſhe engaging him one day to ſing an air of ancient muſic, while ſomebody was ordered to dance to it, the immoderate mirth which this occaſioned in the ſpectators ſo diſguſted him, that he immediately left the court of Sweden. His edition of the Greek mythologiſts, and notes upon Diogenes Laërtius in Menage's edition, ſhow him to have been a man of learning; but he ſuffered no little raillery for his attempt to correct the Hebrew text of the Bible, by a kind of metre he fancied he had found out in thoſe ancient writings.

MEISSEN, a conſiderable town of Germany, in the electorate of Saxony, and in the margravate of Miſnia, with a caſtle. It formerly belonged to the biſhop, but is now ſecularized, and the inhabitants are Lutherans. In this place is a famous manufactory of porcelain. E. Long. 13. 33. N. Lat. 51. 15.

MEL, honey, in the *Materia Medica*. See Honey.

MELA, Pomponius, an ancient Latin writer, was born in the province of Bætica in Spain, and flouriſhed in the reign of the emperor Claudius. His three books of Coſmography, or *De ſitu orbis*, are written in a conciſe, perſpicuous, and elegant manner; and have been thought worthy of the attention and labours of the ableſt critics. Iſaac Voſſius gave an edition of them in 1658, 4to, with very large and copious notes. To this edition is added, *Julii Honorii oratoris excerptum coſmographiæ*, firſt publiſhed from the manuſcript, and *Æthici cosmographia.* Gronovius afterwards published another edition with illustrations by medals. In his last edition are added five books, *De Geographia*, written by some later author; by Jornandes, as Fabricius conjectures.

MELÆNE, or BLACK FLUX, in *Medicine.* See MEDICINE, N° 409.

MELALEUCA, a genus of plants belonging to the polydelphia class. See BOTANY *Index.*

MELAMPODIUM, a name given to black hellebore. See HELLEBORUS, BOTANY *Index.*

MELAMPODIUM, a genus of plants belonging to the syngenesia class; and in the natural method ranking under the 49th order, *Compositæ.* See BOTANY *Index.*

MELAMPUS, in fabulous history, a celebrated soothsayer and physician of Argos, son of Amythaon and Idomenea or Dorippe. He lived at Pylos in Peloponnesus. His servants once killed two large serpents who had made their nests at the bottom of a large oak; and Melampus paid so much regard to their remains, that he raised a burning pile and burned them upon it. He also took particular care of their young ones, and fed them with milk. Some time after this, the young serpents crept to Melampus as he slept on the grass near the oak; and, as if sensible of the favours of their benefactor, they wantonly played around him, and softly licked his ears. This awoke Melampus, who was astonished at the sudden change which his senses had undergone. He found himself acquainted with the chirping of the birds, and with all their rude notes, as they flew around him. He took advantage of this supernatural gift, and soon made himself perfect in the knowledge of futurity, and Apollo also instructed him in the art of medicine. He had soon after the happiness of curing the daughters of Prœtus, by giving them hellebore, which from that circumstance has been called *melampodium;* and, as a reward for his trouble, he married the eldest of these princesses. The tyranny of his uncle Neleus, king of Pylos, obliged him to leave his native country; and Prœtus, to show himself more sensible of his services, gave him part of his kingdom. About this time the personal charms of Pero, the daughter of Neleus, had gained many admirers; but the father promised his daughter only to him who brought into his hands the oxen of Iphiclus. This condition displeased many; but Bias, who was also one of her admirers, engaged his brother Melampus to steal the oxen and deliver them to him. Melampus was caught in the attempt, and imprisoned; and nothing but his services as a soothsayer and physician to Iphiclus would have saved him from death. All this pleaded in the favour of Melampus; but when he had taught the childless Iphiclus how to become a father, he not only obtained his liberty, but also the oxen; and with them he compelled Neleus to give Pero in marriage to Bias. A severe distemper, which had rendered the women of Argos insane, was totally removed by Melampus; and Anaxagoras, who then sat on the throne, rewarded his merit by giving him part of his kingdom, where he established himself, and where his posterity reigned during six successive generations. He received divine honours after death, and temples were raised to his memory.

MELAMPYRUM, COW-WHEAT, a genus of plants belonging to the didynamia class; and in the natural method ranking under the 40th order, *Personatæ.* See BOTANY *Index.*

MELANCHOLY, a kind of delirium attended with gloomy thoughts, heaviness, and sorrow. See MEDICINE, N° 327.

MELANCTHON, PHILIP, born at Bretten in the Palatinate in 1495, was one of the wisest and most able men of his age among the reformers, though of a mild temper, and disposed to accommodate rather than to inflame disputes. In his youth he made an admirable progress in learning, and was made Greek professor at Wittenberg in 1509. Here his lectures upon Homer, and the Greek text of St Paul's Epistle to Titus, drew to him a great number of auditors, and entirely effaced the contempt to which his low stature and mean appearance had exposed him. Melancthon reduced the sciences to systems; and acquired such reputation, that he had sometimes 2500 auditors. He soon entered into an intimate friendship with Luther, who taught divinity in the same university; and in 1519 they went together to Leipsic, to dispute with Eccius. The following years he was continually engaged in various employments; he composed several books; he taught divinity; took several journeys, in order to found colleges and visit churches; and in 1530 drew up a confession of faith, which goes by the name of the *Confession of Augsburg*, because it was presented to the emperor at the diet held in that city. All Europe was convinced, that he was not, like Luther, backward to accommodate the differences between the various sects of Christians. He hated religious disputes, and was drawn into them only through the necessity of the part he was called to act in the world; and therefore would have sacrificed many things to have produced an union among the Protestants. For this reason, Francis I. the French king, wrote to desire him to come and confer with the doctors of the Sorbonne, in order to agree with them about putting an end to all controversies; but though Luther endeavoured to persuade the elector of Saxony to consent to that journey, and though Melancthon himself desired it, that prince, whether he distrusted Melancthon's moderation, or was afraid of quarrelling with the emperor Charles V. would never grant his permission. The king of England also in vain desired to see him. Melancthon, in 1529, assisted at the conferences of Spires. In 1541, he was at the famous conferences at Ratisbon. In 1543, he went to meet the archbishop of Cologne to assist him in introducing the reformation into his diocese; but that project came to nothing: and in 1548, he assisted at seven conferences on the subject of the interim of Charles V. and wrote a censure on that interim, and all the writings presented at these conferences. He was extremely affected at the dissensions raised by Flaccus Illyricus. His last conference with those of the Roman communion was at Worms, in 1557. He died at Wittenberg in 1560, and was interred near Luther. Some days before he died, he wrote upon a piece of paper the reasons which made him look upon death as a happiness; and the chief of them was, that it "delivered him from theological persecutions." Nature had given Melancthon a peaceable temper, which was but ill suited to the time he was to live in. His moderation served only to be his cross. He was like a lamb in the midst of wolves. Nobody liked his mildness; it looked as if he

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was lukewarm; and even Luther himſelf was ſometimes angry at it.

Melancthon was a man in whom many good as well as great qualities were wonderfully united. He had great parts, great learning, great ſweetneſs of temper, moderation, contentedneſs, and the like, which would have made him very happy in any other times but thoſe in which he lived. He never affected dignities, or honours, or riches, but was rather negligent of all theſe things; too much ſo in the opinion of ſome, conſidering he had a family; and his ſon in-law Sabinus, who was of a more ambitious temper, was actually at variance with him upon this very account. Learning was infinitely obliged to him on many accounts; on none more than this, that, as already obſerved, he reduced almoſt all the ſciences which had been taught before in a vague irregular manner, into ſyſtems. Conſidering the diſtractions of his life, and the infinity of diſputes and tumults in which he was engaged, it is aſtoniſhing how he could find leiſure to write ſo many books. Their number is prodigious, inſomuch that it was thought neceſſary to publiſh a chronological catalogue of them in the year 1582. His works indeed are not correct, and he himſelf owned it: but as he found them uſeful, he choſe rather to print a great number, than to finiſh only a few: "which however (as Bayle ſays), was poſtponing his own glory to the advantage of others." His conſtitution was very weak, and required great tenderneſs and management; which made Luther, as hot and zealous as he was, blame him for labouring too earneſtly in the vineyard.

MELANIPPIDES, in fabulous hiſtory, a Greek poet about 520 years before Chriſt. His grandſon of the ſame name flouriſhed about 60 years after at the court of Perdiccas the Second, of Macedonia. Some fragments of their poetry are ſtill extant.

MELANTERIA, an old term in *Natural Hiſtory*, which ſeems to have been applied to copper pyrites.

The Greeks uſed it externally as a gentle eſcharotic and a ſtyptic, as an ingredient in their ointments for old ulcers, and alſo to ſprinkle in the form of powder on freſh wounds in order to ſtop the hæmorrhage.

MELASSES. See MOLASSES.

MELASTOMA, the AMERICAN GOOSEBERRY-TREE, a genus of plants belonging to the decandria claſs; and in the natural method ranking under the 17th order, *Calycanthemæ*. See BOTANY *Index*.

MELCHA, a ſmall village of Barbary, ſituated about 30 miles from the city of Tunis, built on the ruins of CARTHAGE, ſome of which are ſtill viſible.

MELCHITES, in church hiſtory, the name given to the Syriac, Egyptian, and other Chriſtians of the Levant. The Melchites, excepting ſome few points of little or no importance, which relate only to ceremonies and eccleſiaſtical diſcipline, are in every reſpect profeſſed Greeks; but they are governed by a particular patriarch, who reſides at Damas, and aſſumes the title of *patriarch of Antioch*. They celebrate maſs in the Arabian language. The religious among the Melchites follow the rule of St Baſil, the common rule of all the Greek monks. They have four fine convents diſtant about a day's journey from Damas, and never go out of the cloiſter.

MELCHISEDEC, or MELCHIZEDEK, king of Salem, and prieſt of the Moſt High. The ſcripture tells us nothing either of his father, or of his mother, or of his genealogy, or of his birth, or of his death. And in this ſenſe he was a figure of Jeſus Chriſt, as St Paul affirms, who is a prieſt for ever, according to the order of Melchiſedec, and not according to the order of Aaron, whoſe original, life, and death, are known. When Abraham returned from purſuing the four confederate kings, who had defeated the kings of Sodom and Gomorrah, and had taken away Lot Abraham's nephew along with them (Gen. xiv. 17, 18, 19, &c.) Melchiſedek came to meet Abraham as far as the valley of Shaveh, which was afterwards named the King's valley, preſented him with the refreſhment of bread and wine (or he offered bread and wine in ſacrifice to the Lord, for he was a prieſt of the moſt high God), and bleſſed him. Abraham, being deſirous to acknowledge in him the quality of prieſt of the Lord, offered him the tythes of all he had taken from the enemy. After this time, there is no mention made of the perſon of Melchiſedec; only the Pſalmiſt (cx 4.) ſpeaking of the Meſſiah, ſays, "Thou art a prieſt for ever after the order of Melchiſedec." St Paul, in his epiſtle to the Hebrews, unfolds the myſtery which is concealed in what is ſaid of Melchiſedec in the Old Teſtament. See Heb. v. 6—10. An infinite number of difficulties and ſcruples have been ſtarted upon the ſubject of Melchiſedec.—St Jerome thought that Salem, of which Melchiſedec was king, was not Jeruſalem, but the city of Salem near Scythopolis, where they ſtill pretended to ſhow the ruins of the palace of this prince. The greatneſs and extent of theſe ruins are a ſufficient proof of the magnificence of this ancient building. He thinks it was at this city of Salem or Shalem, that Jacob arrived after his paſſage over Jordan, at his return from Meſopotamia (Gen. xxxiii. 18.). Some believe that Salem, where Melchiſedec reigned, is the ſame as Salim ſpoken of in the goſpel of St John, chap. iii. 23. From the time of Epiphanes there were names invented for the father and mother of Melchiſedec. To his father was given the name of Heraclas or Heracles, and to his mother that of Aſhtaroth or Aſtaria. It is generally agreed on by the learned, that when the apoſtle ſays, he was "without father and without mother," no more is meant, than that he is introduced into the hiſtory of Abraham without acquainting us who he was, or whence he came, where he lived, or when he died. Nevertheleſs, ſome have taken St Paul's words literally, and contended that he was not of human but divine nature. Origen and Didymus took him to be an angel; and the author of the Queſtions upon the Old and New Teſtament pretends, that he was the Holy Ghoſt, who appeared to Abraham in a human form. The Arabic Catena, upon the ninth chapter of Geneſis, makes Melchiſedec to be deſcended from Shem by his father, and from Japheth by his mother. Heraclas or Heraclim his father, was, they ſay, ſon or grandſon of Phaleg, and ſon of Heber; and his mother named Salathiel, was daughter of Gomer ſon of Japheth. Cedrenus and others derive Melchiſedec from an Egyptian ſtock. They ſay his father was called Sidon or Sida, and was the founder of the city of Sidon the capital of Phœnicia. Suidas ſays he was of the curſed race of Canaan; for which reaſon the ſcripture does not mention his genealogy. The Jews and Samaritans believed Melchiſedec to be the ſame

Melchisedec. same with the patriarch Shem; which opinion has been followed by a great number of modern writers. M. Jurieu has undertaken to prove that he is the same as Cham or Ham. It would be endless to set down all the opinions upon this matter: therefore we shall only add, that Peter Cunæus and Peter du Moulin have asserted, that Melchisedec who appeared to Abraham was the Son of God, and that the patriarch worshipped him and acknowledged him for the Messiah.

About the beginning of the third century arose the heresy of the Melchisedecians, who affirmed that Melchisedec was not a man, but a heavenly power, superior to Jesus Christ: for Melchisedec, they said, was the intercessor and mediator of the angels, but Jesus Christ was so only for men, and his priesthood only a copy of that of Melchisedec, who was the Holy Ghost.

We shall only beg leave to add here one opinion more concerning Melchisedec, which is that of the learned Heidegger, who, as the author of the *Hist. Patriar.* thinks, has taken the right method of explaining the accounts of Moses and the apostle Paul relating to this extraordinary person. He supposes a twofold Melchisedec; the one historical, whereof Moses gives an account in the 14th chapter of Genesis, as that he was king as well as high priest of Jerusalem; the other allegorical, whom St Paul describes, and this allegorical person is Jesus Christ.

As the history of this prince and priest is so little known, it is no wonder, as Selden observes, that many fabulous accounts have been invented of him; of which the following may suffice as a specimen. Eutychus patriarch of Alexandria relates, that the body of Adam having been embalmed according to his order, was deposited in a cave under a mountain of the children of Seth; but that Adam before his death had commanded that they should take away his remains from that place, and transport them to the middle of the earth: that Noah, to follow the orders of his ancestors, had preserved the bodies of Adam and all the patriarchs with him in the ark: that finding himself near his death, he ordered his son Shem to take the body of Adam, to furnish himself with bread and wine for his journey, to take with him Melchisedec the son of Phaleg, and to go to the place in which an angel would show them where to bury the first man: that Noah added this order, "Command Melchisedec to fix his residence in that place, and to live unmarried all his lifetime, because God has chosen him to do service in his presence; command him, that he build no temple, nor shed the blood of birds, nor four-footed beasts, or any other animal; and that he offer no other oblations to God but bread and wine." This is the reason, according to this author, why Melchisedec, when he met Abraham, brought forth only bread and wine.

A Greek author, under the name of Athanasius, relates, that Mischisedec was the son of an idolatrous king called Melchi and of a queen called Salem.—Melchi, having resolved to offer a sacrifice to the gods, sent his son Melchisedec to fetch him seven calves. In the way the young prince was enlightened by God, and immediately returned to his father, to demonstrate to him the vanity of his idols. Melchi, in wrath, sent him back to fetch the victims. While he was absent, the king sacrificed his eldest son, and a great many other children, to his gods. Melchisedec returning, and conceiving great horror at this butchery, retired to Mount Tabor, where he lived seven years, without clothes, and fed only on wild fruits. At the end of seven years, God appeared to Abraham, bid him go up to Mount Tabor, where he should find Melchisedec. He ordered him to clothe him, and to ask his blessing; which Abraham having done, Melchisedec anointed him with oil, and they came down together from the mountain.

Melcomb-regis. MELCOMB REGIS, a town of Dorsetshire, in England, 130 miles from London, is situated at the mouth of the river Wey, by which it is parted from Weymouth. It appears from the name to have been anciently the king's demesne, and from the records to have paid quit-rent to the crown all along after King Edward I. till it was bought off by the inhabitants before they were united to Weymouth. It lies on the north side of the haven, on a peninsula surrounded by the sea on all sides except on the north. The streets are broad and well paved, and many of the houses large and high. It sent members to parliament in the reign of King Edward I. before Weymouth had that privilege. It was by parliament appointed a staple in the reign of Edward III. In the next reign the French burnt it; and it was thereby rendered so desolate, that the remaining inhabitants prayed and obtained a discharge from customs. On account of its quarrels with Weymouth, in the reign of Henry VI. its privileges as a port were removed to Pool: but in that of Queen Elizabeth they were restored to it by act of parliament, which was confirmed in the next reign, on condition that Melcomb and Weymouth should make but one corporation, and enjoy their privileges in common; and to this was owing the flourishing state of both. In the two reigns last mentioned, a wooden bridge with seventeen arches was built from hence to Weymouth; to which, as well as its church, the chief contributors were certain citizens of London; and upon its decay it was rebuilt in 1770. Here is a good market-place and town-hall, to which the members of the corporation of Weymouth come to attend public business, as the inhabitants do to its church for public worship. For several years past the sea has retired from it on the east, the priory formerly being bounded by the sea; but there is now a street beyond it, from which it is several paces to the high water mark. The priory was situated in the east part of the town, in Maiden street, whose site occupied about an acre, now covered with tenements. On the south side are the remains of the chapel, now converted into a malt-house. Near it are the remains of an ancient building, formerly a nunnery. Here are three meeting houses and a workhouse for the poor. The church, which is in the middle of the town, has a wooden turret for a bell, and had been an old chapel. It was rebuilt in 1605, and made parochial, and is a handsome fabric, with a beautiful altarpiece painted and given by Sir James Thornhill. The port, which generally goes by the name of Weymouth, is said to be the best frequented in the county, and is defended by Sandford and Portland castles. The markets for both towns are Tuesdays and Fridays, but there are no fairs. Melcomb-regis is reckoned bigger, more thriving,

and

and populous than Weymouth. They are both but one corporation and borough, consisting of a mayor, recorder, two bailiffs, an uncertain number of aldermen, and twenty-four capital burgesses. Whoever has been a mayor is ever after an alderman. They send four burgesses to parliament, who are elected by such as have freeholds, whether they are inhabitants or not; the number of voters is near 700. Every elector, as in London, has the privilege of voting for four persons, who when chosen are returned, in two distinct indentures, as the burgesses of Weymouth and the burgesses of Melcomb-regis.

MELDÆ, in *Ancient Geography*, a town of Gallia Celtica, (called *Meldorum Civitas* in the Notitia), on the Matrona. Now *Meaux*, a city of Champagne, on the Marne, in France.

MELEAGER, in fabulous history, a celebrated hero, son of Œneus king of Calydonia, by Althæa daughter of Thestius. The Parcæ were present at the moment of his birth, and predicted his future greatness. Clotho said that he would be brave and courageous; Lachesis foretold his uncommon strength and valour: and Atropos said that he should live as long as that firebrand, which was on the fire, remained entire and unconsumed. Althæa no sooner heard this, than she snatched the stick from the fire, and kept it with the most jealous care, as the life of her son totally depended upon its preservation. The fame of Meleager increased with his years; he signalized himself in the Argonautic expedition, and afterwards delivered his country from the neighbouring inhabitants, who made war against his father, at the instigation of Diana, whose altars Œneus had neglected. But Diana punished the negligence of Œneus by a greater calamity. She sent a huge wild boar, which laid waste all the country, and seemed invincible on account of its immense size. It became soon a public concern: all the neighbouring princes assembled to destroy this terrible animal; and nothing is more famous in mythological history, than the hunting of the Calydonian boar. The princes and chiefs that assembled, and which are mentioned by mythologists, were Meleager son of Œneus, Idas and Lynceus sons of Apharcus, Dryas son of Mars, Castor and Pollux sons of Jupiter and Leda, Pirithous son of Ixion, Theseus son of Ægeus, Anceus and Cepheus sons of Lycurgus, Admetus son of Pheres, Jason son of Æson, Peleus and Telamon sons of Æacus, Iphicles son of Amphitryon, Eurytrion son of Actor, Atalanta daughter of Schœneus, Iolas the friend of Hercules, the sons of Thestius, Amphiaraus son of Oileus, Protheus, Cometes, the brothers of Althæa, Hippothous son of Cercyon, Leucippus, Adrastus, Ceneus, Phileus, Echion, Lelex, Phœnix son of Amyntor, Panopeus, Hyleus, Hippasus, Nestor, Menœtius the father of Patroclus, Amphicides, Laërtes the father of Ulysses, and the four sons of Hippocoon. This troop of armed men attacked the boar, and it was at last killed by Meleager.—The conqueror gave the skin and the head to Atalanta, who had first wounded the animal. This irritated the rest, and particularly Toxeus and Plexippus the brothers of Althæa, and they endeavoured to rob Atalanta of the honourable present. Meleager defended her, and killed his uncles in the attempt. Meantime the news of this celebrated conquest had already reached Calydon, and Althæa went to the temple of the gods to return thanks for the victory which her son had gained: But being informed that her brothers had been killed by Meleager, she in the moment of resentment threw into the fire the fatal stick on which her son's life depended, and Meleager died as soon as it was consumed. Homer does not mention the firebrand; whence some have imagined that this fable is posterior to that poet's age. But he says, that the death of Toxeus and Plexippus so irritated Althæa, that she uttered the most horrible curses and imprecations upon her son's head.

MELEAGER, a Greek poet, the son of Eucrates, was born at Seleucia in Syria, and flourished under the reign of Seleucus VI. the last king of Syria. He was educated at Tyre; and died in the island of Coos, anciently called *Merope*. He there composed the Greek epigrams called by us the *Anthologia*. The disposition of the epigrams in this collection was often changed afterwards, and many additions have been made to them. The monk Planudes put them into the order they are in at present, in the year 1380.

MELEAGRIS, the TURKEY; a genus of birds belonging to the order of gallinæ. See ORNITHOLOGY *Index*.

MELES, the BADGER. See URSUS, MAMMALIA *Index*.

MELES, in *Ancient Geography*, a fine river running by the walls of Smyrna in Ionia, with a cave at its head, where Homer is said to have written his poems. And from it Homer takes his original name *Melesigenes*, given him by his mother Critheis, as being born on its banks. (Herodotus).

MELETIANS, in ecclesiastical history, the name of a considerable party who adhered to the cause of Meletius bishop of Lycopolis, in Upper Egypt, after he was deposed, about the year 306, by Peter bishop of Alexandria, under the charge of his having sacrificed to the gods, and having been guilty of other heinous crimes; though Epiphanius makes his only failing to have been an excessive severity against the lapsed. This dispute, which was at first a personal difference between Meletius and Peter, became a religious controversy; and the Meletian party subsisted in the fifth century, but was condemned by the first council of Nice.

MELIA, AZADERACH, or the *Bead tree*, a genus of plants, belonging to the decandria class; and in the natural method ranking under the 23d order *Trihilatæ*. See BOTANY *Index*.

MELIANTHUS, HONEY-FLOWER, a genus of plants belonging to the didynamia class; and in the natural method ranking under the 24th order *Corydales*. See BOTANY *Index*.

MELIBOEA, in *Ancient Geography*, an island of Syria, at the mouth of the Orontes; which, before it falls into the sea, forms a spreading lake round it. This island was famous for its purple dye. Thought to be a colony of Thessalians; and hence Lucretius's epithet, *Thessalicus*.

MELICA, ROPEGRASS, a genus of the digynia order, belonging to the triandria class of plants; and in the natural method ranking under the 4th order *Gramina*. See BOTANY *Index*.

MELICERES, in *Surgery*, a kind of encysted tumour,

mour, so called when their contents are of the consistence of honey. See TUMOUR, SURGERY *Index*.

MELICERTA, MELICERTES, or *Melicertus*, in fabulous history, a son of Athamas and Ino. He was saved by his mother from the fury of his father, who prepared to dash him against a wall as he had done his brother Learchus. The mother was so terrified that she threw herself into the sea with Melicerta in her arms. Neptune had compassion on the misfortunes of Ino and her son. He changed them both into sea deities. Ino was called *Leucothoë* or *Matuta;* and Melicerta was known among the Greeks by the name of *Palæmon*, and among the Latins by that of *Portumnus*. Some suppose that the Isthmian games were instituted in honour of Melicerta.

MELILLA, an ancient town of Africa, in the kingdom of Fez, and in the province of Garet. It was taken by the Spaniards in 1469, but returned back to the Moors. W. Long. 2. 9. N. Lat. 35. 20.

MELILOT. See TRIFOLIUM, BOTANY and AGRICULTURE *Index*.

MELINDA, a kingdom on the east coast of Africa, situated, according to some, between the third and fourth degree of south latitude; though there is great disagreement among geographers as to its extent. It is allowed by all, however, that the coasts are very dangerous; being full of rocks and shelves, and the sea at some seasons very liable to tempests. The kingdom of Melinda is for the most part rich and fertile; producing almost all the necessaries of life except wheat and rice, both which are brought thither from Cambaya and other parts; and those who cannot purchase them make use of potatoes in their stead, which are here fine, large, and in great plenty. They likewise abound with great variety of fruit trees, roots, plants, and other esculents, and with melons of exquisite taste. They have also great plenty of venison, game, oxen, sheep, hens, geese, and other poultry, &c. and one breed of sheep whose tails weigh between 30 and 40 pounds. The capital city is also called *Melinda*.

MELINUM, in *Natural History*, the name of an earth famous in the earliest ages of painting, being the only white of the great painters of antiquity; and, according to Pliny's account, one of the three colours with which alone they performed all their works. From the description given of this earth it seems to be aluminous, tolerably pure, and in a state of minute division.

MELISSA, in fabulous history, a daughter of Melissus king of Crete, who with her sister Amalthæa fed Jupiter with the milk of goats. She first found out the means of collecting honey; whence it has been fabled that she was changed into a bee, as her name is the Greek word for that insect.

MELISSA, *Baum*, a genus of plants, belonging to the didynamia class; and in the natural method ranking under the 42d order *Verticillatæ*. See BOTANY *Index*.

MELISSUS of SAMOS, a Greek philosopher, was the son of Rhagines and the disciple of Parmenides; and lived about 440 B. C. He pretended that the universe is infinite, immoveable, and without a vacuum. Themistocles was among his pupils.

MELITE, in *Ancient Geography*, an island referred to Africa by Scylax and Ptolemy; but nearer Sicily, and allotted to it by the Romans: commended for its commodious harbours; for a city well built, with artificers of every kind, especially weavers of fine linen; all owing to the Phœnicians, the first colonists. Now *Malta;* remarkable for St Paul's shipwreck. See MALTA.

MELITE, *Melita*, or *Melitina Insula;* an island on the coast of Illyricum in the Adriatic. The *Catuli Melitæi* (Pliny) were famous. Now *Melede*, the name of the island Samos. See SAMOS.

MELITE, in *Ancient Geography*, a town of Ionia, struck out of the number of Ionian towns on account of the arrogance of the people, and Smyrna admitted in lieu of it. The situation not said.

MELITENSIS TERRA, the *Earth of Malta:* an earth of which there are two very different kinds; the one of which is a bole, the other a marl. The latter is that known by medical authors under this name; the former is the Malta earth now in use; but both being brought from the same place, are confusedly called by the same name. The Maltese marl, which is the *terra Melitensis* of medical authors, is a loose, crumbly, and light earth, of an unequal and irregular texture; and, when exposed to the weather, soon falls into fine soft powder: but when preserved and dried, it becomes a loose, light mass, of a dirty white colour, with a grayish cast: it is rough to the touch, adheres firmly to the tongue, is very easily crumbled to powder between the fingers, and stains the hands. Thrown into the water, it swells, and afterwards moulders away into a fine powder. It ferments very violently with acids. Both kinds are found in great abundance in the island of Malta, and the latter has been much esteemed as a remedy against the bites of venomous animals. The other has supplied its place in the German shops; and is used there as a cordial, sudorific, and astringent.

MELITO (canonized), bishop of Sardis in Lydia, in the second century; remarkable for the apology he presented to the emperor Aurelius, in favour of the Christians; on which Eusebius and the other ancient ecclesiastical writers bestow great praises: but that apology and all Melito's other works are lost.

MELITUS, a Greek orator and poet, the accuser of Socrates. The Athenians, after the death of Socrates, discovering the iniquity of the sentence they had passed against that great philosopher, put Melitus to death, 400 B. C.

MELLER, a lake of Sweden, 80 miles long, and 30 broad; on which stands the city of Stockholm.

MELLI, with the country of the Mundingoes, in Africa. The country formerly called *Melli*, now chiefly inhabited by the Mundingoes, who still retain pretty much of the character ascribed to the people of Melli, lies to the south of the river Gambia; on the west it borders on the kingdom of Kabo; on the south it has *Melli*, properly so called, and the mountains that part it from Guinea; and on the east it extends to the kingdom of Gago. With a great part of this country we are little acquainted, as is the case with regard to most of the inland territories of Africa; but towards the sea coast this country is a little better known.

The first place of note we meet with is Kachao, a Portuguese colony, situated on the river of St Domingo, which falls into the sea about 26 leagues below this town.—About 26 leagues above Kachao, on th

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fame fide of the river, is another trading town called *Farini*, where, in the months of October and November, one may trade for about half the quantity of wax and ivory which is traded for at Kachoa. Here are alfo fome flaves to be bought.—Bot is a village near the mouth of the river Gefves, where moft of the traders buy rice; which is in great plenty there, and very good.—Gefves is a village on a river of the fame name, on which the Portuguefe have a factory. At Gefves one may trade yearly for 250 flaves, 80 or 100 quintals of wax, and as many of ivory. Near the mouth of the river of Gefves is a village called *Kurbali*, where there is a confiderable trade for falt; here are alfo fome flaves and ivory. Rio Grande, or the Great River, runs about 10 or 12 leagues to the fouth of the river of Gefves. About 80 leagues from the mouth of it is a nation of negroes, who are confiderable traders in ivory, rice, millet, and fome flaves. They are called *Analons*. Over againft the mouth of Rio Grande is a clufter of iflands called *Biffago Ifles*; the moft confiderable of which is Caffagut, being about fix leagues long and two broad; its foil is very good, and produces millet, rice, and all kinds of pulfe, befides orange and palm trees, and many others. This ifland, with thofe of Carache, Canabac, and La Gallina, are the only ones where the Europeans may trade with fome fecurity. They trade, however, fometimes at the other iflands, but they muft be extremely cautious; and yet after all their precautions, they will be robbed and murdered if they venture to go afhore. The river Nunho runs 16 leagues to the fouth of Rio Grande; it is very confiderable, and comes from a vaft diftance inland. One may buy here 300 quintals of ivory and 100 flaves a-year. Rice grows here admirably well, and is very cheap. There are everywhere fugar canes which grow naturally; and plants of indigo, which might turn to good account. The trade is carried on here from March till Auguft. In the river of Sierra Leone, the late Royal African Company of England had, in the year 1728, two iflands; the one, called *Taffo*, a large flat ifland, near three leagues in circumference, in which the company's flaves had a good plantation; the reft of the ifland is covered with wood, among which are filk cotton trees of an unaccountable fize. The other ifland is *Benfe*, whereon ftood a regular fort. It was formerly the refidence of one of the Englifh chiefs.

MELMOTH, William, Esq. a learned member of Lincoln's Inn, was born in 1666. In conjunction with Mr Peere Williams, Mr Melmoth was the publifher of Vernon's Reports, under an order of the court of chancery. He had once an intention of printing his own Reports; and a fhort time before his death advertifed them at the end of thofe of his coadjutor Peere Williams, as then actually preparing for the prefs. They have, however, not yet made their appearance. But the performance for which he juftly deferves to be held in perpetual remembrance is, "The Great Importance of a Religious Life;" concerning which it may be mentioned, to the credit of the age, that notwithftanding many large editions had before been circulated, 42,000 copies of this ufeful treatife have been fold in the laft 18 years. It is a fomewhat fingular circumftance, that the real author of this moft admirable treatife fhould never before have been publicly known (it having been commonly attributed to the firft earl of Egmont, and particularly by Mr Walpole in his Catalogue); which is the more furprifing, as the author is plainly pointed out in the following fhort character prefixed to the book itfelf: "It may add weight, perhaps, to the reflections contained in the following pages, to inform the reader, that the author's life was one uniform exemplar of thofe precepts which, with fo generous a zeal, and fuch an elegant and affecting fimplicity of ftyle, he endeavours to recommend to general practice. He left others to contend for modes of faith, and inflame themfelves and the world with endlefs controverfy: it was the wifer purpofe of his more ennobled aim, to act up to thofe clear rules of conduct which revelation hath gracioufly prefcribed. He poffeffed by temper every moral virtue; by religion every Chriftian grace. He had a humanity that melted at every diftrefs; a charity which not only thought no evil, but fufpected none. He exercifed his profeffion with a fkill and integrity which nothing could equal but the difinterefted motive that animated his labours, or the amiable modefty which accompanied all his virtues. He employed his induftry, not to gratify his own defires; no man indulged himfelf lefs: not to accumulate ufelefs wealth; no man more difdained fo unworthy a purfuit: it was for the decent advancement of his family, for the generous affiftance of his friends, for the ready relief of the indigent. How often did he exert his diftinguifhed abilities, yet refufe the reward of them, in defence of the widow, the fatherlefs, and him that had none to help him! In a word, few have ever paffed a more ufeful, not one a more blamelefs life; and his whole time was employed either in doing good, or in meditating it. He died on the 6th day of April 1743, and lies buried under the cloifter of Lincoln's Inn Chapel. MEM. PAT. OPT. MER. FIL. DIC." The fon, by whom this character is drawn, is William Melmoth, Efq. the celebrated tranflator of Pliny and of Cicero's Letters; and author of thofe which pafs under the name of *Sir Thomas Fitzofborne*.

MELOCHIA, Jews mallow, a genus of plants belonging to the monodelphia clafs; and in the natural method ranking under the 37th order, *Columniferæ*. See Botany *Index*.

MELODUNUM, in *Ancient Geography*, a town of the Cenones in Gallia Celtica, above Lutetia; now *Melun*, in the Ifle of France, on the Seine.

MELODY, in mufic, a fucceffion of founds ranged in fuch a manner, according to the laws of rhythmus and modulation, that it may form a fentiment agreeable to the ear. Vocal melody is called *finging*; and that which is performed upon inftruments may be termed *fymphonic melody*.

The idea of rhythmus neceffarily enters into that of melody. An air is not an air but in proportion as the laws of meafure and quantity are obferved. The fame fucceffion of founds is fufceptible of as many different characters, as many different kinds of melody, as the various ways by which its emphatic notes, and the quantities of thofe which intervene, may be diverfified; and the change in duration of the notes alone, may difguife that very fucceffion in fuch a manner that it cannot be known. Thus, melody in itfelf is nothing; it is the rhythmus or meafure which determines it, and there can be no air without time. If then we abftract meafure measure from both, we cannot compare melody with harmony; for to the former it is essential, but not at all to the latter.

Melody, according to the manner in which it is considered, has a relation to two different principles. When regarded only as agreeable to the proportions of sound and the rules of modulation, it has its principle in harmony; since it is a harmonical analysis, which exhibits the different gradations of the scale, the chords peculiar to each mode, and the laws of modulation, which are the sole elements that compose an air. According to this principle, the whole power of melody is limited to that of pleasing the ear by agreeable sounds, as the eye may be pleased with an agreeable assemblage of suitable colours. But when considered as an imitative art, by which we may affect the mind with various images, excite different emotions in the heart, inflame or soothe the passions; by which, in a word, we produce different effects upon our moral faculties, which are not to be effectuated by the influence of external sense alone, we must explore another principle for melody: for in our whole internal frame there appears to be no power upon which either harmony alone, or its necessary results, can seize, to affect us in such a manner.

What then is the second principle? It is as much founded on nature as the first; but, in order to discover its foundation in nature, it will require a more accurate though simpler observation, and a more exquisite degree of sensibility in the observer. This principle is the same which varies the tone of the voice, when we speak, according as we are interested in what we say, and according to the different emotions which we feel in expressing it. It is the accent of languages which determines the melody of every nation; it is the accent which determines us to employ the emphasis of speaking while we sing, and to speak with more or less energy according as the language which we use is more or less accented. That language whose accents are the most sensible, ought to produce a more passionate and more lively melody; that which has little accentuation, or none at all, can only produce a cold and languid melody, without character and without expression. These are the true principles: in proportion as we depart from them, when we speak of the power of music upon the human heart, we shall become unintelligible to ourselves and others: our words will be without meaning.

If music does not impress the soul with images but by melody, if from thence it obtains its whole power, it must follow, that all musical sounds which are not pleasing by themselves alone, however agreeable to harmony they may be, is not an intimative music; and, being incapable, even with its most beautiful chords, either to present the images of things, or to excite the finer feelings, very soon cloys the ear, and leaves always the heart in cold indifference. It follows likewise, that notwithstanding the parts which harmony has introduced, and which the present taste of music so wantonly abuses, wherever two different melodies are heard at the same time, they counteract each other, and destroy the effects of both, however beautiful each may be when performed alone: from whence it may be judged with what degree of taste the French composers have introduced in their operas the miserable practice of accompanying one air with another, as well in singing, which is the native expression of pathos and sentiment, as in instrumental performances; which is the same thing as if whimsical orators should take it in their heads to recite two orations at the same time, that the elegance of each might derive more force from the other.

So much for Rousseau. The translator, however, has reason to fear, that the causes by which national melody is diversified and characterized, are more profound and permanent than the mere accentuation of language. This indeed may have great influence in determining the nature of the rhythmus, and the place of emphatic notes; but very little in regulating the nature of the emphasis and expression themselves. If Rousseau's principle be true in its full extent, he must of necessity acknowledge, that an air which was never set or intended for words, however melodious, cannot be imitative; he must likewise confess, that what is imitative in one nation cannot be such in another: nor can it be denied, upon his hypothesis, that the recitative, which is formed upon the mode of speaking, is the most forcible of all melodies; which is absurd. His other observations are at once judicious and profound. Though it is impossible to exhibit the beauty and variety of harmony by playing the same melody at the same time upon different keys, admitting those keys to form among themselves a perfect chord, which will of consequence preserve all the subsequent notes in the same intervals; yet this perfect harmony would by no means be uniformly pleasing to the ear. We must therefore of necessity introduce less perfect chords to vary and increase the pleasure, and these chords in any complex system of music must of necessity produce dissonances. It then becomes the business of the composer to be careful that these discords may arise as naturally from, and return as naturally to perfect harmony as possible. All these causes must inevitably vary the melody of the different parts; but still, amidst all these difficulties, the artist ought to be zealous in preserving the melody of each as homogeneous with the others as possible, that the result of the whole may be in some measure uniform. Otherwise, by counteracting each other, the parts will reciprocally destroy the effects one of another.

MELOE, a genus of insects of the order of coleoptera. See ENTOMOLOGY *Index*.

MELON, a species of CUCUMIS, in the Linnæan system. See BOTANY and GARDENING *Index*.

Water MELON. See ANGURIA, BOTANY *Index*.

MELOS, in *Ancient Geography*, an island between Crete and Peloponnesus, about 24 miles from Scyllæum. It is about 60 miles in circumference, and of an oblong figure. It enjoyed its independence for about 700 years before the time of the Peloponnesian war. This island was originally peopled by a Lacedemonian colony, 1116 years before the Christian era. For this reason the inhabitants refused to join the rest of the island and the Athenians against the Peloponnesians. This refusal was severely punished. The Athenians took Melos, and put to the sword all such as were able to bear arms. The women and children were made slaves, and the island left desolate. An Athenian colony repeopled it, till Lysander reconquered it and re-established the original inhabitants in their possessions.

MELOTHRIA, a genus of plants belonging to the triandria claſs; and in the natural method ranking under the 34th order, *Cucurbitaceæ*. See BOTANY *Index*.

MELPOMENE, in *Fabulous Hiſtory*, one of the muſes, daughter of Jupiter and Mnemoſyne. She preſided over tragedy. Horace has addreſſed the fineſt of his odes to her, as to the patroneſs of lyric poetry. She was generally repreſented as a young woman with a ſerious countenance. Her garments were ſplendid; ſhe wore a buſkin, and held a dagger in one hand and in the other a ſceptre and crown.

MELROSE, a town of Scotland, in the county of Selkirk, and on the confines of Tweedale, ſeated on the ſouth ſide of the river Tweed; with an ancient abbey, now in ruins. W. Long. 2. 32. N. Lat. 55. 32.

This abbey was founded by King David I. in 1136. He peopled it with Ciſtertians brought from Rivale abbey in Yorkſhire, and dedicated it to the Virgin Mary. At the reformation James Douglas was appointed commendator, who took down much of the building, in order to furniſh materials for a large houſe to himſelf, which ſtill remains, and is dated 1590. Nothing is left of the abbey excepting a part of the cloiſter walls elegantly carved; but the ruins of the church are of moſt uncommon beauty. Part is at preſent uſed for divine ſervice, the reſt uncovered; but every part does great honour to the architect.—Alexander II. was buried beneath the great altar, and it is alſo the place of interment of the Douglaſes and other potent families.—Its ſituation is extremely pleaſant.

MELT OF FISHES. In the melt of a living cod there are ſuch numbers of thoſe animalcules ſaid to be found in the ſemen of all male animals, that in a drop of its juice no larger than a grain of ſand, there are contained more than 10,000 of them; and conſidering how many ſuch quantities there are in the whole melt of one ſuch fiſh, it is not incredible, that there are more animals in one melt of it than there are living men at one time upon the face of the earth. However ſtrange and romantic ſuch a conjecture muſt appear, a ſerious conſideration and calculation will make it very evident. An hundred ſuch grains of ſand as thoſe juſt mentioned will make about an inch in length; therefore in a cubic inch there will be a million of ſuch ſands; and if there be 10,000 animals in each of thoſe quantities, there muſt be in the whole 150,000 millions, which is a number vaſtly exceeding that of mankind, even ſuppoſing the whole as populous as Holland.

MELTING CONE, in eſſaying, an hollow cone of braſs or caſt iron, into which melted metalline ſubſtances are thrown, in order to free them from their ſcoriæ. When a ſmall quantity of matter is melted, it will be ſufficient to rub the inſide of the cone with greaſe; but when the quantity is large, eſpecially if it contains any thing ſulphureous, this caution of tallowing the moulds is not ſufficient. In this caſe the eſſayer has recourſe to a lute reduced to thin pap with water, which effectually prevents any injury to the cone.

MELTON MOUBRAY, a town of Leiceſterſhire, 108 miles from London. It is a large well-built place, in a fertile ſoil; with a market on Tueſday, the moſt conſiderable for cattle of any in this part of the iſland. It is almoſt encompaſſed with a little river called the *Eye*, over which it has two fine bridges; and has a large handſome church, with a free ſchool. Here are frequent horſe races, and three fairs in the year.

MELVIL, SIR JAMES, deſcended from an honourable Scots family, being the third ſon of the laird of Raeth, was born about the middle of the 16th century. He went to France very young, in the capacity of page to Queen Mary, then married to the dauphin; and on the death of her huſband, followed her to Scotland, where he was made gentleman of her chamber, and admitted a privy counſellor. She employed him in her moſt important concerns, till her unhappy confinement in Lochleven, all which he diſcharged with the utmoſt fidelity; and, from his own accounts, there is reaſon to conclude, that, had ſhe taken his advice, ſhe might have avoided many of her misfortunes. When ſhe was priſoner in England, ſhe recommended him ſtrongly to her ſon James; with whom he continued in favour and employment until the death of Queen Elizabeth: James would then have taken him to England; but Melvil, now grown old, was deſirous of retiring from buſineſs, and in his retirement he drew up the memoirs of his paſt life for the uſe of his ſon. Theſe Memoirs were accidentally found in Edinburgh caſtle in the year 1660, though nobody knew how they came to be depoſited there; and were publiſhed in folio in 1683.

MEMBERS, in *Anatomy*, the exterior parts, ariſing from the trunk or body of an animal, like the boughs from the trunk of a tree.

MEMBER, in *Architecture*, denotes any part of a building; as a frieze, cornice, or the like.

MEMBER is ſometimes alſo uſed for moulding.

MEMBER, in *Grammar*, is applied to the parts of a period or ſentence.

MEMBER, is alſo uſed to denote ſome particular order or rank in a ſtate or government: thus we ſay, "member of a corporation, member of parliament, member of the council, &c."

MEMBRANE, MEMBRANA, in *Anatomy*, a ſimilar part of an animal body; being a thin, white, flexible, expanded ſkin, formed of ſeveral ſorts of fibres interwoven together, and ſerving to cover or wrap up certain parts of the body. See ANATOMY *paſſim*.

MEMEL, or MEMMEL; a town of Pruſſia, ſituated on the northern extremity of the Curiſche Haf, an inlet of the ſea about 70 miles in length, which is here joined to the Baltic by a narrow ſtrait.—It is an ill built town, with narrow dirty ſtreets; but remarkable for its extenſive commerce, being provided with the fineſt harbour in the Baltic. In 1784, 996 ſhips, amongſt which were 500 Engliſh, arrived here. The imports chiefly are, ſalt, iron, and ſalted herrings; the exports, which greatly exceed the imports, are amber, corn, hemp, flax, and particularly timber. An Engliſh conſul reſides here. The trade is daily increaſing, on account of the high duties which the court of Ruſſia has laid on the imports of Riga.

MEMNON, in *Fabulous Hiſtory*, a king of Ethiopia, ſon of Tithonus and Aurora. He came with a body of 10,000 men to aſſiſt his uncle Priam, during the Trojan war. He behaved with great courage, and killed Antilochus, Neſtor's ſon. The aged father challenged

lenged the Ethiopian monarch; but Memnon refuſed it on account of the venerable age of Neſtor, and accepted that of Achilles. He was killed in the combat, in the ſight of the Grecian and Trojan armies. Aurora prayed Jupiter to grant her ſon ſuch honours as might diſtinguiſh him from other mortals. The god conſented; and immediately a numerous flight of birds iſſued from the burning pile on which the body was laid, and dividing themſelves into two ſeparate bodies, fought with ſuch fury, that above half of them fell down in the fire as victims to appeaſe the manes of Memnon. Theſe birds were called *Memnonides;* and it has been obſerved by ſome of the ancients, that they never failed to return yearly to the tomb of Memnon in Troas, and repeat the ſame bloody engagement in honour of the hero from whom they received their name. The Ethiopians or Egyptians, over whom Memnon reigned, erected a celebrated ſtatue to the honour of their monarch. This ſtatue had the wonderful property of uttering a melodious ſound every day at ſunriſing, like that which is heard at the breaking of the ſtring of a harp when it is wound up. This was effected by the rays of the ſun when they fell upon it. At the ſetting of the ſun, and in the night, the ſound was lugubrious. This is ſupported by the teſtimony of the geographer Strabo, who confeſſes himſelf ignorant whether it proceeded from the baſis of the ſtatue, or the people that were then around it. This celebrated ſtatue was diſmantled by order of Cambyſes when he conquered Egypt; and its ruins ſtill aſtoniſh modern travellers by their grandeur and beauty.

Memnon of Rhodes, one of the generals of Darius king of Perſia, adviſed that prince to lay waſte the country, in order to deprive Alexander the Great's army of ſupport, and afterwards to attack Macedon; but this counſel was diſapproved by Darius's other generals. Memnon behaved at the paſſage of the Granicus like an experienced general. He afterwards defended the city of Miletum with great courage; ſeized the iſlands of Chio and Leſbos; ſpread terror throughout all Greece; and would have put a ſtop to the conqueſts of Alexander, if he had not been prevented by death. Barſina, Memnon's widow, was taken priſoner with Darius's wife, and Alexander had a ſon by her named *Hercules*.

MEMOIRS, in matters of literature, a ſpecies of hiſtory, written by perſons who had ſome ſhare in the tranſactions they relate; anſwering to what the Romans called *Commentarii*.—The journals of the proceedings of a literary ſociety, or a collection of matters tranſacted therein, are likewiſe called *Memoirs*.

MEMORY, a faculty of the mind, which preſents to us ideas or notions of what is paſt, accompanied with a perſuaſion that the things themſelves were formerly real and preſent. What we diſtinctly remember to have perceived, we as firmly believe to have happened, as what is now preſent to our ſenſes.

The opinions of philoſophers concerning the means by which the mind retains the ideas of paſt objects, and how thoſe ideas carry with them evidence of their objects having been actually perceived, ſhall be laid before our readers in another place: (ſee METAPHYSICS, Part I. chap. ii.) At preſent we ſhall throw together ſome obſervations on the memory, which, being of a practical rather than of a ſpeculative nature, cannot be admitted into the article where the nature of the faculty itſelf is diſcuſſed.

"When we remember with little or no effort, it is called *remembrance* ſimply, or *memory*, and ſometimes *paſſive memory* *. When we endeavour to remember what does not immediately (and as it were) of itſelf occur, it is called *active memory*, or *recollection*. A ready recollection of our knowledge, at the moment when we have occaſion for it, is a talent of the greateſt importance. The man poſſeſſed of it ſeldom fails to diſtinguiſh himſelf in whatever ſort of buſineſs he may be engaged." It is indeed evident, that when the power of retention is weak, all attempts at eminence of knowledge muſt be vain; for "memory is the primary and fundamental power †, without which there could be no other intellectual operation. Judgement and ratiocination ſuppoſe ſomething already known, and draw their deciſions only from experience. Imagination ſelects ideas from the treaſures of remembrance, and produces novelty only by varied combinations. We do not even form conjectures of diſtant, or anticipations of future, events, but by concluding what is poſſible from what is paſt."

* *Beattie's Elements of Moral Science.*

† *Idler.*

Of a faculty ſo important, many rules have been given for the regulation and improvement; of which the firſt is, that he who wiſhes to have a clear and diſtinct remembrance, ſhould be temperate with reſpect to eating, drinking, and ſleep. The memory depends very much upon the ſtate of the brain; and therefore whatever is hurtful to the latter, muſt be prejudicial to the former. Too much ſleep clouds the brain, and too little overheats it; therefore either of theſe extremes muſt of courſe hurt the memory, and ought carefully to be avoided. Intemperance of all kinds, and exceſs of paſſion, have the ſame ill effects; ſo that we rarely meet with an intemperate perſon whoſe memory is at once clear and tenacious.

"The livelieſt remembrance is not ſo vivid as the ſenſation that produced it ‡; and ideas of memory do often, but not always, decay more and more, as the original ſenſation becomes more and more remote in time. Thoſe ſenſations and thoſe thoughts have a chance to be long remembered which are lively at firſt; and thoſe are likely to be moſt lively which are moſt attended to, or which are accompanied with pleaſure or pain, with wonder, ſurpriſe, curioſity, merriment, and other lively paſſions. The art of memory, therefore, is little more than the art of attention. What we wiſh to remember we ſhould attend to, ſo as to underſtand it perfectly, fixing our view particularly upon its importance or ſingular nature, that it may raiſe within us ſome of the paſſions above mentioned. We ſhould alſo diſengage our minds from all other things, that we may attend more effectually to the object which we wiſh to remember. No man will read with much advantage who is not able at pleaſure to evacuate his mind, or who brings not to his author an intellect defecated and pure, neither turbid with care, nor agitated with pleaſure. If the repoſitories of thought are already full, what can they receive? If the mind is employed on the paſt or the future, the book will be held before the eyes in vain.

‡ *Beattie's Elements*, &c. and *Idler.*

"It is the practice of many readers, to note in the margin of their books the moſt important paſſages §, the

§ *Elements of Moral Science.*

the ſtrongeſt arguments, or the brighteſt ſentiments. Thus they load their minds with ſuperfluous attention, repreſs the vehemence of curioſity by uſeleſs deliberation, and by frequent interruption break the current of narration or the chain of reaſon, and at laſt cloſe the volume and forget the paſſages and the marks together. Others are firmly perſuaded, that nothing is certainly remembered but what is tranſcribed; and they, therefore, paſs weeks and months in transferring large quotations to a common place-book. Yet, why any part of a book which can be conſulted at pleaſure ſhould be copied, we are not able to diſcover. The hand has no cloſer correſpondence with the memory than the eye. The act of writing itſelf diſtracts the thoughts; and what is read twice, is commonly better remembered than what is tranſcribed. This method, therefore, conſumes time, without aſſiſting the memory. But to write an abridgement of a good book may ſometimes be a very profitable exerciſe. In general, when we would preſerve the doctrines, ſentiments, or facts, that occur in reading, it will be prudent to lay the book aſide, and put them in writing in our own words. This practice will give accuracy to our knowledge, accuſtom us to recollection, improve us in the uſe of language, and enable us ſo thoroughly to comprehend the thoughts of other men, as to make them in ſome meaſure our own."

"Our thoughts have for the moſt part a connec-
* Idler. tion *; ſo that the thought which is juſt now in the mind, depends partly upon that which went before, and partly ſerves to introduce that which follows.—Hence we remember beſt thoſe things of which the parts are methodically diſpoſed and mutually connected. A regular diſcourſe makes a more laſting impreſſion upon the hearer than a parcel of detached ſentences, and gives to his rational powers a more ſalutary exerciſe: and this may ſhow us the propriety of conducting our ſtudies, and all our affairs, according to a regular plan or method. When this is not done, our thoughts and our buſineſs, eſpecially if in any degree complex, ſoon run into confuſion."

As the mind is not at all times equally diſpoſed for the exerciſe of this faculty, ſuch ſeaſons ſhould be made choice of as are moſt proper for it. The mind is ſeldom fit for attention preſently after meals; and to call off the ſpirits at ſuch times from their proper employment in digeſtion, is apt to cloud the brain, and prejudice the health. Both the mind and body ſhould be eaſy and undiſturbed when we engage in this exerciſe, and therefore retirement is moſt fit for it: and the evening, juſt before we go to reſt, is generally recommended as a very convenient ſeaſon, both from the ſtillneſs of the night, and becauſe the impreſſions will then have a longer time to ſettle before they come to be diſturbed by the acceſſion of others proceeding from external objects; and to call over in the morning what has been committed to the memory overnight, muſt, for the ſame reaſon, be very ſerviceable. For, to review thoſe ideas while they continue freſh upon the mind, and unmixed with any others, muſt neceſſarily imprint them more deeply.

Some ancient writers ſpeak of an artificial memory, and lay down rules for attaining it. Simonides the poet is ſaid firſt to have diſcovered this, or at leaſt to have given the occaſion for it. The ſtory they tell of him is this: Being once at a feaſt, he recited a poem which he had made in honour of the perſon who gave the entertainment. But having (as is uſual in poetry) made a large digreſſion in praiſe of Caſtor and Pollux; when he had repeated the whole poem, his patron would give him but half the ſum he had promiſed, telling him he muſt get the other part from thoſe deities who had an equal ſhare in the honour of his performance. Immediately after, Simonides was told that two young men were without, and muſt needs ſpeak with him. He had ſcarcely got out of the houſe, when the room where the company was fell down, killed all the perſons in it, and ſo maſhed the bodies, that, when the rubbiſh was thrown off, they could not be known one from another: upon which Simonides recollecting the place where every one had ſat, by that means diſtinguiſhed them. Hence it came to be obſerved, that to fix a number of places in the mind in a certain order, was a help to the memory: As we find by experience, that, upon returning to places once familiar to us, we not only remember them, but likewiſe many things we both ſaid and did in them. This action therefore of Simonides was afterwards improved into an art; and the nature of it is this: They bid you form in your mind the idea of ſome large place or building, which you may divide into a great number of diſtinct parts, ranged and diſpoſed in a certain order. Theſe you are frequently to revolve in your thoughts, till you are able to run them over one after another without heſitation, beginning at any part. Then you are to impreſs upon your mind as many images of living creatures, or any other inſenſible objects which are moſt likely to affect you, and be ſooneſt revived in your memory. Theſe, like characters in ſhorthand, or hieroglyphics, muſt ſtand to denote an equal number of other words, which cannot ſo eaſily be remembered. When therefore you have a number of things to commit to memory in a certain order, all that you have to do is, to place theſe images regularly in the ſeveral parts of your building. And thus they tell you, that, by going over ſeveral parts of the building, the images placed in them will be revived in the mind; which of courſe will give you the things or words themſelves in the order you deſire to remember them. The advantage of the images ſeems to be this; that, as they are more like to affect the imagination than the words for which they ſtand, they will for that reaſon be more eaſily remembered. Thus, for inſtance, if the image of a *lion* be made to ſignify *ſtrength*, and this word *ſtrength* be one of thoſe I am to remember, and is placed in the porch; when, in going over the ſeveral parts of the building, I come to the porch, I ſhall ſooner be reminded of that image than of the word *ſtrength*. Of this artificial memory, both Cicero and Quintilian ſpeak; but we know not of any modern orator that has ever made uſe of it. It ſeems indeed to have been a laborious way of improving the memory, if it ſerves that end at all, and fitter for aſſiſting us to remember any number of unconnected words than a continual diſcourſe, unleſs ſo far as the remembrance of one word may enable us to recollect more. It is, however, in alluſion to it, that we ſtill call the parts of a diſcourſe *places* or *topics*, and say, *in the first place, in the second place*, &c.

But, doubtless, the most effectual way to gain a good memory, is by constant and moderate exercise of it; for the memory, like other habits, is strengthened and improved by daily use. It is indeed hardly credible, to what a degree both active and passive remembrance may be improved by long practice. *Scaliger* reports of himself, that in his youth he could repeat above 100 verses, having once read them; and *Berthecus* declares, that he wrote his *Comment upon Claudian* without consulting the text. To hope, however, for such degrees of memory as these, would be equally vain as to hope for the strength of *Hercules*, or the swiftness of *Achilles*. "But there are clergymen who can get a sermon by heart * in two hours, though their memory, when they began to exercise it, was rather weak than strong: And pleaders, with other orators who peak in public and *extempore*, often discover, in calling instantly to mind all the knowledge necessary on the present occasion, and every thing of importance that may have been advanced in the course of a long debate, such powers of retention and recollection as, to the man who has never been obliged to exert himself in the same manner, are altogether astonishing. As habits, in order to be strong, must be formed in early life, the memories of children should, therefore, be constantly exercised; but to oblige them to commit to memory what they do not understand, perverts their faculties, and gives them a dislike to learning." In a word, those who have most occasion for memory, as orators and public speakers, should not suffer it to lie idle, but constantly employ it in treasuring up and frequently reviving such things as may be of most importance to them; for by these means it will be more at their command, and they may place greater confidence in it upon any emergency."

* *Idler.*

"Men complain of nothing more frequently than of deficient memory †: and indeed every one finds, that after all his efforts, many of the ideas which he desired to retain have slipped irretrievably away; that acquisitions of the mind are sometimes equally fugitive with the gifts of fortune; and that a short intermission of attention more certainly lessens knowledge than impairs an estate. To assist this weakness of our nature, many methods besides those which we have mentioned have been proposed; all of which may be justly suspected of being ineffectual: for no art of memory, however its effects may have been boasted or admired, has been ever adopted into general use; nor have those who possessed it appeared to excel others in readiness of recollection or multiplicity of attainments." The reader who is desirous to try the effect of those helps, may have recourse to a treatise entitled *A new Method of Artificial Memory*; but the true method of memory is attention and exercise.

† *Elements of Moral Science.*

MNEMONICA, or the art of memory, as it was called by the ancients, has been lately revived and studied in Germany and France. In some notices concerning this subject which we have seen, it is observed that this science is more intimately connected with the Egyptian hieroglyphics than is generally thought, and that this connection may help to explain them. In Germany this art has been revived by M. Aretin; and a pupil of his, M. Kaestner has been permitted to teach the new doctrine at Leipsic, but on the express condition of not allowing his hearers to write down his lectures. This seems to be a singular, and we may add a silly prohibition. The following account is given of this art in a letter from Paris in the beginning of 1807. "During my residence, says the writer, in this metropolis I heard a great deal of a new method of *mnemonique*, or of a method to assist and fix our memory, invented by Gregor de Feinaigle. Notwithstanding the simplicity with which he announced his lectures in the papers, I could not determine myself to become a pupil of his, as I thought to find a quack or mountebank, and to be laughed at by my friends for having thrown away my cash in such a foolish manner. Perhaps I should hesitate to this moment about the utility of this newly invented method to assist our natural memory, had I not had the pleasure of dining at his excellency's the Count of Metternich, the Austrian ambassador, who followed, with all his secretaries, the whole course of lectures: they all spoke very advantageously of it, likewise several other persons of the first rank I met there: in consequence of this I was inserted into the list of pupils, and I follow, at this moment, the lectures. All I can tell you about this method is, it is a very simple one, and easy to be learned, adapted to all ages and sexes: all difficulties in such sciences as require an extraordinary good memory, for instance, the names and epochs in history, are at once overcome and obviated. There is not one branch of science to which this method cannot be applied. It is easy to be perceived that such an invention cannot pass without some critique, and even sarcasms, in the public prints: some of them were very injurious, and plausible enough to mislead the public, who, knowing nothing of the method, are always more ready to condemn than to assist. Mr Feinaigle, to answer all these critics at once, adopted a method not less public for Paris than the public papers, but less public for the rest of Europe: he gave, the 22d of last month, a public exhibition to about 2000 spectators, in which he did not appear at all, only about 12 or 15 of his pupils: each of them made such an application of the method as his situation in life required. The principal parts were the following: history, about names and years; geography, with respect to longitude, latitude, number of inhabitants, square miles, &c. &c.; grammar in various languages, about different editions of the same work; pandects, their division, and title of each book, title, &c; different systems of botany, poetry, arithmetic, &c. &c. At last one desired the company to give him one thousand words, without any connection whatsoever, and without numeric order; for instance, the word *astronomer*, for N°. 62; *wood*, for N° 188; *lovely*, for N° 370; *dynasty*, for N°. 23; *David*, for N° 90, &c. &c. till all the numbers were filled; and he repeated the whole (notwithstanding he heard these words without order, and but once,) in the numerical order; or he told you what word was given against any one number, or what number any one word bore. It is still more striking, but certainly, likewise, more difficult, to retain as many numbers however great they may be. For words and numbers I could venture myself, with the greatest safety, as far as one hundred of each; and I am sure, after having

Memphis.

having fixed them once, which is done in leſs than ten minutes, I could repeat them to you at any period, without ever thinking any more of them *."

* Phil. Mag. 28. '93.

MEMPHIS, an ancient city, and the royal reſidence of the kings in the Higher Egypt; diſtant from the Delta to the ſouth 15 miles, according to Pliny. Called alſo *Moph*, and *Noph*, in ſcripture.

Though this city is now ſo completely ruined, that authors greatly diſagree concerning its ſituation; yet Strabo informs us that in his time it was the moſt magnificent in Egypt, next to Alexandria. It was called the capital of the country; and there was an entire temple of Oſiris, where the Apis or ſacred ox was kept and worſhipped. In the ſame place was an apartment of the mother of the ox; a very magnificent temple of Vulcan; a large circus or ſpace for fighting bulls; and a great coloſſus in the middle of the city, which was thrown down. There was likewiſe a temple of Venus, and a Serapium in a very ſandy place, where the wind heaps up hills of ſand very dangerous to travellers; together with a number of ſphinxes, the heads of ſome of them only being viſible, the others covered up to the middle of their body. The ſame author likewiſe informs us, that in the front of the city there were many lakes; and that it contained a number of palaces, at that time in ruins. Theſe buildings, he ſaid, formerly ſtood upon an eminence: they lay along the ſide of the hill, ſtretching down to the lakes and groves, 40 ſtadia from the city. There was likewiſe a mountain in the neighbourhood, on which were a great number of pyramids, with the ſepulchres of the kings, among which were three remarkable, and two of them accounted wonders of the world. From this deſcription, Mr Bruce concludes that the celebrated capital of Egypt ſtood in the place where the villages of Metrahenny are now ſituated; in oppoſition to Dr Shaw's opinion, who thinks it was ſituated at Geeza or Giſa.

M. Savary has alſo ſhown, that Giſa was not the ſituation of the ancient Memphis. This ſtood, he ſays, on the weſtern bank of the Nile, on the ſpot where the village of Memph now ſtands, which ſtill preſerves the name. Large heaps of rubbiſh are ſtill to be ſeen there; but the Arabs have tranſported to Cairo the columns and remarkable ſtones, which they have diſpoſed, without taſte and without order, in their moſques and public buildings. This city extended as far as Saccara; and was almoſt wholly encompaſſed by lakes, part of which are ſtill ſubſiſting. It was neceſſary to croſs them to convey the dead to the ſepulchre of their fathers. The tombs, hewn out of the rock, were cloſed up with ſtones of a proportionable ſize, and covered with ſand. Theſe bodies embalmed with ſo much care, preſerved with ſo much reſpect, are torn from the monuments they repoſe in, and ſold without decency to ſtrangers by the inhabitants of Saccara. This place is called *the plain of mummies*. There too we find *the well of the birds*, into which one deſcends by means of a rope. It leads to ſubterraneous galleries, filled with earthen vaſes containing the ſacred birds. They are rarely met with entire, becauſe the Arabs break them in hopes of finding idols of gold. They do not conduct travellers into the places where they have found more precious articles. They even cloſe them up carefully, reſerving to themſelves ſome ſecret paſſages by which they deſcend. In a journey into Egypt made by the duke de Chaulnes, he advanced very far into theſe winding labyrinths, ſometimes crawling, and ſometimes ſcrambling on his knees. Informed by Mr Edward Wortley Montague, who has carefully viſited Egypt, he arrived at one of thoſe paſſages which had an opening ſhut up from without by branches of the date tree interwoven, and covered with ſand. He remarked there ſome hieroglyphics *in relievo*, executed in the higheſt perfection. But the Arabs reſiſted every offer he made them to permit him to take drawings of them, or to mould them, in order to preſerve their form. The duke de Chaulnes is of opinion that theſe hieroglyphics, ſculptured with ſo much art that the objects they repreſent may be diſcovered at the firſt ſight, might poſſibly furniſh the key of the others, whoſe contours are ſimply expreſſed, and form a ſort of alphabet of this unintelligible language. Several pyramids are diſtinguiſhable along the mountains which bound Saccara on the weſt, the greateſt part of which appear as lofty as thoſe of Giſa. See PYRAMIDS.

Menage, Menander.

MENAGE (Fr.), denotes a collection of animals; whence we have derived the word *menagery*.

MENANDER, an ancient Greek poet, was born at Athens in the ſame year with Epicurus, which was the third of the 109th Olympiad. His happineſs in introducing the new comedy, and refining an art which had been ſo groſs and licentious in former times, quickly ſpread his name over the world. Pliny informs us, that the kings of Egypt and Macedon gave a noble teſtimony of his merit, by ſending ambaſſadors to invite him to their courts, and even fleets to bring him over; but that Menander was ſo much of a philoſopher, as to prefer the free enjoyment of his ſtudies to the promiſed favours of the great. Of his works, which amounted to above 100 comedies, we have had a double loſs, the originals being not only vaniſhed, but the greateſt part of them, when copied by Terence, having unfortunately periſhed by ſhipwreck before they ſaw Rome. Yet the four plays which Terence borrowed from him before that accident happened, are ſtill preſerved in the Roman habit; and it is chiefly from Terence that moſt people form their judgement of Menander, the fragments that remain of him not being ſufficient to enable them to do it. The ancients have ſaid high things of Menander; and we find the old maſters of rhetoric recommending his works as the true patterns of every beauty and every grace of public ſpeaking. Quintilian declares, that a careful imitation of Menander only, will ſatisfy all the rules he has laid down in his inſtitutions. It is in Menander that he would have his orator ſearch for a copiouſneſs of invention, for a happy elegance of expreſſion, and eſpecially for that univerſal genius which is able to accommodate itſelf to perſons, things, and affections.— But Julius Cæſar has left the loftieſt as well as the juſteſt praiſe of Menander's works, when he calls Terence only a *Half-Menander*. For while the virtues of the Latin poet are ſo deſervedly admired, it is impoſſible we ſhould raiſe a higher notion of excellency than to conceive the great original ſtill ſhining with half its luſtre unreflected, and preſerving an equal part of its graces, above the power of the beſt copier in the world. Menander died in the 3d year of the 122d Olympiad,

Olympiad, as we are taught by the same old inscription from which we learn the time of his birth. His tomb, in Pausanias's age, was to be seen at Athens, in the way from the Piræus to the city, close by the honorary monument of Euripides. Quintilian, in his judgement of Afranius the Roman comedian, who imitated him, censures Menander's morals as much as he commends his writings; and his character, according to Suidas, is, that he was a very "mad fellow after women." Phædrus has given him the gait and dress of a most affected fop:

> "Unguento delibutus, vestitu adfluens,
> "Veniebat gressu delicatulo et languido."
>
> *Lib.* v. fab. 2.

MENANDRIANS, the most ancient branch of Gnostics; thus called from Menander their chief, said by some, without sufficient foundation, to have been a disciple of Simon Magus, and himself a reputed magician.

He taught, that no person could be saved, unless he were baptised in his name; and he conferred a peculiar sort of baptism, which would render those who received it immortal in the next world: exhibiting himself to the world, with the phrensy of a lunatic more than the founder of a sect, as a promised saviour. For it appears by the testimonies of Irenæus, Justin, and Tertullian, that he pretended to be one of the æons sent from the pleroma, or ecclesiastical regions, to succour the souls that lay groaning under bodily oppression and servitude; and to maintain them against the violence and stratagems of the dæmons that hold the reins of empire in this sublunary world. As this doctrine was built upon the same foundation with that of Simon Magus, the ancient writers looked upon him as the instructor of *Menander*. See SIMONIANS.

MENASSEH BEN ISRAEL, a celebrated rabbi, born in Portugal about the year 1604, was the son of Joseph Ben Israel, and followed his father into Holland. Here he was educated by Rabbi Isaac Uziel, under whom he in a short time made such progress in the Hebrew tongue, that at 18 years of age he succeeded him in the synagogue of Amsterdam. In this post he continued several years, and married Rachel of the family of the Abarbanels, whom the Jews imagine to be descended from King David. He afterwards went to his brother Ephraim, a rich merchant, who had settled at Basil; by whose advice he entered into trade. Some time after, the hopes of a more agreeable settlement induced him to come into England, under the protectorship of Cromwell; who gave him a very favourable reception, and one day entertained him at his table with several other learned divines. However, he soon after passed into Zealand; and died at Middleburg about the year 1657. The Jews at Amsterdam obtained his body, and interred it at their expence. He was of the sect of the Pharisees; had a lively wit, a solid judgement, great learning, and all the virtues that can adorn private life. He wrote many works in Hebrew, Latin, Spanish, and English. The principal of those published in Latin, are, 1. His *Conciliator;* a learned and curious work, in which he reconciles those passages of Scripture which seem to contradict each other. 2. *De resurrectione mortuorum.* 3. *De termino vitæ.* 4. *Dissertatio de fragitate humana, ex lapsu Adami, deque Divino in bono opere auxilio.* 5. *Spes Israel.* Dr Thomas Pococke has written his life in English.

MENDELSHON, MOSES, that is, *Moses the son of Mendel*, a Jew of Berlin, and one of the most celebrated writers in Germany, died there in the year 1785 at the age of 57. His fourth attempt as an author was soon after 1767, by a work entitled *Jerusalem;* in which, besides other bold and unjustifiable opinions, he maintains, that the Jews have a revealed law but not a revealed religion; that opinions are not subjects of revelation; and that the only religion of the Jewish nation is that of nature. He acquired great honour by his *Phædon*, or "Discourses on the Immateriality and Immortality of the Soul," translated into the French 1773, 8vo; in which he unfolds this important truth, the great foundation of all morality, with the wisdom of an enlightened philosopher and the charms of an elegant writer. In consequence of this excellent work, he was styled the *Jewish Socrates* by some of the periodical writers; but he wanted the firmness and courage of the Grecian philosopher. His timidity, and even pusillanimity, defects too common in speculative men, prevented him from being of any essential service to his nation; of which he might have become the benefactor by being the reformer. The pliancy of his character, his soft, modest, and obliging disposition, gained him the esteem alike of the superstitious and of the incredulous. After all, he could never procure admission to the Berlin society, or to the conversation of the king of Prussia. At his death he received from his nation those honours which are commonly paid to their first rabbins. Contrary to an imprudent custom prevalent among the Jews of burying their dead before sunset, his interment was delayed till 24 hours after he expired. Though Mendelshon was descended from a respectable family, he was very poor. In early life he entered into a counting-house of his own nation, wherein he greatly recommended himself by his capacity and integrity in business: But philosophy and literature soon became has principal occupation; and to the famous Lessing he was indebted for counsels which, without diverting his attention from those pursuits that were necessary to his subsistence, accelerated his progress in his literary career. Even after the death of his benefactor, Mendelshon retained for him the sincerest regard and the most lively gratitude. Notwithstanding the very strict regimen which he observed, he survived him only a few years; for his feeble frame and weak constitution were gradually and insensibly undermined by intense application to study.

MENDEZ PINTO, FERDINAND, was born at Montemor-o-velho in Portugal, and was at first servant to a Portuguese gentleman. In expectation of making a fortune, he embarked for India in 1537. His vessel being taken by the Turks on his passage, he was carried to Mocka, and sold to a Greek renegado, and afterwards to a Jew, in whose possession he continued till he was redeemed by the governor of Ormus, a Portuguese fort. The governor procured him an opportunity of going out to India, agreeable to his first design. During a residence of twenty-one years in that country, he was witness to very important transactions, and experienced many singular adventures. He returned to Portugal in 1558, where he enjoyed the reward of his labours, after having been thirteen times a slave and sixteen times sold. A very curious account of his travels was written by himself, and published at Lisbon, A. D. 1614, in folio. This work was translated into French by Bernard Figuier, a Portuguese gentleman, and printed at Paris 1645, in 4to. It is written in a very interesting manner, and in a style more elegant than might have been expected from a man whose whole life was spent in the camp and in slavery. It elucidates a great variety of particulars relating to the geography, history, and manners of the inhabitants of China, Japan, Pegu, Siam, Achem, Java, &c. Many of his facts appeared fabulous, but their truth has been since ascertained. M. de Surgi compiled an interesting history from the most singular facts in Mendez Pinto's relation, which he published in the *Vicissitudes de la Fortune*, Paris, 2 vols. 8vo.

MENDICANTS, or BEGGING FRIARS, several orders of religious in Popish countries, who having no settled revenues, are supported by the charitable contributions they receive from others.

This sort of society began in the 13th century; and the members of it, by the tenor of their institution, were to remain entirely destitute of all fixed revenues and possessions; though in process of time their number became a heavy tax upon the people. Innocent III. was the first of the popes who perceived the necessity of instituting such an order; and accordingly he gave such monastic societies, as made a profession of poverty, the most distinguishing marks of his protection and favour. They were also encouraged and patronized by the succeeding pontiffs, when experience had demonstrated their public and extensive usefulness. But when it became generally known, that they had such a peculiar place in the esteem and protection of the rulers of the church, their number grew to such an enormous and unwieldy multitude, and swarmed so prodigiously in all the European provinces, that they became a burden, not only to the people, but to the church itself. The great inconvenience that arose from the excessive multiplication of the mendicant orders was remedied by Gregory X. in a general council, which he assembled at Lyons in 1272. For here all the religious orders that had sprung up after the council held at Rome in 1215, under the pontificate of Innocent III. were suppressed; and the extravagant multitude of mendicants, as Gregory called them, were reduced to a smaller number, and confined to the four following societies or denominations, viz. the DOMINICANS, the FRANCISCANS, the CARMELITES, and the AUGUSTINS or hermits of St Augustin.

As the pontiffs allowed these four mendicant orders the liberty of travelling wherever they thought proper, of conversing with persons of every rank, of instructing the youth and multitude wherever they went; and as those monks exhibited, in their outward appearance and manner of life, more striking marks of gravity and holiness than were observable in the other monastic societies, they arose all at once to the very summit of fame, and were regarded with the utmost esteem and veneration through all the countries of Europe. The enthusiastic attachment to these sanctimonious beggars went so far, that, as we learn from the most authentic records, several cities were divided or cantoned out into four parts, with a view to these four orders; the first part being assigned to the Dominicans, the second to the Franciscans, the third to the Carmelites, and the fourth to the Augustins. The people were unwilling to receive the sacraments from any other hands than those of the mendicants, to whose churches they crowded to perform their devotions, while living, and were extremely desirous to deposite there also their remains after death: nor did the influence and credit of the mendicants end here; for we find in the history of this and of the succeeding ages, that they were employed, not only in spiritual matters, but also in temporal and political affairs of the greatest consequence, in composing the differences of princes, concluding treaties of peace, concerting alliances, presiding in cabinet councils, governing courts, levying taxes, and other occupations, not only remote from, but absolutely inconsistent with, the monastic character and profession. However, the power of the Dominicans and Franciscans greatly surpassed that of the other two orders: insomuch that these two orders were, before the Reformation, what the Jesuits have been since that happy and glorious period, the very soul of the hierarchy, the engines of the state, the secret springs of all the motions of the one and the other, and the authors and directors of every great and important event, both in the religious and political world. By very quick progression their pride and confidence arrived at such a pitch, that they had the presumption to declare publicly, that they had a divine impulse and commission to illustrate and maintain the religion of Jesus; they treated with the utmost insolence and contempt all the different orders of the priesthood; they affirmed, without a blush, that the true method of obtaining salvation was revealed to them alone; proclaimed, with ostentation, the superior efficacy and virtue of their indulgencies; and vaunted beyond measure their interest at the court of heaven, and their familiar connexions with the Supreme Being, the Virgin Mary, and the saints in glory. By these impious wiles, they so deluded and captivated the miserable, and blinded the multitude, that they would not intrust any other but the mendicants with the care of their souls. They retained their credit and influence to such a degree, towards the close of the 14th century, that great numbers of both sexes, some in health, others in a state of infirmity, and others at the point of death, earnestly desired to be admitted into the mendicant order, which they looked upon as a sure and infallible method of rendering heaven propitious. Many made it an essential part of their last wills, that their bodies after death should be wrapped in old ragged Dominican or Franciscan habits, and interred among the mendicants. For such was the barbarous superstition and wretched ignorance of this age, that people universally believed they should readily obtain mercy from Christ, at the day of judgement, if they appeared before his tribunal associated with the mendicant friars.

About this time, however, they fell under an universal odium; but being resolutely protected against all opposition, whether open or secret, by the popes, who regarded them as their best friends and most effectual supports, they suffered little or nothing from the efforts of their numerous adversaries. In the 15th century,

century, besides their arrogance, which was excessive, a quarrelsome and litigious spirit prevailed among them, and drew upon them justly the displeasure and indignation of many. By affording refuge at this time to the Beguins in their order, they became offensive to the bishops, and were hereby involved in difficulties and perplexities of various kinds. They lost their credit in the 16th century by their rustic impudence, their ridiculous superstitions, their ignorance, cruelty, and brutish manners. They discovered the most barbarous aversion to the arts and sciences, and expressed a like abhorrence of certain eminent and learned men, who endeavoured to open the paths of science to the pursuits of the studious youth, recommended the culture of the mind, and attacked the barbarism of the age in their writings and discourse. Their general character, together with other circumstances, concurred to render a reformation desirable, and to accomplish this happy event.

Among the number of mendicants are also ranked the Capuchins, Recollects, Minims, and others, who are branches or derivations from the former.

Buchanan tells us, the mendicants in Scotland, under an appearance of beggary, lived a very luxurious life; whence one wittily called them, not *Mendicant* but *Manducant* friars.

MENE, a Chaldean word, which signifies "he has numbered or counted;" being one of the three words that were written upon the wall by the hand that appeared to Belshazzar, the last king of Babylon, the night that he was put to death. See BELSHAZZAR.

MENECRATES, a physician of Syracuse, who flourished about 360 B. C. is famous for his skill in his profession, but much more for his vanity. He would always be followed by some of the patients he had cured, and with whom he previously stipulated that they should follow him wherever he went. One appeared with the attributes of Hercules, another with those of Apollo, and others again with those of Mercury or Æsculapius; while he, clad in a purple robe, with a golden crown on his head, and a sceptre in his hand, presented himself, to the admiration of the public, under the name of *Jupiter*, and travelled through different countries escorted by these counterfeit deities. He once wrote the following letter to the king of Macedon: Menecrates Jupiter to Philip, greeting. Thou reignest in Macedonia, and I in medicine; thou givest death to those who are in good health, I restore life to the sick; thy guard is composed of Macedonians; the gods themselves constitute mine." Philip answered him in a word, that he wished him restored to reason. Learning some time after that he was in Macedon, Philip sent for him, and invited him to an entertainment. Menecrates and his companions were placed on rich and lofty couches; before which was an altar, covered with the first fruits of the harvest; and whilst an excellent repast was served up to the other guests, perfumes and libations only were offered to these new gods, who, unable to endure the affront, hastily left the palace, in which they never more made their appearance.

MENEDEMUS, a Greek philosopher, born at Erythreum, was the son of Calisthenes, and one of Phedo's followers. He was in the greatest esteem, and enjoyed several important posts, in his own country. He several times defended Erythreum with great bravery, and died of grief when Antigonus became master of it. A person one day saying to him, "It is a great happiness to have what we desire," he replied, "It is a much greater to desire nothing but what we have." He flourished about 300 B. C.

MENELAUS, the son of Atreus, and the brother of Agamemnon, reigned at Sparta, when Paris deprived him of his wife Helen. This rape occasioned the famous war of Troy. See HELEN.

MENELAUS, a mathematician in the reign of the emperor Trajan, wrote three books on the *Sphere*, which have been published by Father Marsenne.

MENES, born at This, a town of Thebais in Upper Egypt, was the founder of the Egyptian empire. He had three sons, viz. Athotis, who ruled after him, at This and Thebes; Curudes, who in Lower Egypt founded the kingdom of Heliopoli, which afterward was the kingdom of Diospoli; and Necherophes, who reigned at Memphis. It is thought this Menes reigned 117 years after the birth of Phaleg, son of Heber, which was the very year of the dispersion of the people throughout the whole earth. In building Memphis, he stopped the Nile near it, by the invention of a causeway 100 furlongs broad, and caused it to run through the mountains.

MENIALS, domestic or household servants, who live under their lord or master's roof.

MENINGES, or MENYNGES, in *Anatomy*, a name given to the dura and pia mater of the brain. See ANATOMY, N° 129.

MENINX, an island in the Mediterranean, to the west of the Syrtis Minor. Supposed by Strabo and Polybius to be Homer's country of the Lotophagi; and hence Ptolemy and Eratosthenes denominate the island *Lotophagitis*, with a cognominal town *Meninx*. It was the country of Vibius Gallus the emperor, and of Volusianus. Now called *Gerbi* and *Zarbi*.

MENIPPUS, a cynic philosopher of Phœnicia. He was originally a slave, but obtained his liberty with a sum of money, and became one of the greatest usurers at Thebes. He grew so desperate from the continual reproaches and insults to which he was daily exposed on account of his meanness, that he destroyed himself. He wrote 13 books of satires, which have been lost.

MENIPPEAN (*satira* MENIPPEA), a kind of satire consisting of prose and verse intermixed. It is thus called from Menippus a cynic philosopher who delighted in composing satirical letters, &c. In imitation of him, Varro also wrote satires under the title of *Satiræ Menippeæ*: whence this sort of composition is also denominated *Varronian satire*.

Among the moderns there is a famous piece under this title first published in 1594, against the chiefs of the league, called also the *Catholicon* of Spain. It is esteemed a masterpiece for the time.

MENISCUS, in *Optics*, a glass or lens, concave on one side and convex on the other; sometimes also called *lunula*. See OPTICS.

MENISPERMUM, MOONSEED, a genus of plants belonging to the diœcia class, and in the natural method ranking under the 11th order, *Sarmentaceæ*. See BOTANY *Index*.

MENNITH, or MINNITH, Judges xi. 33. a town

Mennonites. near Heshbon (Jerome), in Arabia Petræa; in a district named *Ecosipolis*, or *twenty-towns*, (Cellarius). There is also a Minnith mentioned Ezekiel xxvii. as being in a good wheat country: but whether the same with the foregoing is uncertain; though some think that the first Minnith lay in the country of Ammon, (Wells).

MENNONITES, a sect in the United Provinces, in most respects the same with those in other places called *Anabaptists*.

They had their rise in 1536, when Menno Simon, a native of Friesland, who had been a Romish priest, and a notorious profligate, resigned his rank and office in the Romish church, and publicly embraced the communion of the Anabaptists.

Menno was born at Witmarsum, a village in the neighbourhood of Bolswert in Friesland, in the year 1505, and died in 1561 in the duchy of Holstein, at the country seat of a certain nobleman not far from the city of Oldesloe, who, moved with compassion by a view of the perils to which Menno was exposed, and the snares that were daily laid for his ruin, took him with certain of his associates into his protection, and gave him an asylum. The writings of Menno, which are almost all composed in the Dutch language, where published in folio at Amsterdam in the year 1651. About the year 1637, Menno was earnestly solicited by many of the sect with which he connected himself, to assume among them the rank and functions of a public teacher; and as he looked upon the persons who made this proposal to be exempt from the fanatical phrensy of their brethren at Munster (though according to other accounts they were originally of the same stamp, only rendered somewhat wiser by their sufferings), he yielded to their entreaties. From this period to the end of his life, he travelled from one country to another with his wife and children, exercising his ministry, under pressures and calamities of various kinds, that succeeded each other without interruption, and constantly exposed to the danger of falling a victim to the severity of the laws. East and West Friesland, together with the province of Groningen, were first visited by this zealous apostle of the Anabaptists; from whence he directed his course into Holland, Guelderland, Brabant, and Westphalia, continued it through the German provinces that lie on the coasts of the Baltic sea, and penetrated as far as Livonia. In all these places his ministerial labours were attended with remarkable success, and added to his sect a prodigious number of followers. Hence he is deservedly considered as the common chief of almost all the *Anabaptists*, and the parent of the sect that still subsists under that denomination. Menno was a man of genius, undirected by a very sound judgement; he possessed a natural and persuasive eloquence, and such a degree of learning as made him pass for an oracle in the estimation of the multitude. He appears, moreover, to have been a man of probity, of a meek and tractable spirit, gentle in his manners, pliable and obsequious in his commerce with persons of all ranks and characters, and extremely zealous in promoting practical religion and virtue, which he recommended by his example as well as by his precepts. The plan of doctrine and discipline drawn up by Menno was of a much more mild and moderate nature than that of the furious and fanatical ANABAPTISTS, whose tumultuous proceedings have been recited under that article, but somewhat more severe, though more clear and consistent, than the doctrine of the wiser branches of that sect, who aimed at nothing more than the restoration of the Christian church to its primitive purity. Accordingly he condemned the plan of ecclesiastical discipline that was founded on the prospect of a new kingdom, to be miraculously established by Jesus Christ on the ruins of civil government and the destruction of human rulers, and which had been the fatal and pestilential source of such dreadful commotions, such execrable rebellions, and such enormous crimes. He declared publicly his dislike of that doctrine, which pointed out the approach of a marvellous reformation in the church by the means of a new and extraordinary effusion of the Holy Spirit. He expressed his abhorrence of the licentious tenets, which several of the Anabaptists had maintained, with respect to the lawfulness of polygamy and divorce; and finally, considered as unworthy of toleration those fanatics who were of opinion that the Holy Ghost continued to descend into the minds of many chosen believers, in as extraordinary a manner as he did at the first establishment of the Christian church, and that he testified this peculiar presence to several of the faithful by miracles, predictions, dreams, and visions of various kinds. He retained indeed the doctrines commonly received among the Anabaptists, in relation to the baptism of infants, the *millennium*, or 1000 years reign of Christ upon earth, the exclusion of magistrates from the Christian church, the abolition of war, and the prohibition of oaths enjoined by our Saviour, and the vanity as well as the pernicious effects of human science. But while Menno retained these doctrines in a general sense, he explained and modified them in such a manner as made them resemble the religious tenets that were universally received in the Protestant churches; and this rendered them agreeable to many, and made them appear inoffensive even to numbers who had no inclination to embrace them. It however so happened, that the nature of the doctrines considered in themselves, the eloquence of Menno which set them off to such advantage, and the circumstances of the times, gave a high degree of credit to the religious system of this famous teacher among the Anabaptists, so that it made a rapid progress in that sect. And thus it was in consequence of the ministry of Menno, that the different sorts of Anabaptists agreed together in excluding from their communion the fanatics that dishonoured it, and in renouncing all tenets that were detrimental to the authority of civil government, and by an unexpected coalition formed themselves into one community.

Though the Mennonites usually pass for a sect of Anabaptists, yet M. Herman Schyn, a Mennonite minister, who has published their history and apology, maintains, that they are not Anabaptists either in principle or by origin. However, nothing can be more certain than this fact, viz. that the first Mennonite congregations were composed of the different sorts of Anabaptists, of those who had been always inoffensive and upright, and of those who, before their conversion by the ministry of Menno, had been seditious fanatics; besides, it is alleged, that the Mennonites,

nites do actually retain, at this day, fome of thofe opinions and doctrines, which led the feditious and turbulent Anabaptifts of old to the commiffion of fo many and fuch enormous crimes: fuch particularly is the doctrine concerning the nature of Chrift's kingdom, or of the church of the New Teftament, though modified in fuch a manner as to have loft its noxious qualities, and to be no longer pernicious in its influence.

The Mennonites are fubdivided into feveral fects; whereof the two principal are the *Flandrians* or FLEMINGIANS, and the WATERLANDIANS. The opinions, fays Mofheim, that are held in common by the Mennonites, feem to be all derived from this fundamental principle, that the kingdom which Chrift eftablifhed upon earth is a vifible church or community, into which the holy and juft alone are to be admitted, and which is confequently exempt from all thofe inftitutions and rules of difcipline that have been invented by human wifdom, for the correction and reformation of the wicked. This principle, indeed, was avowed by the ancient Mennonites, but it is now almoft wholly renounced: neverthelefs, from this ancient doctrine, many of the religious opinions that diftinguifh the Mennonites from all other Chriftian communities, feem to be derived: in confequence of this doctrine, they admit none to the facrament of baptifm but perfons that are come to the full ufe of their reafon; they neither admit civil rulers into their communion, nor allow any of their members to perform the functions of magiftracy; they deny the lawfulnefs of repelling force by force, and confider war, in all its fhapes, as unchriftian and unjuft; they entertain the utmoft averfion to the execution of juftice, and more efpecially to capital punifhments; and they alfo refufe to confirm their teftimony by an oath. The particular fentiments that divided the more confiderable focieties of the Mennonites are the following: The rigid Mennonites, called the *Flemingians*, maintain with various degrees of rigour, the opinions of their founder Menno, as to the human nature of Chrift, alleging that it was produced in the womb of the Virgin by the creating power of the Holy Ghoft; the obligation that binds us to wafh the feet of ftrangers, in confequence of our Saviour's command; the neceffity of excommunicating and avoiding, as one would do the plague, not only avowed finners, but alfo all thofe who depart, even in fome light inftances pertaining to drefs, &c. from the fimplicity of their anceftors; the contempt due to human learning, and other matters of lefs moment. However this auftere fyftem declines, and the rigid Mennonites are gradually approaching towards the opinions and difcipline of the more moderate or *Waterlandians*.

The firft fettlement of the Mennonites, in the United Provinces, was granted them by William prince of Orange, towards the clofe of the 16th century; but it was not before the following century that their liberty and tranquillity were fixed upon folid foundations, when, by a confeffion of faith publifhed in the year 1626, they cleared themfelves from the imputations of thofe pernicious and deteftable errors that had been laid to their charge. In order to appeafe their inteftine difcords, a confiderable part of the Anabaptifts of Flanders, Germany, and Friefland, concluded their debates in a conference held at Amfterdam, in the year 1630, and entered into the bonds of fraternal communion, each referving to themfelves a liberty of retaining certain opinions. This affociation was renewed and confirmed by new refolutions, in the year 1649; in confequence of which the rigorous laws of Menno and his fucceffors were, in various refpects, mitigated and corrected.

MENOLOGY, MENOLOGIUM, (from μην, *month*, and λογος, *difcourfe*), is much the fame as martyrology, or calendar, in the Latin.

The Greek menologium is divided into the feveral months in the year; and contains an abridgment of the lives of the faints, with a bare enumeration of the names of fuch whofe lives were never written. The Greeks have various menologies; and the Romans tax them with inferting divers heretics in their menologies as faints.—Baillet treats of them at large.

MENSA, in law books, a term that includes in it all patrimony, and neceffaries for livelihood.

MENSALS, MENSALIA, in church hiftory, fuch livings as were formerly united to the tables of religious houfes, and hence called *menfal benefices*. See the article BENEFICE.

MENSES, CATAMENIA, in *Medicine*, the monthly evacuations from the uterus of women not with child or not giving fuck. They are fo called from *menfis* "month," the period wherein they return. They are alfo called *flowers*, *courfes*, &c. By the Jewifh law a woman was unclean while the menftrual blood flowed; and the man who touched her, or the moveables fhe had touched, was declared unclean.—Lev. xv. See MIDWIFERY and MEDICINE.

MENSORES, among the Romans, were harbingers, whofe bufinefs it was to go before the emperor, and fix upon lodgings for him when he travelled into any of the provinces. They alfo marked out encampments, and affigned every regiment its poft.

Menfores were alfo land-furveyors, architects, or appraifers of houfes and public buildings. The diftributors of provifions in the army were called *menfores frumentarii*. And menfores was alfo an appellation given to fervants who waited at table.

MENSURATION.

EVERY branch of the mathematics which has for its object the comparifon of geometrical quantities, and the determination of their proportions to each other, may be comprehended under the general name *Menfuration*. So that, taking the term in its moft extenfive fenfe, whatever is delivered in this work under the titles GEOMETRY, TRIGONOMETRY, CONIC SECTIONS, part of ALGEBRA, and a very confiderable portion of FLUXIONS, may be confidered as conftituting particular branches of this general theory.

The

Tables of Measures.

The term mensuration, however, is also frequently used in a less extensive sense, and is applied to a system of rules and methods by which numerical measures of geometrical quantities are obtained. And it is to this limited view of the subject that we propose to confine our attention in the present treatise. In general, it will only be necessary to give the practical rules, as we have already explained their foundation when treating of GEOMETRY, CONIC SECTIONS, and FLUXIONS; but, in addition to the rules, in a few instances, we shall give their demonstrations.

In all practical applications of mathematics it is necessary to express magnitudes of every kind by numbers. For this purpose a line of some determinate length, as one inch, one foot, &c. is assumed as the measuring unit of lines, and the number expressing how often this unit is contained in any line, is the numerical value or measure of that line.

A surface of some determinate figure and magnitude is assumed as the measuring unit of surfaces, and the number of units contained in any surface is the numerical measure of that surface, and is called its *area*. It is usual to assume, as the measuring unit of surfaces, a square, whose side is the measuring unit of lines.

A solid of a determinate figure and magnitude is in like manner assumed as the measuring unit of solids, and the number of units contained in any solid is its solidity or content. The unit of solids is a cube, each of whose edges is the measuring unit of lines, and consequently each of its faces the measuring unit of surfaces.

A right angle is conceived to be divided into 90 equal angles; and one of these, called an angle of one degree, is assumed as the measuring unit of angles.

The measures generally employed in the application of mensuration to the common affairs of life, and their proportions to each other, are expressed in the following tables.

Table of Lineal Measures.

12 Inches	=	1 Foot.
3 Feet	=	1 Yard.
6 Feet	=	1 Fathom.
$5\frac{1}{2}$ Yards	=	1 Pole, Rod, or Perch.
40 Poles	=	1 Furlong.
8 Furlongs	=	1 Mile.
3 Miles	=	1 League.
$69\frac{1}{2}$ Miles nearly	=	1 Degree.
360 degrees	=	The earth's circumference.

Note. An inch is supposed equal to three barleycorns in length.

4 Inches	=	1 Hand, or handsbreadth.
5 Feet	=	1 Geometrical Pace.
4 Poles or 66 Feet 100 links each $7\frac{92}{100}$ inches	=	1 English chain.
74 Feet	=	1 Scots chain.

Table of Square Measures.

144 Square Inches	=	1 Foot square.
9 Square Feet	=	1 Yard.
$30\frac{1}{4}$ Square Yards	=	1 Pole.
40 Square Poles	=	1 Rood.
4 Roods or 160 Square Poles	=	1 Acre.
10 Square Chains or 100,000 Square Links	=	1 Acre.
640 Square Acres	=	1 Square Mile.

Note. The Scots acre is to the English acre as 100000 to 78694.

Table of Solid Measures.

1728 Cubic Inches	=	1 Cubic Foot.
27 Cubic Feet	=	1 Cubic Yard.

Note. 282 Cubic inches make		1 Ale Gallon.
231		1 Wine Gallon.
2150.42		a Winchester Bushel.
105 Cubic inches		1 Scots Pint.
The Wheat Firlot contains		$21\frac{1}{4}$ Scots Pints.
The Barley Firlot		31 Scots Pints.

SECTION I.

OF THE MENSURATION OF RIGHT LINES AND ANGLES.

Of Right Lines and Angles.

THE rules by which certain of the sides or angles of a triangle are to be found, when other sides and angles are given, might be considered as belonging to this part of mensuration. But as these are fully investigated and explained in the article PLANE TRIGONOMETRY, it is not necessary to deliver them also here. Referring therefore to that article, we shall employ the remainder of this section in the application of trigonometry to the mensuration of heights and distances.

Mensuration of Heights and Distances.

By the application of geometry the measurement of lines, which, on account of their position or other circumstances, are inaccessible, is reduced to the determination of angles, and of other lines which are accessible, and admit of being measured by methods sufficiently obvious.

A line considered as traced on the ground may be measured with rods or a Gunter's chain of 66 feet; but more expeditiously with measuring tapes of 50 or 100 feet. By these, if the ground be tolerably even, and the direction of the line be traced pretty correctly, a distance may, by using proper care, be measured within about 3 inches of the truth in every 50 feet, so that the error may not exceed the 200th part of the whole line.

Vertical angles may be measured with a quadrant furnished with a plummet and sights in the manner indicated by fig. 1. and fig. 2. If an angle of elevation is to be measured, as the angle contained by a horizontal line AC, and a line drawn from A to B the top of a tower, hill, or other eminence; or to a celestial body, as a star, &c.; the centre of the quadrant must be fixed at A, and the instrument moved about A, in the vertical plane, till to an eye placed at G, the object B be seen through the two sights D, *d*. Then will the arch EF, cut off by the plumb-line AF, be the measure of the angle CAB.

Plate CCCXXXIII.

An angle of depression CAB (fig. 2.) is to be measured exactly in the same manner, except that here the eye

eye is to be placed at A the centre of the inſtrument, and the meaſure of the angle is the arch EF.

But the moſt convenient inſtrument of any for obſerving angles, whether vertical or horizontal, is the *Theodolite.* This inſtrument is variouſly conſtructed, ſo as to admit of being ſold at a higher or lower price, according to the degree of accuracy the purchaſer may wiſh to attain in his obſervations with it. An inſtrument of this kind is repreſented in fig. 3. Its principal parts are, 1. A teleſcope and its level C C, D. 2. The vertical arc BB. 3. The horizontal limb and compaſs AA. The limb is generally about 7 inches in diameter. 4. The ſtaff with its parallel plates E.

The teleſcope CC in the beſt inſtruments is generally of the achromatic kind, in order to obtain a larger field and greater magnifying power. In the focus of the eye glaſs are two very fine hairs or wires, at right angles to each other, whoſe interſection is in the plane of the vertical arc. The object glaſs may be moved to different diſtances from the eye glaſs by turning the milled nut *a*, and thus may be accommodated to the eye of the obſerver and diſtance of the object. The ſcrews for moving and adjuſting the croſs hairs, are ſunk a little within the eye tube. On the outſide of the teleſcope are two metal rings which are ground perfectly true. Theſe are to lie on the ſupporters *e*, *e*, called Y's, which are fixed to the vertical arc. The vertical arc BB is firmly fixed to a long axis which is at right angles to the plane of the arc. This axis is ſuſtained by, and moveable on, the two ſupporters, which are fixed firmly to the horizontal plate. On the upper part of the vertical arc are the two Y's for holding the teleſcope; the inner ſides of theſe are ſo framed as to be tangents to the cylindric rings of the teleſcope, and therefore bear only on one part. The teleſcope is confined to the Y's by two loops which turn on a joint, and may therefore be readily opened and turned back when the two pins are taken out.

One ſide of the vertical arc is graduated to half degrees, which are ſubdivided to every minute of a degree by a *nonius.* It is numbered each way from the middle from 0 to 90°; towards the eye end for angles of altitude, and towards the object end for angles of depreſſion. On the other ſide of the vertical arc are two ranges of diviſions, one for taking the upright height of timber in 100th parts of the diſtance between the inſtrument and tree whoſe height is to be meaſured; and the other for reducing hypothenuſal lines to ſuch as are horizontal.

The vertical arc is cut with teeth or a rack, and may be moved regularly, and with eaſe, by turning the milled nut *b*.

The compaſs is fixed to the upper horizontal plate, its ring is divided into 360°, and the bottom of the box is divided into four parts or quadrants, each of which is ſubdivided into 10°. The magnetic needle is ſupported in the middle of the box upon a ſteel pin finely pointed, and there is a wire trigger for throwing the needle off the point when not in uſe.

The horizontal limb AA conſiſts of two plates, one moveable on the other, the outermoſt edge of the upper plate is chamfered to ſerve as an index to the degrees on the lower. The upper plate, together with the compaſs, vertical arc, and teleſcope, are eaſily turned round by a pinion fixed to the ſcrew *c*; *d* is a nut for fixing the index to any part of the limb, and thereby rendering it ſecure, while the inſtrument is moved from one ſtation to another. The horizontal limb is divided into half degrees, and numbered from the right hand towards the left; the diviſions are ſubdivided by the nonius ſcale to every minute of a degree.

On the upper plate, towards the nonius, are a few diviſions ſimilar to thoſe on the vertical arc, giving the 100th parts, for meaſuring the diameter of trees, buildings, &c.

The whole inſtrument fits on the conical ferril of a ſtrong braſs-headed ſtaff, with three ſubſtantial wooden legs. The top or head of the ſtaff conſiſts of two braſs plates E, parallel to each other: four ſcrews paſs through the upper plate and reſt on the lower plate; by the action of theſe the horizontal limb may be ſet truly level, and for this purpoſe a ſtrong pin is fixed to the outſide of the plate, and connected with a ball that fits into a ſocket in the lower plate; the axis of the pin and ball are ſo framed as to be perpendicular to the plate, and conſequently to the horizontal limb.

There are three adjuſtments neceſſary before the inſtrument is applied to the menſuration of angles. In the firſt place, care muſt be taken that the line of collimation (that is, the line of viſion paſſing through the croſs hairs) be exactly in the centre of the cylindric rings round the teleſcope; in the next place, that the level be parallel to this line; and, laſtly, the horizontal limb muſt be ſo ſet, that when the vertical arc is at *zero*, and the upper part moved round, the bubble of the level will remain in the middle of the open ſpace.

When theſe adjuſtments are made, and the inſtrument is to be applied to practice, the lower plate of the horizontal limb AA being ſuppoſed to remain unmoved and parallel to the horizon, the teleſcope is to be directed ſucceſſively to the different objects, whoſe angular poſitions are to be determined, by means of the pinions at *c* and *b*; (the former of which turns the upper part of the inſtrument round in a horizontal plane, and the latter turns the arc BB in a vertical plane). Then, the angle which a line paſſing through the axis of the teleſcope and any object makes with the horizon, will be indicated by the arc of the vertical circle between 0° and the index engraved on the nonius ſcale H fixed to the upper plate of the horizontal limb of the inſtrument. Alſo, the horizontal angle contained by two vertical planes conceived to paſs through any two objects and the centre of the inſtrument, will be ſhewn by the arc of the lower plate of the horizontal limb over which the index engraved on the upper plate has paſſed by the direction of the teleſcope being changed from the one object to the other.

Having thus explained ſhortly the nature of the inſtruments by which acceſſible lines and angles are to be meaſured, and the manner of applying them, we ſhall now ſhew, by a few examples, how to find from theſe other lines which cannot be determined by a direct meaſurement.

Example 1. Having meaſured AE, a diſtance of 200 feet in a direct horizontal line from the bottom of a tower, the angle BCD, contained by the horizontal line CD: and a line drawn from C to the top of the tower, Fig. 4.

Of Right Lines and Angles.

tower, was measured by a quadrant, or theodolite placed at C, and found to be $47° 30'$. The centre C of the instrument was five feet above the line AE at its extremity E. It is required hence to determine AB the height of the tower.

In the right-angled triangle CBD we have given the side CD = 200 feet, and the angle $C = 47° 30'$. And since by the rules of PLANE TRIGONOMETRY,

rad : tan. BCD :: DC : DB;

By employing the logarithmic tables (see LOGARITHMS), and proceeding as is taught in PLANE TRIGONOMETRY, we shall find DB = 218.3 feet. To which add DA=EC=5 feet, the height of the instrument, and we have AB = 223.3 feet, the height of the tower.

Fig. 5. *Ex.* 2. Suppose a cloud, or balloon C, is seen at the same time by two observers at A and B, and that these stations are in the same vertical plane with the object C, and on the same side of it. Also, suppose that its angles of elevation, viz. the angles A and B, are $35°$ and $64°$, and that AB, the distance between the observers, is 880 feet. It is required hence to determine CD the height of the object, also AC, BC its distances from the two observers.

In the triangle CAB, there are given the outward angle CBD=$64°$, and one of the inward angles A=$35°$; hence the other inward angle ACB, which is their difference, is given, and $= 64°—35°=29°$.

Now in the triangle CAB

Sin. ACB : sin. A :: AB : BC,
and sin. ACB : sin. B :: AB : AC.

From these proportions, by actual calculation, BC will be found = 1041 feet, and AC = 1631 feet.

Again, in the right-angled triangle BCD

rad. : sin. B :: BC : CD,

Hence CD will be found = 936 feet.

Ex. 3. Wanting to know the breadth CD of a river, and also the distance of an object A close by its side

Fig. 6. from another object C on its opposite side, a base AB of 400 yards was measured along the bank. Then, by means of a theodolite, the angles CBA and CAB were measured, and found to be $37° 40'$ and $59° 15'$ respectively. It is required thence to determine the breadth CD, and the distance AC between the objects A and C.

This example differs from the last only by the given angles, and distances required, lying in a horizontal instead of a vertical plane.

In the triangle ABC we have the base AB, also the angles A and B, and consequently the angle C given.

And by Plane Trigonometry,

Sin. ACB : sin. B :: AB : AC.

Hence AC is found to be 246.2 yards.

Also, in the right-angled triangle ACD,

rad. : sin. A :: AC : CD.

Hence CD is found to be 211.6 yards.

Ex. 4. At B the top of a tower, which stood on a hill near the sea shore, the angle of depression of a ship at anchor (viz. the angle HBS), was $4° 52'$; and at R, the bottom of the tower, its depression (namely, Fig. 7. the angle NRS) was $4° 2'$. Required AS the horizontal distance of the vessel; and also RA, the height of the bottom of the tower above the level of the sea, supposing RB the height of the tower itself to be 54 feet.

From the angle BSA = HBS = $4° 52'$ subtract the angle RSA = NRS = $4° 2'$, and there remains the angle BSR=$50'$. Also, from the angle HBA = $90°$ subtract HBS=$4° 52'$, and there remains SBR=$85° 8'$.

In the triangle SBR,

Sin. BSR : sin. SBR :: BR : SR;

Hence SR is found. Again, in the triangle SRA,

rad. : sin. RSA :: SR : AR,
and rad. : cos. RSA :: SR : AS.

From the first of these proportions we find AR = 260 feet; and from the second, AS=3690 feet.

Ex. 5. To measure the height of an obelisk CD, Fig. 8. standing on the top of a declivity, two stations at A and B were taken, one at the distance of 40, and the other at the distance of 100 feet from the centre of its base, which was in a straight line with the stations. At the nearer station A, a line drawn from it to the top of the obelisk was found to make an angle of $41°$ with the plane of the declivity; and at B, the more remote station, the like angle was found to be $23° 45'$. Hence it is required to find the height of the obelisk.

From the angle CAD = $41°$, subtract the angle B = $23° 45'$, and there remains the angle BCA = $17° 15'$.

In the triangle BCA,

Sin. BCA : sin. B :: AB : AC. Hence AC=81.49 feet.

And in the triangle ACD,

$AC+AD : AC—AD :: \tan.\frac{1}{2}(D+C) : \tan.\frac{1}{2}(D—C)$.

Hence $\frac{1}{2}(D—C) = 42° 24'\frac{1}{2}$, which, subtracted from $\frac{1}{2}(D+C)$, gives the angle ACD = $27° 5'\frac{1}{2}$.

Lastly, in the triangle ACD,

Sin. ACD : sin. A :: AD : DC.

Hence DC, the height required, will be found to be 57.62 feet.

Ex. 6. Wanting to know the distance between two Fig. 9. inaccessible objects H and M, a base AB of 670 yards was measured in the same plane with the objects, and the following angles were taken at its extremities.

At A $\begin{cases} BAM=40° \ 16' \\ MAH=57 \ \ 40 \end{cases}$ At B $\begin{cases} ABH=42° \ 22' \\ HBM=71 \ \ \ 7 \end{cases}$

Hence it is required to determine HM, the distance between the objects.

In the triangle HAB we have the angle HBA = $42° 22'$, the angle HAB (= HAM + MAB) =

 97°

97° 56′, and therefore the remaining angle AHB = 39° 42′. We have alſo the ſide AB = 670 yards. Hence, by this proportion,

Sin. AHB : ſin. HBA :: AB : AH.

we find AH=706.8 yards.

Again, in the triangle MAB we have the angle MAB=40° 16′, the angle ABM (=ABH+HBM) = 113° 29′, and therefore the angle AMB = 26° 15′. Hence, from the proportion,

Sin. AMB : ſin. ABM :: AB : AM

we get AM=1389.4.

In the triangle HAM, beſides the angle HAM = 57° 40′ we have now the ſides AH = 706.8, and AM = 1389.4 yards, to find the remaining ſide HM. Therefore, proceeding according to the rules of trigonometry, we ſtate this proportion,

AM+AH : AM — AH :: tan. $\frac{1}{2}$(AHM + AMH) : tan. $\frac{1}{2}$(AHM—AMH).

Hence we find half the difference of the angles AHM and AMH to be 30° 36′, which taken from 61° 10′, half the ſum, leaves 30° 34′ for AMH the leaſt of the two angles. Laſtly, from the proportion

Sin. HMA : ſin. HAM :: HA : HM,

we get HM = 1174 yards, the anſwer to the queſtion.

Ex. 7. There are three objects A, B, C, whoſe diſtances aſunder are known to be as follows; namely, from A to B 106$\frac{1}{2}$, from A to C 202, and from B to C 131 fathoms. Now to determine the diſtance of D a fourth object, or ſtation, from each of the other three, the angle ADB was meaſured with a theodolite, or other ſuitable inſtrument; and found to be 13° 30′, and the angle CDB was found 29° 50′. Hence it is required to determine the diſtances DA, DB and DC, ſuppoſing DB the leaſt of the three.

Let a circle be deſcribed about the points A, D and C; and let DB be produced to meet the circle again in E, and draw AE, CE.

In the triangle AEC there are given the ſide AC=202 fathoms, the angle ACE (=ADE, Geom. Sect. II. Theor. 15.) = 13° 30′, and the angle CAE (=CDE)=29° 50′. Hence (by Trigon.) we ſhall have AE=68.716 fathoms.

In the triangle ABC, all its ſides are given, and hence the angle BAC will be found =35° 35′ 54″; to this, add the angle CAE, and the ſum is the angle EAB=65° 25′ 54″.

In the triangle ABE, we have given AB=106.5, AE=68.716, the angle BAE=65° 25′ 54″; hence we ſhall have the angle ABE=38° 43′ 41″. and the angle AEB=75° 51′ 25″.

In the triangle ADE we have the ſide AE=68.716, the angle ADE=13° 30′, and the angle AED=75° 51′ 25″. Hence we have AD=285.43 fathoms, which is one of the diſtances required.

In the triangle ABD we have AB=106.5, the angle ADB=13° 30′, the angle DAB (=ABE—ADB) 25° 13′ 45″. Hence BD, another of the diſtances ſought, will be found =194.45 fathoms.

Laſtly, In the triangle ADC, there is given AC= 202, the angle ADC (=ADB+BDC) =43° 20′, the angle DCA (=DEA) =75° 15′ 25″. Hence we get DC=256.97 fathoms, which is the remaining diſtance ſought.

Ex. 8. From a ſhip at ſea a point of land was obſerved to bear E. by S. and after ſailing N. E. 12 miles, the ſame point was found to bear S. E. by E. How far was the laſt obſervation made from the point of land?

Let A be the firſt poſition of the ſhip, B the ſecond, and C the point of land. In the triangle ABC we have given the angle A=5 points or 56° 15′, the angle B=9 points, or 101° 15′, and the angle C=2 points or 22° 30′. Alſo the ſide AB=12 miles. Hence (by Trigon.) the ſide BC is readily found to be 26.073 miles.

There are various other inſtruments and methods by which the heights or diſtances of objects may be found. One of the moſt ſimple inſtruments, both in reſpect of its conſtruction and application, is a ſquare, ABCD, made of ſome ſolid material, and furniſhed with two ſights on AB, one of its edges, and a plummet faſtened to A, one of its angles, and having the two ſides BC, CD, which contain the oppoſite angle divided into 10, or 100, or 1000 equal parts. Fig. 12.

To meaſure any altitude HK with this inſtrument. Fig. 13. Let it be held in ſuch a poſition that K, the top of the object may be ſeen through the ſights on its edge AB, while its plane is perpendicular to the horizon; then the plummet will cut off from the ſquare a triangle ſimilar to that formed by the horizontal line AI, the vertical line IK, and the line AK drawn from the eye to the top of the object.

If the line of the plummet paſs through D the oppoſite angle of the ſquare, then the height KI will be equal to AI, the diſtance of the eye from the vertical line to be meaſured. If it meet AD, the ſide of the ſquare next the eye, in ſome point E between A and D, then the triangles ABE, AIK being ſimilar, and the angle ABE equal to the angle AKI, we have AE : AB : : AI : IK. Let us now ſuppoſe AD= AB to be divided into 1000 equal parts; then the length of AE will be expreſſed by a certain number of theſe parts; thus the proportion of AE to AB, and conſequently that of AI to IK will be given; therefore if AI be determined by actual meaſurement, we may from the above proportion immediately find IK.

If again the line of the plummet meet DC the ſide of the ſquare oppoſite to the ſights in F, then, in the ſimilar triangles AIK, BCF, the angle AKI is equal to BFC thus we have BC : CF : : AI : IK. Hence IK is determined as before, and in each caſe by adding HI the height of the eye, we ſhall have HK the whole height required.

SECTION II.

MENSURATION OF PLANE FIGURES.

Problem I.

To find the area of a parallelogram, whether it be a ſquare, a rectangle, a rhombus, or a rhomboid.

Rule,

RULE I.

Multiply rhe length by the perpendicular breadth, and the product will be the area.

This rule is demonftrated in GEOMETRY, Sect. IV. Theor. 5.

Fig. 14. *Ex.* 1. Required the area of a fquare ABCD, whofe fide AB is $10\frac{1}{2}$ inches.

Here $10\frac{1}{2}\times10\frac{1}{2}$ or $10.5\times10.5=110.25$ fquare inches is the area required.

Fig. 15. *Ex.* 2. Required the area of a rectangle EFGH whofe length EF is 13.75 chains, and breadth FG is 9.5 chains.

Here $13.75\times9.5=130.625$ fquare chains is the area, which, when reduced to acres, &c. is 13 *ac.* 0 *ro.* 10 *po.*

Ex. 3. Required the area of a parallelogram KLMN, whofe length KL is 37 feet, and perpendicular breadth NO is $5\frac{1}{4}$ or 5.25 feet.

Fig. 16. In this example the area is $37\times5.25=194.25$ fquare feet, or 21.583 fquare yards.

RULE II.

As radius,
To the fine of any angle of the parallelogram,
So is the product of the fides including the angle,
To the area of the parallelogram.

To fee the reafon of this rule it is only neceffary to obferve, that in the parallelogram KLMN, the perpendicular breadth NO is a fourth proportional to *radius*, *fine* of the angle K, and the oblique line KN, (TRIGONOMETRY), and is therefore equal to $\frac{fin.\ K}{rad.}\times KN$; therefore the area of the figure is $\frac{fin.\ K}{rad.}\times KN\times KL$, which expreffion is the fame as the refult obtained by the above rule.

Ex. Suppofe the fides KL and KN are 36 feet, and 25.5 feet, and the angle K is 58°, required the area.

Here it will be convenient to employ the table of logarithms given at the end of the article LOGARITHMS. The operation may ftand thus,

log. rad.	10.00000
log. fin. 58°	9.92842
log. (36×25.5)=log. 36+log. 25.5	2.96284
log. of area	2 89126

area =778.5 fquare feet.

PROBLEM II.

Having given any two fides of a right-angled triangle, to find the remaining fide.

RULE.

1. When the fides about the right angle are given, to find the hypothenufe.

Add together the fquares of the fides about the right angle, and the fquare root of the fum will be the hypothenufe.

2. When the hypothenufe and one of the fides about the right angle is given, to find the other fide.

From the fquare of the hypothenufe fubtract the fquare of the given fide, and the fquare root of the remainder will be the other fide.

This rule is deduced from Theor. 13. Sect. IV. GEOMETRY.

Example 1. In a right-angled triangle ABC, the fides AB and AC, about the right angle, are 33 feet and 56 feet; what is the length of the hypothenufe BC? Fig. 17.

Here $33^2+56^2=3136+1089=4225$,
and $\surd(4225)=65$ feet, = the hypothenufe BC.

Ex. 2. Suppofe the hypothenufe BC to be 65 feet, and AB one of the fides about the right angle to be 33 feet; what is the length of AC the other fide?

Here $65^2-33^2=4225-1089=3136$;
and $\surd(3316)=56$ feet = the fide AC.

PROBLEM III.

To find the area of a triangle.

RULE I.

Multiply any one of its fides by the perpendicular let fall upon it from the oppofite angle, and half the product will be the area.

The truth of this rule is proved in GEOMETRY, Sect. IV. Theor. 6.

Example. What is the area of a triangle ABC, whofe bafe AC is 40, and perpendicular BD is 14.52 chains.

The product of the bafe by the perpendicular, or 40×14.52, is 580.8 fquare chains, the half of which, or 290.4 *fq. ch.*=29 *ac.* 0 *r.* 6.4 *po.* is the area of the triangle. Fig. 18.

RULE II.

As radius,
To the fine of any angle of a triangle,
So is the product of the fides including the angle,
To twice the area of the triangle.

This rule follows immediately from the fecond rule of Prob. I. by confidering that the triangle KNL (fig. 16) is half the parallelogram KNML.

Example. What is the area of a triangle ABC, whofe two fides AB and AC are 30 and 40, and the included angle A is 28° 57′? Fig. 18.

Operation by Logarithms.

log. rad.	10.00000
log. (30×40)=log. 30+log. 40	3.07918
log. fin. 28° 57′	9.68489
log. of twice area	2.76407

twice area = 580.85
area 290.42

RULE

Of Plane Figures.

Rule III.

When the three ſides are given, add together the three ſides, and take half the ſum. Next, ſubtract each ſide ſeverally from the ſaid half ſum, thus obtaining three remainders. Laſtly, multiply the ſaid half ſum, and thoſe three remainders all together, and extract the ſquare root of the laſt product for the area of the triangle.

This practical rule is deduced from the following geometrical theorem. *The area of a triangle is a mean proportional between two rectangles, one of which is contained by half the perimeter of the triangle, and the exceſs of half the perimeter above any one of its ſides; and the other is contained by the exceſſes of half the perimeter above each of the other two ſides.* As this theorem is not only remarkable, but alſo of great utility in menſuration, we ſhall here give its demonſtration.

Fig. 19. Let ABC then be any triangle; produce AB, any one of its ſides, and take BD, and B d, each equal to BC; join CD and C d, and through A draw a line parallel to BC, meeting CD and C d produced in E and e; thus the angle AED will be equal to the angle BCD, (Geometry, Sect. I. Theor. 21.), that is, to the angle BDC or ADC, (Sect. I. Theor. 11.); and hence AE$=$AD (Sect. I. Theor. 12.); and in like manner, becauſe the angle A e d is equal to the angle BC d, that is, to the angle B d C, or A d e, therefore A $e$$=$A d.

On A as a centre, at the diſtance AD or AE, deſcribe a circle meeting AC in F and G; and on the ſame centre, with the diſtance A d or A e, deſcribe another circle meeting AC in f and g, and draw BH and B h perpendicular to CD and C d. Then, becauſe BD, BC, B d are equal, the point C is in the circumference of a circle, of which D d is the diameter, therefore CD and C d are biſected at H and h (Sect. II. Theor. 6.) and the angle DC d is a right angle, (Sect. II. Theor. 17.), and hence the figure CHB h is a rectangle, ſo that B h $=$ CH $=\frac{1}{2}$ CD, and BH $=$ C h $=\frac{1}{2}$ C d.

Join BE, and B e, then the triangle BAC is equal to each of the triangles BEC, B e C (Sect. IV. Theor. 2. Cor. 2); but the triangle BEC is equal to $\frac{1}{2}$ EC $\times$ BH (Sect. IV. Theor. 2.), that is to $\frac{1}{4}$ EC$\times$C d; and in like manner the triangle B e C is equal to $\frac{1}{2}$ e C $\times$ B h, that is to $\frac{1}{4}$ e C$\times$CD, therefore the triangle ABC is equal to $\frac{1}{4}$ EC$\times$C d, and alſo to $\frac{1}{4}$ e C$\times$CD.

Now ſince $CD : Cd :: CE\times CD : CE\times Cd$ } Sect. IV.
and alſo $CD : Cd :: Ce\times CD : Ce\times Cd$ } Theor. 3.

Therefore $CE\times CD : CE\times Cd :: Ce\times CD : Ce\times Cd$; that is, becauſe $CE\times CD = FC\times CG$, and $Ce\times Cd = fC\times Cg$ (Sect. IV. Corollaries to Theor. 28 and 29.).

$$FC\times CG : CE\times Cd : Ce\times CD : fC\times Cg;$$

which laſt proportion (by taking one-fourth of each of its terms, and ſubſtituting the triangle ABC for its equivalent values $\frac{1}{4}$ CE$\times$C d and $\frac{1}{4}$ C $e$$\times$CD) gives us

$$\tfrac{1}{2}FC\times\tfrac{1}{2}CG : trian.\,ABC :: trian.\,ABC : \tfrac{1}{2}fC\times\tfrac{1}{2}Cg.$$

Now, if it be conſidered that the radius of the circle DGE is AB$+$BC, and that the radius of the circle g d e is AB$-$BC, it will readily appear that, putting $2s$ for the perimeter of the triangle ABC, we have

$$FC\;(=AB+BC+AC)=2s$$
$$CG\;(=AB+BC-AC)=2s-2AC,$$
$$fC\;(=AC+\{AB-BC\})=2s-2BC,$$
$$gC\;(=AC-\{AB-BC\})=2s-2AB.$$

Put now a, b, c for the ſides AC, BC, and AB reſpectively, then $\frac{1}{2}FC=s$, $\frac{1}{2}GC=s-a$, $\frac{1}{2}fC=s-b$, $\frac{1}{2}Cg=s-c$; thus the laſt proportion becomes

$$s\times(s-a) : trian.\,ABC :: trian.\,ABC : (s-b)\times(s-c),$$

which concluſion, when expreſſed in words at length, is evidently the proportion to be demonſtrated.

And as a mean proportional between two quantities is found by taking the ſquare root of the product, it follows that the area of the triangle ABC, which is a mean between $s\times(s-a)$ and $(s-b)\times(s-c)$, is equal to

$$\sqrt{\{s\times(s-a)\times(s-b)\times(s-c)\}}$$

which formula, when expreſſed in words at length, gives the preceding rule.

Example. Required the area of a triangle whoſe three ſides are 24, 36, and 48 chains reſpectively.

Here $24+36+48=108=$ the ſum of the three ſides.

And $\frac{108}{2}=54=$ half that ſum.

Alſo $54-24=30$, the firſt remainder; $54-36=18$, the ſecond remainder; and $54-48=6$, the third remainder.

The product of the half ſum and remainders is

$$54\times30\times18\times6=174960.$$

And the ſquare root of this product is

$$\sqrt{(174960)}=418.28 \text{ ſq. ch. the area required.}$$

Problem IV.

To find the area of a trapezoid.

Rule.

Add together the two parallel ſides, then multiply their ſum by the perpendicular breadth, or diſtance between, and half the product will be the area.

This rule is demonſtrated in Geometry, Sect. IV. Theor. 7.

Example. Required the area of the trapezoid AB CD whoſe parallel ſides AB and DC are 7.5. and 12.25 chains, and perpendicular breadth DE is 15.4 chains. Fig. 20.

The ſum of the parallel ſides is $7.5+12.25=19.75$; which multipled by the breadth is

$$19.75\times15.4=304.15;$$

and half this product is

$$\frac{304.15}{2}=152.075\,ſq.\,ch.=15\,ac.\,33.2\,po.$$

the area required.

PROBLEM V.

To find the area of any trapezium.

RULE.

Divide the trapezium into two triangles by a diagonal, then find the areas of these triangles, and add them together.

Note. If two perpendiculars be let fall on the diagonal from the other two opposite angles, the sum of these perpendiculars being multiplied by the diagonal, half the product will be the area of the trapezium. The reason of this rule is sufficiently obvious.

Fig. 21. *Example.* In the trapezium ABCD the diagonal AC is 42, and the two perpendiculars BE, DF are 16 and 18: What is its area?

Here the sum of the perp. is $16+18=34$, which multiplied by 42, and divided by 2 gives

$$\frac{34\times 42}{2}=714 \text{ the area.}$$

PROBLEM VI.

To find the area of an irregular polygon.

RULE.

Draw diagonals dividing the proposed polygon into trapeziums and triangles; then find the areas of all these separately, and add them together for the content of the whole polygon. The reason of this rule, and the manner of applying it, are sufficiently obvious.

PROBLEM VII.

To find the area of a regular polygon.

RULE.

Multiply the perimeter of the polygon, or sum of its sides, by the perpendicular drawn from its centre on one of its sides, and take half the product for the area.

This rule is only in effect resolving the polygon into as many triangles as it has sides, by drawing lines from its centre to all its angles, then taking the sum of their areas for the area of the figure.

Fig. 22. *Example.* Required the area of a regular pentagon ABCDE, whose side AB, or BC, &c. is 25 feet, and perpendicular HK is 17.2 feet.

Here $25\times 5=125$=the perimeter,
And $125=17.2=2150$,
And its half 1075 = the area required.

Note. If only the side of the polygon be given, its perpendicular may be found by the following proportion.
As radius.
To the tan. of half the angle of the polygon,
So is half the side of the polygon,
To the perpendicular.

And here, as well as in all other trigonometrical calculations, we may employ the table of logarithmic sines and tangents given in the article LOGARITHMS.

The angle of the polygon, that is, the angle contained by any two of its adjacent sides, will be found from this theorem, *The sum of all its interior angles is equal to twice as many right angles, wanting four, as it has sides*, which is demonstrated in Theor. 25. Sect. I. GEOMETRY.

PROBLEM VIII.

To find the diameter and circumference of a circle, the one from the other.

RULE I.

As 7 is to 22, so is the diameter to the circumference, nearly.

As 22 is to 7, so is the circumference to the diameter, nearly.

RULE II.

As 113 is to 355, so is the diameter to the circumference, nearly.

As 355 is to 113, so is the circumference to the diameter, nearly.

RULE III.

As 1 is to 3.1416, so is the diameter to the circumference, nearly.

As 3.1416 is to 1, so is the circumference to the diameter, nearly.

Note. The result obtained by the first rule, which is the least accurate of the three, will not differ from the true answer by so much as its 2400th part. But that obtained by the second rule, which is the most accurate, will not differ by so much as its 100000000th part.

The proportion of the diameter of a circle to its circumference is investigated in GEOMETRY, Sect. VI. Prop. 6. Also in FLUXIONS, § 137 and § 140. The manner of finding the first and second rules, and others of the same kind, is explained in ALGEBRA, Sect. XXI. But it is impossible to express exactly, by finite numbers, the proportion of the diameter of the circle to its circumference.

Example. 1. To find the circumference of a circle whose diameter is 20.

By the first rule,

$$7:22::20:\frac{20\times 22}{7}=62\tfrac{6}{7} \text{ the answer.}$$

Or by the third rule $3.1416\times 20=62.832$ the answer.

Ex. 2. The circumference of a circle is 10 feet, what is its diameter?

By the second rule

$$355:113::10:\frac{113\times 10}{355}=3.1831 \text{ the answer.}$$

PROBLEM IX.

To find the length of any arch of a circle

RULE I.

As 180 is to the number of degrees in the arch, so is 3.1416 times the radius to its length.

To see the reason of this rule it is only necessary to consider, that 3.1416 times the radius is (by last rule) equal to half the circumference, or to an arch of 180°, and that the length of an arch is proportional to the number of degrees it contains.

Example.

Fig. 23. *Example.* Required the length of the arch AEB, whose chord AB is 6, the radius AC or CB being 9. Draw CD perpendicular to the chord, then CD will bisect the chord in D, and the arch in E. Now in the right-angled triangle ACD, there is given the hypothenuse AC = 9, and the side AD = 3; hence, by trigonometry, the angle ACE will be found to contain 19° 28′$\frac{3}{10}$ = 19.471 degrees. The double of this, or 38.942, is the number of degrees in the whole arch AEB. Then by the rule

$$180 : 38.942 :: 9 \times 3.1416 : \frac{9 \times 3.1416 \times 38.942}{180}$$

= 6.11701 the answer.

RULE II.

From 8 times the chord of half the arch subtract the chord of the whole arch, and $\frac{1}{3}$ of the remainder will be the length of the arch nearly.

This rule may be demonstrated briefly thus. Let a denote an arch of a circle; then from the series expressing the sine of an arch in terms of the arch, (see FLUXIONS, § 70. *Ex.* 3. also TRIGONOMETRY) we have, putting rad. = 1,

$$\text{Sin.}\ \tfrac{1}{2}a = \tfrac{1}{2}a - \frac{a^3}{48} + \frac{a^5}{3840} - \&c.$$

Therefore, if the arch a be small, so that a^5 is a very small quantity, then

$$\text{Sin.}\ \tfrac{1}{2}a = \tfrac{1}{2}a - \frac{a^3}{48}\ \text{nearly.}$$

In like manner we have

$$\text{Sin.}\ \tfrac{1}{4}a = \tfrac{1}{4}a - \frac{a^3}{384}\ \text{nearly.}$$

By means of the two last equations exterminate the quantity a^3, and the resulting equation is

$$16\ \text{sin.}\ \tfrac{1}{4}a - 2\ \text{sin.}\ \tfrac{1}{2}a = 3a.$$

But $16\ \text{sin.}\ \frac{1}{4}a = 8$ chord $\frac{1}{2}a$, and $2\ \text{sin.}\ \frac{1}{2}a =$ chord a.

Therefore 8 chord $\frac{1}{2}a$ — chord $a = 3a$.

Here we have supposed the radius of the circle to be unity; but the same must evidently be true, whatever be the radius of the circle.

Fig. 23. *Example.* Suppose as before, that the chord AB is 6, and the radius AC is 9. Then $CD = \surd(CA^2 - AD^2) = \sqrt{72} = 8.4852814$, and $DE = 9 - 8.4852814 = 0.5147186$,

and hence $AE = \surd(AD^2 + DE^2) = 3.043836$.

Then by the rule

$$\frac{3.043836 \times 8 - 6}{3} = 6.116896$$

is the length of the arch, nearly the same as before.

PROBLEM X.

To find the area of a circle.

RULE I.

Multiply half the circumference by half the diameter, and the product will be the area.

RULE II.

Multiply the square of the diameter by .7854, and the product will be the area.

The first of these rules has been demonstrated in GEOMETRY, Sect. VI. Prop. 3. And the second rule is deduced from the first, as follows. It appears from Prop. 6. Sect. VI. GEOMETRY, that the diameter of a circle being unity, its circumference is 3.1416 nearly; therefore, by the first rule, its area is $1 \times 3.1416 \div 4 = .7854$. But circles are to one another as the squares of their diameters, (Prop. 4.) therefore, putting d for the diameter of any circle, $1 : d^2 :: .7844 : .7854\,d^2$ = the area of the circle whose diameter is d.

Example. What is the area of a circle whose diameter is 7.

By the second rule $7 \times 7 \times .7854 = 38.4846$ the area.

By the first rule $7 \times 3.1416 =$ the circumference.

Then $\frac{7 \times 3.1416 \times 7}{4} = 7 \times 7 \times .7854$ the area, the same as before.

PROBLEM XI.

To find the area of any sector of a circle.

RULE I.

Multiply the radius by half the arch of the sector, and the product will be the area, as in the whole circle.

RULE II.

As 360 is to the degrees in the arc of the sector, so is the area of the whole circle to the area of the sector.

The first of these rules follows easily from the rule for the whole area, by considering that the whole circumference is to the arch of the sector, as the whole area to the area of the sector, that is,

circum. :: arch of sect. :: rad. × $\frac{1}{2}$ circum. : area of sect.

Hence area of sect. = rad. × $\frac{1}{2}$ arch of sect.

The second rule is too obvious to need any formal proof.

Example. To find the area of a circular sector ACB whose arch AEB contains 18 degrees, the diameter being 3 feet. Fig. 23.

1. By the first rule.

First $3.1416 \times 3 = 9.4248$ the circum.

And 360 : 18 :: 9.4248 : .47124 the arch of sect.

Then $.47124 \times 3 \div 4 = .35343$ the area.

2. By the second rule.

First $.7854 \times 3^2 = 7.0686$ the area of the circle.

Then 360 : 18 :: 7.0686 : .35343 the area.

PROBLEM

Of Plane Figures.

Problem XII.

To find the area of a segment of a circle.

Rule I.

Find the area of the sector having the same arch with the segment by the last problem. Find also the area contained by the chord of the segment and the two radii of the sector. Then take the sum of these two for the answer when the segment is greater than a semicircle, or take their difference when it is less than a semicircle. As is evident by inspection of the figure of a segment.

Fig. 23. *Example.* To find the area of the segment AEBDA, its chord AB being 12, and the radius AC or BC 10.

First, as AC : AD :: rad. : sin. $36^{\circ}\ 52'\frac{1}{3} = 36.87$ degrees, the degrees in the angle ACE or arch AE. And their double, or $73.74 =$ the degrees in the whole arch AEB.

Now $.7854 \times 400 = 314.16$ the area of the whole circle.

Therefore $360^{\circ} : 73.74 :: 314.16 : 64.3504 =$ area of the sector CAEB.

Again $\sqrt{(CA^2 - AD^2)} = \sqrt{(100-36)} = \sqrt{64} = 8 = DC$.

Therefore $AD \times DC = 6 \times 8 = 48 =$ area of the triangle.

Hence sector ACBA — triangle $ACB = 16.3504$ the area of seg. AEBDA.

Problem XIII.

To find the area of any segment of a parabola, that is the space included by any arch of a parabola, and the straight line joining its extremities.

Rule.

Multiply the base of the segment by its height, and take $\frac{2}{3}$ of the product for the area.

This rule is demonstrated in Prop. 12. Part. I. Conic Sections.

Fig. 24. *Example.* The base AB of a parabolic segment. ACB is 10, and its altitude CD, (that is, the greatest line that can be drawn in the segment perpendicular to the base AB) is 4: What is its area?

$$\text{Here } 10 \times 4 \times \tfrac{2}{3} = \frac{80}{3} = 26\tfrac{2}{3} \text{ the area.}$$

Problem XIV.

To find the area of an ellipse.

Rule.

Multiply the product of the two axes by the number .7854 for the area of the ellipse.

For the area of an ellipse is equal to the area of a circle whose diameter is a mean proportional between the axes of the ellipse, (Conic Sections, Part II. Prop. 22.) that is, to the area of a circle, the square of whose diameter is equal to the product of the axes. But by Prob. X. the area of a circle is equal to the square of the diameter multiplied by .7854; therefore the area of an ellipse is equal to the product of the axes multiplied by the same number .7854.

Example. If the axes of an ellipse, ACBD, be 35 and 25. What is the area? Fig. 25.

$$35 \times 25 \times .7854 = 687.225 \text{ the area.}$$

Note. As to hyperbolic areas, the mathematical reader will find formulas for their exact mensuration in Fluxions, § 152. Ex. 4. and 5.

Problem XV.

To find nearly the area of a figure bounded by any curve line $A a a'' a''$ &c. P, and a straight line BQ and AB, PQ two other straight lines drawn from the extremities of the curve perpendicular to BQ.

Rule.

Let BQ, the base of the figure, be divided into any even number of equal parts by the perpendiculars $b\,a$, $b'\,a'$, $b''\,a''$, &c. which meet the curve in the points a, a', a'', &c. Fig. 26.

Let F and L denote the first and last perpendiculars AB and PQ.

Let E denote the sum of all the remaining even perpendiculars, viz. $a\,b$, $a''\,b''$, $a''''\,b''''$, the second, fourth, sixth, &c.

Let R denote the sum of the remaining perpendiculars, viz. $a'\,b'$, $a'''\,b'''$, &c.

And put D for Bb, or bb', &c. the common distance between the perpendiculars.

Then the area of the figure will be nearly equal to

$$\tfrac{1}{3}D \times (F + 4 \times 4E + 2R);$$

and the approximation will be so much the more accurate according as the number of perpendiculars is the greater.

Demonstration. Join the tops of the first and third perpendiculars by the line $A\,a'$ meeting the second perpendicular in E, and draw CD through a so as to form the parallelogram $A\,a'$ DC; then the space bounded by the curve line Aaa' and the three straight lines AB, Bb', $b'\,a'$ will be made up of the trapezoid $AB\,b'\,a'$, and the space bounded by the arch $A\,a\,a'$ and its chord $A\,a'$. Now if the arch $A\,a\,a'$ be small, this last space will be nearly two-thirds of the parallelogram AD, for it will be nearly equal to the area contained by the straight line $A\,a'$, and an arch of a parabola passing through the points A, a, a', and having $a\,b$ for a diameter, which area is $\frac{2}{3}$ of its circumscribing parallelogram. (Conic Sections, Part I. Prop. xii.) Therefore the space $A\,a\,a'\,b'$ BA will be nearly equal to the sum of the trapezoid $AB\,b'\,a'$ and $\frac{2}{3}$ of the parallelogram AD, which sum is evidently equal to $\frac{1}{3}$ of the trapezoid $AB\,b'\,a'$ together with $\frac{2}{3}$ of the trapezoid

CB b'D.

CBb'D. Now the area of the trapezoid AB$b'a'$ is $\frac{AB+a'b'}{2}\times Bb'$ (GEOMETRY, Sect. IV. Theor. 7.) $=\frac{AB+a'b'}{2}\times 2Bb$; and in like manner the area of the trapezoid CBb'D is $\frac{CB+Db'}{2}\times Bb'=ab\times 2Bb$; therefore the area of the figure A$aa'b'$B is nearly

$$\tfrac{1}{3}\times\frac{AB+a'b'}{2}\times 2Bb+\tfrac{2}{3}\times ab\times 2Bb$$

$$=\tfrac{1}{3}(AB+4ab+a'b')\times Bb.$$

In the very same way it may be shewn that the area of the figure $a'\,a''\,a'''\,b'''\,b'$ is nearly

$$\tfrac{1}{3}(a'b'+4a''b''+a'''b''')\times Bb,$$

and that the area of the figure $a'''\,a^{iv}$ PQ b''' is nearly

$$\tfrac{1}{3}(a'''b'''+4a^{iv}b^{iv}+PQ)\times Bb.$$

Therefore, the area of the whole figure bounded by the curve line AP, and the straight lines AB, BQ, QP, is nearly equal to the sum of these three expressions, namely to

$$\tfrac{1}{3}Bb\times\left\{\begin{array}{l}AB+PQ\\+4(ab+a''b''+a^{iv}b^{iv})\\+2(a'b'+a'''b''')\end{array}\right\}$$

as was to be demonstrated.

Fig. 27. *Example* 1. Let it be required to find the area of the quadrant ABC, whereof the radius AC=1.

Let AC be bisected by the perpendicular DE, and let CD be divided into four equal parts by the perpendiculars mn, pq, rs. Now because CA=1, therefore CD=$\frac{1}{2}$, Cr=$\frac{3}{8}$, Cp=$\frac{1}{4}$, Cm=$\frac{1}{8}$. Hence DE $=\sqrt{(EC^2-CD^2)}=\sqrt{(1-\frac{1}{4})}=\frac{1}{2}\sqrt{3}$; and in like manner $rs=\frac{1}{8}\sqrt{55}$, $pq=\frac{1}{4}\sqrt{15}$, $mn=\frac{1}{8}\sqrt{63}$. Therefore

$F+L=1+\frac{1}{2}\sqrt{3}$	$=1.8660$
$4E=\frac{1}{2}\sqrt{55}+\frac{1}{2}\sqrt{63}$	$=7.6767$
$2R=\frac{1}{2}\sqrt{15}$	$=1.9365$
The sum	11.4792
Multiply by $\frac{1}{3}$ D =	$\frac{1}{24}$
The product is	.4783
Subtract the triangle CDE =	.2165
There remains the sector CBE =	.2618
The triple of which is the quadrant ABC =	.7854

Fig. 28. *Ex.* 2. To find the area of the hyperbola FDM, of which the abscis FM=10, the semiordinate MD=12, and semitransverse CF=15.

Let FM be divided into five equal parts by the semiordinates HI, mn, pq, rs. Thus CH=17, Cm=19, Cp=21, Cr=23, CM=25. Now, since from the nature of the curve, $\sqrt{(CM^2-CF^2)}$: MD :: $\sqrt{(CH^2-CF^2)}$: HI (CONIC SECTIONS, Part III. Prop. 19. and GEOMETRY, Sect. IV. Theor. 12.), that is, in numbers, 20 : 12 :: 8 : HI, therefore HI=$\frac{24}{5}$. In like manner we find $mn=\frac{6}{5}\sqrt{34}$, $pq=\frac{18}{5}\sqrt{6}$, and $rs=\frac{12}{5}\sqrt{19}$. Therefore

F+4(HI+MD)	= 16.8
4E(=4mn+4rs)	= 68.8399
2R(=2pq)	= 17.6363
The figure HIDM	= 103.2762×$\frac{2}{3}$=68.8508

to which adding FIH, considered as a portion of a parabola, we have 75.245 for the area of the hyperbola.

OF LAND SURVEYING.

THE instruments most commonly employed in land surveying are the Chain, the Plane Table, and Cross.

A statute acre of land being 160 square poles, the chain is made 4 poles or 66 feet in length, that 10 square chains, (or 100,000 square links) may be equal to an acre. Hence each link is 7.92 inches in length.

The plane table is used for drawing a plan of a field, and taking such angles as are necessary to calculate its area. It is of a rectangular form, and is surrounded by a moveable frame, by means of which a sheet of paper may be fixed to its surface. It is furnished with an index by which a line may be drawn on the paper in the direction of any object in the field, and with scales of equal parts by which such lines may be made proportional to the distances of the objects from the plane table when measured by the chain, and its frame is divided into degrees for observing angles.

The cross consists of two pair of sights set at right angles to each other upon a staff having a pike at the bottom to stick into the ground. Its use is to determine the points where a perpendicular drawn from any object to a line will meet that line; and this is effected by finding by trials a point in the line, such that the cross being fixed over it so that one pair of the sights may be in the direction of the line, the object from which the perpendicular is to be drawn may be seen through the other pair; then the point thus found will be the bottom of the perpendicular, as is evident.

A theodolite may also be applied with great advantage to land-surveying, more especially when the ground to be measured is of great extent.

In addition to these, there are other instruments employed in surveying, as the perambulator, which is used for measuring roads and other great distances. Levels, with telescopic or other sights, which are used to determine how much one place is higher or lower than another. An ofsett-staff for measuring the ofsetts and other short distances. Ten small arrows, or rods of iron or wood, which are used to mark the end of every chain length. Pickets or staves with flags to be set up as marks or objects of direction; and lastly, scales, compasses, &c. for protracting and measuring the plan upon paper.

The observations and measurements are to be regularly entered as they are taken, in a book which is called the Field-book, and which serves as a register of all that is done or occurs in the course of the survey.

To

Of Plane Figures.

To Measure a Field by the Chain.

Fig. 29. Let A m BCD q represent a field to be measured. Let it be resolved into the triangles A m B, ABD, BCD, A q D. Let all the sides of the large triangles ABD, BCD, and the perpendiculars of the small ones A m B, A q D from their vertices m, q be measured by the chain, and the areas calculated by the rules delivered in this section, and their amount is the area of the whole. But if, on account of the curvature of its sides the field cannot be wholly resolved into triangles, then, either a straight line may be drawn over the curve side, so that the parts cut off from the field, and those added to it, may be nearly equal. Or, without going beyonds the bounds of the field, the curvilineal spaces may be measured by the rule given in Prob. XV. of this section.

To Measure a Field with the Plane Table.

Fig. 30. Let the plane table be fixed at F, about the middle of the field ABCDE, and its distances FA, FB, FC, &c. from the several corners of the field measured by the chain. Let the index be directed from any point assumed on the paper to the points A, B, C, D, &c. successively, and the lines F a, F b, F c, drawn in these directions. Let the angles contained by these lines be observed, and the lines themselves made proportional to the distances measured. Then their extremities being joined, there will be formed a figure $a\,b\,c\,d\,e$ similar to that of the field; and the area of the field may be found by calculating the areas of the several triangles of which it consists.

To Plan a Field from a given Base Line.

Fig. 31. Let two stations A, B be taken within the field, but not in the same straight line with any of its corners; and let their distance be measured. Then the plane table being fixed at A, and the point a assumed on its surface directly above A, let its index be directed to B, and the straight line $a\,b$ drawn along the side of it to represent AB. Also, let the index be directed from a to an object at the corner C, and an indefinite straight line drawn in that direction, and so of every other corner successively. Next, let the plane table be set at B, so that b may be directly over B, and $b\,a$ in the same direction with BA, and let a straight line be drawn from b in the direction BC. The intersection of this line with the former, it is evident, will determine the point C, and the triangle $a\,b\,c$ on the paper will be similar to ABC in the field. In this manner all the other points are to be determined, and these being joined there will be an exact representation of the field.

If the angles at both stations were observed, as the distance between them is given, the area of the field might be calculated from these data, but the operation is too tedious for practice. It is usual therefore to measure each lines in the figure that has been constructed as will render the calculation easy.

SECTION III.

MENSURATION OF SOLIDS.

Problem I.

To find the surface of a right prism, or cylinder.

3

Of Solids.

Rule.

Multiply the perimeter of the end by the length or height of the solid, and the product will be the surface of all its sides; to which add also the area of the two ends of the prism when required.

The truth of this rule will be evident, if it be considered that the sides of a right prism are rectangles, whose common length is the same as the length of the solid, and their breadths taken all together make up the perimeter of the ends of the prism. And as a cylinder may be considered as the limit of all the prisms which can be inscribed in or circumscribed about its base; so the surface of the cylinder will be the limit of the surfaces of these prisms, and the expression for that limit is evidently the product of the circular base by its height. Or a cylinder may be considered as a prism of an indefinitely great number of sides.

Ex. 1. What is the surface of a cube, the length of its side AB being 20 feet? Fig. 32.

Here $4\times20=$ 80 the perim. of end.

And $80\times20=$ 1600 the four sides.
And $2\times20\times20=$ 800 the top and bottom.

The sum 2400 = the area or surface.

Ex. 2. What is the convex surface of a cylinder whose length AB is 20 feet, and the circumference of its base 3 feet? Fig. 33.

Here $3\times20=60$ feet, the answer.

Problem II.

To find the surface of a right pyramid or cone.

Rule.

Multiply the perimeter of the base by the slant height or length of the side, and half the product will evidently be the surface of the sides, or the sum of the areas of all the triangles which form it. To which add the area of the end or base, if required.

Note. Here a cone is considered as a cylinder of an indefinitely great number of sides. Fig. 34.

Ex. 1. What is the upright surface of a triangular pyramid, ABCD, the slant height, AE, being 20 feet, and each side of the base 3 feet?

Here $\frac{3\times3\times20}{2}=90$ feet, the surface.

Ex. 2. Required the convex surface of a cone, the slant height AB being 50 feet, and the diameter of its base $8\frac{1}{2}$ feet. Fig. 35.

Here $8.5\times3.1416=$ circum. of base.

And $\frac{8.5\times3.1416\times50}{2}=667.59$, the answer.

Problem

PROBLEM III.

To find the surface of the frustum of a right pyramid or cone, being the lower part, when the top is cut off by a plane parallel to the base.

RULE.

Add together the perimeters of the two ends, and multiply their sum by the slant height, and take half the product for the answer.

The truth of this rule will be evident if it be considered that the sides of the frustum are trapezoids, whose parallel sides bound its top and base, and whose common breadth is its slant height.

Fig. 36. *Example.* How many square feet are in the surface of a frustum AG of a square pyramid, whose slant height AE is 10 feet; also each side of the greater end AC is 3 feet 4 inches, and each side of the lesser end EG 2 feet 2 inches.

Here $3\frac{1}{3}\times 4=13\frac{1}{3}$ the per. of gr. end.

And $2\frac{1}{6}\times 4=8\frac{2}{3}$ the per. of less end.

And their sum is 22 feet.

Therefore $\frac{22\times 10}{2}=110$ feet, is the answer.

PROBLEM IV.

To find the solid content of any prism or cylinder.

RULE.

Find the area of the base or end of the figure, and multiply it by the height or length, and the product will be the area.

This rule follows immediately from Theor 11. Sect. VIII. and Theor 2. Sect IX. GEOMETRY.

Fig. 32. *Ex.* 1. What is the solid content of a cube AG, the length of whose side is 24 inches?

Here $24\times 24=576$ sq. inches, the area of the end.

And $576\times 24=13824$ cub. inches is the solidity.

Fig. 33. N° 2. *Ex.* 2. Required the content of a triangular prism, whose length AD is 20 feet, and the sides of its triangular base ABC are 3, 4, and 5 feet.

First, the area of the triangular base is found by Rule 3. of Prob. 3. Sect. II. to be

$\surd(6\times 3\times 2\times 1)=6$ sq. feet.

Therefore $6\times 20=120$ cub. feet the solidity.

Ex. 3. The Winchester bushel is a cylinder $18\frac{1}{2}$ inches in diameter, and eight inches deep. How many cubic inches does it contain?

By Prob. 10. of Sect. II. the area of its base is

$.7854\times 18.5^2=268.803$ sq. inches;

Therefore $268.803\times 8=2150.424$ is the solid content.

PROBLEM V.

To find the solid content of any pyramid or cone.

RULE.

Find the area of the base, and multiply that area by the height, and one-third of the product will be the content of the solid.

This rule is demonstrated in Theor. 16. Sect. VIII. and Theor. 3. Sect. IX. GEOMETRY.

Ex. 1. What is the content of a triangular pyramid ABCD, whose perpendicular height AF is 30 feet, and each side of its base BCD is three feet. Fig. 34.

First, the area of the base, as found by Rule 3. of Prob. 3. Sect. II. is

$$\surd(4.5\times 1.5\times 1.5\times 1.5)=3.89711.$$

Therefore $\frac{3.89711\times 30}{3}=38.9711$ cub. feet is the solid content.

Ex. 2. What is the solid content of a cone, the radius BC of its base being nine inches, and its height AC 15 feet. Fig. 35.

Here $.7854\times\frac{3^2}{2^2}=1.76715$ is the area of the base in square feet.

And $\frac{1.76715\times 15}{3}=8.8357$ cub. feet is the solid content.

PROBLEM VI.

To find the solidity of the frustum of a cone or pyramid.

RULE.

Add into one sum the areas of the two ends, and the mean proportional between them, that is, the square root of their product, and one-third of that sum will be a mean area, which being multiplied by the perpendicular height or length of the frustum will give the content.

Demonstration. Let PABCD be any pyramid, and AG a frustum of it contained between ABCD its base, and EFGH a plane parallel to the base. Put a for the side of a square equal to AC the base of the frustum; b for the side of a square equal to EG its top; h for LM the height of the frustum, and c for PL the height of the part of the pyramid above the frustum. Then a^2 is the area of the base of the frustum; b^2 is the area of its top; $\frac{1}{3}a^2(h+c)$ is the solid content of the whole pyramid; (GEOM. Sect. VIII. Theor. 16.) $\frac{1}{3}b^2c$ is the content of its upper part; and therefore Fig. 36.

$$\tfrac{1}{3}\left\{a^2(h+c)-b^2c\right\}$$

is the solid content of the frustum itself. Now the base and top of the frustum being similar figures, (Sect. VIII. Theor.

Of Solids.

Theor. 13.) their areas are to one another as the squares of AB and EF their homologous sides, (Sect. IV. Theor. 27.) But AB : EF : : BP : PF (Sect. VII. Theor. 7. and Sect. IV. Theor. 20.) : : PM : PL, (Sect. VII. Theor. 14.); therefore the area of the base of the frustum is to the area of its top as PM^2 : PL^2, that is, $a^2 : b^2 :: (h+c)^2 : c^2$, and consequently $a : b :: h+c : c$; hence $ac=bh+bc$, and $c=\frac{bh}{a-b}$, and $h+c=\frac{ah}{a-b}$. Let these values of c and $h+c$ be now substituted in the preceding expression for the content of the frustum, and it will become, by proper reduction,

$$\tfrac{1}{3}h\frac{a^3-b^3}{a-b}.$$

Let the numerator of the fractional part of this formula be actually divided by its denominator, and we shall obtain for the area of the frustum this more simple expression,

$$\tfrac{1}{3}h\,(a^2+ab+b^2),$$

which formula, when expressed in words, is the rule. And as a cone may be considered as the limit of all the pyramids that can be inscribed in it, when the number of sides is conceived indefinitely increased, it is evident that the rule will apply alike to the cone and pyramid.

Ex. 1. Required the solidity of the frustum of a hexagonal pyramid, the side of whose greater end is four feet, and that of its lesser end is three feet, and its height nine feet.

First, by Prob. 7. Sect. II. the area of the base of the frustum is found to be 41.569, and the area of its lesser end 23.383 square feet. And the mean proportional between these is

$$\sqrt{(41.569\times 23.383)}=31.177.$$

Hence the mean area is

$$\tfrac{1}{3}(23.383+41.569+31.177)=32.043.$$

And the solid content of the frustum is

$$32.043\times 9=288.387 \text{ cubic feet.}$$

Ex. 2. What is the solidity of the frustum of a cone, the diameter of the greater end being five feet, that of the lesser end three feet, and the altitude nine feet.

Here the area of the greater end is (by Prob. 10. Sect. II.) $5^2\times .7854$, and the area of the lesser end is $3^2\times .7854$, and the mean proportional between them is $\sqrt{(5^2\times 3^2\times .7854^2)}=5\times 3\times .7854$; therefore the mean area is

$$\frac{.7854}{3}\times(5^2+3^2+5\times 3)=12.8282.$$

And the content of the frustum

$$12.8282\times 9=115.4538 \text{ cub. feet.}$$

Problem VII.

To find the surface of a sphere, or of any segment or zone of it.

Rule.

Of Solids.

Multiply the circumference of the sphere by the height of the part required, and the product will be the curve surface, whether it be a segment, a zone, or the whole sphere.

Note. The height of the whole sphere is its diameter.

The truth of this rule has been already shown in the article Fluxions, §. 165. It may however be deduced from principles more elementary, by reasoning as follows. Let PCQ be a semicircle, and ABCDE several successive sides of a regular polygon inscribed in it. Fig. 57. Conceive the semicircle to revolve about the diameter PQ as an axis, then the arch ABCDE will generate a portion of the surface of a sphere, and the chords AB, BC, CD, &c. will generate the surfaces of frustums of cones; and it is easy to see that the number of chords may be so great that the surface which they generate shall differ from the surface generated by the arch ACE by a quantity which is less than any assigned quantity. Bisect AB in L, and draw AF, LM, BG, CH, &c. perpendicular to PQ. For the sake of brevity, let *circ.* AF denote the circumference of a circle whose radius is AF. Then because AF, BG, LM, are to each other respectively as *circ.* AF, *circ.* BG, *circ.* LM (Geom. Sect. VI. Prop. 4.), and because $\frac{1}{2}$(AF+BG)=LM, therefore $\frac{1}{2}$ (*circ.* AF+*circ.* BG) = *circ.* LM. Now the area of the surface generated by the chord AB is $\frac{1}{2}$ (*circ.* AF+*circ.* BG($\times$AB, (Prob. 3.) therefore the same area is also equal to (*circ.* LM)$\times$AB. Draw AO parallel to FG, and draw LN to the centre of the circle. Then the triangles AOB, LMN are manifestly similar; therefore AB : AO :: NL : LM :: *circ.* NL : *circ.* LM; and hence AO$\times$*circ.* NL=AB$\times$*circ.* LM. But this last quantity has been proved equal to the surface generated by AB, therefore the same surface is equal to AO$\times$ *circ.* NL, or to FG$\times$*circ.* NL, that is, to the rectangle contained by FG and the circumference of a circle inscribed in the polygon. In the same way it may be shown that the surfaces generated by BC, CD, DE, are respectively equal to GH$\times$*circ.* LN, HI$\times$*circ.* LN, IK$\times$*circ.* LN. Therefore the whole surface generated by the chords AB, BC, CD, DE, &c. is equal to (FG+GH+HI+IK)$\times$ *circ.* LN=FK$\times$ *circ.* LN. Conceive now the number of chords between A and E to be indefinitely increased; then, observing that the limit of the surface generated by the chords is the surface generated by the arch ABCDE, and that the limit of NL is NP, the radius of the generating circle, it follows that the spherical surface or zone generated by the arch ACE is equal to the product of the circumference of the sphere by FK the height of the zone.

Ex. 1. What is the superficies of a globe whose diameter is 17 inches?

First $17\times 3.1416=53.4072$ inches=the circum.

Then $53.4072\times 17=907.9224$ sq. inches=6.305 square feet the answer.

Ex. 2. What is the convex surface of a segment 8 inches in height cut off from the same globe?

Here

Of Solids.

Here $53.4072 \times 8 = 427.2576$ sq. inches $= 2.967$ sq. feet the answer.

PROBLEM VIII.

To find the solidity of a sphere.

RULE I.

Multiply the area of a great circle of the sphere by its diameter, and take $\frac{2}{3}$ of the product for the content.

RULE II.

Multiply the cube of the diameter by the decimal .5236 for the content.

The first of these rules is demonstrated in GEOMETRY, Sect. IX. Theor. 6. And the second is deduced from the first, thus: put d for the diameter of the sphere, then $d^2 \times .7854$ is the area of a great circle of the sphere, and by the first rule $\frac{2}{3}d \times d^2 \times .7854 = d^3 \times .5236$ is its content.

Example. What is the content of a sphere whose diameter is 6 feet. ?

Answer $6^3 \times .5236 = 113.0976$ cub. feet.

PROBLEM IX.

To find the solid content of a spherical segment.

RULE.

From 3 times the diameter of the sphere take double the height of the segment, then multiply the remainder by the square of the height, and the product by the decimal .5236 for the content.

This rule has been investigated in FLUXIONS, §. 163. But it may be proved in a more elementary manner by means of the following axiom. *If two solids be contained between two parallel planes; and if the sections of these solids by a third plane parallel to the other two, at any altitude, be always equal to one another, then the solids themselves are equal. Or more generally thus. If two solids between two parallel planes be such, that any sections of them by a third plane parallel to the other two have always to each other the same given ratio, then the solids themselves are to one another in that ratio.* We have given this proposition in the form of an axiom for the sake of brevity, but its truth may be strictly demonstrated, as has been done when treating of pyramids and the sphere, in GEOMETRY, Sect. 8. and 9.

Fig 38. Let us now suppose ABE to be a quadrant; C the centre of the circle; AFEC a square described about the quadrant; and CF the diagonal of the square. Suppose the figures to revolve about AC as an axis, then the quadrant will generate a hemisphere, the triangle ACF will generate a cone, and the square AE a cylinder. Let these three solids be cut by a plane perpendicular to the axis, and meeting the plane of the square, in the line DHBG; and join CB. Then, because CDB is a right-angled triangle, a circle described with CB as a radius is equal to two circles described with CD and DB as radii (GEOMETRY, Sect. VI. Prop. 4. Cor. 2.). But CB=DG, and since CA=AF, therefore CD=DH; therefore the circle described with the radius DG, is equal to the sum of the circles described with the radii DH, DB; that is, the section of the cylinder at any altitude, is equal to the corresponding sections of the sphere and cone taken together. Consequently, by the foregoing axiom, the cylinder is equal to the hemisphere and cone taken together, and also the segment of the cylinder between the planes AF, DG is equal to the sum of the segments of the hemisphere and cone contained between the same planes. Put 2CE, or 2AF, the diameter of the circle, $=d$, and AD, the height of the spherical segment, $=h$. Then $AC=\frac{1}{2}d$ and $2CA-2AD=2CD=d-2h$. Let n denote the number .7854. Then the area of the base common to the conic frustum AH, and cylinder AG, is $n\,d^2$, (Sect. II. Prob. 10.), and the area of the top of the frustum is $n\,(d-2h)^2$, and the mean proportional between these areas is $n\,(d-2h)\,d$. Therefore the solid content of the frustum is (by Prob. 3. of this sect.)

$$\tfrac{1}{3}\left\{ n\,d^2 + n\,(d-2h)^2 + n\,d\,(d-2h) \right\} \times h.$$

$$= n\,d^2 h - 2\,n\,d\,h^2 + \tfrac{4}{3}\,n\,h^3.$$

Now the solid content of the cylinder is $n\,d^2 h$: (Prob. 1.) Therefore the solid content of the spherical segment, (which is equal to the difference between the cylinder AG and conic frustum AH) is equal to

$$n\,d^2 h - (n\,d^2\,h - 2\,n\,d\,h^2 + \tfrac{4}{3}\,n\,h^3),$$

that is, to $2\,n\,d\,h^2 - \frac{4}{3}\,n\,h^3$, or to

$$\frac{2n}{3}\,(3\,d-2\,h)\,h^2,$$

which expression, if it be considered that $\frac{2n}{3}$ or $\frac{2 \times .7854}{3}$ is equal to .5236, is evidently the same as that given by the rule.

Example. In a sphere whose diameter is 21, what is the solidity of a segment whose height is 4.5 inches ?

First $3 \times 21 - 2 \times 4.5 = 54$.

Then $54 \times 4.5 \times 4.5 \times .5236 = 572.5566$ inches, the solidity required.

PROBLEM X.

To find the solid content of a paraboloid, or solid, produced by the rotation of a parabola about its axis.

RULE.

Multiply the area of the base by the height, and take half the product for the content.

To demonstrate this rule, let AGC and BHD be two equal semi-parabolas lying in contrary directions, and having their vertices at the extremity of the line AB. Let AD, BC be ordinates to the curves. Complete the rectangle ABCD, and conceive it to revolve about AB as an axis; then the rectangle will generate a cylinder, the radius of whose base will be AD, and the two semi-parabolas will generate two equal paraboloids having the same base and altitude as the cylinder. Let a plane be drawn perpendicular to the axis, and let FHGE be the common section of this plane and the generating Fig. 39.

generating figure. Let P denote the parameter of the axis. Then ſince

$$EG^2=P\times AE,$$
$$\text{and } EH^2=P\times EB,$$
$$EG^2+EH^2=P\times AB=CB^2.$$

Hence it appears, as in the demonſtration of the preceding rule, that of the ſolids deſcribed by ADCB, ACB, ADB between the ſame parallel planes, the ſection of the cylinder at any altitude is equal to the correſponding ſections of the paraboloids taken together. Conſequently (by the Axiom) the cylinder is equal to both the paraboloids taken together; hence each is half a cylinder of the ſame baſe and altitude agreeing with the rule.

The ſame thing is alſo proved in FLUXIONS, §. 163.

Example. If the diameter of the baſe of a paraboloid be 10 and its height 12 feet; what is its content?

Here $10\times.7854=7.854$ the area of the baſe.

And $\frac{1}{2}\times7.854\times12=47.124$ cub. feet is the ſolidity.

PROBLEM X.

To find the ſolid content of a fruſtum of a paraboloid.

RULE.

Add together the areas of the circular ends, then multiply that ſum by the height of the fruſtum, and take half the product for its ſolid content.

To prove this rule put A and a for the greater and leſſer ends of the fruſtum, and h for its height; alſo let c denote the height of the portion cut off from the complete paraboloid, ſo as to form the fruſtum. Then, by the laſt problem, the content of the complete paraboloid is $\frac{1}{2}A(h+c)$, and the content of the part cut off is $\frac{1}{2}ac$, therefore the content of the fruſtum is

$$\tfrac{1}{2}\left\{A(h+c)-ac\right\}=\tfrac{1}{2}\left\{Ah+c(A-a)\right\}$$

But from the nature of the parabola, $c:h+c::a:A$; hence $Ac=ah+ac$ and $c=\frac{ah}{A-a}$.

Let this value of c be ſubſtituted inſtead of it in the above expreſſion for the content of the fruſtum, and it becomes

$$\tfrac{1}{2}(Ah+ah)=\tfrac{1}{2}h(A+a),$$

and hence is derived the rule.

Example. Required the ſolidity of the fruſtum of a paraboloid, the diameter of the greater end being 58, and that of the leſſer end 30, and the height 18.

Firſt, (by Prob. 10. Sect. II.) we find the areas of the ends to be $58^2\times.7854$, and $30^2\times.7854$; therefore their ſum is $(58^2+30^2)\times.7854=4264\times.7854$. And the content of the figure is $\frac{1}{2}\times4264\times.7854\times18=30140.5104$, the anſwer.

PROBLEM XI.

To find the ſolid content of a parabolic ſpindle or ſolid generated by the rotation of AEB an arc of a parabola, about AB an ordinate to the axis. Fig. 40.

RULE.

Multiply the area of the middle ſection by the length, and take $\frac{8}{15}$ of the product for the content of the ſolid.

For the inveſtigation of this rule we muſt refer the reader to FLUXIONS, § 163. *Ex.* 2.

Example. The length of the parabolic ſpindle AEBeA is 60, and the middle diameter Ee 34; what is the ſolidity?

Here $34^2\times.7854$ is area of the middle ſection.

Therefore $34^2\times.7854\times60\times\frac{8}{15}=29053.5168$ is the ſolidity required.

PROBLEM XII.

To find the ſolid content of the fruſtum of a parabolic ſpindle, one of the ends of the fruſtum paſſing through the centre of the ſpindle.

RULE.

Add into one ſum eight times the ſquare of the diameter of the greater end, and three times the ſquare of the leſſer end, and four times the product of the diameters; multiply the ſum by the length, and the product multiplied by .05236, or $\frac{1}{15}$ of .7854, will be the content.

For, referring the reader to FLUXIONS, § 163. Ex. 2. as before, and ſubſtituting h for $AC=\frac{1}{2}b$, but, in other reſpects, retaining the figure and notation, we have this general expreſſion for the ſegment APp,

$$\frac{\pi x^3}{a^2}\left(\frac{4h^2}{3}-hx+\frac{x^2}{5}\right),$$

which, when $x=h$ gives $\frac{8\pi h^5}{15a^2}$ for the value of the ſemi-ſpindle. From this quantity let the former be ſubtracted, and there will remain

$$\frac{8\pi h^5}{15a^2}-\frac{\pi x^3}{a^2}\left(\frac{4h^2}{3}-hx+\frac{x^2}{5}\right)$$

for the content of the fruſtum. In this expreſſion let z be put inſtead of $h-x$ or CD, and, denoting CE the radius of the greater end of the ſpindle by d, let $\frac{h^2}{d}$ be ſubſtituted inſtead of its value a. Then we ſhall have the content of the fruſtum otherwiſe expreſſed by

$$\frac{\pi d^2 z}{h^4}\left\{h^4-\frac{2h^2z^4}{3}+\frac{z^4}{5}\right\}$$

which value, by putting $h\sqrt{\frac{d-y}{d}}$ in its two laſt terms inſtead

Of Solids. instead of z, is changed to

$$\pi z \times \frac{[illegible] + 4dy + 3y^2}{15},$$

and hence is derived the preceding rule.

Example. Suppose the diameter of the greater end to be 8, and the diameter of the lesser end 6, and the length 10, required the content?

First $8 \times 8^2 + 3 \times 6^2 + 4 \times 8 \times 6 = 812$.

Then, $812 \times 10 \times .05236 = 425.1632$, the content.

Problem XIII.

To find the solid content of a spheroid, or solid generated by the rotation of an ellipse about either axis.

Rule.

Multiply continually together the fixed axis, and the square of the revolving axis, and the number .5236 or $\frac{1}{6}$ of 3.1416, and the last product will be the solidity.

Fig. 41. For, let the semiellipse, ADB, and semicircle AEB revolve about the same fixed axis AB, and thus generate a spheroid and sphere. Let CD the revolving semiaxis of the ellipse meet the circle in E, and draw QP any ordinate to the fixed axis meeting the circle in R. Then, from the nature of the ellipse $PQ^2 : PR^2 :: CD^2 : CE^2$ or CA^2 (Conic Sections, Part II. Prop. 11. Cor. 3.) Hence it follows, (Geometry, Sect. VI. Prop. 4.), that every section of the spheroid is to the corresponding section of the sphere in the same given ratio, namely, that of the square of the revolving axis to the square of the fixed axis; therefore (Axiom in the dem. of Prob. 9.) the whole spheroid is to the whole sphere in the same ratio. That is, (because the content of the sphere is $AB^3 \times .5230$) $AB^2 : (2\,CD)^2 :: AB^3 \times .5236$: (the cont. of spheroid). Hence the content of the spheroid is $AB \times (2\,CD)^2 \times .5236$.

Ex. 1. What is the solid content of an oblong spheroid, or solid generated by the rotation of an ellipse about its greater axis, the axes being 50, and 30?

Here $50 \times 30^2 \times .5236 = 23562$, the content.

Ex. What is the solid content of an oblate spheroid, or solid generated by the rotation of an ellipse about its lesser axis, the two axes being as before.

Here $30 \times 50^2 \times .5236 = 39270$ the answer.

Problem XIV.

To find the solid content of the frustum of a spheroid, its ends being perpendicular to the fixed axis, and one of them passing through the centre.

Rule.

To the area of the less end add twice that of the greater, multiply the sum by the altitude of the frustum, and $\frac{1}{3}$ of the product will be the content.

Note. This rule will also apply to the sphere.

Demonstration. Let ABE be a quadrant of an ellipse, C its centre, CAFE its circumscribed rectangle, and CF its diagonal. Draw any straight line DG parallel to CE, meeting AC, CF, ABE and EF in D, H, B, and G. Then by Conic Sections, Part II. Prop. 11. Of Solids. Fig. 42.

$$CE^2 \text{ or } AF^2 : DB^2 :: CA : CA^2 - CD^2,$$

and by sim. tr. $AF^2 : DH^2 :: CA^2 : CD^2$.

Therefore (Geometry, Sect. III. Theor. 8),

$$AF^2 : DB^2 + DH^2 :: CA^2 : CA^2;$$
$$\text{Hence } DB^2 + DH^2 = AF^2 = DG^2.$$

Conceive now the figure to revolve about AC as an axis, so that the elliptic quadrant may generate the half of a spheroid, the rectangle AE a cylinder, and the triangle ACF a cone; then it is evident (as was shown in the case of the sphere in Prob. 9.) that every section of the first of these solids by a plane perpendicular to the axis is equal to the difference of the sections of the other two, and consequently that the frustum of the spheroid between CE and DG is equal to the difference between the cylinder having DG or CE for the radius of its base, and CD for its altitude, and the cone having DH for the radius of its base, and DC for its altitude.

Put n for the number 3.1416, then (Prob. 4.) the content of the cylinder is $4\,n \times DG^2 \times CD$, and (Prob. 5.) the content of the cone is $\frac{4}{3} n \times DH^2 \times CD$, and therefore the content of the frustum of the spheroid is

$$4\,n \times CD\,(DG^2 - \tfrac{1}{3}\,DH^2).$$

But it was shewn that $DH^2 = DG^2 - DB^2$; therefore the content of the frustum is also equal to

$$\tfrac{4}{3}\,n \times CD\,(2\,CE^2 + DB^2),$$

and hence is derived the rule.

Ex. Suppose the greater end of the frustum to be 15, the less end 9, and the length 10 inches, required the content?

The area of the greater end is $15^2 \times .7854$, and the area of the less $9^2 \times .7854$, therefore the content is

$$.7854\,(9^2 + 2 \times 15^2) \times \tfrac{10}{3} = 1390.158 \text{ cubic inches.}$$

Problem XV.

To find the solid content of a hyperboloid, or solid generated by the rotation of a hyperbola about its transverse axis.

Rule.

As the sum of the transverse axis and the height of the solid is to the sum of the said transverse axis and $\frac{2}{3}$ of the height, so is half the cylinder of the same base and altitude to the solidity of the hyperboloid.

Demonstration. Let BAb be a hyperbola, Aa its transverse axis, C its centre, CF,Cf its asymptotes, FAf a tangent at its vertex. Draw FE parallel to CA, and draw any straight line parallel to Ff, meeting the asymptotes in H and b, the curve in B and b, the axis in D, and the line FE in G. Then, because $AF^2 = BH \times hB$ (Conic Sections, Part III. Prop 11.) and Fig. 43.

Of Solids.

and HB × hB = DH² — DB² (Geometry, Sect. IV. Theor. 12.), therefore AF² = DH² — DB² and DB² = HD² — DG². Hence it appears, that if the figure be conceived to revolve about CA as an axis, ſo that the hyperbolic arc AB may generate a hyperboloid, the triangle DCH a cone, and the rectangle DAFG a cylinder, any ſection of the firſt of theſe ſolids by a plane Hh, perpendicular to the axis, will be equal to the difference of the ſections of the other two by the ſame plane. Therefore the hyperboloid BAb is equal to the difference between the conic fruſtum FHhf and the cylinder FGgf. Let Aa the tranſverſe axis be denoted by p, Ff = its conjugate axis by q, AD the height of the ſolid by h, Bb its baſe by b. Then, becauſe by ſimilar triangles, &c,

$$\mathrm{CA} : \mathrm{CD} :: \mathrm{F}f : \mathrm{H}h :: \mathrm{F}f^2 : \mathrm{F}f \times \mathrm{H}h,$$

therefore $\mathrm{F}f \times \mathrm{H}h = \frac{\mathrm{CD}}{\mathrm{CA}} \times \mathrm{F}f^2 = \frac{(\frac{1}{2}p + h)q^2}{\frac{1}{2}p} = q^2 + \frac{2hq^2}{p}$.

Now $\mathrm{F}f^2 = q^2$, and $\mathrm{H}h^2$ $(= \mathrm{B}b^2 + \mathrm{F}f^2) = b^2 + q^2$, therefore putting n for .7854, we have (by Prob. 6.) the content of the conic fruſtum FHhf equal to

$$\frac{nh}{3}\left(q^2 + b^2 + q^2 + q^2 + \frac{2hq^2}{p}\right) = \frac{nh}{3}\left(3q^2 + b^2 + \frac{2hq^2}{p}\right);$$

from this ſubtract nhq^2, the expreſſion for the content of the cylinder FGgf, and there will remain

$$\frac{nh}{3}\left(b^2 + \frac{2hq^2}{p}\right)$$

for the content of the hyperboloid. But from the nature of the hyperbola

$$\mathrm{A}a^2 : \mathrm{F}f^2 :: \mathrm{AD} \times \mathrm{D}a : \mathrm{BD}^2,$$

that is $p^2 : q^2 :: (p+h)\,h : \frac{1}{4}b^2$;

therefore $\frac{2hq^2}{p} = \frac{pb^2}{2(p+h)}$; and hence the content of the hyperboloid is alſo equal to

$$\frac{nh}{3}\left(b^2 + \frac{pb^2}{2(p+h)}\right) = \frac{nhb^2}{2} \times \frac{p + \frac{2}{3}h}{p+h}.$$

Now if it be conſidered that the quantity nhb^2 is the expreſſion for the content of a cylinder whoſe baſe is b and height h, it will appear evident, that this laſt formula is the ſame as would reſult from the foregoing rule.

Ex. Suppoſe the height of the hyperboloid to be 10, the radius of its baſe 12, and its tranſverſe axis 30. What is its content?

1 Becauſe a cylinder of the ſame baſe and altitude is 24² × .7854 × 10, therefore, we have the proportion,

$$40 : \frac{110}{3} :: \frac{24^2 \times .7854 \times 10}{2} :$$

$$\frac{24^2 \times .7854 \times 10 \times 110}{40 \times 3 \times 2} = 2073.456,$$ the content of the ſolid as required.

Of GAUGING.

Of Gauging.

Gauging treats of the meaſuring of caſks, and other things falling under the cognizance of the officers of the exciſe, and it has received its name from a gauge or rod uſed by the practitioners of the art.

From the way in which caſks are conſtructed, they are evidently ſolids of no determinate geometrical figure. It is, however, uſual to conſider them as having one or other of the four following forms:

1. The middle fruſtum of a ſpheroid.
2. The middle fruſtum of a parabolic ſpindle.
3. The two equal fruſtums of a paraboloid.
4. The two equal fruſtums of a cone.

We have already given rules by which the content of each of theſe ſolids may be found in cubic feet, inches, &c. But as it is uſual to expreſs the contents of caſks in gallons, we ſhall give the rules again in a form ſuited to that mode of eſtimating capacity. Obſerving that in each caſe the lineal dimenſions of the caſk are ſuppoſed to be taken in inches.

Problem. I.

To find the content of a caſk of the firſt, or ſpheroidal variety.

Rule.

To the ſquare of the head diameter add double the ſquare of the bung diameter, and multiply the ſum by the length of the caſk. Then let the product be multiplied by .0009¼, or divided by .1077 for ale gallons, or multiplied by .0011⅓ or divided by 882 for wine gallons.

The truth of this rule may be proved thus. Put B for FG, the bung diameter, H for AH the head diameter, and L for AD, the length of the caſk, then (by Prob. 14.) the content of the caſk is $(2\mathrm{B}^2 + \mathrm{H}^2)\mathrm{L} \times \frac{.7854}{3}$, which being divided by 282 (the cubic inches in an ale gallon) gives $(2\mathrm{B}^2 + \mathrm{H}^2)\,\mathrm{L} \times .00928371$, or $(2\mathrm{B}^2 + \mathrm{H}^2) \times \frac{1}{1077.157} \times \mathrm{L}$, for the content in ale gallons. And being divided by 231, (the cubic inches in a wine gallon) gives $(2\mathrm{B}^2 + \mathrm{H}^2) \times .00113333\ \mathrm{L}$, or $(2\mathrm{B}^2 + \mathrm{H}^2) \times \frac{1}{882.355} \times \mathrm{L}$, for the content in wine gallons. Fig. 44.

Ex. Suppoſe the bung and head diameters to be 32 and 24, and the length 40 inches. Required the content?

Here $(2 \times 32^2 + 24^2) \times 40 \times .0009\frac{1}{4} = 97.44$ ale gallons, is the content required.

And $(2 \times 32^2 + 24^2) \times 40 \times .0011\frac{1}{3} = 118.95$ wine gallons is the ſame content.

Problem II.

To find the content of a caſk of the ſecond, or parabolic ſpindle form.

Rule.

To the ſquare of the head diameter add double that of the bung diameter, and from the ſum take $\frac{2}{5}$, or $\frac{4}{10}$ of

Of Gauging

of the ſquare of the difference of the ſaid diameters. Then multiply the remainder by the length, and the product multiplied, or divided by the ſame numbers as in the rule to laſt problem, will give the content.

For by Problem 12. the content in inches is

$$\frac{8B^2+4BH+3H^2}{15}\times .7854\,L;$$

and this formula may be otherwiſe expreſſed thus,

$$\left\{2B^2+H^2-\tfrac{2}{5}(B-H)^2\right\}\times\frac{.7854}{3}\times L,$$

and hence is derived the rule, the multipliers or diviſors being evidently the ſame as in laſt problem.

Ex. The dimenſions of a caſk being the ſame as in laſt problem; required the content.

Anſwer. $(2\times 32^2+24^2-\tfrac{2}{5}\times 8^2)\times 40\times .0009\tfrac{1}{4}$ $=96.49$ the content in ale gallons.

And $10393.6\times .0011\tfrac{1}{3}=117.79$ the content in wine gallons.

Problem III.

To find the content of a caſk of the third or paraboloidal variety.

Rule.

To the ſquare of the bung diameter add the ſquare of the head diameter, and multiply the ſum by the length; then, if the product be multiplied by .0014, or divided by 718, the reſult will be the content in ale gallons; or if it be multiplied by .0017, or divided by 588, the reſult will be the content in wine gallons.

For by Problem 10. the content in inches is $\tfrac{1}{2}(B^2+H^2)\times .7854\,L$; and this expreſſion being divided by 282 gives $(B^2+H^2)\times .00139255\,L$ or $(B^2+H^2)\times\frac{1}{718.105}\times L$ for the content in ale gallons; and divided by 231 gives $(B^2+H^2)\times .0017\,L$ or $(B^2\times H^2)\times\frac{1}{588.233}$ for the content in wine gallons.

Ex. Suppoſe the dimenſions of a caſk, as before; required the content.

Anſwer. $(32^2+24^2)\times 40\times .0014=89.1$ the content in ale gallons.

And $64000\times .0017=108.8$ the content in wine gallons.

Problem IV.

To find the content of a caſk of the fourth or conical variety.

Rule.

To three times the ſquare of the ſum of the diameters add the ſquare of the difference of the diameters; multiply the ſum by the length; and multiply the reſult by $.00023\tfrac{1}{5}$ or divide it by 4308 for the content in ale gallons; or multiply the reſult by $.0028\tfrac{1}{3}$, or divide it by 3529, for the content in wine gallons.

For by Problem 6. the content in inches is $\tfrac{1}{3}(B^2+BH+H^2)\times .7854\,L$ which expreſſion is equivalent to

$$\left\{3(B+H)^2+(B-H)^2\right\}\times\frac{.7854}{12}L.$$

Now $\frac{.7854}{12}$ divided by 282 gives $.00023209=\frac{1}{4308.628}$ the multiplier for ale gallons, and divided by 231 gives $.00028333=\frac{1}{3529.42}$ the multiplier for wine gallons.

Ex. Suppoſing the dimenſions of a caſk as before, What is its content?

Anſwer, $(3\times 56^2+8^2)\times 40\times .00023\tfrac{1}{5}=87.93$, the content in ale gallons.

And $378880\times .00028\tfrac{1}{3}=107.35$, is the content in wine gallons.

As theſe four forms of caſks are merely hypothetical, it may reaſonably be expected that ſome degree of uncertainty will attend the application of the rules to actual meaſurement. The following rule, however, given by Dr Hutton in his excellent treatiſe on menſuration will apply equally to any caſk whatever. And as the ingenious author obſerves, that its truth has been proved by ſeveral caſks which have been actually filled with a true gallon-meaſure after their contents were computed by it, we preſume that it is more to be depended upon in practice than the others.

Rule.

Add into one ſum 39 times the ſquare of the bung diameter, 25 times the ſquare of the head diameter, and 26 times the product of the diameters; multiply the ſum by the length, and the product by .00034; then the laſt product divided by 9 will give the wine gallons, and divided by 11 will give the ale gallons.

In inveſtigating this rule the ingenious author aſſumed as a hypotheſis, that one-third of a caſk at each end is nearly the fruſtum of a cone, and that the middle part may be taken as the middle fruſtum of a parabolic ſpindle. This being ſuppoſed, let AB and CD be the two right-lined parts, and BC the parabolic part; produce AB and DC to meet in E, and draw lines as in the figure. Let L, B, and H denote the ſame as before. Then, ſince AB has the ſame direction as EB at A, ABE will be a tangent to a parabola BF, and therefore $FI=\tfrac{1}{2}EI$. But $BI=\tfrac{1}{3}AK$, and hence, by ſim. triangles $EI=\tfrac{1}{3}EK$; conſequently $FI=\tfrac{1}{2}EI=\tfrac{1}{6}EK=\tfrac{1}{5}FK=\tfrac{1}{10}(B-H)$; ſo that the common diameter $BL=FG-2FI=B-\tfrac{1}{5}(B-H)=\tfrac{1}{5}(4B+H)$, which call c. Now by the rules for parabolic ſpindles and conic fruſtums we obtain (putting n for .7854) Fig. 44.

$$\frac{8B^2+4BC+3C^2}{15}\times\frac{Ln}{3}=\frac{328B^2+44BH+3H^2}{25\times 45}$$

$\times Ln$ for the parabolic or middle part; and $\frac{C^2+CH+H^2}{3}$

$$\times\frac{2Ln}{3}=\frac{160B^2+280BH+310H^2}{25\times 45}\times Ln$$ for the two

ends,

Of Gauging ends, and the ſum of theſe two gives after proper reduction $(39B^2+26BH+25H^2)\times\frac{Ln}{90}$, nearly, for the content in inches. And the quantity $\frac{n}{90}$ or $\frac{.7854}{90}$ being divided by 231 gives $\frac{.00034}{9}$ the multiplier for wine gallons; and ſince 231 is to 282 as 9 to 11 nearly, $\frac{.00034}{11}$ will be the multiplier for ale gallons as in the rule.

Ex. Suppoſe a caſk to have the ſame dimenſions as in the four former rules; required the content.

Here $(39^2\times32^2+26\times32\times24+25\times24^2)\times40\times.00034$—1010.5; which being divided by 9 and by 11 we obtain 112.3 wine gallons or 91.9 ale gallons for the content required.

Menſtrual ‖ Mentz. MENSTRUAL, or MENSTRUOUS, in *Phyſiology*, is applied to the blood which flows from women in their ordinary monthly purgations. See MIDWIFERY and MEDICINE *Index*.

MENSTRUUM, in *Chemiſtry*, any body which in a fluid or ſubtilized ſtate is capable of interpoſing its ſmall parts betwixt the ſmall parts of other bodies, ſo as to divide them ſubtly, and form a new uniform compound of the two.

MENTHA, MINT, a genus of plants belonging to the didynamia claſs, and in the natural method ranking under the 42d order *Verticillatæ*. See BOTANY *Index*.

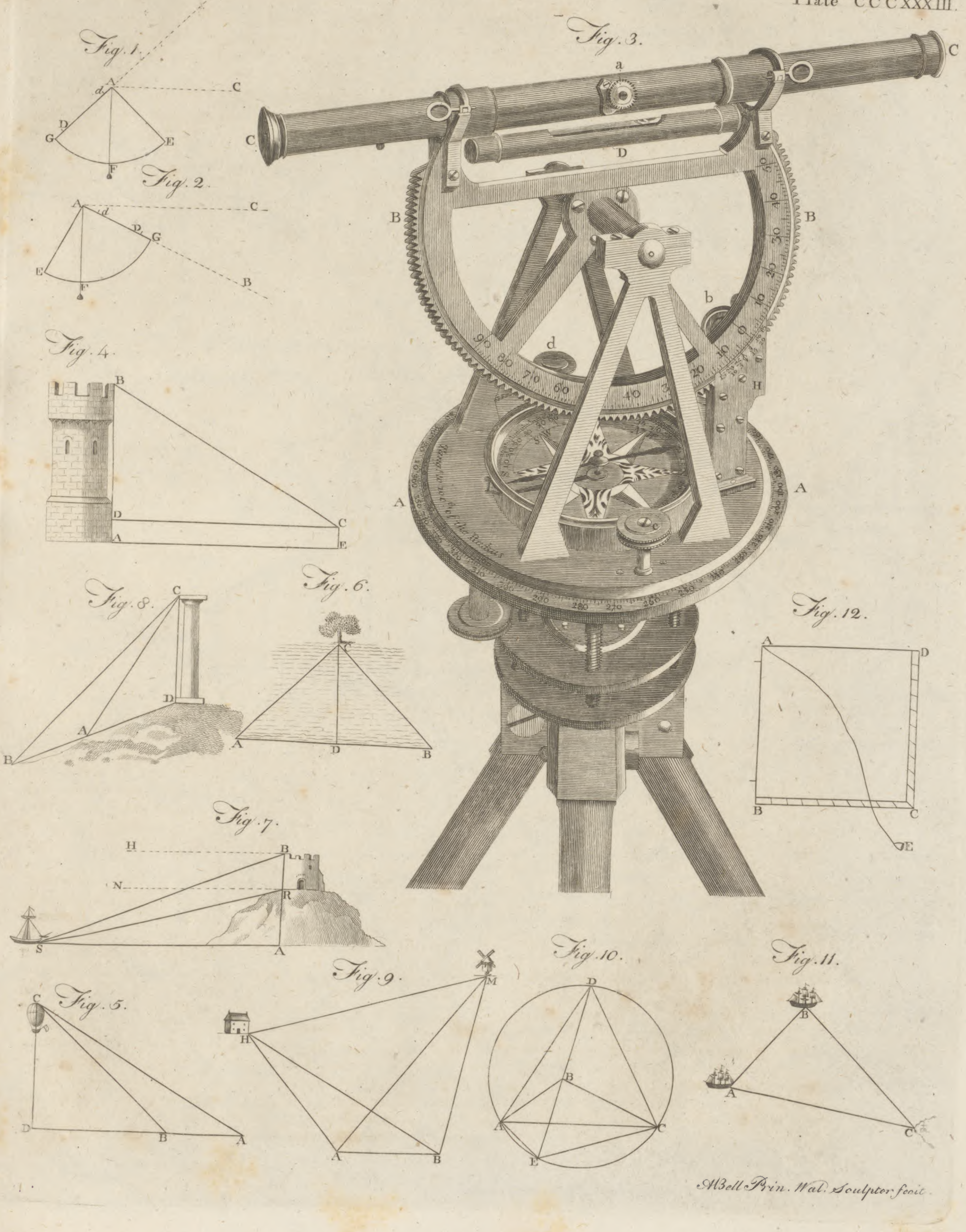
MENTOR, in fabulous hiſtory, a faithful friend of Ulyſſes; a ſon of Hercules; a king of Sidonia, who revolted againſt Artaxerxes Ochus, and afterwards was reſtored to favour by his treachery to his allies, &c. *Diod.* 16. An excellent artiſt in poliſhing cups and engraving flowers on them. *Plin.* 33. c. 11.—*Mart.* 9. ep. 60. v. 16.

MENTZ, an archbiſhopric and electorate in Germany. It lies on the banks of the river Maine, between the electorate of Triers on the weſt, the Palatinate on the ſouth, Franconia on the eaſt, and the Wetterau on the north. It is about 60 miles in length from north-eaſt to ſouth-weſt, and about 50 in breadth. A conſiderable part of the elector's revenue ariſes from the toll on the Rhine and Maine, and from the tax on the excellent wines produced in this country. The chief towns of any trade are, 1. Mentz; (ſee the next article.) In its neighbourhood is Hockheim, ſo celebrated for good wines, that the beſt Rheniſh is from thence called *old hock*. It is a pretty village, containing about 300 families; and belongs to the chapter of Mentz, the dean of which enjoys the revenue of it: in a good year he makes from twelve to fifteen thouſand guilders of his wine. He and the Auguſtins of Mentz and Francfort have the excluſive enjoyment of the beſt Hockheimer wine, of which, in good years, a piece, conſiſting of 100 meaſures, ſells for from 900 to 1000 guilders from the preſs. "This (ſays the Baron Rieſbeck) is certainly one of the deareſt wines in the world. Having a deſire to taſte it on the ſpot, we were obliged to pay a rixdollar; it was, however, of the beſt vintage in this century, viz. that of 1766. Nor ſhould we have had it, but for an advocate of Mentz, to whom the hoſteſs meant to ſhew favour. This was the firſt German wine I had met with which was entirely without any ſour taſte: it was quite a perfume to the tongue; whereas the other wine of Hockheim, let it be as good as it may, is not quite clear of vinegar; though for this alſo, if it has any age, you are forced to pay a guilder and a half." 2. Bingen is a pleaſant town, which ſtands in the diſtrict called *Rhinegau*. This town, which, together with the toll on the Rhine, is worth about 30,000 guilders, belongs to the chapter of Mentz, is extremely beautiful, and contains about 4500 inhabitants. A great part of the corn which is carried into the Rhinegau from the neighbouring Palatinate, comes through this place, which, on the other hand, ſupplies the Palatinate with drugs, and various foreign commodities. This traffic alone would make the place very lively; but, beſides this, it has very fruitful vineyards. The hill, at the foot of which it lies, and one ſide of which is made by the gullet through which the Nahe runs into the Rhine, forms another ſteep rock behind this gullet parallel to the Rhine and the golden Rudeſheimer mountain; it therefore enjoys the ſame ſun as this does, which makes the Budeſheimer wine that grows on it little inferior to the Rudeſheimer. See RUDESHEIM. The riſing grounds about it produce wines that are eſteemed preferable to thoſe of Baccharac, ſo much in vogue heretofore.—3. Elfeld, five miles weſt from Mentz, is a ſtrong fortified town, on the north ſide of the Rhine, and the chief of the Rhinegau.—Here is Rudeſheim, a place noted for the growth of the beſt wines in theſe parts. 4. Weiſbaden lies between ſix and ſeven leagues from Francfort, and about five or ſix miles north of Mentz; it is the metropolis of a country belonging to the branch of Naſſau-Saarbrak, and is famous for its mineral waters.

According to Rieſbeck, the ſee of Mentz is indebted for its increaſe of riches to St Boniface, who may be called, with great juſtice, the apoſtle of the Germans. It was this man, an Engliſhman by birth, who in the time of Charlemagne baptized Witikind and the other brave Saxons who had ſo long reſiſted baptiſm with their ſwords, and ſpread the empire of the vicar of Jeſus Chriſt as far as the northern and eaſtern ſeas. He it was who introduced the Roman liturgy into Germany, and made the ſavage inhabitants abſtain from eating horſe's fleſh. He raiſed the papal power to a higher pitch than it had been raiſed in any other country in Chriſtendom; and, in recompence of his ſervices, the pope made all the new founded biſhoprics in the north of Germany ſubject to the ſee of Mentz, which Boniface

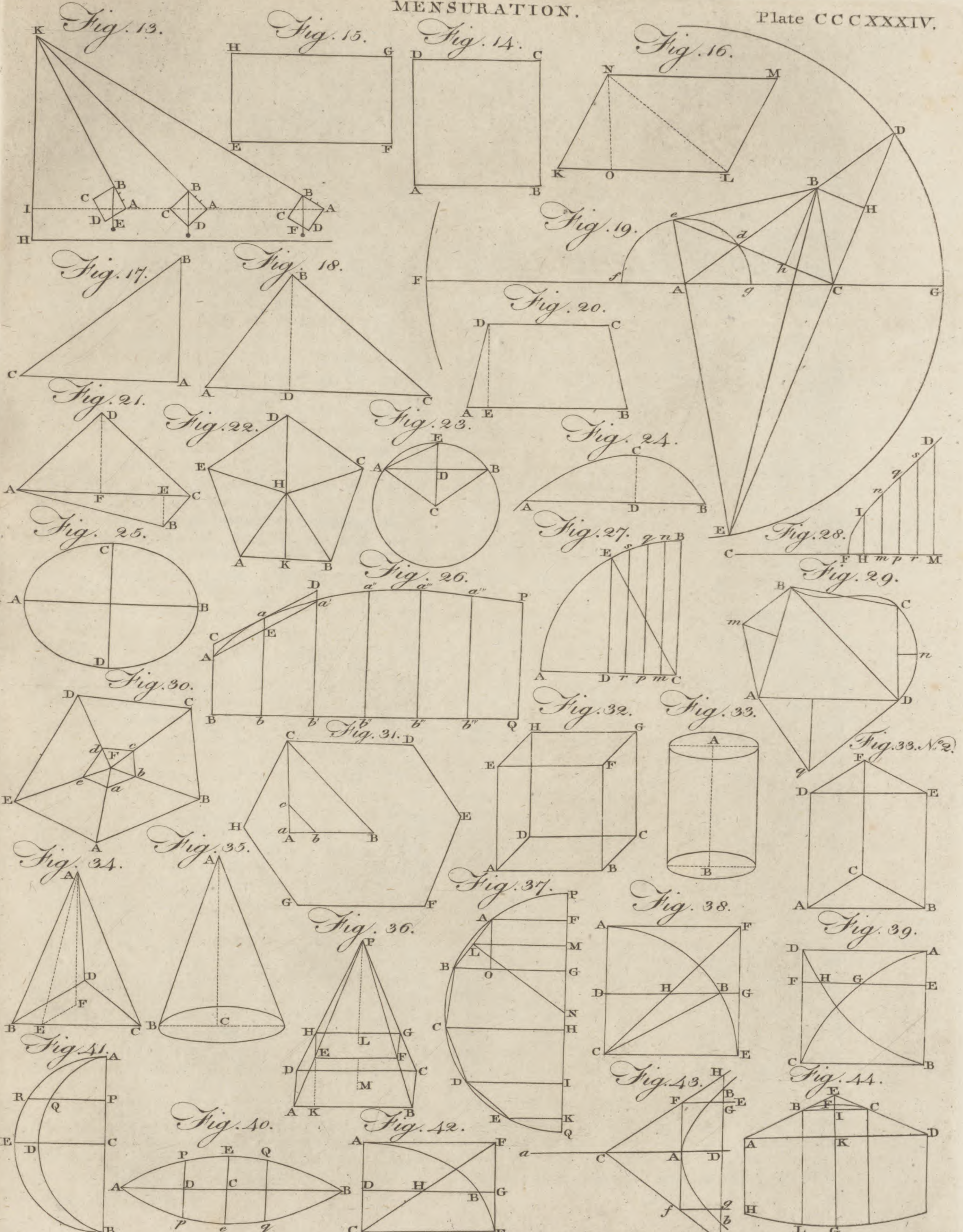
MENSURATION.

Plate CCCXXXIII.



A. Bell Prin. Wal. Sculptor fecit.

MENSURATION. Plate CCCXXXIV.



A. Bell Prin. Wal. Sculptor fecit.

Mentz.

face had chosen for his residence. The provinces, the most considerable in the whole papal dominions, all Suabia, Franconia, Bohemia, and almost all Saxony, with a part of Switzerland, Bavaria, and the Upper Rhine, belong to this diocese. Though the reformation, and revenge of the kings of Bohemia, have lessened it one-third, it still contains the archbishopric of Sprengel, and eleven bishoprics, most of which are the most considerable of Germany, as Wurzburg, Paderborn, Hildesheim, Augsburg, &c. When the building of the papal monarchy was completed by Gregory VII. the archbishops of Mentz became powerful enough to be at the head of the empire. In the 13th and 14th centuries, they were so eminent as to be able to make emperors without any foreign assistance; and it was to one of them that the house of Hapsburg was indebted for its first elevation. Since the boundaries of the two powers have been more acurately ascertained, and the temporal has so much got the better of the spiritual, the power and influence of the archbishops of this place have of course been much reduced; still, however, they are possessed of very important prerogatives, which they might exert with much more efficacy than they do, were it not that various circumstances have rendered them too dependent on the emperors. They are still the speakers in the electoral college, have the appointment of the diets under the emperors, and may order a re-examination of the proceedings of the imperial courts. These high privileges are, however, too much subject to the controul of the house of Austria; nor are their spiritual powers any longer what they once were. Their suffragan bishops have taken it into their heads that all bishops are alike as to power, and that the title of archbishop only entitles its possessor to the first place amongst brothers who are equal. The temporals, however, which are still annexed to this chair, make him who sits in it rich amends for the diminution of his spiritual and political splendor. Though he does not absolutely possess the largest, yet he certainly has the richest and most peopled domain of any ecclesiastical potentate in Germany. The country, it is true, does not contain more than 125 German miles square, whereas the archbishopric of Saltzburg contains 240; but then Saltzburg has only 250,000 inhabitants, whereas Mentz has 320,000. The natural riches of the territory of Mentz, and its advantageous situation, make a subject of Mentz much richer than one of Saltzburg, the greatest part of which is only inhabited by herdsmen. In the territory of Mentz there are 40 cities; in that of Saltzburg only seven. The tax on vessels which go down the Rhine of itself produces 60,000 guilders, or 6000l. a-year, which is nearly as much as all the mines of Saltzburg put together, excepting only the salt mine at Halle. The tax on wine, here and in the country round, produces the court above 100,000 guilders, or 10,000l. a-year, in which sum we do not reckon the customs of the countries which lie at a greater distance. Upon the whole, the income of the present archbishop may be valued at 1,700,000 guilders, or 170,000l.

If the lands of the elector lay all together, they would produce a sufficiency of corn and all the prime necessaries of life; but as several parts of them lie wide asunder, the people are compelled to purchase a great deal from foreigners. The capital itself, as well as the adjacent Rhinegau, depends on the Palatinate for its corn, notwithstanding the great abundance of that and every other species of grain in its own possessions in Wetterau. The noblest production of the elector's territory on the Rhine is the wine, which is almost the only true Rhenish. Connoisseurs, indeed, allow the wines of Neirstein, Baccarach, and a very few other places out of this country, to be true Rhenish: but they do not give this name to the wines of the Palatinate, of Bardon, and of Alsatia. There is a great deal of wine made in the countries which lie on the south and west of the Rhine, at Laubenheim, Bodenheim, Budesheim, and Bingen; but the true Rhenish, that which inspires so many who are and so many who are not poets, comes only from the Rhinegau, which lies on the northern banks of the Rhine. See Rhinegau.

The civil list of the archbishop (according to Baron Riesbeck), is by much too immoderate and expensive. "He has his ministers, his counsellors of state, and eighty or ninety privy counsellors of various denominations. The expence of this establishment is very disproportionate to the revenue of the state. This is owing to the large number of poor nobility, who can only accept of employments of this kind. Ignorance of the true principles of government are the causes of this evil. The consequences are, that a great number of persons, who might be usefully employed, live in idleness. Even the military establishment of the country appears to me more calculated for the purpose of feeding a hungry nobility than for real use. At the accession of the present elector, though the whole army only consisted of 2200 men, there were six generals. The regular establishment paid for and supported by the country is 8000 men; but though there are only 2000 men kept up, the money expended for their support, particularly that given to numberless useless officers, might be made use of more for the benefit of the country. The army of the archbishop consists of a German guard of 50 men and 25 horses, a Swiss guard, a squadron of hussars of 130 men (the most useful troops, as they purge the land of robbers and murderers), a corps of artillery of 104 men, three regiments of infantry of 600 men each, and some companies belonging to the armies of Franconia and the Upper Palatinate. Of the fortifications of the capital we may say much the same as of the army. Were they, indeed, improved and kept up as they ought to be, they would vie with Luxemburg, and be the most powerful of all the barriers against France. It is true, that the nature of the ground does not allow of a regular plan; but for single parts, I have seen no place of the same capabilities, where greater advantages have been taken of the ground for the erection of the several works. The beauty, as well as size of them, is indeed an object of great wonder; but though the circle of the Upper Rhine, and even the empire in general, has laid out great sums on the building these fortifications, parts of them are not finished, and parts of them are ready to fall to pieces. Their extent, indeed, would require a great army to man them. But this, as well as the maintaining and keeping them up, is evidently beyond the power of this court, or indeed of the whole circle of

Mentz. of the Upper Rhine united. They are, therefore, alſo to be looked upon as one of the things which ſerve more for magnificence than real uſe."

Mentz, a conſiderable town of Germany, in the circle of the Lower Rhine, and capital of the electorate of the ſame name, is ſituated on the Rhine near its confluence with the Maine, 20 miles north weſt of Worms, 15 weſt of Francfort, and 75 eaſt of Triers, in E. Long. 8. 20. N. Lat. 40. 51. This city claims a right to the invention of the art of printing: (ſee *Hiſtory of* Printing). Here is a very beautiful quay along the river, defended by ſeveral works well fortified with cannon. That part of the city which extends towards the river is moſt populous. The beſt vineyards for Rheniſh wine being in this neighbourhood, Mentz has a flouriſhing trade in that commodity more particularly; and its commerce is the briſker, by reaſon that all the merchandiſe which paſſes up and down the Rhine ſtops in its harbour to change bottoms.

The northern part of the city, in which the archbiſhop reſides, is full of very regular buildings. Here are three regular ſtreets, called the *Blerchen*, which run parallel to each other from the banks of the Rhine to 600 yards within the city, and are cut almoſt regularly by very pretty croſs ſtreets. The archbiſhop's palace has a moſt commanding view of theſe ſtreets, the Rhine, and the Rhinegau. There are alſo ſome good buildings in the old part of the city. The market of beaſts is extremely well worth ſeeing; and you here and there meet with other agreeable ſpots. The market in the middle of the town, though not regular, is one of the prettieſt places in Germany. The cathedral is well worth notice. It is an immenſe large old Gothic building, the ſpire of which was ſtruck with lightning about 20 years ago, and entirely laid in aſhes. As it was made of a foreſt of wood, it burned 14 hours before it was entirely conſumed. To prevent theſe accidents for the future, the chapter had the preſent one built to the ſame height in ſtone, an undertaking which coſt them 40,000 guilders or 4000l. It is a great pity (Baron Rieſbeck obſerves) that it is overloaded with ſmall ornaments: and a ſtill greater, that this wonderful edifice is ſo choked up with ſhops and houſes as to be hardly more than half viſible. As, however, houſes and ſhops are very dear in this part of the town, one cannot be very angry with the chapter for chooſing rather to make the moſt of its ground, than to ſhow off the church to the beſt advantage. The rent of a ſhop and a ſingle room to live in is 150 guilders or 15l. per annum in this part of the town. There is hardly another church in Germany of the height and length of this cathedral; and the inſide of it is decorated with ſeveral magnificent monuments of princes and other great perſonages. Beſides the cathedral, the city of Mentz contains ſeveral other churches in the modern ſtyle, very well worth ſeeing. St Peter's, and the Jeſuits church, though both too much loaded with ornament, are among this number. The church of the Auguſtins, of which the inhabitants of Mentz are ſo proud, is a maſterpiece of bad taſte; but that of Ignatius, though little is ſaid about it, would be a model of the antique, if here likewiſe there had not been too much ornament laviſhed. Upon the whole, the palaces of the nobleſſe want that noble ſimplicity which alone conſtitutes true beauty and magnificence. In another century the externals of the city will be quite changed. The late prince built a great deal, and the preſent has a taſte for the ſame ſort of expence. The monks and governors of hoſpitals alſo have been forced to rebuild their houſes; ſo that when a few more ſtreets are made broader and ſtraighter, the whole will have no bad appearance. The inhabitants, who together with the garriſon amount to 30,000, are a good kind of people, and, like all the catholics of Germany, make great account of a good table. Their faces are intereſting, and they are not deficient either in wit or activity. Mentz.

There are few cities in Germany beſides Vienna which contain ſo rich and numerous a nobility as this does: there are ſome houſes here which have eſtates of 100,000 guilders, or 10,000l. a-year. The counts of Baſſenheim, Schonborn, Stadion, Ingelheim, Elz, Oſtein, and Walderdorf, and the lords of Dahlberg, Breitenbach, with ſome others, have incomes of from 30,000 to 100,000 guilders. Sixteen or eighteen houſes have from 15,000 to 30,000 guilders annual revenue.—The nobility of this place are ſaid to be ſome of the oldeſt and moſt untainted in Germany. There are amongſt them many perſons of extraordinary merit, who join uncommon knowledge to all the duties of active life. Upon the whole, they are far ſuperior to the greater part of the German nobility. Their education, however, is ſtill too ſtiff. The firſt miniſter of the court was refuſed admittance into their aſſemblies for not being ſufficiently noble; and they think they degrade themſelves by keeping company with bourgeois.

The clergy of this place are the richeſt in Germany. A canonry brings in 3500 Rheniſh guilders in a moderate year. The canonry of the provoſt brings him in 40,000 guilders a-year; and each of the deaneries is worth 2600 guilders. The income of the chapter altogether amounts to 300,000 guilders. Though it is forbidden by the canons of the church for any one to have more than a ſingle prebend, there is not an eccleſiaſtic in this place who has not three or four; ſo that there is hardly a man amongſt them who has not at leaſt 8000 guilders a-year. The laſt provoſt, a count of Elz, had prebends enough to procure him an income of 75,000 guilders. Excluſive of the cathedral, there are ſeveral other choirs in which the canonries bring in from 1200 to 1500 guilders a-year. To give an idea of the riches of the monaſteries of this place, Baron Rieſbeck informs us, that at the deſtruction of the Jeſuits, their wine, which was reckoned to ſell extremely cheap, produced 120,000 rixdollars. A little while ago the elector aboliſhed one Carthuſian convent and two nunneries, in the holy cellars of which there was found wine for at leaſt 500,000 rixdollars. "Notwithſtanding this great wealth (continues our author), there is not a more regular clergy in all Germany. There is no dioceſe, in which the regulations made by the council of Trent have been more ſtrictly adhered to than they have here; the archbiſhops having made a particular point of it both at the time of the reformation and ever ſince. One thing which greatly contributes to keep up diſcipline is the not ſuffering any prieſt to remain in the country who

who has not fixed and stated duties, and a revenue annexed to them. Most of the irregularities in Bavaria, Austria, and other countries, arise from abbés who are obliged to subsist by their daily industry and any masses which they can pick up. These creatures are entirely unknown here. The theological tenets of this court are also much purer than those of any other ecclesiastical prince in Germany. I was pleased to see the Bible in the hands of so many common people, especially in the country. I was told that the reading of it was not forbidden in any part of the diocese; only persons were enjoined not to read it through, without the advice of their confessors. For a long time superstition has been hunted through its utmost recesses; and though it is not quite possible to get entirely clear of pilgrimages and wonder-working images, you will meet with no priest bold enough to exorcise or to preach such nonsense as we hear in the pulpits of other German churches."

Though the trade of this place has been constantly on the increase for these 18 or 20 years past, yet it is by no means what it ought to be from the situation and other advantages. The persons here who call themselves merchants, and who make any considerable figure, are in fact only brokers, who procure their livelihood at the expence of the country or territory round, or who act for the merchants of Francfort. A few toy-shops, five or six druggists, and four or five manufacturers of tobacco, are all that can possibly be called traders. There is not a banker in the whole town; and yet this country enjoys the staple privilege, and commands by means of the Maine, Necker, and Rhine, all the exports and imports of Alsatia, the Palatinate, Franconia, and a part of Suabia and Hesse, as far as the Netherlands. The port too is constantly filled with ships, but few of them contain any merchandise belonging to the inhabitants of the place. The French took it by surprise in October 1792; it surrendered to the king of Prussia in 1793; the French made a fruitless attack upon it in 1795; it was relieved from a blockade by the Austrians in 1796, and the French got possession of it in October 1797.

MENTZEL, Christian, born at Frustenwall in the Mittel-mark, is celebrated for his skill in medicine and botany, in pursuit of which he travelled through many countries. He had correspondents in the most distant parts of the world. He died A. D. 1701, about the 79th year of his age. He was a member of the academy *des Curieux de la Nature*. His works are, 1. *Index nominum plantarum*, printed at Berlin in folio, 1696; and reprinted with additions in 1715, under the title of *Lexicon plantarum polyglotton universale*. 2. A Chronology of China, in German, printed at Berlin 1696 in 4to. The following manuscripts of his composition are preserved in the royal library at Berlin. 1. *Sur l'Histoire Naturelle du Brasil*, in four volumes folio. 2. *Sur les Fleurs et les Plantes du Japon*, with coloured plates, two vols folio.

MENUS, in *Ancient Geography*, a river of Germany: now the *Maine*, rising in Franconia, and running from east to west into the Rhine at Mentz.

MENUTHIAS, in *Ancient Geography*, an island adjoining to the north-east of the promontory Prasum of Ethiopia beyond Egypt. Some take it to be *Madagascar*, or the island *St Laurence*. Isaac Vossius will have it to be *Zanzibar*; Madagascar being at a greater distance from the continent than the ancients ever sailed to, whereas Menuthias was nearer: yet though Zanzibar be nearer the continent, it is however nearer the equator than Ptolemy's Menuthias, placed in south latitude $12\frac{1}{2}$ degrees.

MENYANTHES, Marsh-trefoil, or *Bogbean*; a genus of plants belonging to the pentandria class; and in the natural method ranking under the 21st order, *Preciæ*. See Botany *Index*.

MENZIKOFF, Alexander, was originally an apprentice to a pastry-cook near the palace of Moscow; but by a fortunate circumstance was drawn from that situation in early life, and placed in the household of Peter the Great. Having made himself master of several languages, and being formed for war and for business, he first rendered himself agreeable, and afterwards became necessary, to his master. He assisted Peter in all his projects; and was rewarded for his services with the government of Ingria, the rank of prince, and the title of *major-general*. He signalized himself in Poland in 1708 and 1709; but in 1713 he was accused of embezzling the public money, and fined in 300,000 crowns. The czar remitted the fine; and having restored him to favour, gave him the command of an army in the Ukraine in 1719, and sent him as his ambassador into Poland in 1722. Constantly employed about the means of preserving his influence after the death of his master, who was then evidently on the decline, Menzikoff discovered the person to whom the czar intended to leave the succession. The emperor was highly offended, and his penetration cost him the principality of Plescoff. Under the czarina Catherine, however, he was higher in favour than ever; because, on the death of the czar in 1725, he was active in bringing different parties in Russia to agree to her succession. This princess was not ungrateful. In appointing her son-in-law Peter II. to be her successor, she commanded him to marry the daughter of Menzikoff, and gave the czar's sister to his son. The parties were actually betrothed: and Menzikoff was made duke of Cozel and grand steward to the czar. But this summit of elevation was the prelude to his fall. The *Dolgoroukis*, favourites of the czar, had influence enough to procure his banishment, together with that of his family, to one of his own estates at the distance of 250 leagues from Moscow. He had the imprudence to leave the capital with the splendor and magnificence of a governor going to take possession of his province. His enemies took advantage of this circumstance to inflame the indignation of the czar. At some distance from Moscow he was overtaken by a detachment of soldiers. The officer who commanded them made him alight from his chariot, which he sent back to Moscow; and placed him and his whole family in covered waggons, to be conducted into Siberia, in the habit of peasants. When he arrived at the place of his destination, he was presented with cows and sheep big with young, and poultry, without knowing from whom he received the favour. His house was a simple cottage; and his employment was to cultivate the ground, or to superintend its cultivation. New causes of sorrow were added to the severities of exile. His wife died in the journey; he had the misfortune to lose one

one of his daughters by the smallpox; and his other two children were seized with the same disease, but recovered. He sunk under his misfortunes, November 2. 1729; and was buried beside his daughter, in a little chapel which he had built. His misfortunes had inspired him with sentiments of devotion, which, amid the splendor of his former situation, he had altogether neglected. His two surviving children enjoyed greater liberty after the death of their father. The officer permitted them to attend public worship on Sundays by turns. One day when his daughter was returning from the village, she heard herself accosted by a peasant from the window of a cottage, and, to her great surprise, recognised in this peasant the persecutor of her family, Dolgorouki; who, in his turn, had fallen a sacrifice to the intrigues of the court. She communicated this intelligence to her brother, who could not behold, without emotion, this new instance of the vanity and instability of honours and power. Young Menzikoff and his sister were soon after recalled to Moscow by the czarina Ann; and left Dolgorouki in possession of their cottage. He was made captain of the guards, and received the fifth part of his father's possessions. His sister was appointed maid of honour to the empress, and afterwards married to great advantage.

MENZINI, Benedict, a celebrated Italian poet, born at Florence, was professor of eloquence at the college Della Sapienza at Rome, where he died in 1704. He wrote, 1. The art of poetry. 2. Satires, elegies, hymns, and the Lamentations of Jeremiah. 3. *Academia Tusculana*, a work in verse and prose, which passes for his masterpiece.

MEOTIS, or Palus Meotis, a sea of Turkey, which divides Europe from Asia; extending from Crim Tartary to the mouth of the river Don or Tanais.

MEPHITIC, a name expressing any kind of noxious vapour; but generally applied to that species of vapour called *fixed air*. See Carbonic Acid, Chemistry *Index*.

MEPHITIS Fanum, a temple erected to the goddess Mephitis, near Lacus Amsancti; who was worshipped also at Cremona. Figuratively, *Mephitis* denotes a noisome or pestilential exhalation, (Virgil).

MEQUINEZ, or Miquinez, the northern capital of the Morocco empire, stands at the extremity of the province of Beni Hassen, 80 leagues north from the city of Morocco (which is the southern imperial city), and 20 to the east of Sallee and the ocean. Maknassa, its founder, built it first at the bottom of a valley; but Muley Ismael extended it considerably over the plain that lies to the west of the valley. It is surrounded with well cultivated fields and hills, adorned with gardens and olive plantations, and abundantly watered with rivulets. Accordingly, fruits and kitchen stuffs thrive here exceedingly, and even the superior urbanity of the inhabitants announces the temperature of the climate. The winter indeed is very inconvenient, on account of the dirtiness of the town, the streets not being paved, and the soil being slimy.

Mequinez is surrounded with walls; the palace itself is fortified with two bastions, on which formerly some small guns were mounted. Muley Ismael, and Muley Abdallah, often in this city resisted the efforts of the Brebes, the sworn enemies of their tyranny. To the west are seen some walls of circumvallation, six feet in height, which were probably mere intrenchments for the infantry; the attacks of the Brebes being only sudden and momentary inroads, which did not require a long defence. There is at Mequinez, as well as at Morocco, a walled and guarded suburb for the Jews. The houses are neater here than at Morocco. The Jews here are more numerous; and they can turn their industry to greater account, because the Moors in this city are more polished, and (being nearer to Europe) more visited, than those in the southern parts. Near the Jewry, there is another enclosed and separate quarter, called the *Negro town*. It was built by Muley Ismael, for the accommodation of those black families which composed his soldiery. This town is now uninhabited, as are all those destined for the same use through the rest of the empire.

At the south-east extremity of the city stands the palace of the emperor, which was built by Muley Ismael. The space occupied by this palace is very great; it includes several gardens, elegantly disposed, and well watered. There is a large garden in the centre, surrounded by a vast and pretty regular gallery, resting on columns, which communicates with the apartments. Those of the women are very spacious, and have a communication with a large chamber which looks into the garden. As you pass from one apartment to another, you find at intervals regular courts paved with square pieces of black and white marble; in the middle of these courts is a marble basin, from the centre of which rises a *jet d'eau*, and the water falls down into this basin. These fountains are numerous in the palace; they are useful for domestic purposes, and they serve for the ablutions, which the scruples of the Mahometans have exceedingly multiplied. The palaces of the Moorish kings are large, because they are composed only of one range of apartments; these are long and narrow, from 18 to 20 feet high; they have few ornaments, and receive the light by two large folding doors, which are opened more or less as occasion requires. The rooms are always lighted from a square court in the centre, which is generally encompassed with a colonnade.

The Moors here are more courteous than those in the southern parts; they are civil to strangers, and invite them into their gardens, which are very neat. The women in this part of the empire are beautiful; they have a fair complexion, with fine black eyes, and white teeth. I have sometimes seen them taking the air on the terraces; they do not hide themselves from Europeans, but retire very quickly on the appearance of a Moor.

MERA-de-Asta, formerly a large town of Andalusia, seated on the river Guadaleta, between Arcos and Xeres de la Frontera; but now only a large heap of ruins. Here the Arabs conquered Roderick the last king of the Goths, and by that victory became masters of Spain in 713.

MERCATOR, Gerard, one of the most celebrated geographers of his time, was born at Ruremonde in 1512. He applied himself with such industry to geography and mathematics, that he is said to have frequently forgot to eat and drink. The emperor Charles V. had a particular esteem for him, and the duke of Juliers made him his cosmographer. He composed a chronology, some geographical tables, an atlas, &c. engraving and colouring the maps himself. He died in 1594. His method of laying down charts is still used, and bears the name of *Mercator's charts*.

MERCATOR, *Nicholas*, an eminent mathematician in the 17th century, was born at Holstein in Denmark; and came to England about the time of the restoration, where he lived many years. He was fellow of the Royal Society; and endeavoured to reduce astrology to rational principles, as appeared from a MS. of his in the possession of William Jones, Esq. He published several works, particularly *Cosmographia*. He gave the quadrature of the hyperbole by an infinite series; which was the first appearance in the learned world of a series of this sort drawn from the particular nature of the curve, and that in a manner very new and abstracted.

Mercator's Sailing, that performed by Mercator's chart. See NAVIGATION.

MERCATORUM FESTUM, was a festival kept by the Roman merchants on the 15th of May, in honour of Mercury, who presided over merchandise. A sow was sacrificed on the occasion, and the people present sprinkled themselves with water fetched from the fountain called *aqua Mercurii*; the whole concluding with prayers to the god for the prosperity of trade.

MERCHANT, a person who buys and sells commodities in gross, or deals in exchanges; or that traffics in the way of commerce, either by importation or exportation. Formerly every one who was a buyer or seller in the retail way was called a *merchant*, as they still are both in France and Holland; but here shopkeepers, or those who attend fairs or markets, have lost that appellation.

Previous to a person's engaging in a general trade, and becoming an universal dealer, he ought to treasure up such a fund of useful knowledge as will enable him to carry it on with ease to himself, and without risking such losses as great ill-concerted undertakings would naturally expose him to. A merchant should therefore be acquainted with the following parts of commercial learning: 1. He should write properly and correctly. 2. Understand all the rules of arithmetic that have any relation to commerce. 3. Know how to keep books of double and single entry, as journals, a leger, &c. 4. Be expert in the forms of invoices, accounts of sales, policies of insurance, charter-parties, bills of lading, and bills of exchange. 5. Know the agreement between the money, weights, and measures of all parts. 6. If he deal in silk, woollen, linen, or hair manufactures, he ought to know the places where these different sorts of merchandises are manufactured, in what manner they are made, what are the materials of which they are composed, and from whence they come, the preparations of these materials before working up, and the places to which they are sent after their fabrication. 7. He ought to know the lengths and breadths which silk, woollen, or hair stuffs, linen, cottons, fustians, &c. ought to have according to the several statutes and regulations of the places where they are manufactured, with their different prices, according to the times and seasons; and if he can add to his knowledge the different dyes and ingredients which form the various colours, it will not be useless. 8. If he confines his trade to that of oils, wines, &c. he ought to inform himself particularly of the appearances of the succeeding crops, in order to regulate his disposing of what he has on hand; and to learn as exactly as he can what they have produced when got in, for his direction in making the necessary purchases and engagements. 9. He ought to be acquainted with the sorts of merchandise found more in one country than another, those which are scarce, their different species and qualities, and the properest method for bringing them to a good market either by land or sea. 10. To know which are the merchandises permitted or prohibited, as well on entering as going out of the kingdoms or states where they are made. 11. To be acquainted with the price of exchange, according to the course of different places, and what is the cause of its rise and fall. 12. To know the customs due on importation or exportation of merchandises, according to the usage, the tariffs, and regulations, of the places to which he trades. 13. To know the best manner of folding up, embaling, or tunning, the merchandises for their preservation. 14. To understand the price and condition of freighting and insuring ships and merchandise. 15. To be acquainted with the goodness and value of all necessaries for the construction and repairs of shipping, the different manner of their building; what the wood, the masts, cordage, cannons, sails, and all requisites, may cost. 16. To know the wages commonly given to the captains, officers, and sailors, and the manner of engaging with them. 17. He ought to understand the foreign languages, or at least as many of them as he can attain to; these may be reduced to four, viz. the Spanish, which is used not only in Spain but on the coast of Africa, from the Canaries to the Cape of Good Hope: the Italian, which is understood on all the coasts of the Mediterranean, and in many parts of the Levant: the German, which is understood in almost all the northern countries; and the French, which is now become almost universally current. 18. He ought to be acquainted with the consular jurisdiction, with the laws, customs, and usages of the different countries he does or may trade to; and in general all the ordinances and regulations both at home and abroad that have any relation to commerce. 19. Though it is not necessary for a merchant to be very learned, it is proper that he should know something of history, particularly that of his own country; geography, hydrography, or the science of navigation; and that he be acquainted with the discoveries of the countries in which trade is established, in what manner it is settled, of the companies formed to support those establishments, and of the colonies they have sent out.

All these branches of knowledge are of great service to a merchant who carries on an extensive commerce; but if his trade and his views are more limited, his learning and knowledge may be so too: but a material requisite for forming a merchant is, his having on all occasions a strict regard to truth, and his avoiding fraud and deceit as corroding cankers that must inevitably destroy his reputation and fortune.

Trade is a thing of so universal a nature, that it is impossible for the laws of Britain, or of any other nation, to determine all the affairs relating to it; therefore

Merchet, Mercia

fore all nations, as well as Great Britain, show a particular regard to the law-merchant, which is a law made by the merchants among themselves: however, merchants and other strangers are subject to the laws of the country in which they reside. Foreign merchants are to sell their merchandise at the port where they land, in gross, and not by retail; and they are allowed to be paid in gold or silver bullion, in foreign coin or jewels, which may be exported. If a difference arises between the king and any foreign state, the merchants of that state are allowed six months time to sell their effects and leave the kingdom; during which time they are to remain free and unmolested in their persons and goods. See the articles COMMERCE, and *Mercantile Law*.

MERCHET (MERCHETUM), a fine or composition paid by inferior tenants to the lord, for liberty to dispose of their daughters in marriage. No baron, or military tenant, could marry his sole daughter and heir, without such leave purchased from the king, *pro maritanda filia*. And many of our servile tenants could neither send their sons to school, nor give their daughters in marriage, without express leave from the superior lord. See Kennet's Glossary *in Maritagium*. See also MARCHET, under which word it is stated, and very generally understood, that this was a right claimed by the lord of the manor in the time of the feudal system of passing the first night after marriage with his female villain. According to Mr Astle, the mercheta was a compact between the lord and his vassal for the redemption of an offence committed by the vassal's unmarried daughter; and also a fine paid by a sokeman or a villain to his lord for permission to marry his daughter to a free man; and in cases where the vassal gave away his daughter without having obtained this license, he subjected himself to a heavier fine.

MERCIA, the name of one of the seven kingdoms founded in England by the Saxons. Though the latest formed, it was the largest of them all, and grew by degrees to be by far the most powerful. On the north it was bounded by the Humber and the Mersey, which separated it from the kingdom of Northumberland; on the east by the sea, and the territories of the East Angles and Saxons; on the south by the river Thames; and on the west by the rivers Severn and Dee. It comprehended well nigh 17 of our modern counties, being equal in size to the province of Languedoc in France; very little, if at all, less than the kingdom of Arragon in Spain; and superior in size to that of Bohemia in Germany.

Penda is regarded as its first monarch; and the kingdom is thought to derive its name from the Saxon word *merc*, which signifies "a march, bound, or limit," because the other kingdoms bordered upon it on every side; and not from the river Mersey, as some would persuade us. Penda assumed the regal title A. D. 626, and was of the age of 50 at the time of his accession; after which he reigned near 30 years. He was of a most furious and turbulent temper, breaking at different times with almost all his neighbours, calling in the Britons to his assistance, and shedding more Saxon blood than had been hitherto spilled in all their intestine quarrels. He killed two kings of Northumberland, three of the East Angles, and compelled Kenwall king of the West Saxons to quit his

Mercia.

dominions. He was at length slain, with most of the princes of his family, and a multitude of his subjects, in a battle fought not far from Leeds, by Oswy king of Northumberland. This battle, which the Saxon chronicle tells us was fought at Winwidfield, A. D. 655, made a great change in the Saxon affairs, which the unbridled fury of Penda had thrown into great confusion. He had the year before killed Anna king of the East Angles in battle, whose brother Ethelred notwithstanding took part with Penda. On the other hand, Penda the eldest son of Penda, to whom his father had given the ancient kingdom of the Mid Angles, had two years before married the natural daughter of King Oswy, and had been baptized at his court. At that time it should seem that Oswy and Penda were upon good terms; but after the latter had conquered the East Angles, he resolved to turn his arms against the kingdom of Northumberland. Oswy by no means had provoked this rupture; on the contrary, Bede tells us that he offered large sums of money, and jewels of great value, to purchase peace: these offers being rejected, he was reduced to the necessity of deciding the quarrel by the sword. The river near which the battle was fought overflowing, there were more drowned than killed. Amongst these, as the Saxon chronicle says, there were 30 princes of the royal line, some of whom bore the title of *kings*; and also Ethelred king of the East Angles, who fought on the side of Penda against his family and country.

His son Penda, who married the daughter of that conqueror, became a Christian, and was not long after murdered, as is said, by the malice of his mother. His brother Wolfher becoming king of Mercia, embraced in process of time the faith of the gospel, and proved a very victorious and potent monarch; and is, with no fewer than seven of his immediate successors, commonly styled *king of the Anglo-Saxons*, though none of them are owned in that quality by the Saxon chronicle. But though possibly none of them might enjoy this honour, they were undoubtedly very puissant princes, maintaining great wars, and obtaining many advantages over the sovereigns of other Saxon states, and especially the East Angles, whom they reduced. The extent of the Mercian territories was so ample as to admit, and so situated as to require, the constituting subordinate rulers in several provinces; to whom, especially if they were of the royal line, they gave the title of *kings*; which occasions some confusion in their history. Besides the establishing episcopal sees and convents, the Saxon monarchs took other methods for improving and adorning their dominions; and as Mercia was the largest, so these methods were most conspicuous therein. Coventry, as being situated in the centre, was usually, but not always, the royal residence. Penda, who was almost continually in a state of war, lived as his military operations directed, in some great town on the frontiers. Wolfher built a castle or fortified palace for his own residence, which bore his name.—Offa kept his court at Sutton Walls near Hereford.

In each of the provinces there resided a chief magistrate; and if he was of the royal blood, had usually the title of *king*. Penda, at the time he married Oswy's daughter, had the title of *king of Leicester*.—

Ethelred

Ethelred made his brother Merowald king of Hereford; who, dying without issue, bequeathed it to his younger brother Mercelm. The like honours were sometimes conferred upon the princesses; and hence, in Mercia especially, we occasionally read of *vice-queens*. By these means the laws were better executed, the obedience of the subjects more effectually secured, and the splendor of these residences constantly kept up and augmented.

At length, the crown devolving sometimes on minors and sometimes on weak princes, intestine factions also prevailing, the force of this hitherto mighty kingdom began sensibly to decline. This falling out in the days of Egbert, the most prudent as well as the most potent monarch of the West Saxons, he took advantage of these circumstances; and having encouraged the East Angles to make an attempt for the recovery of their independence, he, in a conjuncture every way favourable to his design, broke with the Mercians, and after a short war obliged them to submit. But this was not an absolute conquest, the kings of Mercia being allowed by him and his successors to retain their titles and dominions, till the invasion of the Danes put an end to their rule, when this kingdom had subsisted above 250 years; and when the Danes were afterwards expelled by the West Saxons, it sunk into a province, or rather was divided into many.

MERCURIAL, something consisting of, or relating to, mercury.

MERCURIALIS, DOGS MERCURY; a genus of plants belonging to the dioecia class; and in the natural method ranking under the 38th order, *Tricoccæ*. See BOTANY *Index*.

MERCURIFICATION, in metallurgic chemistry, the obtaining the mercury from metallic minerals in its fluid form. See CHEMISTRY and MINERALOGY *Index*.

MERCURY, or QUICKSILVER. See CHEMISTRY and MINERALOGY *Index*.

MERCURY, in the heathen mythology. See HERMES.

Most of the actions and inventions of the Egyptian Mercury have likewise been ascribed to the Grecian, who was said to be the son of Jupiter and Maia, the daughter of Atlas. No one of all the heathen divinities had so many functions allotted to him as this god: he had constant employment both day and night, having been the common minister and messenger of the whole Pantheon; particularly of his father Jupiter, whom he served with indefatigable labour, and sometimes, indeed, in a capacity of no very honourable kind. Lucian is very pleasant upon the multitude of his avocations; and, according to the confession of the emperor Julian, Mercury was no hero, but rather one who inspired mankind with wit, learning, and the ornamental arts of life, than with courage. The pious emperor, however, omits some of his attributes; for this god was not only the patron of trade, but also of theft and fraud.

Amphion is said, by Pausanias, to have been the first that erected an altar to this god; who, in return, invested him with such extraordinary powers of music (and masonry), as to enable him to fortify the city of Thebes in Bœotia, by the mere sound of his lyre.

Horace gives us the best part of his character:

Thou god of wit, from Atlas sprung,
Who by persuasive pow'r of tongue,
And graceful exercise, refin'd
The savage race of human kind,
Hail! winged messenger of Jove,
And all th' immortal pow'rs above,
Sweet parent of the bending lyre,
Thy praise shall all its sounds inspire.
Artful and cunning to conceal
Whate'er in sportive theft you steal,
When from the god who gilds the pole,
E'en yet a boy, his herds you stole;
With angry voice the threat'ning power
Bade thee thy fraudful prey restore;
But of his quiver too beguil'd,
Pleas'd with the theft, Apollo smil'd.
You were the wealthy Priam's guide,
When safe from Agamemnon's pride,
Through hostile camps, which round him spread
Their watchful fires, his way he sped.
Unspotted spirits you consign
To blissful seats and joys divine;
And, pow'rful, with thy golden wand,
The light, unbodied crowd command;
Thus grateful does thy office prove
To gods below, and gods above. FRANCIS.

This ode contains the substance of a very long hymn to Mercury, attributed to Homer. Almost all the ancient poets relate the manner in which the Grecian Mercury discovered the lyre; and tell us that it was an instrument with seven strings; a circumstance which makes it essentially different from that said to have been invented by the Egyptian Mercury, which had but three. However, there have been many claimants besides Mercury to the seven-stringed lyre. See LYRE.

His most magnificent temple was on Mount Cylene, in Arcadia. He is described by the poets as a fair beardless youth, with flaxen hair, lively blue eyes, and a smiling countenance. He has wings fixed to his cap and sandals, and holds the caduceus (or staff surrounded with serpents, with two wings on the top), in his hand; and is frequently represented with a purse, to show that he was the god of gain. The animals sacred to him, were the dog, the goat, and the cock. In all the sacrifices offered to him, the tongues of the victims were burnt; and those who escaped imminent danger sacrificed to him a calf with milk and honey.

MERCURY, ☿ in *Astronomy*. See ASTRONOMY *Index*.

This planet is brightest between his elongations and superior conjunction, very near to which last he can generally be seen. He becomes invisible soon after he has found his elongation, going towards his inferior conjunction; and becomes visible again a few days before his next elongation. The brightness of this planet alters sometimes very considerably in 24 hours. It has been observed when less than three degrees distant from the sun, and may, perhaps, sometimes be seen even in conjunction with it.

Mercury and Venus appear brightest and most beautiful in the opposite parts of their orbits: the first, between his elongations and superior conjunction; and the other, between her elongations and inferior conjunction. Therefore, Venus is seen in great perfection as a crescent, particularly in her inferior conjunction, whilst Mercury is seldom seen in such perfect phases. Mercury should be always observed on or near the meridian. When farthest from the sun, he always appears with a very faint light; and when he has a great south declination, or the atmosphere is not perfectly clear, he seldom can be seen in those parts of his orbit, where he only begins to recover his brightness, or where it is much diminished. He has frequently been seen on the meridian even with a small telescope and small power; and it appears from the above statement that he may be obscured in a clear day rather more than half his orbit, or near one hundred and fourscore days in the year.

MERCURY, in *Heraldry*, a term used in blazoning by planets, for the purple colour used in the arms of sovereign princes.

MERCY, a virtue that inspires us with compassion for our brethren, and which inclines us to give them assistance in their necessities. Mercy is also taken for those favours and benefits that we receive either from God or man, particularly in the way of forgiveness of injuries or of debts. Nothing can be more beautiful than the description of mercy given us by Shakespeare, in the pleading between Portia and the Jew:

Por. Then must the Jew be merciful.
Shy. On what compulsion must I? tell me that.
Por. The quality of mercy is not strain'd;
It droppeth as the gentle rain from heav'n
Upon the place beneath. It is twice bless'd:
It blesseth him that gives, and him that takes.
'Tis mightiest in the mightiest; it becomes
The throned monarch better than his crown:
The sceptre shows the force of temporal power,
The attribute to awe and majesty,
Wherein doth sit the dread and fear of kings;
But mercy is above this scepter'd sway,
It is enthroned in the hearts of kings;
It is an attribute to God himself,
And earthly power doth then show likest God's,
When mercy seasons justice. Therefore, Jew,
Though justice be thy plea, consider this,
That in the course of justice none of us
Should see salvation. We do pray for mercy;
And that same prayer doth teach us all to render
The deeds of mercy. *Merchant of Venice*, act iv.

MERCY-SEAT, or PROPITIATORY, in Jewish antiquity, the covering of the ark of the covenant.—The Hebrew name of this cover, which we translate mercy-seat, is *Capporeth* (Exod. xxv. 17, 22.), from *Cappor*, which signifies *to cover*, *to shut up*, *to expiate*, *to pay*. This cover was of gold, and at its two ends were fixed the two cherubims of the same metal, which by their wings extended forwards, seemed to form a throne for the majesty of God, who in scripture is represented to us as sitting between the cherubims, and the ark itself was as it were his footstool. It was from hence that God gave his oracles to Moses, or to the high priest that consulted him, Exod. xxv. 22. Numb. vii. 89.)

MERETRIX, among the Romans, differed from the *prostibula*. The *prostibulæ* were common courtesans, with bills over their doors, signifying their profession, and were ready at all times to entertain customers; whereas the *meretrices* entertained none but at night.—The *meretrices* differed in their dress from the *matrons*; the former wore the *toga* and short *tunics*, like those of the men: the latter wore the *palla* and the *stola* of such a length as to reach to their feet.

MERGANSER. See MERGUS.

MERGUS, a genus of birds of the order of anseres. See ORNITHOLOGY *Index*.

MERIAN, MARIA SIBYLLA, a celebrated paintress, born at Frankfort in 1647, was the daughter of Matthias Merian, a noted engraver and geographer.—As she showed a very early fondness for painting, she was instructed by Abraham Mignon; from whom she learned great neatness of handling and delicacy of colour. Her genius particularly led her to paint reptiles, flowers, and insects, which she designed after nature, and studied every object with a most curious and inquisitive observation; so that her works rose every day more and more into reputation. Frequently she painted her subjects in water colours on vellum, and finished an astonishing number of designs, as she was equally indefatigable in her work and in her inquiries into the curiosities of nature. She drew the flies and caterpillars in all the variety of changes and forms in which they successively appear from their quiescent state till they become butterflies; and also drew frogs, toads, serpents, ants, and spiders, after nature, with extraordinary exactness and truth. She even undertook a voyage to Surinam, to paint those insects and reptiles which were peculiar to that climate; and at her return to her own country published two volumes of engravings after her designs, which are well known to the curious. She died in 1717. Her daughter Dorothea Henrietta Graff, who painted in the same style, and had accompanied her mother to Surinam, published a third volume collected from the designs of Sibylla; which complete work has been always admired by the learned, as well as by the professors of painting.

MERIDA, a strong town of Spain, in Estremadura, built by the Romans before the birth of Christ. Here are some fine remains of antiquity, particularly a triumphal arch, but which is considerably decayed. It is seated in an extensive and fertile plain, 47 miles east of Elva, and 45 south by east of Alcantara. W. Long. 6. 4. N. Lat. 38. 42.

MERIDA, a town of North America, in New Spain, and capital of the province of Yucatan, where the bishop and the governor of the province reside. It is inhabited by Spaniards and native Americans; is 30 miles south of the sea, and 120 north-east of Campeachy. W. Long. 89. 25. N. Lat. 20. 15.

MERIDA, a town of South America, in the kingdom of New Granada, seated in a country abounding with all kinds of fruits, 130 miles north-east of Pampeluna. W. Long. 71. 0. N. Lat. 8. 30.

MERIDEN, or MIREDEN, a town of Warwickshire, 97 miles from London on the London road, near Coventry. It is pleasantly situated, though in a wet clayey situation, and is not ill built. The church stands on an elevated spot, and contains some good monuments. There is an inn here, about half way from

from St Clement's foreſt to Coventry, one of the fineſt in this part of Engand, being built like a nobleman's ſeat.

MERIDIAN, in *Geography*, a great circle ſuppoſed to be drawn through any part on the ſurface of the earth, and the two poles; and to which the ſun is always perpendicular at noon. See GEOGRAPHY.

In aſtronomy, this circle is ſuppoſed to be in the heavens, and exactly perpendicular to the terreſtrial one. See ASTRONOMY.

MERIDIANI, in antiquity, a name which the Romans gave to a kind of gladiators who entered the arena about noon after the beſtiarii (who fought in the morning againſt beaſts) had finiſhed. They were thus called from *meridies*, i. e. *noon*, the time when they exhibited their ſhows. The meridiani were a ſort of artleſs combatants, who fought man with man, ſword in hand. Hence Seneca takes occaſion to obſerve, that the combats of the morning were full of humanity compared with thoſe which followed.

MERIDIONAL DISTANCE, in *Navigation*, the ſame with departure, or eaſting and weſting; being the difference of longitude between the meridian under which the ſhip now is, and any other meridian which ſhe was under before.

MERIDIONAL parts, miles, or minutes, in *Navigation*, are the parts by which the meridians in a Mercator's chart do increaſe, as the parallels of latitude decreaſe.

MERIONETHSHIRE, a county of North Wales, is bounded on the north by Caernarvonſhire and Denbighſhire; on the eaſt by Montgomeryſhire; on the weſt by St George's channel, or the Iriſh ſea; and on the ſouth by the river Dyffi, which parts it from Cardiganſhire; extending 40 miles in length and 36 in breadth. It is divided into ſix hundreds, in which are four market towns, 37 pariſhes, about 5787 houſes, and 29,506 inhabitants in 1801. It lies in the dioceſe of Bangor, and ſends one member to parliament. The air is very ſharp in winter, on account of its many high barren mountains; and the ſoil is as bad as any in Wales, it being very rocky and mountainous. However, this county feeds large flocks of ſheep, many goats, and large herds of horned cattle, which find pretty good paſture in the valleys. Beſides theſe, among their other commodities may be reckoned Welch cotton, deer, fowl, fiſh, and eſpecially herrings, which are often taken on this coaſt in great plenty.

MERIT, ſignifies *deſert*. This term is more particularly applied to ſignify the moral goodneſs of the actions of men, and the rewards to which thoſe actions entitle them.

MERLIN, AMBROSE, a famous Engliſh poet and reputed prophet, flouriſhed at the end of the 5th century. Many ſurpriſing and ridiculous things are related of him. Several Engliſh authors have repreſented him as the ſon of an incubus, and as tranſporting from Ireland to England the great ſtones which form Stonehenge on Saliſbury plain. Extravagant prophecies and other works are alſo attributed to him, on which ſome authors have even written commentaries.

MERLIN. See FALCO, ORNITHOLOGY *Index*.

MERLON, in *Fortification*, is that part of a parapet which is terminated by two embraſures of a battery.

MERLUCIUS, the HAKE. See GADUS, ICHTHYOLOGY *Index*.

MERMAID, or MERMAN, a ſea-creature frequently talked of, ſuppoſed half human and half a fiſh.

However naturaliſts may doubt of the reality of *mermen* or *mermaids*, we have teſtimony enough to eſtabliſh it; though, how far theſe teſtimonies may be authentic, we cannot take upon us to ſay. In the year 1187, as Lary informs us, ſuch a monſter was fiſhed up in the county of Suffolk, and kept by the governor for ſix months. It bore ſo near a conformity with man, that nothing ſeemed wanting to it but ſpeech. One day it took the opportunity of making its eſcape; and plunging into the ſea, was never more heard of. *Hiſt. de Angleterre*, P. I. p. 403.

In the year 1430, after a huge tempeſt, which broke down the dikes in Holland, and made way for the ſea into the meadows, &c. ſome girls of the town of Edam in Weſt Frieſland, going in a boat to milk their cows, perceived a mermaid embarraſſed in the mud, with a very little water. They took it into their boat, and brought it with them to Edam, dreſſed it in woman's apparel, and taught it to ſpin. It fed like one of them, but could never be brought to offer at ſpeech. Some time afterwards it was brought to Haerlem, where it lived for ſome years, though ſtill ſhowing an inclination to the water. Parival relates, that they had given it ſome notion of a Deity, and that it made its reverences very devoutly whenever it paſſed by a crucifix. *Delices de Hollande*.

In the year 1560, near the iſland of Manaar, on the weſtern coaſt of the iſland of Ceylon, ſome fiſhermen brought up, at one draught of a net, ſeven mermen and mermaids; of which ſeveral Jeſuits, and among the reſt F. Hen. Henriques and Dimas Boſquez, phyſicians to the viceroy of Goa, were witneſſes. The phyſician, who examined them with a great deal of care, and made diſſection thereof, aſſerts, that all the parts both internal and external were found perfectly conformable to thoſe of men. See the *Hiſt. de la compagnie de Jeſus*, P. II. T. iv. N° 276. where the relation is given at length.

We have another account of a merman, ſeen near the great rock called *Diamond*, on the coaſt of Martinico. The perſons who ſaw it, gave in a preciſe deſcription of it before a notary. They affirmed that they ſaw it wipe its hand over its face, and even heard it blow its noſe.

Another creature of the ſame ſpecies was caught in the Baltic in the year 1531, and ſent as a preſent to Sigiſmund king of Poland, with whom it lived three days, and was ſeen by all the court. Another very young one was taken near Rocca de Sintra, as related by Damian Goes. The king of Portugal and the grand maſter of the order of St James, are ſaid to have had a ſuit at law to determine which party theſe monſters belong to.

In Pontopidan's Natural Hiſtory of Norway, alſo, we have accounts of mermaids; but not more remarkable or any way better atteſted than the above, to which we have given a place, merely to ſhew how far the folly and extravagance of credulity have been carried by weak minds.

MERNS, MEARNS, or KINCARDINESHIRE, a county of Scotland. See KINCARDINESHIRE.

MERODACH was an ancient king of Babylon, who was placed among the gods, and worſhipped by the Babylonians. Jeremiah (chap. l. 2.), ſpeaking of the ruin of Babylon, ſays, "Babylon is taken, Bel is confounded, Merodach is broken in pieces; her idols are confounded, her images are broken in pieces." We find certain kings of Babylon, in whoſe names that of Merodach is contained: for example, Evil-merodach and Merodach baladan. Evil-merodach was the ſon of Nebuchadnezzar the Great, and had for his ſucceſſor the wicked Belſhazzar. Merodach-baladan, ſon of Baladan king of Babylon, having heard that Hezekiah had been cured miraculouſly (Iſa. xxxix.), and that the ſun had gone backwards to give him an aſſurance of his recovery, ſent him preſents, and made him compliments upon the recovery of his health. Ptolemy calls him *Mardoc-empadus;* and ſays, that he began to reign at Babylon 26 years after the beginning of the era of Nabonaſſar, that is, in the year of the world 2283.

MEROE, in *Ancient Geography*, an iſland of Ethiopia beyond Egypt, in the Nile; with a cognominal town, the metropolis of the Ethiopians.

The Jeſuits have endeavoured to prove, that the province of Gojam in Abyſſinia is the Meroë of the ancients; but this is ſtrongly conteſted by Mr Bruce, who is of opinion, that it muſt be looked for ſomewhere between the ſource of the Nile and its union with the Atbara. The latter, he thinks, is very plainly the Aſtaboras of the ancients; and Pliny ſays, that this ſtream encloſes the left ſide of Meroë as the Nile does the right, in which caſe we muſt ſuppoſe him looking ſouthward from Alexandria, otherwiſe the words would not apply.

We are told by Diodorus Siculus, that Meroë had its name from a ſiſter of Cambyſes king of Perſia, who died there in the expedition undertaken by that prince againſt the Ethiopians. His army periſhed with hunger and thirſt in the deſerts beyond Meroë, which could not have happened if they had reached Gojam, the latter being one of the moſt plentiful countries in the world. A further proof that Gojam cannot be the ancient Meroë is, that the latter was encloſed between the rivers Nile and Aſtaboras, while Gojam is almoſt entirely ſurrounded by the Nile. If the ancients were acquainted with Gojam, they muſt alſo have been acquainted with the fountains of the Nile, which we certainly know they were not. Pliny ſays that Meroë, the moſt conſiderable of all the iſlands of the Nile, was called *Aſtaboras*, from the name of its left channel, which cannot be ſuppoſed any other than the junction of the Nile and Atbara. He informs us moreover, that the ſun was vertical twice in the year, viz. when proceeding northward he entered the 18th degree of Taurus, and when returning he came to the 14th degree of Leo; but this could never be the caſe with Gojam, which lies in about 10 degrees north latitude.

Again, the poet Lucan deſcribes Meroë by two circumſtances which cannot apply to any other than the peninſula of Atbara. One is, that the inhabitants were black; which was the caſe with the Gymnoſophiſts and firſt inhabitants, and which has been the caſe with all the reſt down to the Saracen conqueſt: but the inhabitants of Gojam, as well as the other Abyſſinians, are fair, at leaſt greatly different in complexion from the blacks; they are alſo long-haired, and nobody imagined that they ever had philoſophers or ſcience among them, which was eminently the caſe with the ancient inhabitants of Meroë. The other circumſtance is, that the ebony tree grew in the iſland of Meroë, which at this day grows plentifully in the peninſula of Atbara, and part of the province of Kuara, but not in Gojam, where the tree could not ſubſiſt on account of the violent rains which take place during ſix months of the year. Mr Bruce mentions another circumſtance quoted from the poet Lucan, which likewiſe tends to prove the identity of Meroë and Atbara; viz. that though there are many trees in it, they afford no ſhade. This our traveller found by experience, when returning from Abyſſinia through Atbara. "The country (ſays he) is flat, and has very little water. The foreſts, though thick, afforded no ſort of ſhade, the hunters for the ſake of their ſport, and the Arabs for deſtroying the flies, having ſet fire to all the dry graſs and ſhrubs; which paſſing with great rapidity in the direction of the wind from eaſt to weſt, though it had not time to deſtroy the trees, did yet wither, and occaſion every leaf that was upon them to fall, unleſs in thoſe ſpaces where villages had been, and where water was. In ſuch ſpots a number of large ſpreading trees remained full of foliage; which, from their great height and being cleared of underwood, continued in full verdure, loaded with large, projecting, and exuberant branches. But even here the pleaſure that their ſhade afforded was very temporary, ſo as to allow us no time for enjoyment. The ſun, ſo near the zenith, changed his azimuth ſo rapidly, that every few minutes I was obliged to change the carpet on which I lay, round the trunk of the tree to which I had fled for ſhelter; and though I lay down to ſleep perfectly ſcreened by the trunk or branches, I was preſently awakened by the violent rays of a ſcorching ſun, the ſhade having paſſed beyond me. In all other places, though we had travelled conſtantly in a foreſt, we never met with a tree that could ſhade us for a moment, the fire having deprived them of all their leaves." The heat of Atbara is exceſſive, the thermometer having been obſerved at $119\frac{1}{2}°$: two of Mr Bruce's company died of thirſt, or at leaſt of the conſequences of drinking after extreme thirſt. The inhabitants live in the greateſt miſery, and are continually in danger from the neighbouring Arabs, who, by deſtroying and burning their corn, are able to reduce them to a ſtarving condition. Notwithſtanding all their diſadvantages, however, they have a manufacture of coarſe cotton towels, of a ſize juſt ſufficient to go round the waiſt, which paſs current as money throughout the whole country.

MEROM, in *Ancient Geography*. The waters of Merom, at which place Jabin and the other confederate kings met to fight Joſhua (xi. 5.), are generally ſuppoſed by the learned to be the lake Semechon, which lies between the head of the river Jordan and the lake Genneſareth; ſince it is agreed on all hands, that the city Hazor, where Jabin reigned, was ſituated upon this lake. But others think, that the waters of Merom or Merome were ſomewhere about the brook Kiſhon, ſince there is a place of that name mentioned in the account of the battle againſt Siſera (Judg. v. 21.) And it is more rational to think, that the confederate kings advanced

advanced as far as the brook Kiſhon, and to a paſs which led into the country, to hinder Joſhua from penetrating it, or even to attack him in the country where he himſelf lay encamped, than to imagine that they waited for him in the midſt of their own country; leaving all Galilee at his mercy, and the whole tract from the brook Kiſhon to the lake Semechon.

MEROPE, in *Fabulous Hiſtory*, one of the Atlantides. She married Siſyphus the ſon of Æolus, and like her ſiſters was changed into a conſtellation after death. It is ſaid that in the conſtellation of the Pleiades the ſtar of Merope appears more dim and obſcure than the reſt, becauſe ſhe, as the poets obſerve, married a mortal, while her ſiſters married ſome of the gods or their deſcendants.

MEROPS, in *Fabulous Hiſtory*, a king of the iſland of Cos, who married Clymene, one of the Oceanides. He was changed into an eagle, and placed among the conſtellations. Alſo a celebrated ſoothſayer of Percoſus in Troas, who foretold the death of his ſons Adraſtus and Amphius, who were engaged in the Trojan war. They ſlighted their father's advice, and were killed by Diomedes.

MEROPS, a genus of birds belonging to the order of picæ. See ORNITHOLOGY *Index*.

MEROVINGIAN CHARACTER, derives its name from Meroüée, the firſt king of France of that race, which reigned 333 years, from Pharamond to Charles Martel. This race is ſaid by ſome to have terminated in Childeric III. A. D. 751. There are many MSS. in the French libraries ſtill extant in this character.

MEROZ, in *Ancient Geography*, a place in the neighbourhood of the brook Kiſhon, whoſe inhabitants refuſing to come to the aſſiſtance of their brethren when they fought with Siſera, were put under an anathema (Judges v. 23.) "Curſe ye Meroz, ſays the angel of the Lord; curſe ye bitterly the inhabitants thereof: becauſe," &c. Some have thought that Meroz is the ſame as Merus or Merom; and this F. Calmet thinks the moſt probable opinion in this matter. Others will have it, that Meroz was a mighty man, who dwelt near the Kiſhon, and not caring to come to the aſſiſtance of Barak and Deborah, was excommunicated by the angel of the Lord by the ſound of 400 trumpets. The angel of the Lord, according to ſome, was Barak, the general of the Lord's army; but according to others he was the high prieſt for the time being, or a prophet.

MERSA, a town of Barbary, pleaſantly ſituated about 11 miles from the city of Tunis, and two from Melcha the ſite of ancient Carthage. The bey has here two country houſes, one of them very coſtly work, built by Haſſan Bey ſurnamed the *Good*. From theſe are orange gardens reaching almoſt to the ſea-ſhore; on the edge of which is a famous well of ſweet water, eſteemed the beſt and lighteſt in the kingdom. Cloſe to this is a coffeehouſe, whither numbers of people from the neighbouring places reſort to drink coffee, and a glaſs of this natural luxury ſo peculiarly enjoyed in the eaſtern countries. In the middle of the court is a large mulberry tree, under the ſhade of which they ſit and ſmoke and play at cheſs; inhaling the comfortable ſea breeze that refreſhes this delightful ſpot. The water is drawn up by a camel with the Perſian wheel.

There are the remains of an ancient port, or cothon, (ſuppoſed to be an artificial one), built by the Carthaginians after Scipio had blocked up the old port, nothing but the turret or lighthouſe being left.

MERS or MERSE, a county of Scotland, called alſo *Berwickſhire*. This laſt name it derives from the town of Berwick, which was the head of the ſhire before it fell into the hands of the Engliſh, and obtained the appellation of *Mers* or *March*, becauſe it was one of the borders towards England. See BERWICK, *County of*.

MERSENNE, MARIN, in Latin *Merſennus*, a learned French author, born at Oyſé, in the province of Maine, anno 1588. He ſtudied at La Fleche at the ſame time with Des Cartes; with whom he contracted a ſtrict friendſhip, which laſted till death. He afterwards went to Paris, and ſtudied at the Sorbonne; and in 1611 entered himſelf among the Minims. He became well ſkilled in Hebrew, philoſophy, and mathematics. He was of a tranquil, ſincere, and engaging temper; and was univerſally eſteemed by perſons illuſtrious for their birth, their dignity, and their learning. He taught philoſophy and divinity in the convent of Nevers, and at length became ſuperior of the convent; but being willing to apply himſelf to ſtudy with more freedom, he reſigned all the poſts he enjoyed in his order, and travelled into Germany, Italy, and the Netherlands. He wrote a great number of excellent works; the principal of which are, 1. *Queſtiones celeberrimæ in Geneſim*. 2. *Harmonicorum libri*. 3. *De ſonorum natura, cauſis, et effectibus*. 4. *Cogitata phyſico-mathematica*. 5 *La verité des Sciences*. 6. *Les queſtions inouies*. He died at Paris in 1648. He had the reputation of being one of the beſt men of his age. No perſon was more curious in penetrating into the ſecrets of nature, and carrying all the arts and ſciences to their utmoſt perfection. He was in a manner the centre of all the men of learning, by the mutual correſpondence which he managed between them. He omitted no means to engage them to publiſh their works; and the world is obliged to him for ſeveral excellent diſcoveries, which, had it not been for him, would perhaps have been loſt.

MERSY, a river of England, which runs through the counties of Lancaſter, York, and Cheſter, and empties itſelf into the Iriſh ſea at Liverpool. By means of inland navigation, it has communication with the rivers Dee, Ribble, Ouſe, Trent, Darwent, Severn, Humber Thames, Avon, &c.; which navigation, including its windings, extends above 500 miles, in the counties of Lincoln, Nottingham, York, Lancaſter, Weſtmorland Cheſter, Stafford, Warwick, Leiceſter, Oxford, Worceſter, &c.

MERSEY Iſland, an iſland of Eſſex, at the mouth of the Coln, ſouth of Colcheſter. It was ſeized by the Danes in the reign of King Alfred, for their winter quarters. It had eight pariſhes, now reduced to two, viz. Eaſt and Weſt Merſey. There was formerly a blockhouſe on the iſland.

MERULA, or *Blackbird*. See TURDUS, ORNITHOLOGY *Index*.

MERUS, in *Ancient Geography*, a mountain of the Hither India, hanging over the city Nyſſa, built by Bacchus, and ſituated between the rivers Cophen and Indus. The name, denoting the *thigh*, gave riſe to the fable of Bacchus being inſerted into Jupiter's thigh, and being born twice; because in this mountain he and his army are said to have been preserved, when disease and pestilence raged in the plains below.

MESARAIC VESSELS, in the general sense, are the same with MESENTERIC.

In common use, mesaraic is more frequently applied to the veins, and mesenteric to the arteries, of the mesentery. See ANATOMY.

MESCHED, a considerable town of Persia, and in the province of Chorassan; fortified with several towers, and famous for the magnificent sepulchre of Iman Risa, of the family of Ali, to whom the Persians pay great devotion. It is seated on a mountain near this town, in which are fine turquoise stones; in E. Long. 59. 25. N. Lat. 37. 0.

MESEMBRYANTHEMUM, FIG-MARIGOLD, a genus of plants, belonging to the icosandria class; and in the natural method ranking under the 13th order, *Succulentæ*. See BOTANY *Index*.

MESENTERIC, or MESARAIC, an epithet given to two arteries arising from the descending aorta, and proceeding to the mesentery. See MESENTERY.

MESENTERITIS, or *Inflammation of the* MESENTERY. See MEDICINE *Index*.

MESENTERY, MESENTERIUM, (formed of μεσος, *middle*, and εντερον, *intestine*), in anatomy, a fatty membranous body, thus called as being placed in the middle of the intestines, which it connects to one another. See ANATOMY, N° 94.

MESHES *of* NETS, the openings or interstices between the threads.

MESN, or MESNE, a term in law, signifying him who is lord of a manor, and so hath tenants holding of him; yet he himself holds of a superior lord.

The word is properly derived from *maisne*, *quasi minor natu*; because his tenure is derived from another, from whom he holds.

MESN also denotes a writ, which lieth where there is lord mesn and tenant; and the tenant is distrained for services due from the mesn to the superior lord.

This is in the nature of a writ of right; and in this case the tenant shall have judgement to be acquitted or indemnified by the mesne lord; and if he makes default therein, or does not appear originally to the tenant's writ, he shall be forejudged of his mesnalty, and the tenant shall hold immediately of the lord paramount himself.

MESOCHRI, were musicians among the ancients, who presided in concerts, and by beating a wooden desk regularly with their feet, directed the measure of the music. For the purpose of beating time, they wore wooden clogs, called by the ancients *crupezia*, which occasioned the sound to be better heard.

MESOCOLON, in *Anatomy*, that part of the mesentery, which, having reached the extremity of the ileum, contracts and changes its name. See ANATOMY, N° 94.

MESOLOGARITHMS, according to Kepler, are the logarithms of the co-sines and co-tangents; the former of which were called by Baron Napier *anti-logarithms*, and the latter *differentials*.

MESOPOTAMIA, the ancient name of the province of DIARBECK, in Turkey in Asia. It is situated between the rivers Euphrates and Tigris; having Assyria on the east, Armenia on the north, Syria on the west, and Arabia Deserta with Babylonia on the south. The Hebrews called it *Padan aram*, (Gen. xxviii. 2. &c.), and *Aram Naharaim* (title of Psal. lx.) or Aram *of the two rivers*, because it was first peopled by Aram father of the Syrians, and is situated between the two rivers already mentioned. This country is much celebrated in Scripture, as being the first dwelling of men both before and after the deluge; and because it gave birth to Phaleg, Heber, Terah, Abraham, Nahor, Sarah, Rebekah, Rachel, Leah, and to the sons of Jacob. Babylon was in the ancient Mesopotamia, till, by vast labour and industry, the two rivers of the Tigris and Euphrates were united into one channel. The plains of Shinar were in the same country. Often they gave it the name of Mesopotamia (Deut. xxiii. 4. &c.) and sometimes that of Syria, (Hosea xii. 12.). Balaam son of Beor was of Mesopotamia, Deut. xxiii. 4. Chushan-rishathaim king of Mesopotamia kept the Hebrews in subjection some time after the death of Joshua, Judg. iii. 8.

MESOPTERYGIUS, a term applied to such fishes as have only one back-fin, which is situated in the middle of the back.

MESPILUS, the MEDLAR, a genus of plants belonging to the icosandria class; and in the natural method ranking under the 36th order, *Pomaceæ*. See BOTANY *Index*.

MESS, in a military sense, implies a number of soldiers, who, by laying away a certain proportion of their pay towards provisions, mess together: six or eight is generally the number of each mess. Experience proves, that nothing contributes more to the health of a soldier, than a regular and well chosen diet, and his being obliged every day to boil the pot: it corrects drunkenness, and in a great measure prevents gaming, and thereby desertion.

MESSALINA, VALERIA, a daughter of Messala Barbatus. She married the emperor Claudius, and disgraced herself by her cruelties and incontinence. Her husband's palace was not the only seat of her lasciviousness, but she prostituted herself in the public streets, and few men there were at Rome who could not boast of having enjoyed the favours of the impure Messalina. Her extravagances at last irritated her husband, who commanded her to appear and answer all the accusations which were brought against her: upon which she attempted to destroy herself; and when her courage failed, one of the tribunes who had been sent to her despatched her with his sword. It is in speaking of her debaucheries and lewdness that Juvenal says,

Et lassata viris, necdum satiata, recessit.

Her name has become a common appellation to denote a woman of shameless and inordinate lust.

MESSANA, in *Ancient Geography*, the first town of Sicily on crossing over from Italy, situated on the strait now called the *Faro*, (Italicus). Anciently called *Zancle*, according to Diodorus Siculus, from King Zanclus; or, according to others, from the Sicilian term *Zanclon*, denoting a sickle, alluding to the curvity of the coast; a name appropriated by the poets; and hence *Zanclæi*, the people, (Herodotus, Pausanias).

The

The other name *Messana* is from the *Messinii* of Peloponnesus, (Strabo). Thucydides ascribes its origin to Anaxilas the Messenian, tyrant of Rhegium, who received all comers, calling the town after the name of his country. The Greeks always call it *Messene;* the Romans *Messena* constantly, to distinguish it from *Messene* of Peloponnesus. Now MESSINA, lately ruined by earthquakes.

MESSENA, or MESSENE, an inland town, and the capital of Messenia, a country of Peloponnesus; erroneously replaced by Ptolemy on the coast. It was built by Epaminondas, who called all the Messenian exiles, and gave the town the name of *Messene*. A place vying in point of strength and situation with Corinth, according to Strabo; and therefore Demetrius Phalereus advised Philip, father of Perseus, that if he wanted to have Peloponnesus in his power, he should make himself master of these two towns, as thus he would have the ox by both horns.

MESSENGERS, are certain officers chiefly employed under the direction of the secretaries of state, and always in readiness to be sent with all kinds of despatches foreign and domestic. By virtue of the secretaries warrants, they also take up persons for high treason, or other offences against the state. The prisoners they apprehend are usually kept at their own houses, for each of which they are allowed 6s. 8d. per day by the government: and when they are sent abroad, they have a stated allowance for their journey, viz. 30l. for going to Paris, Edinburgh, or Dublin; 25l. for going to Holland; and to other places in the same proportion; part of which money is advanced for the expence of their journey. Their standing salary is 45l. per annum; and their posts, if purchased, are esteemed worth 300l. But these sums have now probably been increased. The messengers wait 20 at a time, monthly, and are distributed as follows, viz. four at court, five at one secretary's office, five at another, two at the third for North Britain, three at the council office, and one at the lord chamberlain's of the household.

MESSENGERS, in Scotland. See LAW, Part III.

MESSENGERS of the Exchequer, are four officers who attend the exchequer, in the nature of pursuivants, and carry the lord treasurer's letters, precepts, &c.

MESSENGER of the Press, a person who, by order of the court, searches printing-houses, booksellers shops, &c. in order to discover the printers or publishers of seditious books, pamphlets, &c.

MESSENIA, a country in the south of Peloponnesus, mostly maritime, situated between Elea to the west, and Laconia to the east. Anciently a part of Laconia under Menelaus, and called *Messene* by Homer; interpreted by the scholiast, *Messenæa Regia*. *Messenii*, the people, reduced to a state of slavery and subjection by the Spartans; *Messenius*, the epithet.

This country is famous in history, on account of the resistance made by the Messenians against the Spartans, and the exploits of their hero Aristomenes. The first hostilities commenced about the year 652 B. C. on what occasion is uncertain. Though the Messenians were inferior in the knowledge of the art of war to the Spartans; yet, by keeping for some time on the defensive, they improved so much, that in three years time they found themselves in a capacity of giving battle to their enemies in the open field; nor did they appear to be in any degree inferior either in courage or conduct: the war was therefore protracted, with various success, on both sides. At last, both consulted the oracle at Delphi; and received for answer, "that whoever should first dedicate 100 tripods in the temple of Jupiter at Ithome, a strong hold of the Messenians, should be masters of the country." The inhabitants of Messenia, on hearing this, having no money to make the tripods of brass, fell to cutting them out in wood; but before this could be accomplished, a Spartan having got into the city by stratagem, dedicated 100 little tripods of clay: which threw the Messenians into such despair, that they at last submitted to the Spartans.

The new subjects of Sparta were treated with the utmost barbarity by these cruel tyrants; so that a new war commenced under Aristomenes, a man of unconquerable valour, and enthusiastically fond of liberty. He perceived that the Argives and Arcadians, who were called the *allies* of the Lacedæmonians, adhered to them only through fear of their power; but that in reality they hated them, and wished to revenge the injuries they had done them. To these Aristomenes applied; and receiving an answer conformable to his wishes, he engaged his countrymen unanimously to take up arms. About a year after the revolt began, and before either party had received any auxiliaries, the Spartans and Messenians met at a village called *Deræ*, where an obstinate engagement ensued. Aristomenes was conceived to have performed more than mortal achievements: in gratitude therefore, respect being also had to his royal descent, his countrymen unanimously saluted him *king;* which title be modestly waved, alleging, that he took up arms to set them free, and not to make himself great: he consented, however, to accept the title of *general*, with a power of doing whatsoever he thought requisite for the service of the public. Knowing well the superstition of the age in which he lived, he resolved to intimidate the Spartans, by showing them what he was sure they would take for an ill omen. Disguising himself therefore, he went privately to the city, where, in the night, he hung up a shield on the wall of the temple of Minerva, with this inscription: *Aristomenes dedicates this, out of the spoils of the Spartans, to the goddess.* It was easily perceived that this war would be both long and bloody; the Lacedæmonians therefore sent deputies to Delphi, to inquire of the oracle concerning its event: the answer they received was, *That it behoved the Spartans to seek a leader from Athens.* The Athenians naturally envious of the Spartans, granted their request indeed, but in such a manner as manifested their spite; for they sent them for a general Tyrtæus, a schoolmaster and poet, lame of one foot, and who was suspected to be a little out of his wits. But here their skill failed them; for this captain, notwithstanding his despicable appearance, proved of great consequence to Sparta, teaching them how to use good, and how to bear up under ill fortune.

In the mean time, Aristomenes had drawn together a mighty army, the Eleans, Argives, Sicyonians, and Arcadians, having sent troops to his assistance; the Spartans in this, as in the former war, having no ally but Corinth. The Spartan kings, according to the

Meſſenia. cuſtom of their city, no ſooner took the field, than, notwithſtanding their inferiority in number, they offered the enemy battle, which Ariſtomenes readily accepted. It was long, obſtinate, and bloody; but in the end the Meſſenians were victorious, and the Lacedæmonians put to flight with a great ſlaughter. It is ſcarce to be conceived how much the Spartans were ſtruck with this defeat: they grew weary of the war, diſſatisfied with their kings, diffident of their own power, and in a word ſunk into a ſtate of general uneaſineſs and want of ſpirit. It was now that the Athenian general convinced them, that he was capable of fulfilling all the promiſes of the oracle; he encouraged them by his poems, directed them by his counſels, and recruited their broken armies with choſen men from among the Helotes. Ariſtomenes, on the other hand, acted with no leſs prudence and vigour. He thought it not enough to reſtore the reputation of the Meſſenians, if he did not alſo reſtore their wealth and power: he therefore taught them to act offenſively againſt their enemies; and, entering the territories of Sparta, he took and plundered Pharæ, a conſiderable borough in Laconia, putting all ſuch as made any reſiſtance to the ſword, carrying off at the ſame time an immenſe booty. This, however, was an injury which the Spartans could not brook with patience; they therefore ſent immediately a body of forces to overtake the Meſſenians, which accordingly they did: but Ariſtomenes routed theſe purſuers, and continued to make a mighty ſlaughter of them, till ſuch time as he was diſabled by having a ſpear thruſt in his ſide, which occaſioned his being carried out of the battle. His cure, which took up ſome time, being finiſhed, he reſolved to carry the war even to the gates of Sparta; and to that purpoſe raiſed a very great army: but, whether he found his deſign impracticable, or was really diverted by ſome dream, he gave out, that Caſtor and Pollux, with their ſiſter Helena, had appeared to him, and commanded him to deſiſt. A ſhort time after this retreat, going with a ſmall party to make an incurſion, and attempting to take priſoners ſome women who were celebrating religious rites near Egila, a village in Laconia, thoſe zealous matrons fell upon him and his ſoldiers with ſuch fury, that they put them to flight, and took him priſoner: however, he ſoon afterwards made his eſcape, and rejoined his forces. In the third year of the war, the Spartans with a great force entered Meſſenia, whither Ariſtocrates king of Arcadia was come, with a great body of troops, to the aſſiſtance of his allies: Ariſtomenes therefore made no difficulty of fighting when the Spartans approached; but they entering privately into a negociation with Ariſtocrates, engaged him with bribes and promiſes to betray his confederates. When the battle began, the deceitful Arcadian repreſented to the forces under his command the mighty danger they were in, and the great difficulty there would be of retreating into their own country, in caſe the battle ſhould be loſt: he then pretended, that the ſacrifices were ominous; and, having terrified his Arcadians into the diſpoſition of mind fitteſt to ſerve his purpoſe, he not only drew them off from both wings, but, in his flight, forced through the Meſſenian ranks, and put them too in confuſion. Ariſtomenes and his troops, however, drew themſelves into cloſe order, that

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they might defend themſelves the beſt they could: and indeed they had need of all their valour and ſkill; for the Lacedæmonians, who expected this event, immediately attacked and ſurrounded them on all ſides. Fortune was, on this occaſion, too powerful either for the courage or the conduct of the Meſſenians; ſo that, notwithſtanding their utmoſt efforts, moſt of their army were cut to pieces, and amongſt them the chief of their nobility. Ariſtomenes, with the poor remains of his ſhattered forces, retired as well as he could; and, perceiving that it was now impoſſible to maintain the war againſt the Lacedæmonians upon equal terms, he exhorted his countrymen to fortify Mount Era, and to make the beſt diſpoſitions poſſible for a long defence. He likewiſe placed garriſons in Pylus and Methone on the ſea coaſts; and to theſe three places he gathered all the inhabitants, leaving the reſt of Meſſenia to the mercy of the Spartans. They, on the other hand, looked on the war as now in a manner finiſhed; for which reaſon they divided the lands among their citizens, and cauſed them to be carefully cultivated, while they beſieged Era. But Ariſtomenes quickly convinced them that the war was far from being over: he choſe out of all the Meſſenians 300 men, with whom he ravaged all the adjacent country: carried off a prodigious booty; and, when Meſſenia could no longer ſupply the wants of his garriſon, penetrated into Laconia, and bore away corn, wine, cattle, and whatever elſe was neceſſary to the ſubſiſtence of his countrymen ſhut up in Era: ſo that at laſt the Spartans were conſtrained to iſſue a proclamation, forbidding the cultivation, not only of the Meſſenian territory in their hands, but alſo of Laconia in its vicinity; whereby they diſtreſſed themſelves more than their enemies, inducing at laſt a famine in Sparta itſelf, which brought with it its uſual attendant, ſedition. Here again all things had gone wrong, if the wiſdom of the poet Tyrtæus had not ſupported the Spartan courage; nor was it without much difficulty that he influenced them to continue the blockade of Era, and to maintain a flying camp for the ſecurity of the country.

Ariſtomenes, in ſpite of all theſe precautions, committed terrible depredations with his ſmall corps of 300 men. Amongſt other places which he plundered, the city of Amyclæ was one; from whence he carried not only a great quantity of riches, but alſo many carriages laden with proviſions. The kings of Sparta lying with their troops in its neighbourhood, as ſoon as they heard of this expedition, marched after Ariſtomenes with the utmoſt diligence; and, as the Meſſenians were encumbered with their booty, came up with them before they could reach Era. In this ſituation of things, Ariſtomenes, prompted rather by deſpair than prudence, diſpoſed his troops in order of battle; and, notwithſtanding they were ſo few, made a long and vigorous reſiſtance againſt the whole Lacedæmonian army. At length, however, numbers prevailed: the greateſt part of the Meſſenians were ſlain on the ſpot; and Ariſtomenes, with about 50 of his men who ſurvived the ſlaughter, were taken priſoners; that chief having received ſo many wounds, that he was ſenſeleſs when they carried him away. The Lacedæmonians expreſſed the loudeſt joy at the ſight of this illuſtrious captive; who for ſo many years, by his ſingle abilities, had

Messenia. had enabled his exhausted country to defend itself against the whole force of Sparta. When he was recovered of his wounds, they decreed him and all his fellow prisoners to be thrown together into a deep cavern, which was the common punishment of the lowest kind of offenders. This judgement was executed with the utmost severity, excepting that Aristomenes had leave to put on his armour. Three days he continued in this dismal place, lying upon and covered over with dead bodies. The third day, he was almost famished through want of food, and almost poisoned with the stench of corrupted carcases, when he heard a fox gnawing a body near him. Upon this he uncovered his face, and perceiving the fox just by him, he with one hand seized one of its hind legs, and with the other defended his face, by catching hold of its jaw when it attempted to bite him. Following as well as he could his struggling guide, the fox at last thrust his head into a little hole; and Aristomenes then letting go his leg, he soon forced his way through, and opened a passage to the welcome rays of light, from which the noble Messenian had been so long debarred. Feeble as he was, Aristomenes wrought himself an outlet with his nails; and travelling by night with all the expedition he could, at length arrived safe at Era, to the great joy and amazement of his countrymen. When this news was first blazed abroad, the Spartans would have had it pass for a fiction; but Aristomenes soon put the truth of it out of doubt, by falling on the posts of the Corinthians, who, as allies of the Spartans, had a considerable body of troops before Era. Most of their officers, with a multitude of private men, he slew; pillaged their camp; and, in short, did so much mischief, that the Spartans, under the pretence of an approaching festival, agreed to a cessation of arms for 40 days, that they might have time to bury their dead. On this occasion, Aristomenes for the second time celebrated the *hecatomphonia*, or the sacrifice appointed for those who had killed 100 of the enemy with their own hands. He had performed the same before and after his second battle; and he lived to do it a third time: which must appear wonderful to the reader, when he is informed, that, notwithstanding this truce, certain Cretan archers in the service of the Spartans seized Aristomenes as he was walking without the walls, and carried him away a prisoner. There were nine of them in all; two of them immediately flew with the news to Sparta, and seven remained to guard their prize, whom they bound, and conducted to a lone cottage inhabited only by a widow and her daughter. It so fell out, that the young woman dreamt the night before, that she saw a lion without claws, bound, and dragged along by wolves; and that she having loosed his bonds, and given him claws, he immediately tore the wolves to pieces. As soon as Aristomenes came into the cottage, and her mother, who knew him, had told her who he was, she instantly concluded that her dream was fulfilled; and therefore plied the Cretans with drink, and, when they were asleep, took a poniard from one of them, cut the thongs with which Aristomenes was bound, and then put it into his hands. He presently verified her vision, by putting all his guards to death; and then carried her and her mother to Era, where, as a reward for her service, he married the young woman to his son Gorgus, then about 18 years of age. Messenia.

When Era had held out near eleven years, it fell into the hands of Sparta by an accident: the servant of one Empiramus, a Spartan commander, driving his master's cattle to drink at the river Neda, met frequently with the wife of a Messenian, whom he engaged in an amour. This woman gave him notice, that her husband's house was without the wall; so that he could come to it without danger, when the good man was abroad; and she likewise gave him intelligence when her husband was upon duty in the garrison. The Spartan failed not to come at the time appointed; but they had not been long in bed before the husband returned, which put the house into great confusion: the woman, however, secured her gallant; and then let in her husband, whom she received in appearance with great joy, inquiring again and again by what excess of good fortune she was blessed with his return. The innocent Messenian told her, that Aristomenes being detained in his bed by a wound, the soldiers knowing that he could not walk the rounds, had a grant to retire to their houses, to avoid the inclemency of the season. The Spartan no sooner heard this, than he crept softly out of doors, and hastened away to carry the news to his master. It so happened, that the kings were at this time absent from the camp, and Empiramus had the chief command of the army. As soon as he received this information, he ordered his army to begin its march, though it rained excessively, and there was no moon light. The fellow guided them to the ford, and managed matters so well that they seized all the Messenian posts: yet, after all, they were afraid to engage; darkness, and high wind, heavy rain, together with the dread of Aristomenes, keeping them quiet in the places they had seized. As soon as it was light, the attack began; and Era had been quickly taken, if only the men had defended it; but the women fought with such fury, and by their mingling in the fray, brought such an accession of numbers, as made the event doubtful. Three days and two nights this desperate engagement lasted: at last, all hopes of preserving the city being lost, Aristomenes drew off his wearied troops. Early in the fourth morning, he disposed the women and children in the centre, the Messenian youth in the front and rear, the less able men in the main body: himself commanded the van; the rear-guard was brought up by Gorgus and Manticlus, the former the son of Aristomenes, the latter of Theocles, a Messenian of great merit, who fell with much glory in this attack, fighting valiantly in the cause of his country. When all things were ready, Aristomenes caused the last barrier to be thrown open; and, brandishing his spear, marched directly towards the Spartan troops, in order to force a passage. Empiramus, perceiving his intent, ordered his men to open to the right and left, and fairly gave them a passage; so that Aristomenes marched off in triumph, as it were, to Arcadia.

The Arcadians, when they heard that Era was taken, were very desirous of succouring their old confederates in this deep distress: they therefore entreated their king Aristocrates to lead them into

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Meſſenia. But he, corrupted by the Lacedæmonians, perſuaded them that it was too late; that the Meſſenians were all cut off; and that ſuch a ſtep would only expoſe them to the fury of the conquerors. When the thing appeared to be otherwiſe, and it was known that Ariſtomenes was on the frontiers of Arcadia, they went in crowds to carry him proviſions, and to teſtify their readineſs to afford him and thoſe under his command all the aſſiſtance in their power. Ariſtomenes deſired to be heard before a general aſſembly; which being accordingly convoked, he there opened one of the boldeſt and beſt laid ſchemes recorded in hiſtory: he ſaid, that he had yet 500 undaunted ſoldiers, who, at his command, would undertake any thing; that it was very probable moſt of the Spartans were employed in pillaging Era, and that therefore he determined to march and ſurpriſe Sparta; which appeared ſo ſenſible, that all the aſſembly loudly commended his great capacity and unſhaken courage. Ariſtocrates, however, took care to betray him; having, by various pretences, retarded the execution of the project. The Arcadians, who began to ſuſpect him, waited for and ſurpriſed the meſſengers as they came back. They took the letters from them, and read them openly in the aſſembly. The purport of them was, that they acknowledged his great kindneſs both now and in the battle; and promiſed, that the Lacedemonians would be grateful. As ſoon as the letters were read, the Arcadians fell to ſtoning their king, frequently calling upon the Meſſenians to aſſiſt them; which, however, they did not, waiting for Ariſtomenes's orders; who, far from triumphing in this ſpectacle, ſtood ſtill, with his eyes fixed on the ground, which he wet with his tears, his ſoul pierced with ſorrow to ſee a crowned head ſo ſhamefully and ſo deſervedly put to death. The Arcadians afterwards erected a monument over him, with an inſcription to perpetuate his infamy. As for the Meſſenians under the command of Gorgus and Manticlus, they paſſed over into Sicily; where they founded the city of Meſſene, one of the moſt famous in the iſland. Ariſtomenes remained, however, in Greece; where he married all his daughters, except the youngeſt, to perſons of great rank. A prince of Rhodes, inquiring of the oracle at Delphi whom he ſhould eſpouſe, that his ſubjects might be happy under his poſterity, was directed to marry the daughter of the moſt worthy of the Greeks; which anſwer was immediately underſtood to point at the virgin daughter of Ariſtomenes. Her therefore he demanded, and received; Ariſtomenes accompanying him back to his dominions, where he formed a ſcheme of uniting the Lydians and Medes againſt the Spartans, reſolving with this view to go into Media, and to the court of Sardis; but while he meditated theſe great things, death ſurpriſed him, and thereby freed Lacedæmon from the moſt formidable enemy ſhe ever had.

MESSIAH, a word ſignifying one *anointed*, or inſtalled into an office by unction. It was uſual among the Jews to anoint kings, high prieſts, and ſometimes prophets, at the deſignation or inſtallment of them, to ſignify emblematically the mental qualifications neceſſary for diſcharging theſe offices. Saul, David, Solomon, and Joaſh, kings of Judah, received the royal unction. Aaron and his ſons received the ſacerdotal, and Eliſhah the diſciple of Elijah received the prophetic unction.—The name MESSIAH, *Anointed* or *Chriſt* (Χριστος), was given to the kings and high-prieſts of the Jews. The patriarchs and prophets are alſo called by the name of *Meſſiahs*, or the *Lord's anointed*. See 1 Sam. xii. 3, 5. 1 Chron. xvi. 22. Pſ. cv. 15.

But this name MESSIAH was principally and by way of eminence given by the Jews to their expected great Deliverer, whoſe coming they ſtill vainly wait; and is a name the Chriſtians apply to *JESUS Chriſt*, in whom the prophecies relating to the Meſſiah were accompliſhed. The ſum of theſe prophecies is, That there ſhould be a glorious perſon named *Meſſiah*, deſcended from Abraham, Iſaac, and Jacob, who ſhould be born at Bethlehem, of a virgin of the family of David, then in its decline, before the Jews ceaſed to be a people, while the ſecond temple was ſtanding, and about 500 years after Ezra's time; who, though appearing in mean circumſtances, ſhould be introduced by a remarkable forerunner, whoſe buſineſs it ſhould be to awaken the attention and expectation of the people. That this illuſtrious perſon called *Meſſiah* ſhould himſelf be eminent for the piety, wiſdom, and benevolence of his character, and the miraculous works he ſhould perform: yet that, notwithſtanding all this, he ſhould be rejected and put to death by the Jews; but ſhould afterwards be raiſed from the dead, and exalted to a glorious throne, on which he ſhould through all generations continue to rule, at the ſame time making interceſſion for ſinners. That great calamities ſhould for the preſent be brought on the Jews for rejecting him: whereas the kingdom of God ſhould by his means be erected among the Gentiles, and diſperſe itſelf even unto the ends of the earth; wherever it came, deſtroying idolatry, and eſtabliſhing true religion and righteouſneſs. In a word, That this glorious perſon ſhould be regarded by all who believed in him as a divine teacher, an atoning ſacrifice, and a royal governor: by means of whom God would make a covenant with his people, very different from that made with Iſrael of old; in conſequence of which they ſhould be reſtored to, and eſtabliſhed in, the divine favour, and fixed in a ſtate of perpetual happineſs. See *JESUS Chriſt*, and CHRISTIANITY.

The Jews, as was already obſerved, ſtill wait for the coming of the *Meſſiah*, being impreſſed with the notion of a temporal *Meſſiah*, who is to be a mighty conqueror, and to ſubdue all the world. Moſt of the modern rabbins, according to Buxtorf, believe that the *Meſſiah* is already come, but that he keeps himſelf concealed, and will not manifeſt himſelf becauſe of the ſins of the Jews. Some of the Jews, however, in order to reconcile thoſe prophecies that ſeem to contradict each other as to the character and condition of the *Meſſiah*, have had recourſe to the hypotheſis of two *Meſſiahs*, who are yet to ſucceed each other; one in a ſtate of humiliation and ſuffering; the other of glory, ſplendor, and power. The firſt, they ſay, is to proceed from the tribe of Ephraim, who is to fight againſt Gog, and to be ſlain by Annillus, Zech. xii. 10. The ſecond is to be of the tribe of Judah, and

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and lineage of David, who is to conquer and kill Annillus, and reftore the kingdom of Ifrael, reigning over it in the higheft glory and felicity.

Jefus Chrift afferts himfelf the *Meffiah*. In St John iv. 25. the Samaritan woman fays to Jefus, *I know that when* Meffiah *comes, who is called the* Chrift, *he will tell us all things. Jefus anfwered her, I that fpeak to thee am he.*

There are feveral impoftors, who have endeavoured to pafs for *Meffiahs*, as Chrift himfelf predicted. J. Lent, a Dutchman, has written a hiftory *De Pfeudomeffiis*, "Of Falfe Meffiahs." The firft he mentions was one Barcochab, who appeared under the empire of Adrian. The laft was Rabbi Mordecai, who began to be talked of in 1682. A little before him, viz. in 1666, appeared Sabbethai Sebi, who was taken by the Turks, and turned Mahometan.

MESSINA, an ancient, large, handfome, and ftrong city of Sicily, and in the Val di-Demona, with a citadel, feveral forts, a fine fpacious harbour, and an archbifhop's fee. It is feated on the fea fide, 110 miles eaft of Palermo, 260 fouth by eaft of Rome, and 180 fouth-eaft of Naples. E. Long. 15. 50. N. Lat. 38. 10. The public buildings and the monafteries were numerous and magnificent, and it contained about 60,000 inhabitants; the harbour is one of the fafeft in the Mediterranean, and extremely deep; the viceroy of Sicily refides here fix months in the year; and it was a place of great trade in filk, oil, fruit, corn, and excellent wine, efpecially fince it was declared a free port. This city in the beginning of the year 1783 fuffered moft dreadfully by the earthquakes which fhook great part of Calabria and Sicily to their foundations, overturned many rich and populous towns, and buried thoufands in their ruins: (fee CALABRIA, and EARTHQUAKE, GEOLOGY *Index*).—The following account of Meffina, as it ftood before the above period, is extracted from Mr *Swinburne's Travels in Sicily*.

A large chain of mountains preffes upon the fhore, and part of the city ftands upon elevated ground. The mountains are many of them nobly wooded; the hills before them finely chequered with groves and fields. As the town runs in a fweep along the edge of a declivity, every building of confequence is feen to advantage, while the lefs noble parts are hidden by the Palazzata. This is a regular ornamental range of lofty houfes, with 19 gates, anfwering to as many ftreets: it follows the femicircular bend of the port for one mile and five poles, and would have been the handfomeft line of buildings in Europe had the defign been completed; but a confiderable part of the extent is not finifhed, except merely in the front wall, and that feems to be in a very ruinous condition. Philibert Emmanuel of Savoy, viceroy of Sicily, in 1622, began this princely work. Before it is a broad quay, decorated with ftatues and fountains; fhips of any burden can moor clofe to the parapet in great depth of water. At the weft extremity is a fmall fort and a gate; the other end is clofed by the governor's houfe and the citadel, a modern pentagonal fortrefs, built on the point where the ifthmus or *braccio di San Raniero* iffues from the main land. On this flip of low ground, which with the Palazzato forms the circular harbour of Meffina, is placed the lighthoufe (*lazaretto*), and on the point the old caftle of St Salvatore. The circumference of the port is four miles: it probably owes its formation to an earthquake, which opened an immenfe chafm, and then filled it with water. Near the lighthoufe is a kind of whirlpool in the fea, fhown as the Charybdis of the ancients.

The inner part of Meffina is dirty, though it contains a confiderable number of neat churches and large fubftantial dwellings. The cathedral is Gothic, enriched with Saracenic mofaics on the altars and fhrines; the front of the high altar is particularly fplendid: Gagini has embellifhed the pulpit and fome tombs with excellent fpecimens of his art.—In the treafury of this church is preferved the palladium of Meffina, a letter from the Virgin Mary to its citizens (A). This is the title upon which the Meffinefe build their pretenfions

(A) The ftory is as follows: After St Paul had made fome ftay at Meffina (a circumftance of his travels unnoticed by St Luke), the Meffinefe prevailed upon him to return to Jerufalem with an embaffy of four perfons fent by the city to the Virgin Mary. Their excellencies were gracioufly received by her, and brought back a letter written with her own hand in the Hebrew tongue, which St Paul tranflated into Greek. By the irruption of the Saracens this invaluable treafure was loft, and utterly forgotten till the year 1467, when Conftantine Lafcaris, a refugee Greek, found a copy of it, and turning it into Latin, made it known to the citizens, and then to all the Catholic world. Its authenticity is now fo well eftablifhed at Meffina, that Regna the hiftorian candidly acknowledges, that whoever was to confefs even a doubt on the fubject in that city would be treated as an infidel.

This curious epiftle is conceived in thefe terms:—Maria Virgo, Joachim filia, Dei humillima Chrifti Jefu crucifixi mater, ex tribu Judæ, ftirpe David, Meffanenfibus omnibus falutem, et Dei Patris Omnipotentis benedictionem. Vos omnes fide magna legatos ac nuncios per publicum documentum ad nos mififfe conftat. Filium noftrum Dei genitum Deum et hominem effe fatemini, et in cœlum poft fuam refurrectionem afcendiffe, Pauli apoftoli electi prædicatione mediante viam veritatis agnofcentes. Ob quod vos et ipfam civitatem benedicimus, cujus perpetuam protectricem nos effe volumus. Anno filii noftri XLII. Indict. I. III. Nonas Junii, luna XXVII. feria V. ex Hyerofolymis.

Thus tranflated:—"The Virgin Mary, daughter of Joachim, moft humble mother of God, Jefus Chrift crucified, of the tribe of Juda and the family of David, health and the bleffing of God the Father Almighty to all the people of Meffina. Out of the abundance of your faith, you have, in confequence of a public deliberation, fent a deputation to me; and fince you acknowledge that my Son is both God and man, and that he afcended into heaven after his refurrection, as you have learned from the preaching of St Paul the apoftle, I

Messina.

pretensions to pre-eminence over the whole island, nay over the whole world; to its virtues and patronage they attribute every piece of good fortune, and to their own unworthiness all sinister events that have befallen them. The authenticity of this epistle has been seriously impugned, and of course vigorously defended by many Sicilian divines and disputators.

There is another church in this city that deserves particular notice, not so much on account of its architecture or ornaments, as for its being the last refuge of the Greek liturgy, which was once the predominant service of the island, but gradually abolished by different conquerors. It is dedicated to the Virgin Mary de Grapheo, or of the *Letter*, which denomination may perhaps have furnished Lascaris with the idea of his letter. It is known at present by the name of *la Cottolica*. According to the Greek canons, the entrance of monastic churches was reciprocally forbidden to each sex, and the cathedrals were the only places of worship where a daily sacrifice was offered up by the bishop and clergy, and where both men and women were present at the same time, but in different parts of the church. From this general admittance the building acquired the title of *Catholic* or *universal*.

Messina is all paved with lava, cut into large flags of two feet square: a material which the vicinity of lavas renders it easy to procure, and which being very hard resists friction better than any other.

During a series of ages, notwithstanding the various revolutions and calamities to which it has been exposed, this city has still maintained its original situation; while most other cities have shifted their ground more or less from the place where they were first founded. But its situation enjoys advantages which have still tempted such of its inhabitants as escaped from the ravages of war and the desolation of earthquakes, to prefer it to every other spot, however delightful or secure. It is of very ancient origin; it has been under many different races of monarchs; and its name has been repeatedly changed: It has been at different times called *Zancle*, *Mamertina*, *Messana*. Its first name *Zancle*, which in the old language of Sicily meant "a sickle;" alluding, as some authors suppose, to the form of the port; or, according to others, to the fertility of the country. Allured by the advantages of its situation, the Cumæans, a commercial and enterprising people, invaded the island and drove the Siculi from this settlement; they were in their turn overpowered by a band of Samian adventurers, who made way for a colony of citizens of Messene, and under these masters it changed its name to *Messana*. Their government was of short duration; for in the 289th year before Christ it was destroyed by the Mamertines, a warlike unprincipled nation inhabiting the south part of Bruttium. These soldiers being received into Messana on their return to Italy from Syracuse, where they had served as mercenaries in the army of Agathocles, took an opportunity of massacring the inhabitants and usurping their possessions. The city was now called *Mamertina*; and, in order to support themselves against the resentment of the Sicilian powers, the Mamertines implored the protection of the Romans, who, eager to extend their dominion beyond the limits of Italy, and jealous of the growing power of Carthage, made no scruple to succour these assassins with a consular army. This step brought on the first Punic war. The Mamertines reaped no other fruit from the alliance but a more honourable degree of slavery; for such was the real nature of their connexion with Rome, whatever name it might be disguised under.

Messina was, however, always distinguished by particular attentions and favours from the senate; and, excepting a short period during the wars of the triumvirate, appears to have tasted all the sweets of Roman prosperity, without partaking of the bitter draughts of adversity. Its fate, in the ruin of the empire, was similar to that of the rest of Sicily. In 829 Messina fell into the hands of the Saracens, but obtained very honourable terms of capitulation; for half the city was left to the Christians, where they were to be governed by their own laws, and profess their own religion undisturbed. In the other resided the bey of one of the five provinces into which the Arabian conquerors had divided the island. Notwithstanding this indulgence, Messina was the first to cast off the yoke in 1037, when George Maniaces landed an army of Greeks and Normans on the shore of the Faro. It afterwards held out against the whole Mussulman force, till the feeble state of a distracted empire shut out all hopes of assistance from Constantinople. This unfortunate city then opened its gates to the army of the caliph, and felt very severely the weight of his resentment, but it did not long groan under the yoke; for in less than 20 years Roger the Norman took it by surprise and delivered it from Mahometan oppression. During the crusado our Richard Cœur de Lion and Philip Augustus king of France wintered here in their way to Palestine; a sojourn marked by continual quarrels, conflagration, and bloodshed. The Messinese were particularly tardy in entering into the national conspiracy of 1282, but afterwards exceeded the rest of the insurgents in deeds of cruelty: This, and the importance of their situation, singled them out for the first objects of Charles's vengeance. He invested their city very closely, and declared so openly his determination to refuse all terms whatever to the besieged, that they saw no hopes of safety but in an obstinate defence. Their courage, perseverance, and sufferings, were excessive; at length their strength and resources began to fail rapidly, and every circumstance seemed to denounce their speedy destruction, when Roger Lauria appeared off the harbour with the Arragonian fleet, forced the king to retire with precipitation across the

I give my blessing to you and all your city, and agree to become your protectress. In the 42d year of my Son, the 1st of the Indiction, the 3d day of June, and the 27th of the moon, at Jerusalem."

Not to dwell upon the astronomical blunders in these dates, let it suffice to observe, that Lascaris was not aware that Denis the Little, a Syrian monk in the 6th century, was the first who made use of the era that commences at our Saviour's birth.

Messina. the straits, and in his sight defeated and destroyed his naval armament. Robert, grandson of Charles I. also made a fruitless attack; but in the disturbed reign of Frederick III. Messina was delivered up to Louis king of Naples and his consort Queen Joan, who entered it in triumph. In a few years it returned to its former possessors. The year 1672 was remarkable for the revolt of the Messinese.—They threw off the Spanish yoke, and swore allegiance to Louis XIV. king of France. They were for some time vigorously assisted by the French; but before the Spaniards had gained the least advantage to excite any hopes of recovering so valuable a possession, Louis found himself necessitated from motives of political interest to desert his new subjects, and leave them to the mercy of their old incensed masters. The horror of being thus abandoned, and the chastisement inflicted by Spain, broke the fierce spirit of the Messinese; they were still stunned with the remembrance and effects of this blow, when the plague in 1743 was introduced from the Levant, and swept away more than half the inhabitants. From this chain of calamities, the opulence, trade, and population of Messina, have been gradually sinking; and unless very favourable circumstances happen, will every year fall lower. The number of its inhabitants does not now exceed 30,000.

The following particulars are added from M. Houel, who visited this city since the late earthquakes, which completed its destruction.

On the front of the cathedral there is a square, which, though not regular, is far from being mean. This was not the largest square in Messina before its overthrow; but it was the most elegant, the most splendidly adorned, and the best frequented. There stands in this square an equestrian statue of Charles II. of Spain, in bronze, which has been spared by the earthquake. It stands on a marble pedestal, in the middle of the square. Opposite to this statue is an elegant marble fountain, ornamented with a variety of figures, representing men and other animals, all of them spouting out water in great abundance; which used, in summer, to spread an agreeable and refreshing coolness over the square, that induced company to assemble here. Seven streets terminated here. The cathedral forms a part of the square. It is dedicated to the blessed Virgin; the occasion of which has been already mentioned.

There is an anniversary feast celebrated in Messina, which is called *the feast of the Letter*. A lock of the Virgin's hair, which she sent to the Messenians at the same time with the letter, is carried through the city in procession in a crystal vessel. She made also a present of her picture to the Messenian deputies. It is placed over the tabernacle. None but the canons of the cathedral are permitted to touch, or take up on their shoulders, the silver shrine in which the crystal vessel with the Virgin's hair is deposited. Eight of those canons, with mitres on their heads, bear this shrine in the procession. The canopy suspended over it is supported by six senators in their robes. The picture and the hair are shown to strangers. This procession, and the other religious ceremonies of this festival, are followed by horse races. The spirits of the people being already elevated by their religious exercises, they engage with amazing eagerness in these and the other diversions with which they are accompanied: a tumultuous joy reigns over the city; and the evening concludes with illuminations and fireworks. The ships in the harbour pay the citizens the compliment of entertaining them with a discharge of their guns on the occasion. Messina.

Through a square called the *Square of the Great Hospital*, runs a large and impetuous torrent, the *Porto delle Legni*. It is precipitated from those lofty mountains which overlook this city on the south side. The channel which it has cut out for itself is at times entirely full. It would, on such occasions, overflow the square and other parts of the city, were it not confined by walls which have been built on both sides to prevent such accidents.—Another stream of a similar origin, called the *Torrent of La Bocetta*, runs through another part of the city, it is also confined within walls to prevent it from overflowing.

The *Square of St John of Malta* is one of the largest in Messina. In the middle of this square is a fine marble fountain, ornamented with a variety of sculptured figures and jets d'eau. Beside the fountain there used to stand a large reservoir for horses to drink out of.

In the time of the annual festivals, there used to be exhibited on the water of the reservoir a galley, or rather a fictitious representation of a galley, with galley-slaves, soldiers, officers, and a commander on board, all in arms, and the galley properly equipped as a ship of war. This galley was decorated with great art; and by night the masts, and every other suitable part, were hung with lamps, which illumined it in a very splendid manner. Every thing around was so artificially disposed, that when the fireworks were played off, the spectator was led to think, though he perceived only one galley, that the noise which he heard was produced by a naval combat; and that the other ships were concealed from his view by the smoke occasioned by the guns and fireworks. This, when properly conducted, was a noble spectacle. The senate repaired thither from the cathedral, attended with a guard and a numerous company. In one carriage sat six senators, the governor of the city, and sometimes the archbishop. It was exceedingly large, and drawn by six white horses very richly harnassed. Other carriages followed, with the train who attended the governor and the senators.

Almost all festivals owe their origin to some extraordinary event, or some singular story either true or false. It is said, that when the splendor with which the feast of the *Assumption de la Bara* was celebrated at Messina, first began to attract foreigners to the city, on that occasion such crowds repaired thither as to alarm the inhabitants with the fears of a famine: But one year, when the number of strangers was greater than usual at the time of this festival, the magistrates were very much at a loss how to supply them with provisions; and at length, every other resource failing, no hopes of relief remained but from the kindness of the Blessed Virgin. Fervent prayers were addressed to their patroness: and next morning by day-break three brigantines appeared entering the harbour with full sails. They proved to be loaded with corn. It was eagerly purchased: and the people of the city hasted to appease their hunger. But when they came after

 refreshing

Messina. refreshing themselves to pay the corn merchants their money, neither ships nor merchants could be found. After their first emotions of surprise had subsided, they naturally concluded that such a seasonable supply must undoubtedly be a present from the Virgin, who, being pleased with the zeal of her Messenian votaries, and desirous to prevent the concourse of strangers who attended the festival from diminishing, had interposed in this miraculous manner to save them from the distresses of famine. A new festival was celebrated in gratitude to their generous benefactress. Three small vessels of silver were made, and dedicated to the Virgin in memory of the event; and these are at present used as lamps in the cathedral. The senate likewise decreed, that the clergy should pay annually a small tax, to be laid out in constructing a small galley to swim on the fountain, and in defraying the expences of the fireworks. The profits of the clergy are so considerable on the occasion of the festival, that they may be supposed to pay the tax with great cheerfulness.

In Messina, as in the other cities of Sicily, the women wrap themselves in a large black mantle above the rest of their dress. The stuffs are richer or plainer according to rank and circumstances. People who are not rich enough to have fine clothes of their own, hire them at so much an hour. There are women who make a livelihood by lending out their clothes. The mantle covers the wearer from head to foot.—It reduces the old and the young, the ill-shaped and the handsome, pretty much to an equality in point of appearance. This must naturally appear very unfavourable to the influence of beauty. But yet, on proper occasions, at church or in a public walk, the ladies of Messina find means to open and adjust the mantle so as to display all their beauties of face and shape, and to attract the affections of lovers, perhaps more powerfully than if their dress were suited to display their charms in a more ostentatious manner.

Between Messina and the tower of Faro there stands a small church called the *Madona of the Grotto*. It was anciently a temple of a round structure, and ornamented with columns like the temple of the sun at Rome. Modern columns now supply the place that was occupied by the ancient. There are large niches in the rock adjoining to the temple, which are thought to be of equal antiquity. These contain no sculptured figures; but in Pagan times they might possibly contain some.

Messina being situated between Mount Ætna and the gulf of Charybdis, and being likewise at no great distance from the volcanoes of Lipari and Stromboli, must have been in all ages liable to suffer by earthquakes. Such terrible events, however, appear to have been more unfrequent in ancient than in modern times, and have actually alarmed the present age oftener than any other. In the year 1693 a fourth part of the cities of Sicily was destroyed by an earthquake. Messina merely felt the shock; all its buildings, however, suffered. In the year 1742 it suffered another equally violent. A plague which followed in 1743 retarded the repairs necessary after the earthquake. In the year 1780 this city continued, for more than six months, to suffer from new earthquakes.

Were the state of the elements, previous to these dreadful events, carefully examined, it might perhaps be found to undergo certain changes which might be considered as prognosticating them. Messina.

The autumn of the year 1782 was unusually cold and rainy. Fahrenheit's thermometer was often as low as 56 degrees. The succeeding winter was dry; and the mercury never fell under 25 degrees: And, what is uncommon in that season, storms were now and then observed to arise from the west. The pilots in the channel observed that the tides no longer rose at the usual periods, and the gulf of Charybdis raged with extraordinary fury.

On the 5th of February 1783, the air was heavy and calm; the sky obscured with thick clouds, and the atmosphere seemingly all in a flame. About half after twelve at noon, the earth began to shake with a dreadful noise. The shocks continually increased, and became at length so violent as to open the ground, and to overturn in two or three minutes a considerable part of the buildings.

A long white cloud appeared to the north-west; and soon after another, very dark, in the same quarter of the heavens. The latter in a moment spread over the whole horizon, and deluged the city with rain and hail, accompanied with dreadful claps of thunder. The inhabitants fled in the utmost terror to the fields and the ships in the harbour.

From mid-day till five in the afternoon the earthquake continued almost without interruption. The shocks then became somewhat less frequent. The cries of the dying; the shrieks of those who were half buried under the ruins; the wild terror with which others, who were still able, attempted to make their escape; the despair of fathers, mothers, and husbands, bereft of those who were dearest to them; then formed altogether a scene of horror, such as can but seldom occur in the history of the calamities of the human race. Amid that awful scene, instances of the most heroic courage and the most generous affection were displayed. Mothers, regardless of their own safety, rushed into every danger to snatch their children from death. Conjugal and filial affection prompted deeds not less desperate and heroic. But no sooner did the earthquake cease, than the poor wretches who had escaped began to feel the influence of very different passions. When they returned to visit the ruins, to seek out the situation of their fallen dwellings, to inquire into the fate of their families, to procure food and collect some remains of their former fortunes—such as found their circumstances the most wretched became suddenly animated with rage, which nothing but wild despair could inspire. The distinction of ranks, and the order of society were disregarded, and property eagerly violated. Murder, rapine, and lawless robbery, reigned among the smoking ruins.

About one in the morning another shock of the earthquake was felt, which overturned most of the houses that were still standing. Most of those whom want, or avarice, or humanity, still detained among the ruins, now shared the same fate with their friends whom the former shocks had buried under them.

The succeeding day scarce alleviated the distress of this dismal night: the few wretches who still survived found themselves destitute of every necessary. At length order was in some degree re-established; and in two

two days after every perſon was ſupplied at leaſt with ſome ſmall portion of the neceſſaries for ſubſiſtence.

None yet thought of returning to take up their abode among the ruins. The common people fixed their reſidence on the plain of Porto Salvo, near the town of Salleo. The nobles, magiſtrates, and merchants, took up their abode on another plain, on the other ſide of the ſtream Porto de Legno; the ſoldiers at Terra Nuova.

Some violent ſhocks which were again felt on the 7th of February and the 28th of March completed the deſtruction of the city. The corn magazines, however, eſcaped without damage; and the public ovens and the aqueducts were but little injured. From theſe facts it may perhaps be inferred, that had not the houſes of Meſſina been, in general, haſtily built at the firſt, and afterwards careleſsly repaired, fewer of them would have been overthrown by the earthquake.

The neighbouring villages having ſuffered but little, were the firſt to relieve the remaining inhabitants of Meſſina in their diſtreſs. Malteſe gallies for ſome days ſupplied neceſſaries to the poor and the ſick with a generoſity which merits the higheſt praiſe. They brought ſurgeons and whatever was needful for the cure of the wounded. The ſupplies ſent by the king of France were refuſed, for what reaſon we know not. What money was needed for the ſupport of the people was taken from the treaſury of the city of Meſſina; for what the king of Naples ſent was ſeized and ſpent by the garriſon.

It is ſaid that not more than 800 or 900 perſons periſhed by this earthquake. The ſea during that convulſion of the land was ſlightly agitated in the harbour. Farther out the ſea was more violently agitated; but none of the ſhips in the harbour were daſhed to pieces. The waters roſe ſo high as to be injurious in a very conſiderable degree to Pharo, as well as along the coaſt of Scylia and Bagnara.

This earthquake was not of a momentary duration, like that by which Liſbon was deſtroyed, and like many others; for more than ſixty days, from the 5th of February to the beginning of April, Meſſina continued to be ſhaken, and in that time felt more than 200 ſhocks; and even after that period the alarm was again and again renewed. Not only the magiſtrates, the ſoldiers, and the people, but the prieſts likewiſe, with their tabernacle and altar, retired to the barracks. The nuns, too, deſerted their cloiſters, and ſought a retreat without the walls. Some of them confined themſelves to the gardens of their convents; others mixed indiſcriminately with the people.

The chief damage which the public buildings within the city ſuffered was the fall of the dome of the church of Purgatory. Only the walls were left ſtanding; and even theſe had ſuffered conſiderably. One half of the ſteeple of the cathedral was beaten to the ground. The magazines of Porto Franco were likewiſe very much ſhattered. The fort of St Salvator, being built on an artificial foundation, the ſide next the ſea is there fallen down; but on the other ſide, where it is founded on a rock, it has ſtood unmoved by all the ſhocks of the earthquake.

On the 5th of February, when the earthquake was more violent than at any time afterwards, a ſtrong ſmell of ſulphur was felt. The earth was affected ſomewhat in the ſame way as if it had been borne upon a fluid; and ſeemed to reel with the ſhocks much like a ſhip toſſed with the waves. This tremulous motion was felt all over Sicily; but towards Pharo it became weaker. On the following days the ſky was cloudy; the mountains of Sicily and the ſhores of Calabria continued covered with a thick fog like ſmoke. North and north-eaſt winds raged with the moſt violent impetuoſity.

The diſaſtrous year of this earthquake was ſcarce concluded, the chaſms which it had opened in the ground were ſtill yawning, and the poor inhabitants of the adjacent country ſtill trembled with terror, when the elements again renewed their fury to ravage this miſerable land.

On Tueſday the 6th of January 1784, about ſunriſe, the wind began to blow ſoftly from the northeaſt. The ſea gradually ſwelled, roſe beyond its bed with rapid impetuoſity, overflowed the quay of Meſſina, and laſhed with its billows the ruins of the Palazzata. It looſened and diſplaced many of the ſtones of the mole, ſpread over the whole ſtreet, and attacked the pedeſtals of the ſtatues which had been ſpared by the earthquake, and ſtill ſtood firm among the ruins. The ſame furious wind which ſwelled the ſea in ſo extraordinary a manner, ravaged the whole coaſt from Meſſina all the way to Syracuſe.

MESSUAGE, Messuagium, in *Law*, a dwelling-houſe, with ſome land adjoining aſſigned for its uſe. By the name of *meſſuage* may a garden, ſhop, mill, cottage, chamber, cellar, or the like, paſs.—In Scotland, *meſſuage* denotes what is called in England the *manor-houſe*, viz. the principal dwelling-houſe within any barony.

MESOPORPHYRON, a name given by the Greeks to the Roman *laticlave*; becauſe that garment, being edged on each ſide, where it opened before, with purple, appeared when cloſed with two purple ſtripes down the middle. The ſame term was alſo applied to the *anguſticlave*.

META, in the Roman circus, was a pile of ſtones of a pyramidical form, intended as a boundary of the *ſtadium*, or chariot courſe.—When the meta was paſſed the ſeventh time, the race was concluded. The greateſt art and management were required in avoiding the meta, and yet going as near it as poſſible. If they went too near, they were in the greateſt danger of breaking the chariot to pieces; and if they took too large a circuit in the turn, they gave their rivals an opportunity of getting within them, beſides loſing a great deal of ground. The boundary of the Grecian *ſtadium*, or courſe, was called τελος, τερμα, γραμμη and αργα γραμμη; to which laſt name Horace probably alludes, in calling death "*ultima linea rerum*."

The *metæ* at Rome were firſt of wood, afterwards of ſtone; but the emperor Claudius made them of gold, or rather gilded them. In the Roman circus there were two *metæ*, one at the entrance of the courſe, and the other at the end of it. An egg was placed upon the top of the *metæ*.

METACARPUS, or Metacarpium, (from μετα, *behind*, and καρπος, *hand*), in *Anatomy*, that part of the hand between the wriſt and the fingers. See Anatomy, N° 55.

METAGITNION, the ſecond month of the Athenian year, anſwering to the latter part of our July and the

the beginning of Auguſt, and ſo called from *metagitnia*, a feſtival in honour of Apollo, which was kept in it. The Bœotians called this month *panemus*, and the Syracuſans, *carnius*.

METAL, in *Natural Hiſtory*, is a ſubſtance which is diſtinguiſhed from others by its ductility, malleability, tenacity, opacity, &c. for an account of which, ſee CHEMISTRY.

METAL, in *Heraldry*. There are two metals uſed in heraldry, by way of colours, viz. gold and ſilver, in blazon called *or* and *argent*.

In the common painting of arms theſe metals are repreſented by white and yellow, which are the natural colours of thoſe metals. In engraving, gold is expreſſed by dotting the coat, &c. all over; and ſilver, by leaving it quite blank.

It is a general rule in heraldry, never to place metal upon metal, or colour upon colour: ſo that if the field be of one of the metals, the bearing muſt be of ſome colour; and if the field be of any colour, the bearing muſt be one of the metals.

METALEPSIS. See ORATORY, N° 59.

METALLISATION, is defined to be the natural proceſs by which metals are formed in the bowels of the earth.

METALLURGY, in a more general ſenſe, comprehends the whole art of working metals, from the ſtate of ore to the utenſil; and in this ſenſe, eſſaying, ſmelting, refining, parting, ſmithery, gilding, &c. are only branches of metallurgy. But in a more limited ſenſe it includes only the operations which are followed in ſeparating metals from their ores. For an account of theſe proceſſes, ſee MINERALOGY *Index;* and for the practical branches, ſee GILDING, PARTING, PURIFYING, REFINING, SMITHERY.

METAMORPHOSIS, in general, denotes the changing of ſomething into a different form; in which ſenſe it includes the transformation of inſects, as well as the mythological changes related by the ancient poets.

Mythological metamorphoſes were held to be of two kinds, apparent and real: thus, that of Jupiter into a bull, was only apparent; whereas that of Lycaon into a wolf, was ſuppoſed to be real.

Moſt of the ancient metamorphoſes include ſome allegorical meaning, relating either to phyſics or morality; ſome authors are even of opinion that a great part of the ancient philoſophy is couched under them; and Lord Bacon and Dr Hooke have attempted to unriddle ſeveral of them.

METAPHOR, in *Rhetoric*. See ORATORY, N° 54.

METAPHOR *and Allegory*, in poetry.—A metaphor differs from a ſimile, in form only, not in ſubſtance: in a ſimile the two ſubjects are kept diſtinct in the expreſſion, as well as in the thought; in a metaphor, the two ſubjects are kept diſtinct in the thought only, not in the expreſſion. A hero reſembles a lion, and upon that reſemblance many ſimilies have been raiſed by Homer and other poets. But inſtead of reſembling a lion, let us take the aid of the imagination, and feign or figure the hero to be a lion; by that variation the ſimile is converted into a metaphor; which is carried on by deſcribing all the qualities of a lion that reſemble thoſe of the hero. The fundamental pleaſure here, that of reſemblance, belongs to the thought. An additional pleaſure ariſes from the expreſſion: the poet, by figuring his hero to be a lion, goes on to deſcribe the lion in appearance, but in reality the hero; and his deſcription is peculiarly beautiful, by expreſſing the virtues and qualities of the hero in new terms, which, properly ſpeaking, belong not to him, but to the lion. This will better be underſtood by examples. A family connected with a common parent, reſembles a tree, the trunk and branches of which are connected with a common root: but let us ſuppoſe, that a family is figured, not barely to be like a tree, but to be a tree; and then the ſimile will be converted into a metaphor, in the following manner:

Edward's ſev'n ſons, whereof thyſelf art one,
Were ſev'n fair branches, ſpringing from one root;
Some of theſe branches by the deſt'nies cut:
But Thomas, my dear lord, my life, my Glo'ſter,
One flouriſhing branch of his moſt royal root,
Is hack'd down, and his ſummer leaves all faded,
By Envy's hand and Murder's bloody axe.

Richard II. act i. ſc. 3.

Figuring human life to be a voyage at ſea.

There is a tide in the affairs of men,
Which, taken at the flood, leads on to Fortune:
Omitted, all the voyage of their life
Is bound in ſhallows and in miſeries.
On ſuch a full ſea are we now afloat;
And we muſt take the current when it ſerves,
Or loſe our ventures. *Julius Cæſar*, act iv. ſc. 5.

Figuring glory and honour to be a garland of flowers:

Hoſpur.——————Wou'd to heav'n,
Thy name in arms were now as great as mine!
Pr. Henry. I'll make it greater ere I part from thee;
And all the budding honours on thy creſt
I'll crop, to make a garland for my head.

Firſt Part of Henry IV. act v. ſc. 9.

Figuring a man who hath acquired great reputation and honour to be a tree full of fruit:

——————Oh, boys, this ſtory
The world may read in me; my body's mark'd
With Roman ſwords; and my report was once
Firſt with the beſt of note. Cymbeline lov'd me;
And when a ſoldier was the theme, my name
Was not far off; then was I as a tree,
Whoſe boughs did bend with fruit. But in one night,
A ſtorm or robbery, call it what you will,
Shook down my mellow hangings, nay, my leaves;
And left me bare to wither.

Cymbeline, act iii. ſc. 3.

"Bleſt by thy ſoul, thou king of ſhells, ſaid Swaran of the dark-brown ſhield. In peace, thou art the gale of ſpring; in war, the mountain-ſtorm. Take now my hand in friendſhip, thou noble king of Morven."

Fingal.

"Thou dwelleſt in the ſoul of Malvina, ſon of mighty Oſſian. My ſighs ariſe with the beam of the eaſt: my tears deſcend with the drops of night. I was a lovely tree in thy preſence, Oſcar, with all my branches round me: but thy death came like a blaſt from the deſert, Metaphor. desert, and laid my green head low; the spring returned with its showers, but no leaf of mine arose."

Fingal.

An *allegory* differs from a metaphor; and a *figure of speech* differs from both. A metaphor is defined above to be an act of the imagination, figuring one thing to be another. An allegory requires no such operation, nor is one thing figured to be another: it consists in choosing a subject having properties or circumstances resembling those of the principal subject: and the former is described in such a manner as to represent the latter: the subject thus represented is kept out of view: we are left to discover it by reflection; and we are pleased with the discovery, because it is our own work. (See the word ALLEGORY.)

Quintilian gives the following instance of an allegory.

O navis, referent in mare te novi
Fluctus. O quid agis? fortiter occupa portum.
Horat. Lib. i. ode 14.

and explains it elegantly in the following words: "Totusque ille Horatii locus, quo navim pro republica, fluctuum tempestates pro bellis civilibus, portum pro pace atque concordia, dicit."

In a *figure of speech*, there is no fiction of the imagination employed, as in a metaphor; nor a representative subject introduced, as in an allegory. This figure, as its name implies, regards the expression only, not the thought; and it may be defined, the using a word in a sense different from what is proper to it.—Thus youth, or the beginning of life, is expressed figuratively by *morning of life:* morning is the beginning of the day; and in that view it is employed to signify the beginning of any other series, life especially, the progress of which is reckoned by days. See FIGURE *of Speech.*

Metaphor and *allegory* are so much connected, that it seemed proper to handle them together: the rules particularly for distinguishing the good from the bad, are common to both. We shall therefore proceed to these rules, after adding some examples to illustrate the nature of an *allegory*, which, with a view to this article, was but slightly illustrated under its proper name.

Horace, speaking of his love to Pyrrha, which was now extinguished, expressed himself thus:

———————Me tabulâ facer
Votivâ paries indicat uvida
Suspendisse potenti
Vestimenta maris Deo. *Carm.* lib. i. ode 5.

Again:
Phœbus volentem prælia me loqui,
Victas et urbes, increpuit, lyra
Ne parva Tyrrhenum per æquor
Vela darem. *Carm.* lib. iv. ode 15.

Queen. Great lords, wise men ne'er sit and wail their loss,
But cheerly seek how to redress their harms.
What though the mast be now blown overboard,
The cable broke, the holding anchor lost,
And half our sailors swallowed in the flood!
Yet lives our pilot still. Is't meet that he
Should leave the helm, and, like a fearful lad,
With tearful eyes add water to the sea,
And give more strength to that which hath too much;
While in his moan the ship splits on the rock,
Which industry and courage might have sav'd?
Ah, what a shame! ah, what a fault were this!
Third Part of Henry VI. act v. sc. 5.

Metaphor.

Oroonoko. Ha! thou hast rous'd
The lion in his den; he stalks abroad,
And the wide forest trembles at his roar.
I find the danger now. *Oroonok*, act iii. sc. 2.

"My well beloved hath a vineyard in a very fruitful hill. He fenced it, gathered out the stones thereof, planted it with the choicest vine, built a tower in the midst of it, and also made a wine press therein; he looked that it should bring forth grapes, and it brought forth wild grapes. And now, O inhabitants of Jerusalem, and men of Judah, judge, I pray you, betwixt me and my vineyard. What could have been done more to my vineyard, that I have not done? Wherefore, when I looked that it should bring forth grapes, brought it forth wild grapes? And now go to, I will tell you what I will do to my vineyard: I will take away the hedge thereof, and it shall be eaten up; and break down the wall thereof, and it shall be trodden down. And I will lay it waste: it shall not be pruned, nor digged, but there shall come up briars and thorns: I will also command the clouds that they rain no rain upon it. For the vineyard of the Lord of hosts is the house of Israel, and the men of Judah his pleasant plant." *Isaiah* v. 1.

The rules that govern metaphors and allegories are of two kinds. The construction of these figures comes under the first kind: the propriety or impropriety of introduction comes under the other.—To begin with rules of the first kind; some of which coincide with those already given for similies; some are peculiar to metaphors and allegories.

In the first place, It has been observed, that a simile cannot be agreeable where the resemblance is either too strong or too faint. This holds equally in metaphor and allegory; and the reason is the same in all. In the following instances, the resemblance is too faint to be agreeable.

Malcolm. ———But there's no bottom, none,
In my voluptuousness: your wives, your daughters,
Your matrons, and your maids, could not fill up
The cistern of my lust. *Macbeth*, act iv. sc. 4.

The best way to judge of this metaphor, is to convert it into a simile: which would be bad, because there is scarce any resemblance between lust and a cistern, or betwixt enormous lust and a large cistern.

Again:

He cannot buckle his distemper'd cause
Within the belt of rule. *Macbeth*, act v. sc. 2.

There is no resemblance between a distempered cause and any body that can be confined within a belt.

Again:

Steep me in poverty to the very lips.
Othello, act iv. sc. 9.

Poverty

Metaphor

Poverty here muſt be conceived a fluid, which it reſembles not in any manner.

Speaking to Bolingbroke baniſh'd for ſix years:

The ſullen paſſage of thy weary ſteps,
Eſteem a ſoil, wherein thou art to ſet
The precious jewel of thy home-return.
Richard II. act ii. ſc. 6.

Again:

Here is a letter, lady,
And every word in it a gaping wound
Iſſuing life-blood.
Merchant of Venice, act iii. ſc. 3.

Tantæ *molis* erat Romanam condere gentem.
Æneid. i. 37.

The following metaphor is ſtrained beyond all endurance: Timur-bec, known to us by the name of *Tamerlane the Great*, writes to Bajazet emperor of the Ottomans in the following terms:

"Where is the monarch who dares reſiſt us? where is the potentate who doth not glory in being numbered among our attendants? As for thee, deſcended from a Turcoman ſailor, ſince the veſſel of thy unbounded ambition hath been wreck'd in the gulf of thy ſelf-love, it would be proper, that thou ſhouldſt take in the ſails of thy temerity, and caſt the anchor of repentance in the port of ſincerity and juſtice, which is the port of ſafety; leſt the tempeſt of our vengeance make thee periſh in the ſea of the puniſhment thou deſerveſt."

Such ſtrained figures, as obſerved above, are not unfrequent in the firſt dawn of refinement; the mind in a new enjoyment knows no bounds, and is generally carried to exceſs, till taſte and experience diſcover the proper limits.

Secondly, Whatever reſemblance ſubjects may have, it is wrong to put one for another, where they bear no mutual proportion. Upon comparing a very high to a very low ſubject, the ſimile takes on an air of burleſque: and the ſame will be the effect where the one is imagined to be the other, as in a metaphor; or made to repreſent the other, as in an allegory.

Thirdly, Theſe figures, a metaphor eſpecially, ought not to be crowded with many minute circumſtances; for in that caſe it is ſcarcely poſſible to avoid obſcurity. A metaphor above all ought to be ſhort: it is difficult, for any time, to ſupport a lively image of a thing being what we know it is not; and for that reaſon, a metaphor drawn out to any length, inſtead of illuſtrating or enlivening the principal ſubject, becomes diſagreeable by overſtraining the mind. Here Cowley is extremely licentious. Take the following inſtance.

Great and wiſe conqu'ror, who where'er
Thou com'ſt, doſt fortify, and ſettle there!
Who canſt defend as well as get;
And never hadſt one quarter beat up yet;
Now thou art in, thou ne'er will part
With one inch of my vanquiſh'd heart;
For ſince thou took'ſt it by aſſault from me
'Tis garriſon's ſo ſtrong with thoughts of thee,
It fears no beauteous enemy.

I

For the ſame reaſon, however agreeable long allegories may at firſt be by their novelty, they never afford any laſting pleaſure: witneſs the *Faëry Queen*, which with great power of expreſſion, variety of images, and melody of verſification, is ſcarce ever read a ſecond time.

In the fourth place, The compariſon carried on in a ſimile, being in a metaphor ſunk by imagining the principal ſubject to be that very thing which it only reſembles; an opportunity is furniſhed to deſcribe it in terms taken ſtrictly or literally with reſpect to its imagined nature. This ſuggeſts another rule, That in conſtructing a metaphor, the writer ought to make uſe of ſuch words only as are applicable literally to the imagined nature of his ſubject: figurative words ought carefully to be avoided; for ſuch complicated figures, inſtead of ſetting the principal ſubject in a ſtrong light, involve it in a cloud, and it is well if the reader, without rejecting by the lump, endeavour patiently to gather the plain meaning, regardleſs of the figures:

A ſtubborn and unconquerable flame
Creeps in his veins, and drinks the ſtreams of life.
Lady Jane Gray, act i. ſc. 1.

Copied from Ovid:

Sorbent avidæ præcordia flammæ.
Metamorph. lib. ix. 172.

Let us analyze this expreſſion. That a fever may be imagined a flame, we admit: though more than one ſtep is neceſſary to come at the reſemblance: a fever, by heating the body, reſembles fire; and it is no ſtretch to imagine a fever to be a fire: again, by a figure of ſpeech, flame may be put for fire, becauſe they are commonly conjoined; and therefore a fever may be termed a *flame*. But now admitting a fever to be a flame, its effects ought to be explained in words that agree literally to a flame. This rule is not obſerved here; for a flame drinks figuratively only, not properly.

King Henry to his ſon Prince Henry:

Thou hid'ſt a thouſand daggers in thy thoughts,
Which thou haſt whetted on thy ſtony heart
To ſtab at half an hour of my frail life.
Second Part Henry IV. act iv. ſc. 11.

Such faulty metaphors are pleaſantly ridiculed in the *Rehearſal*:

"*Phyſician.* Sir, to conclude, the place you fill has more than amply exacted the talents of a wary pilot; and all theſe threatening ſtorms, which, like impregnate clouds, hover o'er our heads, will, when they once are graſp'd but by the eye of reaſon, melt into fruitful ſhowers of bleſſings on the people.

"*Bayes.* Pray mark that allegory. Is not that good.

"*Johnſon.* Yes, that graſping of a ſtorm with the eye is admirable." Act ii. ſc. 1.

Fifthly, The jumbling different metaphors in the ſame ſentence, beginning with one metaphor and ending with another, commonly called a *mixt metaphor*, ought never to be indulged.

K. Henry.

K. Henry. ———Will you again unknit
This churlish knot of all-abhorred war,
And move in that obedient orb again,
Where you did give a fair and natural light?
First Part Henry VI. act v. sc. 1.

Whether 'tis nobler in the mind, to suffer
The stings and arrows of outrageous fortune;
Or to take arms against a sea of troubles,
And by opposing end them.
Hamlet, act iii. sc. 2.

In the sixth place, It is unpleasant to join different metaphors in the same period, even where they are preserved distinct: for when the subject is imagined to be first one thing and then another in the same period without interval, the mind is distracted by the rapid transition; and when the imagination is put on such hard duty, its images are too faint to produce any good effect:

At regina gravi jamdudum saucia cura,
Vulnus alit venis, et cæco carpitur igni.
Æneid. iv. 1.

————Est mollis flamma medullas
Interea, et tacitum vivit sub pectore vulnus.
Æneid. iv. 66.

Motum ex Metello consule civicum,
Bellique causas, et vitia, et modos,
Ludumque fortunæ, gravesque
Principum amicitias, et arma
Nondum expiatis uncta cruoribus,
Periculosæ plenum opus aleæ,
Tractas, et incedis per ignes
Subpositos cineri doloso.
Horat. Carm. lib. ii. ode 1.

Rebus angustis animosus atque
Fortis adpare: sapienter idem
Contrahes vento nimium secundo
Turgida vela. *Hor. Carm.* lib. ii. ode 10.

In the last place, It is still worse to jumble together metaphorical and natural expression, so as that the period must be understood in part metaphorically, in part literally; for the imagination cannot follow with sufficient ease changes so sudden and unprepared: a metaphor begun and not carried on, hath no beauty; and instead of light, there is nothing but obscurity and confusion. Instances of such incorrect composition are without number: we shall, for a specimen, select a few from different authors. Speaking of Britain,

——This precious stone set in the sea,
Which serves it in the office of a wall,
Or as a moat defensive to a house,
Against the envy of less happier lands.
Richard II. act ii. sc. 1.

In the first line Britain is figured to be a precious stone: in the following line, Britain, divested of her metaphorical dress, is presented to the reader in her natural appearance.

These growing feathers pluck'd from Cæsar's wing,
Will make him fly an ordinary pitch,
Who else would soar above the view of men,
And keep us all in servile fearfulness.
Julius Cæsar, act i. sc. 1.

The following is a miserable jumble of expressions, arising from an unsteady view of the subject, between its figurative and natural appearance:

But now from gath'ring clouds destruction pours,
Which ruins with mad rage our halcyon hours:
Mists from black jealousies the tempest form,
Whilst late divisions reinforce the storm.
Dispensary, canto iii.

To thee the world its present homage pays,
The harvest early, but mature the praise.
Pope's Imitation of Horace, book ii.

Oui, sa pudeur ne'st que franche grimace,
Qu'une ombre de vertu qui garde mal la place,
Et qui s'evanouit, comme l'on peut savoir,
Aux rayons du soleil qu'une bourse vait voir.
Moliere, L'Etourdi, act iii. sc. 2.

Et son feu, de pourvû de sense et de lecture,
S'éteint à chaque pas, faut de nourriture.
Boileau, L'Art Poetique, chant. iii. l. 319.

Dryden, in his dedication of the translation of *Juvenal*, says, "When thus, as I may say, before the use of the loadstone, or knowledge of the compass, I was sailing in a vast ocean, without other help than the pole-star of the ancients, and the rules of the French stage among the moderns," &c.

"There is a time when factions, by the vehemence of their own fermentation, stun and disable one another." *Bolingbroke.*

This fault of jumbling the figure and plain expression into one confused mass, is not less common in allegory than in metaphor.

Take the following examples:

————Heu! quoties fidem,
Mutatosque Deos flebit, et aspera
Nigris æquora ventis
Emirabitur insolens,
Qui nunc te fruitur credulus aureâ:
Qui semper vacuam, semper amabilem
Sperat, nescius auræ
Fallacis. *Horat. Carm.* lib. i. ode 5.

Pour moi sur cette mer, qu'ici bas nous courons,
Je songe à me pourvoir d'esquif et d'avirons,
A regler mes desires, à prévenir l'orage,
Et sauver, s'il se peut, ma Raison du naufrage.
Boileau, epitre 5.

Lord Halifax, speaking of the ancient fabulists: "They (says he) wrote in signs, and spoke in parables: all their fables carry a double meaning: the story is one, and entire; the characters the same throughout; not broken or changed, and always conformable to the nature of the creature they introduce. They never tell you, that the dog which snapped at a shadow, lost his troop of horse; that would be unintelligible. This is his

Metaphor. his (Dryden's new way of telling a ſtory, and confounding the moral and the fable together." After inſtancing from the Hind and Panther, he goes on thus: "What relation has the hind to our Saviour? or what notion have we of a panther's bible? If you ſay he means the church, how does the church feed on lawns, or range in the foreſt? Let it be always a church, or always a cloven-footed beaſt; for we cannot bear his ſhifting the ſcene every line."

A few words more upon allegory. Nothing gives greater pleaſure than this figure, when the repreſentative ſubject bears a ſtrong analogy, in all its circumſtances, to that which is repreſented: but the choice is ſeldom ſo lucky; the analogy being generally ſo faint and obſcure, as to puzzle and not pleaſe. An allegory is ſtill more difficult in painting than in poetry: the former can ſhow no reſemblance but what appears to the eye; the latter hath many other reſources for ſhowing the reſemblance. And therefore, with reſpect to what the abbé du Bos terms *mixt allegorical compoſitions*, theſe may do in poetry; becauſe, in writing, the allegory can eaſily be diſtinguiſhed from the hiſtorical part: no perſon, for example, miſtakes Virgil's Fame for a real being. But ſuch a mixture in a picture is intolerable; becauſe in a picture the objects muſt appear all of the ſame kind, wholly real or wholly emblematical. For this reaſon, the hiſtory of Mary de Medicis, in the palace of Luxembourg, painted by Rubens, is unpleaſant by a perpetual jumble of real and allegorical perſonages, which produce a diſcordance of parts, and an obſcurity upon the whole: witneſs, in particular, the tablature repreſenting the arrival of Mary de Medicis at Marſeilles; where, together with the real perſonages, the Nereids and Tritons appear ſounding their ſhells: ſuch a mixture of fiction and reality in the ſame group is ſtrangely abſurd. The picture of Alexander and Roxana, deſcribed by Lucian, is gay and fanciful; but it ſuffers by the allegorical figures. It is not in the wit of man to invent an allegorical repreſentation deviating farther from any ſhadow of reſemblance, than one exhibited by Louis XIV. anno 1664; in which an enormous chariot, intended to repreſent that of the ſun, is dragged along, ſurrounded with men and women, repreſenting the four ages of the world, the celeſtial ſigns, the ſeaſons, the hours, &c. a monſtrous compoſition, and yet ſcarcely more abſurd than Guido's tablature of Aurora.

In an allegory, as well as in a metaphor, terms ought to be choſen that properly and literally are applicable to the repreſentative ſubject: nor ought any circumſtance to be added that is not proper to the repreſentative ſubject, however juſtly it may be applicable properly or figuratively to the principal. The following allegory is therefore faulty:

> Ferus et Cupido,
> Semper ardentes acuens ſagittas.
> Cote *cruentâ*. *Horat.* lib. ii. ode 8.

For though blood may ſuggeſt the cruelty of love, it is an improper or immaterial circumſtance in the repreſentative ſubject: water, not blood, is proper for a whetſtone.

We proceed to the next head, which is, to examine in what circumſtances theſe figures are proper, in what improper. This inquiry is not altogether ſuperſeded by what is ſaid upon the ſame ſubject in the article COMPARISON; becauſe, upon trial, it will be found, that a ſhort metaphor or allegory may be proper, where a ſimile, drawn out to a greater length, and in its nature more ſolemn, would ſcarcely be reliſhed. Metaphor.

And, in the firſt place, A metaphor, like a ſimile, is excluded from common converſation, and from the deſcription of ordinary incidents. Secondly, In expreſſing any ſevere paſſion that totally occupies the mind, metaphor is unnatural.

The following example, of deep deſpair, beſide the highly figurative ſtyle, has more the air of raving than of ſenſe:

> *Caliſta.* Is it the voice of thunder, or my father?
> Madneſs! confuſion! let the ſtorm come on,
> Let the tumultuous roar drive all upon me,
> Daſh my devoted bark; ye ſurges, break it;
> 'Tis for my ruin that the tempeſt riſes.
> When I am loſt, ſunk to the bottom low,
> Peace ſhall return, and all be calm again.
> *Fair Penitent*, act v.

The following metaphor is ſweet and lively; but it ſuits not the fiery temper of Chamont, inflamed with paſſion: parables are not the language of wrath venting itſelf without reſtraint:

> *Chamont.* You took her up a little tender flow'r,
> Juſt ſprouted on a bank, which the next froſt
> Had nipp'd; and with a careful loving hand,
> Tranſplanted her into your own fair garden,
> Where the ſun always ſhines: there long ſhe flouriſh'd,
> Grew ſweet to ſenſe, and lovely to the eye;
> Till at the laſt a cruel ſpoiler came,
> Cropt this fair roſe, and rifled all its ſweetneſs,
> Then caſt it like a loathſome weed away.
> *Orphan*, act iv.

The following ſpeech, full of imagery, is not natural in grief and dejection of mind.

> *Gonſalez.* O my ſon! from the blind dotage
> Of a father's fondneſs theſe ills aroſe.
> For thee I've been ambitious, baſe, and bloody:
> For thee I've plung'd into this ſea of ſin;
> Stemming the tide with only one weak hand,
> While t'other bore the crown (to wreathe thy brow),
> Whoſe weight has ſunk me ere I reach'd the ſhore.
> *Mourning Bride*, act v. ſc. 6.

There is an enchanting picture of deep diſtreſs in Macbeth, where Macduff is repreſented lamenting his wife and children, inhumanly murdered by the tyrant. Stung to the heart with the news, he queſtions the meſſenger over and over: not that he doubted the fact, but that his heart revolted againſt ſo cruel a misfortune. After ſtruggling ſome time with his grief, he turns from his wife and children to their ſavage butcher: and then gives vent to his reſentment, but ſtill with manlineſs and dignity:

> O, I could play the woman with mine eyes,
> And braggart with my tongue. But, gentle Heav'n!
> Cut ſhort all intermiſſion; front to front
> Bring thou this fiend of Scotland and myſelf;

Within

Metaphor.

Within my ſword's length ſet him. If he 'ſcape,
Then Heav'n forgive him too.

Metaphorical expreſſion, indeed, may ſometimes be uſed with grace where a regular ſimile would be intolerable: but there are ſituations ſo ſevere and diſpiriting, as not to admit even the ſlighteſt metaphor. It requires great delicacy of taſte to determine with firmneſs, whether the preſent caſe be of that nature: perhaps it is; yet who could wiſh a ſingle word of this admirable ſcene altered?

But metaphorical language is proper when a man ſtruggles to bear with dignity or decency a misfortune however great; the ſtruggle agitates and animates the mind:

Wolſey. Farewell, a long farewell to all my greatneſs;
This is the ſtate of man: to day he puts forth
The tender leaves of hope; to-morrow bloſſoms,
And bears his bluſhing honours thick upon him;
The third day comes a froſt, a killing froſt,
And when he thinks, good eaſy man, full ſurely
His greatneſs is a-ripening, nips his root,
And then he falls as I do. *Henry VIII.* act iii. ſc. 6.

METAPHRAST, a tranſlator, or perſon who renders an author into another form or another language, word for word.

METAPHYSICS.

1 Definition.

METAPHYSICS has been defined, by a writer deeply read in the ancient philoſophy, "The ſcience of the principles and cauſes of all things exiſting." This definition, we think, extremely proper: and hence it is, that *mind* or intelligence, and eſpecially the *ſupreme intelligence*, which is the cauſe of the univerſe, and of every thing which it contains, is the principal ſubject of this ſcience; and hence, too, the ſcience itſelf received its name. Ariſtotle, indeed, who, of all the ancient metaphyſicians whoſe works have come down to us, was unqueſtionably the greateſt, calls this ſcience THE FIRST PHILOSOPHY, as being not only ſuperior, but alſo prior in the order of nature, to the whole circle of the other arts and ſciences. But, "what is firſt to nature, is not firſt to man." Nature begins with *cauſes*, which produce *effects*. Man begins with *effects*, and by them aſcends to *cauſes*. Thus all human ſtudy and inveſtigation proceed of neceſſity in the reverſe of the natural order of things, from *ſenſible* to *intelligible*, from *body* the effect, to *mind*, which is both the firſt and the final cauſe. Now, PHYSICS being the name given by the Stagyrite to the philoſophy of body, ſome of his interpreters, from this neceſſary courſe of human ſtudies, called that of mind METAPHYSICS, implying by that term, not only that its ſubject is more ſublime and difficult, but alſo that the ſtudy of it would be moſt properly and ſucceſsfully entered upon AFTER THAT OF PHYSICS. To this name, which, though it has ſometimes been treated with ridicule, is abundantly ſignificant, the followers of Ariſtotle were led by their maſter, who, to the books in which he pretends to elevate the mind above things corporeal to the contemplation of God and things ſpiritual, prefixed the Greek words μετα τα φυσικα (A).

2 Diviſion of the ſcience into

The ſcience of Metaphyſics has been divided, according to the objects which it conſiders, into ſix principal parts, which are called, 1. *Ontology*; 2. *Coſmology*; 3. *Anthropoſophy*; 4. *Pſychology*; 5. *Pneumatology*; and, 6. *Metaphyſical theology*.

3 Ontology;

1. That part of the ſcience which is named *ontology*, inveſtigates and explains the nature and eſſence of all beings, as well as the qualities and attributes that eſſentially appertain to them. Hence it has been ſaid that ontology ſhould proceed in its operations from the moſt ſimple ideas; ſuch as do not admit of any other qualities of which they may be compounded. Theſe ſimple ideas are of *being*, of *eſſence*, of *ſubſtance*, of *mode*, of *exiſtence* as well with regard to time as place, of a *neceſſary cauſe* of *unity*; the idea of *negation*; the difference between a *being* that is *ſimple* or *compound*, *neceſſary* or *accidental*, *finite* or *infinite*; the ideas of *eſſential* and *abſtract properties*, ſuch as of the *greatneſs*, *perfection*, and *goodneſs* of *beings*, &c. The buſineſs therefore of ontology, is to make us acquainted with every kind of being in its nature and eſſential qualities, which diſtinguiſh it from all other beings. This knowledge being once eſtabliſhed on ſimple principles, juſt conſequences may thence be drawn, and thoſe things proved after which the metaphyſician inquires, and which is the buſineſs of his ſcience to prove.

It is eaſy to conceive, that even a clear knowledge of beings, and their eſſential properties, would be ſtill defective and uſeleſs to man, if he did not know how to determine and fix his ideas by proper denominations, and conſequently to communicate his perceptions to thoſe whom he would inſtruct, or againſt whom he is obliged to diſpute. To render our ideas therefore intelligible to others, we muſt have determinate words or denominations for each being, and the qualities of each being; and ontology teaches us thoſe terms which are ſo neceſſary to fix our ideas, and to give them the requiſite perſpicuity and preciſion, that when we endeavour to extend the ſphere of

(A) ΤΩΝ ΜΕΤΑ ΤΑ ΦΥΣΙΚΑ. Cujus inſcriptionis hæc ratio eſt, quod in hoc opere ea tractantur quorum theoria poſterior eſt doctrinæ naturali ſaltem quoad nos, qui à corporum cognitione rerumque caducarum in ſubſtantiarum immaterialium atque immortalium contemplationem provehimur.

Du Val. Synopſ. Doctr. Peripat.

Diviſions of the Science. of our knowledge, we may not waſte our time in diſputes about words.

4 Coſmology; 2. Metaphyſics, having, in as ſolid a manner as poſſible, explained and eſtabliſhed the principles above mentioned, continues its inquiries to the ſecond part, which is called *coſmology*, and examines into the eſſence of the world and all that it contains; its eternal laws; of the nature of matter; of motion; of the nature of tangible bodies, their attributes and adjuncts; and of all that can be known by reaſoning and experience. It is alſo in coſmology that the metaphyſicians of this ſchool examine the Leibnitzian ſyſtem; that is, whether God, in creating the world, muſt neceſſarily have created the beſt world; and if this world be ſo in fact. In this manner they purſue the argument, from conſequence to conſequence, to its laſt reſort, frequently with very little advantage to truth and ſcience.

5 Anthropoſophy; 3. *Anthropoſophy*, or the knowledge of man, forms the third branch of metaphyſics. It is ſubdivided into two parts. The firſt, which conſiſts in the knowledge of the exterior parts of the human frame, belongs not to this ſcience, but to Anatomy and Phyſiology. The buſineſs of the metaphyſician is here to aſcertain the nature of thoſe powers by which all the motions eſſential to life are produced; and to diſcover, if poſſible, whether they be corporeal or ſpiritual. This inquiry leads at the ſame time to

6 Pſychology; 4. *Pſychology;* which conſiſts in the knowledge of the intellectual ſoul in particular; concerning which the moſt profound, the moſt ſubtle, and moſt abſtract reſearches, have been made that human reaſon is capable of: and concerning the ſubſtance of which, in ſpite of all theſe efforts, it is yet extremely difficult to ſupport any poſitive opinion with concluſive or probable arguments.

7 Pneumatology; 5. The fifth part of metaphyſics is called *pneumatology*. By this term, which has not been long in uſe, metaphyſicians mean the knowledge of all ſpirits, *angels*, &c. It is eaſy to conceive what infinite art is neceſſary to give an account of that, of which nothing poſitive can ever be known in the preſent ſtate of human exiſtence. But the metaphyſician of this ſchool readily offers to ſhow us, "what is the idea of a ſpirit; the effective exiſtence of a ſpirit; what are its general qualities and properties; that there are rational ſpirits, and that theſe rational ſpirits have qualities that are founded in the moral attributes of God:" for this is in ſo many words what is attempted to be taught in pneumatology.

8 Metaphyſical theology. 6. *Metaphyſical theology*, which Leibnitz and ſome others call *theodicy*, is the ſixth and laſt branch of the ſcience of metaphyſics. It teaches us the knowledge of the exiſtence of God; to make the moſt rational ſuppoſitions concerning his divine eſſence, and to form a juſt idea of his attributes and perfections, and to demonſtrate them by abſtract reaſoning. Theodicy differs from natural theology, in as much as this laſt borrows, in fact, from theodicy proofs and demonſtrations to confirm the exiſtence of a ſupreme Being: but after having ſolidly eſtabliſhed that great truth, by extending its conſequences natural theology teaches us what are the relations and connexions that ſubſiſt between the ſupreme Being and men, and what are the duties which reſult from theſe relations.

We have briefly mentioned theſe diviſions of the ſcience, becauſe they were once prevalent in the ſchools. The greater part of them, however, appears to us to be not only ſuperfluous, but ſuch as can ſerve no other purpoſe than to perplex the mind. The only beings of which we know any thing are mind and body; and we have no reaſon to think that there are any other beings in the univerſe. Of bodies indeed there are various kinds, endowed with different properties: and it is extremely probable, that of minds endowed with different powers, the variety may be equally great. Our own minds we know to be united in one ſyſtem with bodies by which they perform all their operations; and we can demonſtrate that there is another Mind, which is independent of all body, and is the cauſe of all things. Between theſe there may be numberleſs orders of minds; but their energies are wholly unknown to us, and therefore they can never become the objects of ſcience. Diviſions of the Science. 9 This diviſion uſeleſs and improper.

Mind and body therefore, *i. e.* the minds and bodies which we know to exiſt, together with their powers and properties, eſſential and accidental, can alone be the ſubjects of rational inquiry. We may inquire into the eſſence of mind and the eſſence of body, and endeavour to aſcertain in what reſpects they differ. We may examine the nature of different bodies, in order to diſcover whether all bodies, however modified, have not ſomething in common; and we may conſider the properties, relations, and adjuncts of bodies, and endeavour to diſtinguiſh thoſe which are accidental from ſuch as appear to be ſo neceſſary that without them body itſelf could not exiſt. Of minds we cannot make the ſame compariſon. In this part of the ſcience we have not ſufficient data for an accurate and complete induction: we can only examine the powers of our own mind; and by probable analogy make ſome eſtimate of the powers of ſuperior minds, as obſervation will help us to gueſs at the powers of thoſe which are placed beneath us in the ſcale of exiſtence.

If this be ſo, Coſmology, as diſtinguiſhed from Ontology, cannot properly be a branch of Metaphyſics. For if mind and body, with their ſeveral powers, properties, and adjuncts, compoſe the univerſe, it is obvious, that when we have aſcertained, as well as we are able, the eſſence of mind and the eſſence of body, together with the powers and properties of each, and have traced them all to the firſt cauſe, we have done every thing in the ſcience of the univerſe, if we may uſe the expreſſion, which belongs to the province of the metaphyſician. The particular laws of motion on the earth and in the planetary ſyſtem belong to the natural philoſopher and aſtronomer.

In like manner, Anthropoſophy, Pſychology, Pneumatology, if they be not words expreſſive of diſtinctions where there is no difference, ſeem to be at leaſt very needleſsly disjoined from each other. Of the nature of ſpirits we can know nothing but from contemplating the powers of our own minds; and the body of man is in the province, not of the metaphyſician, but of the anatomiſt and phyſiologiſt. Anthropoſophy, pſychology, aud pneumatology, if they be uſed to denote our knowledge of all minds except the Supreme, are words of the ſame import; for of no created minds except our own can we acquire ſuch knowledge as deſerves the name of ſcience.

Ontology

Diviſions of the Science.

Ontology has ſometimes been defined the ſcience of *being in the abſtract;* but in the courſe of our inquiries it will be ſeen, that *being in the abſtract* is a phraſe without meaning. Conſidered as the ſcience of *real beings* and their *properties*, Ontology is a very ſignificant word, of the ſame import with Metaphyſics, comprehending in itſelf the knowledge of the nature of all things exiſting. Or if it be thought proper to make a diſtinction between ontology and theology, the former branch of the ſcience will teach the knowledge of body and created minds, whilſt it is the province of the latter to demonſtrate the exiſtence and attributes of that mind which is uncreated.

10 Another propoſed.

Body and mind, therefore, with their properties, adjuncts, and powers, comprehend the whole ſubject of the ſcience of metaphyſics: and as we are earlier acquainted with body than with mind, the natural order of conducting our inquiries ſeems to be, to begin with the former, and thence proceed to the latter. It is obvious, however that if we would purſue theſe inquiries with any hopes of ſucceſs, we muſt firſt trace human knowledge from its ſource, aſcertain the nature of truth, and ſhow what kind of evidence on each topic to be treated ought to enforce conviction. In this view of the ſcience, metaphyſics appears to be divided into three parts; the firſt treating *of human underſtanding;* the ſecond, *of body with its adjuncts;* and the third, *of mind with its powers.*

11 Idea and notion explained.

Previous to the entering upon ſuch inquiries, ſome philoſophers of great merit have thought it expedient to explain the terms which they might have occaſion to uſe. Their conduct is judicious and worthy of imitation; for the objects of metaphyſics being, for the moſt part, ſuch as fall not under the cognizance of the ſenſes, are liable to be differently apprehended by different men, if the meanings of the words by which they are expreſſed be not aſcertained with the utmoſt preciſion. We intend, however, to uſe very few words but in the common acceptation; and we therefore hope, that as terms of ſcience are explained under different words in the Dictionary, to which references are made, we have little or no occaſion for ſwelling the article by previous definitions. There are indeed two words which have given riſe to much uſeleſs diſputation, which yet cannot be baniſhed from ſpeculative philoſophy, and which it will therefore be proper here to define. The words to which we allude are *idea* and *notion.* These are very generally conſidered as ſynonymous; but we think that much logomachy might have been avoided by aſſigning to each a determinate ſignification. We know not any philoſopher who made much uſe of the word *idea* before Plato; but with his myſterious doctrine concerning ideas we have here nothing to do: our preſent buſineſs is to aſcertain the preciſe meaning of the word, which is evidently derived from ειδω to *ſee*, as the word *notion* is from "noſco, novi, *notum*," and that from γινωσκω to *know* or *underſtand.* In the original ſenſe of the two words, therefore, *notion* is more comprehenſive than *idea*, becauſe we *know* many things which cannot be *ſeen.* We have not a doubt, but that at firſt the word *idea* was employed to denote only thoſe forms of external objects which men contemplate in their imaginations, and which are originally received through the ſenſe of *ſight.* Its ſignification was afterwards extended to the relicts of every ſenſation, of touch, taſte, ſound, and ſmell, as well as of ſight; and at laſt it was confounded with *notion*, which denotes the mental apprehenſion of whatever may be known. In our uſe of the word *idea*, except when we quote from others, we ſhall employ it only to denote that appearance which abſent objects of ſenſe make in the memory or imagination (B); and by the word *notion* we ſhall denote our apprehenſion or knowledge of ſpirits, and all ſuch things as, though they be the objects of ſcience, cannot be perceived by the external ſenſes. Having ſaid this, we proceed to our inquiries, beginning with that into human underſtanding.

PART I. OF HUMAN UNDERSTANDING.

Preliminary Obſervations on the ORIGIN *of our* IDEAS *and* NOTIONS.

12 No innate ideas or notions in the human mind.

THAT the mind of man has no innate ideas or notions, but comes into the world ignorant of every thing, is a truth which ſince the days of Locke has been very little diſputed. In the firſt book of his Eſſay on the Human Underſtanding, that acute philoſopher has demonſtrated, that the rudiments or firſt principles of all our knowledge are communicated to us by ſenſation; and he has compared the mind, previous to the operation of external objects upon the ſenſes, to a *tabula raſa* or ſheet of white paper. To repeat his arguments would ſwell the article to no purpoſe. There is not a man capable of attending to his own ideas, who

(B) In thus reſtricting the meaning of the word *idea*, we have the honour to agree with the great Engliſh Lexicographer.—" He was particularly indignant againſt the almoſt univerſal uſe of the word *idea* in the ſenſe of *notion* or *opinion*, when it is clear that *idea* can only ſignify ſomething of which an image may be formed in the mind. We may have an *idea* or *image* of a mountain, a tree, or a building; but we cannot ſurely have an *idea* or *image* of an *argument* or *propoſition.* Yet we hear the ſages of the law delivering their *ideas* upon the queſtion under conſideration; and the firſt ſpeakers in Parliament entirely coinciding in the *idea*, which has been ſo ably ſtated by an honourable member; or repreſenting an *idea* as unconſtitutional, and fraught with the moſt dangerous conſequences to a great and free country. This Johnſon called *modern cant.*" *Boſwell's Life of Johnſon.*

Origin of Ideas and Notions.

who can entertain a doubt in what manner he received them. Without the ſenſe of ſight, we could never have known colours; nor ſound, without hearing; nor hardneſs, ſoftneſs, ſmoothneſs, pain, or bodily pleaſure, without touch; nor odours, without ſmell, &c.

Self-evident as theſe facts are, objections have been ſtarted to the inferences drawn from them; and Locke has been accuſed of advancing principles ſubverſive of all diſtinction between truth and falſehood, and favourable of courſe to univerſal ſcepticiſm.—"The firſt book of his Eſſay, which with ſubmiſſion (ſays Dr Beattie*) I think the worſt, tends to eſtabliſh this dangerous doctrine, that the human mind, previous to education and habit, is as ſuſceptible of one impreſſion as of another: a doctrine which, if true, would go near to prove that truth and virtue are no better than human contrivances; or at leaſt that they have nothing permanent in their nature, but may be as changeable as the inclinations and capacities of men; and that there is no ſuch thing as common ſenſe in the world. Surely this is not the doctrine which Mr Locke meant to eſtabliſh." We are ſo thoroughly ſatisfied that it is not, that we cannot help wondering how ſuch inferences could, by a man of learning, genius, and candour, be drawn from any thing which is to be found in the Eſſay on the Human Underſtanding.

* *Eſſay on the Nature and Immutability of Truth.*

But the Doctor thinks Mr Locke's "ſimile of the mind to white paper one of the moſt unlucky alluſions that could have been choſen; becauſe the human ſoul, when it begins to think, is not extended, nor of a white colour, nor incapable of energy, nor wholly unfurniſhed with ideas, nor as ſuſceptible of one impreſſion or character as of any other:" and it has been obſerved by another objector †, that "on a ſheet of white paper you may write that ſugar is bitter; wormwood ſweet; fire and froſt in every degree pleaſing and ſufferable: that compaſſion and gratitude are baſe; treachery, falſehood, and envy, noble; and that contempt is indifferent to us."

† *J. Uſher, author of* Clio. *See a vol. of Fugitive Pieces printed for J. Davies, London,* 1774.

13
Objections anſwered.

All this is true; but we apprehend it is not to the purpoſe. Mr Locke has no where expreſſed himſelf in ſuch a manner as to lead us to ſuppoſe that he believed the ſoul to be extended or coloured; or, when it begins to think, incapable of energy, and wholly unfurniſhed with ideas: but he certainly did believe, that it begins not to think the firſt inſtant of its exiſtence, and that it *acquires* all the ideas of which it is ever poſſeſſed. We may undoubtedly write upon a piece of white paper that ſugar is bitter, and that wormwood is ſweet; but how the capacity of paper to receive the ſymbols of falſe propoſitions ſhould make Mr Locke's compariſon improper or dangerous, we cannot comprehend. Mr Uſher indeed ſays, that it is improper on this account, "that no human art or induſtry is able to make thoſe impreſſions upon the mind: in reſpect of them, the mind diſcovers not a paſſive capacity, but reſiſts them with the force of fate." Does it indeed? does the mind reject the idea of ſugar or of bitterneſs, of contempt or of indifference? May not any man have the *idea* of ſugar and at the ſame time the *idea* of bitterneſs, and compare the one with the other in his mind, as well as the word *ſugar* may be written beſide the word *bitter*, and connected with it on the ſame piece of paper? In all this we perceive nothing that is impoſſible or even difficult. The mind cannot indeed be made to feel that ſugar has the ſame taſte with wormwood; but who ever thought that it could? Not Mr Locke, we ſhall be bold to ſay; nor does his ſimile give the ſmalleſt countenance to ſuch an abſurdity. The author of the Eſſay on the Human Underſtanding underſtood his ſubject too well to imagine that either truth or falſehood could be communicated to paper, or that paper is capable of comparing ideas. Paper is capable of receiving nothing but lines or figures; and it paſſively receives whatever lines or figures we may chooſe to inſcribe on it: yet if a pen be carried over it in a circular direction, the figure impreſſed will not be a ſquare; juſt as, to the mind of one eating ſugar, the taſte communicated is not that of wormwood.

On a piece of paper a circle may be deſcribed, and cloſe beſide it a ſquare: in like manner an agreeable ſenſation may be communicated to the mind, and immediately afterwards a ſenſation that is diſagreeable. Theſe two ſenſations, or the ideas which they leave behind them, may be compared together; and it is certainly true that no art or induſtry can make them appear ſimilar in the mind: but is it not equally true, that no art or induſtry can make the circle and the ſquare ſimilar on the paper? The paper is ſuſceptible of any ſort of plain figures, and the mind is equally ſuſceptible of any ſort of ideas or ſenſations; but figures diſſimilar cannot be made to coincide, neither can diſcordant ideas be made to agree. Again, one may write upon paper, that "a circle *is* a ſquare," and likewiſe that "a circle *is not* a ſquare;" and both theſe propoſitions may be communicated to the mind by the organs of ſight or of hearing. The paper receives the *words* expreſſive of the falſe as well as thoſe expreſſive of the true propoſition; and the mind receives the *ideas* and *relations* ſignified by the one cluſter of words as well as thoſe ſignified by the other: but in the mind the *idea* of a ſquare is *different* from that of a circle, and on the paper the *figure* of a ſquare is *different* from the *figure* of a circle. The great difference between the mind and the paper is, that *the former* is *conſcious* of its ideas, and *perceives* their agreement or diſagreement; whereas the paper is *not* conſcious of the figures drawn upon it, nor perceives any thing about them. But ſtill thoſe figures are what they are; they either agree or diſagree on the paper, as well as the ideas either agree or diſagree in the mind. It is not in the power of the mind to alter the *ideas* of the ſquare and the circle, not in the power of the paper to alter the *forms* of theſe figures.

It appears then, that the principles of Mr Locke, and the compariſon by which he illuſtrates them, have no more tendency to ſubvert the difference between truth and falſehood, right and wrong, than the paſſiveneſs of paper has to ſubvert the difference between a ſtraight line and a crooked, a circle and a ſquare: and with a view to eſtabliſh the doctrine of innate ideas and inſtinctive principles of knowledge, we might with as much propriety aſk, Whether it be poſſible to imagine that any mode of manufacture could make paper of ſuch a nature, as that a pen drawn over it in a circular direction would leave the figure of a ſquare? as that, "Whether it be poſſible to imagine, that any courſe of education could ever bring a rational creature to believe that two and two are equal to three."

The

Origin of Ideas and Notions.

The mind being thus, as we may ſay, originally white paper, void of all characters, without ideas or notions of any kind, the firſt queſtion which we have to conſider is, Whence and in what manner it derives the materials of all its knowledge? To this queſtion the only anſwer which can be given is, That it derives them from obſervation and experience; from obſervation, either employed upon external objects of ſenſe, or turned inwardly upon its own operations. Our ſenſes, converſant about particular external objects, convey into the mind ſeveral diſtinct perceptions; ſuch as thoſe of *colour*, *figure*, *heat*, *cold*, *bitterneſs*, *ſweetneſs*, and all thoſe things which are uſually called *ſenſible qualities*. The notions, ideas, or whatever elſe they may be called, which are acquired in this manner, may be called *ſenſible knowledge*; and the ſource of that knowledge is termed *ſenſation*.

14 But all derived from ſenſation and reflection.

The other fountain from which experience furniſhes the underſtanding with knowledge, is that attention which we are capable of giving to the operations of our own minds when employed about thoſe ideas which were originally ſuggeſted by objects of ſenſe. Theſe operations, when the ſoul comes to reflect on them, furniſh us with a ſet of notions entirely different from the ideas of ſenſe; ſuch as the notions of *perception*, *thinking*, *doubting*, *believing*, *reaſoning*, *knowing*, *willing*, and all the different energies and paſſions of our own minds. Of theſe operations we are always conſcious when we are awake: but it requires, as ſhall be ſhown afterwards, no inconſiderable effort to ſet them, as it were, at a diſtance, to reflect on them and conſider what they are; but when we have made this effort, we acquire notions as diſtinct, and perhaps more important, than thoſe ideas which we receive through the medium of the ſenſes.

Senſation and reflection then furniſh mankind with the firſt materials of all their knowledge. The mind ſeems not to have ideas or notions of any kind which it did not receive by one or other of theſe ways. By means of the ſenſes it perceives external objects; and by that power which it has of turning its attention upon itſelf, it diſcovers the nature and manner of its own operations.

Although the knowledge which we acquire from *reflection* be of equal importance, and perhaps of greater certainty than that which we receive through the medium of the ſenſes, it comes into the mind at a much later period; both becauſe it is impoſſible that the faculties of the mind ſhould operate without materials, and becauſe it is much more difficult to attend to theſe operations even while they are going on, than to the objects of ſenſe which ſolicit our attention. It is for this reaſon pretty late before children have any notions whatever of the operations of their own minds; and of the greater part of theſe operations the bulk of mankind have no clear or accurate notions during their whole lives. On the other hand, every human being is ſo ſurrounded with bodies, which perpetually and variouſly affect his ſenſes, that a variety of ſenſible ideas force an entrance even into the minds of children. In order therefore to trace the procedure of the underſtanding, and to aſcertain the extent and limits of human knowledge, it ſhould ſeem that we muſt begin with conſidering the external ſenſes, that we may diſcover the manner in which we receive knowledge by means of them, the objects of that knowledge, and its certainty. It is to be obſerved, however, that though we conſider the mind as poſſeſſed of many powers or faculties, and inquire firſt into the nature of that faculty which we conceive to be firſt exerted, this is done merely for the ſake of proceeding in our ſubject with method and perſpicuity. The mind is one ſimple and undivided being; and in every mental energy it is the whole mind, and not any part or portion of it, that is energetic. On this account, it is impoſſible to explain even the nature of ſenſation and perception to him who knows not what is meant by *will* and *underſtanding*; but to every one who is acquainted with the common import of theſe words, and who has read the ſhort ſyſtem of LOGIC inſerted in this Work, we hope that our theory of perception will be intelligible and convincing.

Of Senſation.

CHAP. I. *Of* SENSATION *and* PERCEPTION.

SECT. I. *Of Senſation.*

15 Senſation by five organs.

THE Supreme Being, who made us and placed us in this world, has given us ſuch powers of mind as he ſaw to be ſuited to our ſtate and rank in his creation. He has given us the power of perceiving many objects around us; but that power is limited in various ways; and particularly in this, that without the organs of the ſeveral ſenſes we perceive no external object. The ſenſes, as every one knows, are five in number, and each communicates its proper ſenſation. It is by the eyes alone that we ſee, by the ears that we hear, by the noſe that we ſmell, and by the tongue and palate that we taſte; the ſenſe of feeling or touch is ſpread over the whole body, for we feel equally by our hands and by our feet, &c. To the powers of perception by the ſenſes it is neceſſary not only that we have all the organs enumerated, but that we have them alſo in a ſound and natural ſtate. There are many diſorders of the eye which cauſe total blindneſs, as well as others which impair without deſtroying the power of viſion. The ſame thing is true of the organs of all the other ſenſes.

All this is ſo well known from experience, that it needs no proof; but it may be worth while to obſerve, that it is known from experience only *. For any thing that we know to the contrary, our Creator might have endowed us with the power of perception by a thouſand organs of ſenſe, all different from thoſe which we poſſeſs; and it is certain that he himſelf perceives every thing more perfectly than we do without bodily organs. For it is to be obſerved, that the organs of ſenſe are different from the being which is ſentient.—It is not the eye which ſees, nor the ear which hears; theſe are only the organs by which we ſee and hear. A man cannot ſee the ſatellites of Jupiter but by means of a teleſcope, nor hear a low voice but by means of an ear trumpet. Does he from this conclude that it is the teleſcope which ſees thoſe ſatellites, or the trumpet which hears that voice? Such a concluſion would be evidently abſurd. It is no leſs abſurd to conclude that it is the eye which ſees, or the ear which hears. The teleſcope and the trumpet are artificial organs of ſight and of hearing, of which the eye and the ear are natural organs; but the natural organs ſee and hear as little as the artificial.

* Reid's Eſſays on the Intellectual Powers of Man.

16 Theſe organs themſelves not ſentient, but

17 Inſtruments of ſenſation.

That this is the caſe with reſpect to the eye and the ear, Of Senſation.

ear, is ſo obvious, that, as far as we know, it has never been denied. But with reſpect to the ſenſes of touch, taſte, and ſmell, the truth at firſt view appears not ſo evident. A celebrated writer has obſerved *, that "after the utmoſt efforts, we find it beyond our power to conceive the flavour of a roſe to exiſt in the mind': we are neceſſarily led to conceive that pleaſure as exiſting in the noſtrils, along with the impreſſion made by the roſe upon that organ (c); and the ſame will be the reſult of experiments with reſpect to every feeling of taſte, touch, and ſmell. Touch (he ſays), affords the moſt ſatisfactory evidence, and philoſophy detects the deluſion." To detect this deluſion requires, indeed, no great depth in philoſophy; for it is ſo far from being true that we are neceſſarily led otherwiſe than by aſſociation, of which the laws ſhall be explained afterwards, to conceive the pleaſure or pain of touch as exiſting at that part of our body upon which the impreſſion is made, that, as every man muſt have obſerved, children previous to experience cannot diſtinguiſh the preciſe place of their bodies which is affected by the touch of any external object. Nay, we believe it will be found upon trial, that if a full grown man, with all the experience of age to guide him, be pricked with a pin on any part of his body which he has ſeldom handled, and never ſeen, he will not readily nor at firſt put his finger upon the wound, nor even come very *near* to the wound. This, however, he would certainly and infallibly do were the ſenſe of touch neceſſarily conceived as exiſting at the organ. To theſe obſervations objections may perhaps be made, which we cannot ſtay to obviate; but the following, we think, will admit of none. We appeal to every man who has experienced that particular ſenſation of touch which Scaliger dignified with the name of a ſixth ſenſe, whether, whilſt thoſe ſenſations were new to him, he was neceſſarily led to conceive them as exiſting at any particular organ. If he was not, it follows undeniably that the organs of ſenſation are different from the being which is ſentient; that it is not the eye which ſees, the ear which hears, the noſtrils which ſmell, the tongue which taſtes, nor any part of the body which feels; and that it is by experience that we learn to aſſociate our ſeveral ſenſations with thoſe organs upon which the impreſſions are made.

* *Elements of Criticiſm.*

It is, however, certain that we receive no ſenſation from external objects, unleſs when ſome impreſſion is made upon the organ of ſenſe, either by the immediate application of the object itſelf, or by ſome medium which paſſes between the object and the organ †. In two of our ſenſes, viz. *touch* and *taſte*, there muſt be an immediate application of the object to the organ. In the other three the ſenſation is occaſioned by the impreſſion of ſome medium paſſing from the object to the organ. The effluvia of bodies drawn into the noſtrils with the breath are the medium of ſmell; the undulations of the air are the medium of hearing; and the rays of light paſſing from viſible objects to the eye are the medium of ſight. Theſe are facts known from experience to hold univerſally both in men and in brutes. It is likewiſe a law of our nature perfectly known to all who know any thing of anatomy, that in order to actual ſenſation the impreſſions made upon the external organs muſt be communicated to the nerves, and from them to the brain. Firſt, The object, either immediately, or by ſome medium, makes an impreſſion upon the organ; the organ ſerves only as a medium, by which the impreſſion is communicated to the nerves; and the nerves ſerve as a medium to carry it on to the brain. Here the corporeal part ends; at leaſt we can trace it no farther. The reſt is all intellectual.

† *Reid's Eſſays on the Intellectual Powers of Man*, and *Hartley's Obſervations on Man.*

18 The brain and nerves neceſſary to ſenſation.

The proof of theſe impreſſions upon the nerves and brain in ſenſation is this, that from many obſervations and experiments it is found, that when the organ of any ſenſe is perfectly ſound, and has the impreſſion made upon it by the object ever ſo ſtrongly, yet if the nerve which ſerves that organ be cut or tied hard, there is no ſenſation; and it is well known that diſorders in the brain deprive us of ſenſation, while both the organ and its nerve are ſound.

19 Proceſs of nature in ſenſation.

There is ſufficient reaſon, therefore, to conclude, that in ſenſation the object produces ſome change in the organ; that from the organ the change proceeds to the nerve, and from the nerve to the brain. Hence it is that we have poſitive ſenſations, from negative objects, or mere nonentities, ſuch as *darkneſs*, *blackneſs*, and *vacuity*. For, ſenſation reſulting from changes in the brain, whatever produces any change muſt of courſe occaſion a new ſenſation: but it is obvious, that the mere abſence of any impreſſion, by the removal of the object which produced it, muſt as neceſſarily cauſe a change in the organ, nerves, and brain, as the preſence of a new impreſſion from a new object. To theſe changes, or that which *immediately* produces them, we give the name of *impreſſions;* becauſe we know not how, in a general manner, to expreſs more properly any change produced by an external cauſe without ſpecifying the nature of that cauſe. Whether it be preſſure, or attraction, or repulſion, or vibration, or ſomething unknown, for which we have no name, ſtill it may be called an impreſſion.

Sir Iſaac Newton was perhaps the firſt who ſuppoſed that the rays of light falling upon the bottom of the eye excite vibrations in the *tunica retina;* and that thoſe vibrations being propagated along the ſolid fibres of the optic nerves into the brain, cauſe the actual ſenſation of ſeeing. This hypotheſis was adopted by Dr Hartley, applied to the other ſenſes, and ſhown to be

(c) Another eminent writer thinks on this ſubject very differently, and in our opinion much more juſtly.— "Suppoſe (ſays Dr Reid) a perſon who never had this ſenſe (viz. *ſmell*) before, to receive it all at once, and to ſmell a roſe; can he perceive any ſimilitude or agreement between the ſmell and the roſe? or indeed between it and any other object whatever? Certainly he cannot. He finds himſelf affected in a new way, he knows not why, or from what cauſe. He is conſcious that he is not the cauſe of it himſelf; but he cannot from the nature of the thing determine whether it be cauſed by body or ſpirit; by ſomething near, or by ſomething at a diſtance. He cannot give it a *place* any more than he can give a place to melancholy or joy; nor can he conceive it to have any exiſtence but when it is ſmelled." *Inquiry into the Human Mind*, ch. 2. ſect. 2.

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be at leaſt as probable as any which has yet been invented to account for the perception of external objects by means of the organs of ſenſe. Be this as it may, experience informs us, that whatever be the nature of thoſe impreſſions and changes which are made by external objects upon the ſenſes, nerves, and brain, we have without them no actual ſenſation, and of courſe perceive nothing *ab extra*. Hence it has been

20 In ſenſation the mind is partly active.

ſuppoſed, that the mind is wholly paſſive in ſenſation, and that ſenſation is *neceſſarily* produced by thoſe impreſſions. But this we believe to be a miſtake. Every man who has been attentive to his own thoughts and actions, muſt know inſtances of impreſſions having been certainly made upon his organs of ſenſe without producing any ſenſation, or ſuggeſting to his mind the perception of the particular objects by which the impreſſions were cauſed. He whoſe mind is intenſely employed in any particular purſuit, may have his eyes open upon an object which he does not ſee; or he may not hear the ſound of a clock ſtriking within two yards of him: Nay, we will venture to affirm, that there is hardly one reader of this article to whom ſuch abſences of ſenſation have not often occurred. Now, as there is no reaſon to ſuppoſe, that in the one caſe the undulations of the air, cauſed by the ſtriking of the clock, did not reach his ears, or that in the other the rays of light, reflected from the object, did not fall upon his eyes, which were open to receive them; the only reaſon which can be aſſigned for his not having, in theſe inſtances, had audible and viſible ſenſations, is, that his mind was ſo engaged in ſomething elſe as not to pay to the vibrations in his brain that attention, if we may ſo ſay, without which impreſſions *ab extra* can produce no ſenſation. There are, indeed, ſome impreſſions on the organs of ſenſe ſo violent and ſo ſudden, as to force themſelves upon the mind however employed. Such are thoſe made on the ear by thunder, and on the eye by ſtrong light. In theſe caſes, ſenſation is involuntary and unavoidable; whence we conclude, not that in ſuch inſtances the mind is paſſive or deſtitute of energy, but that by the violent agitation given to the brain, it is rouſed from its reverie, and compelled to give attention. It appears, therefore, that in ſenſation the mind exerts ſome kind of energy; for in nothing but in the ſentient being itſelf can we ſeek for the cauſe why, when all external circumſtances are the ſame, organical impreſſions ſometimes produce ſenſations and ſometimes not; and that cauſe can only be the energy of the mind; what kind of energy, we pretend not to ſay.

Sect. II. *Of Perception by the Senſes.*

21 Difficult to account for the perception of objects.

How the correſpondence is carried on between the thinking principle within us and the material world without us, has always, as Dr Reid obſerves, been found a very difficult problem to thoſe philoſophers who conſider themſelves as obliged to account for every phenomenon in nature. It is, indeed, a problem of which we expect not to ſee a complete ſolution. A few ſteps beyond the vulgar we may certainly go; but the nature of that connexion by which the mind and body are united, will probably remain for ever unknown. One queſtion, however, which has employed much of the attention of philoſophers, both ancient and modern, appears to be not wholly unanſwerable. It is, Whether by means of our ſenſes we perceive external objects mediately or immediately; or in other words, Whether ſenſation and perception be one and the ſame thing, or two things ſucceeding each other? On this ſubject, till of late, there appears to have been in the main a great uniformity in the ſentiments of philoſophers, notwithſtanding their variations reſpecting particular points. Of ſome of the moſt eminent of them, we ſhall give the opinions as we find them collected by one * who is well acquainted with their writings, who is thoroughly qualified to eſtimate their reſpective merits, and who cannot be ſuſpected of partiality to that theory which we feel ourſelves compelled to adopt.

* Dr Reid in his *Eſſays on the Intellectual Powers of Man.*

22 The hypotheſis of Plato;

"Plato illuſtrates our manner of perceiving external objects thus: He ſuppoſes a dark ſubterraneous cave, in which men lie bound in ſuch a manner as that they can direct their eyes only to one part of the cave. Far behind there is a light, of which ſome rays come over a wall to that part of the cave which is before the eyes of our priſoners. A number of men variouſly employed paſs between them and the light, whoſe ſhadows are ſeen by the priſoners, but not their perſons themſelves. In this manner did that philoſopher conceive that by our ſenſes we perceive not things themſelves, but only the ſhadows of things; and he ſeems to have borrowed his notions on this ſubject from the diſciples of Pythagoras.

23 Of Ariſtotle.

"If we make due allowance for Plato's allegorical genius, his ſentiments with reſpect to ſenſation and perception correſpond very well with thoſe of the Peripatetics. Ariſtotle, the founder of that ſchool, ſeems to have thought, that the ſoul conſiſts of two or three parts, or rather that we have three ſouls—the vegetable, the animal, and the rational. The animal ſoul he held to be a certain *form* of the body, which is inſeparable from it, and periſhes at death. To this ſoul the ſenſes belong; and he defines a ſenſe to be that which is capable of receiving the ſenſible forms, or ſpecies of objects, without any of the matter of them; as wax receives the form of the ſeal without any of its matter. Of this doctrine it ſeems to be a neceſſary conſequence, that bodies are conſtantly ſending forth, in all directions, as many different kinds of forms without matter as they have different ſenſible qualities. This was accordingly maintained by the followers of Ariſtotle, though not, as far as we know, taught by himſelf. They diſputed concerning the nature of theſe forms or ſpecies, whether they were real beings or nonentities: but of matter and form we ſhall have occaſion to ſpeak afterwards.

24 Of Des Cartes;

"After Ariſtotle had kept poſſeſſion of the ſchools for more than a thouſand years. his authority, which had often ſupplied the place of argument, was called in queſtion by Lord Bacon and others. Des Cartes, however, was the firſt philoſopher who, convinced of the defects of the prevailing ſyſtem, attempted to form another entirely new: but on the nature of perception by means of the ſenſes he differs little or nothing from thoſe who had preceded him in that department of ſcience. He denies, indeed, and refutes by ſolid reaſoning, the doctrine which maintains that *images*, *ſpecies*, or *forms* of external objects, come from the objects themſelves, and enter into the mind by the avenues

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"According to this ſyſtem it would appear, that we perceive not external objects *directly* by means of our ſenſes; but that theſe objects, operating either mediately or immediately upon the organs of ſenſe, and they again upon our nerves and brain, excite in the mind certain ſenſations; whence we *infer* the exiſtence of external objects from our ſenſations of which they are the cauſe. Perception of external objects, therefore, according to Des Cartes, is not one ſimple original act of the mind, but may be reſolved into a proceſs of reaſoning from effects to cauſes."

25 Of Malebranche; The doctrines of Malebranche, Locke, and Hartley, reſpecting perception, differ not eſſentially from that of Des Cartes. Malebranche, indeed, ſuppoſes, that external objects are not themſelves the cauſes of perception; but that the Deity, being always preſent to our minds more intimately than any other being, does, upon occaſion of the impreſſions made upon our organs of ſenſe, diſcover to us, as far as he thinks proper, and according to fixed laws, his own ideas of the object: and thus, according to him, we ſee all things in God, or in the divine ideas. He agrees, however, with Des Cartes and the ancient philoſophers, in conſidering it as a truth which it is impoſſible to refute, that we perceive not the objects without us, the ſun, moon, and ſtars, &c. becauſe it is not likely that the ſoul ſallies out of the body, and takes a walk, as it were, through the heavens to contemplate theſe objects. She ſees them not therefore by themſelves; and the immediate object of the mind, when it ſees the ſun, is not the ſun itſelf, but ſomething which is intimately united to the mind, and is that which he calls an *idea*.

26 Of Locke. Locke, ſpeaking of the reality of our knowledge, ſays: "It is evident the mind knows not things immediately, but only by the intervention of the *ideas* it has of them. Our knowledge, therefore, according to him, is real only ſo far as there is a conformity between our ideas and the things which they repreſent." The manner of our perceiving external objects he illuſtrates by the following ſimilitude: "Methinks the underſtanding is not much unlike a cloſet wholly ſhut from light, with only ſome little opening left, to let in external viſible reſemblances or ideas of things without. Would the pictures coming into ſuch a dark room but ſtay there, and lie ſo orderly as to be found upon occaſion, it would very much reſemble the underſtanding of a man in reference to all objects of ſight, and the ideas of them *." He has elſewhere † defined an *idea* thus: "Whatſoever the mind perceives in itſelf, or is the immediate object of perception, thought, or underſtanding, that I call an *idea*; and the power to produce any idea in our mind, I call *quality* of the ſubject wherein the power is." He likewiſe thinks it "eaſy to draw this obſervation, that the ideas of what he calls primary qualities of bodies, viz. *extenſion*, *ſolidity*, *figure*, *mobility*, &c. are reſemblances of theſe qualities as they really exiſt in the bodies themſelves."

* *Eſſay on the Underſtanding*, book ii. chap 11.

† Book ii. chap. 8.

This unguarded expreſſion, which affirms that ideas in the mind are the reſemblances of external things, has brought upon Mr Locke much undeſerved ridicule. That on this and other occaſions he uſes the word *idea* with too great latitude, and that he often confounds ideas with ſenſations, and even with the cauſes of ſenſation, muſt be admitted by his warmeſt admirers: but we believe, that by an attentive reader, who peruſes his whole work, and compares ſuch paſſages as are obſcure with thoſe which are clearer, his meaning may always be diſcovered, and with reſpect to ſenſation and perception will generally be found juſt. That by calling the ideas of primary qualities reſemblances of the qualities themſelves, he meant nothing more than that bodies in all poſſible ſtates impreſs the ſenſes, nerves, and brain, in ſuch a manner as to produce in the mind certain ſenſations, between which and thoſe impreſſions there is an inſeparable, though unknown, connection, is evident from the account which he gives of the manner of perception. "Our ſenſes (ſays he), converſant about particular ſenſible objects, do convey into the mind ſeveral diſtinct perceptions of things, according to thoſe various ways in which theſe objects affect them: and thus we come by thoſe ideas we have of *yellow*, *white*, *heat*, *cold*, *ſoft*, *hard*, *bitter*, *ſweet*, and all thoſe which we call ſenſible qualities; which when I ſay the ſenſes convey into the mind, I mean, they from external objects convey into the mind what produces thoſe perceptions." And as bodies can act only by impulſe, he adds, that "thoſe perceptions can be produced only by an impreſſion made upon the ſenſes, and ſome motion thence continued by our nerves to the brain or ſeat of perception."

Dr Hartley was the pupil of Locke and Newton; and has, in a more ſatisfactory manner than all who had preceded or have ſince followed him, explained the material part of the proceſs of perception. His principles we ſhall have occaſion, during the courſe of the article, to develope pretty fully. For our preſent purpoſe it is ſufficient to ſay, that all his obſervations and arguments evidently ſuppoſe, that nothing diſtant from the mind can be perceived in the immediate act of ſenſation; but that the apparently immediate perception of external objects is an inſtance of early and deep-rooted aſſociation. 27 Of Hartley.

In this ſentiment Mr Hume agrees with his predeceſſors; but he obſcures his philoſophy, and miſleads his reader, by confounding ſenſations with the impreſſions from which they proceed. "Every one (ſays he*) will allow, that there is a conſiderable difference between the perceptions of the mind, when a man feels the pain of exceſſive heat, or the pleaſure of moderate warmth, and when he afterwards recals to his memory this ſenſation, or anticipates it by his imagination." 28 Of Hume.

* *Inquiry concerning Human Underſtanding*, ſect. ii.

Of Perception. tion." The less forcible and lively of these perceptions he with great propriety calls *ideas;* but it is either through wilful perverseness, or confusion of intellect, that he chooses to call the others *impressions*. Sensation and perception are caused by *impressions;* but they are no more impressions themselves, than the pain occasioned by the stroke of a bludgeon is the stroke itself, or the bludgeon with which it was struck. But more of this afterwards.

29 Agreement of philosophers, and the reason of it.

Thus far, then, that we perceive not external objects *directly*, but infer their existence from certain sensations excited in our minds by the operation of these objects upon our *senses*, *nerves* and *brain*, seems to have been the opinion of every philosopher from Pythagoras † to Mr Hume. For an opinion so universal, and at the same time so contrary to the persuasion of the multitude, some cogent reason must have been assigned. That reason has been given by many philosophers, but by none with greater perspicuity than Dr Porterfield, in his Essay concerning the Motion of the Eyes. "How body acts upon the mind, or mind upon body (says he), I know not; but this I am very certain of, that nothing can act, or be acted upon, where it is not: and therefore, our mind can never perceive any thing but its own proper modifications, and the various states of the sensorium to which it is present. So that it is not the external sun and moon, which are in the heavens, that our mind perceives, but only their image or representation impressed on the sensorium. How the soul of a seeing man sees those images, or how it receives those ideas from such agitations in the sensorium, I know not; but I am sure it can never perceive the external bodies themselves to which it is not present."

† See *Mosheim's edition of Cudworth's Intellectual System*, where the opinions of the philosophers of antiquity are more faithfully collected than in any other work with which we are acquainted.

This reasoning appears to have force; and, perhaps, the unanimous agreement of thinking men in all ages has still greater force; yet the doctrine which prevailed so long, and which to Locke appeared so evident as to need no proof, has been since called in question by some eminent philosophers of our own country; who, though they allow that we cannot perceive external objects but by means of the senses, yet affirm that they are the objects themselves which we perceive directly; and that in perception there is no association which can be resolved into a process of reasoning from sensations the effects, to external objects the causes. Dr Reid, who was perhaps the first, and is unquestionably the ablest of this class of philosophers, had expressed himself on the subject as follows:

"If we attend to the ACT of our mind, which we call the perception of an external object of sense, we shall find in it these three things: *First*, Some conception or notion of the object perceived. *Secondly*, A strong and irresistible conviction and belief of its present existence. And, *Thirdly*, That this conviction and belief are immediate, and not the effect of reasoning ‡." To the first and second of these propositions, we are persuaded that Des Cartes and Locke would readily have assented; nor do we imagine that they would have denied the third, had the author allowed that this strong and irresistible conviction is the consequence of an early and deep-rooted association resolvable into a process of reasoning. This, however, the learned professor does not allow; for he repeatedly affirms, that it is instinctive and original, and that "the constitution of our power of perception determines us to hold the existence of what we distinctly perceive as a first principle, from which other truths may be deduced, but it is deduced from none." With this view of the matter, he could with no propriety attempt to support his own opinion by argument; but to the reasonings of Dr Porterfield and others in defence of the Cartesian theory, he replies in the following words: "That nothing can act immediately where it is not, I think must be admitted (D); for I agree with Sir Isaac Newton, that power without substance is inconceiveable. It is a consequence of this, that nothing can be acted upon immediately where the agent is not present; let this, therefore, be granted. To make the reasoning conclusive, it is farther necessary, that when we perceive objects, either they act upon us, or we act upon them. This does not appear self-evident, nor have I ever met with any proof of it †."

‡ *Essays on the Intellectual Powers of Man*, Essay ii. ch. 5.

† *Essays on the Intellectual Powers of Man*, Essay ii. chap. 14.

Of the profundity of Dr Reid's understanding, we have the most firm conviction; nor is there any metaphysician, ancient or modern, from whom we differ with greater reluctance: but we cannot help thinking this a very rash assertion, as his own works appear to us to afford complete proof, that, in perception, the mind both acts and is acted upon. Let us attend, however, to the reasons which, on this occasion, induced

(D) One of the most celebrated of Dr Reid's followers thinks otherwise. "That no distant subject can act upon the mind, is a proposition (says Lord Kames) which undoubtedly requires evidence; for it is not instinctively certain: And, therefore, till the proposition be demonstrated, every man may without scruple rely upon the conviction of his senses, that he hears and sees things at a distance." But his Lordship ought to have known, that Locke and Berkeley, the two philosophers whom he was combating, have no where called in question the conviction of their senses. They do not, indeed, admit, that the external organs are themselves percipient, or that by means of them the mind can *immediately* perceive distant objects; but they have no where denied, that through the *medium* of them the mind comes to the knowledge of external existence. And the reasons which they assign for this twofold opinion are, that in perception they experience action or the effects of action, which is not their own; and that it is an intuitive truth, that nothing can act where it is not present. "But admitting (says his Lordship) that no being can act but where it is, is there any thing more simple or more common, than the acting upon subjects at a distance by intermediate means? This holds in fact with respect both to seeing and hearing." It certainly does, and with respect to the other senses likewise; but it is the very thing for which Locke and Berkeley would have contended, had any man in their days presumed to call it in question. It is the very foundation of their system; and if it be granted, nothing can be more evident, than that external existence is not the *immediate* object of perception. See *Appendix to Elements of Criticism.*

Of Perception.

ced him to think, that in perception there is no action either of the object on the mind or of the mind on the object.

"When we say, that one being acts upon another, we mean, that some power or force is exerted by the agent, which produces, or has a tendency to produce, a change in the thing acted upon. If this be the meaning of the phrase, as I conceive it is, there appears no reason for asserting, that in perception, either the object acts upon the mind or the mind upon the object. An object, in being perceived, does not act at all. I perceive the walls of the room where I sit; but they are perfectly inactive, and therefore act not upon the mind. To be perceived, is what logicians call an external denomination, which implies neither action nor quality in the object perceived."

30 We think unsuccessfully; and

This last sentence we pretend not to understand. Substance without qualities is to us inconceivable, and certainly is no object of perception; for Dr Reid himself has told us, and told us truly, that "the objects of perception are the various qualities of bodies." That an object in being perceived does not act at all, is directly contrary to what the ingenious author has taught us, both in his *Inquiry* and in his *Essays*, viz. that "it is a law of our nature that we perceive not external objects, unless certain impressions be made by the object upon the organ, and by means of the organ upon the nerve and brain;" for if the external object in being perceived make impressions, it is certainly not true that it acts not at all. It is indeed readily acknowledged, that when one perceives the walls of the room where he fits, these walls do not act immediately upon the organs of sight; but it does not, therefore, follow, that they are perfectly inactive; for it is known to all mankind, that from every point of the wall which is seen, rays of light are reflected to the eye; that those rays make upon the *retina tunica* an impression, which is conveyed by the optic nerve to the brain; and that this impression on the brain is one of the immediate causes of vision. In what *particular manner* it causes vision, we shall never be able to discover, till we know more of the laws which unite mind and body, and by which one of these is qualified to act upon the other; but because we know not the *manner* of this operation, to affirm that there is no operation at all seems to be as absurd as it would be to affirm, because we perceive no necessary connexion between a stroke and the sensation of sound, that the sound of a musical string is not caused by the stroke of a plectrum. That God might have given us powers of perception of a different kind from those which we possess, there can be no doubt; but with what we might have been, we have no concern. As we are, we know perfectly that the eye is an instrument of vision, because without it nothing can be seen: we know also, that the retina and optic nerves are equally necessary; because if they be disordered, vision is still wanting; we know likewise, that the brain is necessary to all perception; because, when it is disordered, thinking either entirely ceases, or is proportionably disturbed. And, lastly, We are not more certain of our own existence, than that *actual perception* takes not place but when the object makes an impression upon some organ of sense: for when no rays of light fall upon the eye, we see nothing; when no sapid body is applied to the tongue and palate, we taste nothing; and if we could be removed from every thing solid, we would feel nothing. These are conclusions which cannot be controverted. They are admitted equally by the philosopher and by the plain unlettered man of common sense; nor are they rendered one whit less certain by our not being able to go a step farther, so as to discover in what *manner* the brain or the affections of it can be the immediate instrument of sensation and perception. For (as Dr Reid, in the spirit of true philosophy, observes ‡), "in the operations of mind, as well as in those of bodies, we must often be satisfied with knowing that certain things are connected and invariably follow one another, without being able to discover the chain that goes between them. It is to such connexions that we give the name of *laws of nature;* and when we say that one thing produces another by a law of nature, this signifies no more than that one thing which we call in popular language *the cause*, is constantly and invariably followed by another which we call *the effect;* and that we know not *how* they are connected.

‡ *Inquiry into the Human Mind*, 4th edit. p. 258.

In the preceding section we have observed, that in sensation the mind exerts some energy; and therefore, as on every hypothesis perception is a consequence of sensation, it follows, that in perception the mind cannot be wholly inactive. Dr Reid, in his Essays on the Intellectual Powers of Man, seems to affirm that it is. "I see no reason (says he) to believe, that in perception the mind acts upon the object. To perceive an object is one thing, to act upon it is another: Nor is the last at all included in the first. To say that I act upon the wall, by looking at it, is an abuse of language, and has no meaning." This is indeed true; it would be a great abuse of language to say, that by looking at the wall a man acts upon it; but we do not believe that any man ever said or supposed such a thing. The philosophers, whose opinion he is combating, might argue in this manner. We are conscious that in perception the mind is active; nothing can act immediately where it is not; the mind cannot act immediately upon external existence: external existence, therefore, is not the immediate object of that energy which is exerted in perception. As Dr Reid affirms that external existence is the immediate object of perception, he must deny the first proposition in this argument; for *if it* be granted, as we have just seen that in his reply to Dr Porterfield he admits the second, the laws of reasoning will compel him to admit the third. To say, that in perception the mind acts not upon *external* objects, is a truth in which all mankind are agreed; and it is the very principle from which his antagonists infer, that the conviction of the present existence of external objects is not an original and instinctive consequence of sensation, but an early and deep-rooted association which may be resolved into a process of reasoning. His meaning, therefore, must be, that in perception the mind *acts not at all:* but this is directly contrary to his definition of perception, which he calls an ACT of the mind; it is likewise contrary to his theory of perception, as it is detailed in *the Inquiry into the Human Mind on the principles of Common Sense.* We are there taught, with equal elegance and perspicuity, "that an impression made by an external object upon the organ, nerves, and brain, is is followed by a *ſenſation*, and that this ſenſation is followed by the perception of the object." We are likewiſe taught, that "although the Peripatetics had no good reaſon to ſuppoſe an active and paſſive intellect, they yet came nearer the truth, in holding the mind to be, in ſenſation, partly paſſive and partly active, than the moderns in affirming it to be purely paſſive. Senſation, imagination, memory, and judgement, have by the vulgar, in all ages, been conſidered as acts of the mind. The manner in which they are expreſſed in all languages ſhows this: for when the mind is much employed in them, we ſay, it is very active; whereas, if they were impreſſions only, we ought to ſay that the mind is very paſſive." All this is undeniable; but if ſenſation neceſſarily precede perception, and if in ſenſation the mind be active, what becomes of the aſſertion, that in perception it acts not at all? Indeed we may appeal to the common ſenſe of mankind, whether any thing can be perceived without ſome mental energy of the percipient. For when the impreſſions made on the external ſenſes are faint, in order to be conſcious of them an evident exertion is requiſite, not of the organ only, but alſo of the mind, as in perceiving very remote objects and ſounds; but when the impreſſions are ſtronger, the perception is involuntary and unavoidable, as has been already explained in the preceding ſection.

31
Therefore the old theory of perception to be preferred to his.

It being thus certain that in perception the mind both acts and is acted upon, and it being univerſally acknowledged that nothing can act where it is not, we feel ourſelves compelled to admit with the Carteſians, that in perception the conviction of the preſent exiſtence of external objects is not original and inſtinctive, but the conſequence of an early and unavoidable aſſociation of certain ſenſations with the cauſes which produce them. In this opinion we are ſtill more confirmed by the well-known fact, that particular preſſures upon the organ, nerves, and brain, excite not only ſenſations, but even perceptions of objects apparently external, when no ſuch objects are within the reach of our ſenſes. Thus §, if a man in the dark preſs either corner of his eye with his finger, he will ſee a circle of colours like thoſe in the feather of a peacock's tail, though no ſuch external object be before him, and though the room be ſo dark that nothing external could poſſibly be ſeen. Again, If a burning coal be nimbly moved round in a circle, with gyrations continually repeated, the whole circumference of the circle will at once appear on fire, though it is certain that there can be really no fire but one portion of that circumference, equal in length to the diameter of the coal. Theſe are facts known to all mankind; and they are perfectly irreconcileable with the ſuppoſition, that the perception of external objects by the ſenſe of ſight is original and inſtinctive; but they are at once accounted for, if it be true that rays of light falling from external objects upon the *retina tunica* agitate the optic nerves and brain, and that ſuch agitations excite ſenſations in the mind which experience has taught us to refer to external objects, as, under God, their ultimate cauſe.

§ *Hartley's Obſervations on Man.*

But though we have declared ourſelves to be in this inſtance Carteſians, we do not admit all the abſurdities which have ſometimes been imputed to that ſyſtem of perception. We do not believe that external objects are perceived by means of images of them in the mind or the brain; nor do we think that Des Cartes or Locke has anywhere affirmed that they are, otherwiſe than by an expreſſion obviouſly figurative, denoting, not that the actual ſhapes of things are delineated in the brain or upon the mind, but only that impreſſions of ſome kind or other are conveyed to the brain by means of the organs of ſenſe and their correſponding nerves; and that between theſe impreſſions and the ſenſations excited in the mind, there is a real, and in our preſent ſtate a neceſſary, though unknown, connexion. 32

That theory fairly ſtated, and

Upon the whole, we think that there is good evidence for believing, that in perception the proceſs of nature is as follows: *Firſt*, If the object be not in contact with the organ of ſenſe, there muſt be ſome medium which paſſes between them; as, in viſion, the rays of light; in hearing, the vibrations of claſtic air; and in ſmelling, the effluvia of the body ſmelled; otherwiſe we have neither ſenſation nor perception. *Secondly*, There muſt be ſome action or impreſſion upon the organ of ſenſe, either by the immediate application of the object, as in the two ſenſes of touch and taſte; or by the medium that goes between them, as in the other three ſenſes. *Thirdly*, The nerves which go from the brain to the organ, muſt receive ſome impreſſion by means of that which was made upon the organ; and by means of theſe nerves that impreſſion muſt be carried to the brain. *Fourthly*, The impreſſion made upon the organ, nerves, and brain, rouſes the dormant energy of the mind; and this double action of the mind and the object produces a ſenſation And, *laſtly*, As we know by experience that the mind alone cannot, by any exertion of its own, produce one ſenſation, and are intuitively certain that nothing can begin to exiſt without a cauſe, we infer from the exiſtence of any new ſenſation the exiſtence of ſome other cauſe than the internal energy of the mind, from which that ſenſation proceeds; and this cauſe experience teaches us to be the external object. This proceſs is carried on ſo rapidly, and the ſeveral parts of it, by being continually repeated, are ſo cloſely aſſociated, that except by a reflex act of the mind we diſtinguiſh them not from one another, and therefore we denominate the whole *perception*. 33

Shown to differ little from Dr Reid's.

It is with extreme diffidence that we advance a doctrine which Dr Reid has controverted; but he differs from us only in the laſt ſtage § of the proceſs, where he ſuppoſes ſenſation and perception to be two ſimple and independent acts of the mind. Yet he ſometimes expreſſes himſelf, as if he thought, as we do, that in perception the belief of the preſent exiſtence of external objects is rather the reſult of experience than an inſtinctive perſuaſion. Thus, ſpeaking of the perception which we have in ſmelling a roſe, he ſays §, "Perception has always an external object, and the object of my perception in this caſe is that quality in the roſe which I diſcern by the ſenſe of ſmell. Obſerving that the agreeable ſenſation is raiſed when the roſe is near, and ceaſes when it is removed, I am led by my nature [we think *by experience* would have been more proper] to conclude ſome quality to be in the roſe, which is the cauſe of this ſenſation. This quality in the roſe is the object perceived; and that act of my mind, by which I have the conviction and belief

§ See *Inquiry into the Human Mind*, 4th edit. p. 383.

§ *Eſſays on the Intellectual Powers of Man*, Eſſay ii. chap. 15. and 21.

Objects of the reſpective Senſes.

lief of this quality, is what in this caſe I call perception. Again (he ſays) that "three of our ſenſes, viz. ſmell, taſte, and hearing, originally give us only certain ſenſations, and a conviction that theſe ſenſations are occaſioned by ſome external object. We give a name to that quality of the object by which it is fitted to produce ſuch a ſenſation, and connect that quality with the object and with its other qualities. Thus we learn, that a certain ſenſation of ſmell is produced by a roſe; and that quality in the roſe by which it is fitted to produce this ſenſation we call the *ſmell of the roſe*. Here it is evident that the ſenſation is original. The perception that the roſe has that quality which we call its *ſmell*, is acquired."

To this doctrine no Carteſian could poſſibly object; for it is the very account which Des Cartes himſelf would have given of perception by the organ of ſmell, as it reſolves ſuch a perception into an early aſſociation between a certain ſenſation and that external quality from which we know by experience that the ſenſation proceeds. Indeed this excellent author repeatedly affirms, that every different perception is conjoined with a ſenſation which is proper to it; and that the one is the ſign, and the other the thing ſignified. He likewiſe doubts *, whether children, from the time that they begin to uſe their ſenſes, make a diſtinction between things which are only conceived or imagined, and things which really exiſt. But if the conviction of the preſent exiſtence of external objects were in perception *inſtinctive*, we cannot ſee how there could be room for ſuch a doubt; for the mere ſenſes of children are as perfect as thoſe of full grown men; and they know well the difference between actually ſucking their nurſes and only thinking of that operation, though they be not capable of expreſſing that difference in language.

* *Eſſays on the Intellectual Powers of Man.*

34 Both theories afford intuitive evidence that ſomething exiſts beſides the perception and the ſenſation.

But if in perception our conviction of the preſent exiſtence of external objects be not inſtinctive, what, it may be aſked, is the evidence that ſuch objects really exiſt? This queſtion we ſhall partly anſwer in the following ſection, and more completely when we come to examine Berkeley's theory of the non-exiſtence of matter: but from what has been ſaid already, it is ſufficiently evident, that every ſenſation compels us to believe in the preſent exiſtence of ſomething different from ourſelves, as well as from our ſenſations.

SECT. III. *Of the Objects of each Senſe reſpectively.*

35 Touch, the ſenſe by which we perceive heat and cold, &c.

HITHERTO we have conſidered ſenſation and perception in general, and ſhown that it is not by inſtinct that we perceive the exiſtence of external objects. This will appear more clearly, if we can aſcertain the preciſe nature of that information which each ſenſe affords us: and in order to this, we ſhall begin with the ſenſe of *touch*, not only becauſe it is that which is certainly firſt exerciſed, but alſo becauſe there is a meaning in which all the others may be reſolved into it.

Objects of the reſpective Senſes.

36 The nature of heat and cold, which are perceived immediately.

By means of touch we perceive many things, of which the chief are, heat and cold, hardneſs and ſoftneſs, roughneſs and ſmoothneſs, extenſion, figure, ſolidity, and motion. Of theſe perceptions, ſome are immediate; and others, as we are perſuaded, early aſſociations, which may be reſolved into a proceſs of reaſoning. The perceptions of heat and cold are immediate. When a perſon for the firſt time in his life approaches the fire, he feels heat; and when he is firſt expoſed to the froſt, he feels cold. What are heat and cold, and where do they reſide? They are obviouſly the reverſe of each other; but are they external objects, or mere ſenſations in the mind? They are undoubtedly ſenſations which have no exiſtence but when they are felt. To every man not altogether a ſtranger to theſe ſpeculations, this propoſition is ſelf-evident; but to the bulk of the people it appears an extravagant paradox. To make it plain, however, to the meaneſt capacity, it is ſufficient to obſerve, that at a certain diſtance the fire has no perceptible influence upon any perſon; if that diſtance be leſſened, we feel an agreeable warmth; approach a little nearer, and the warmth becomes diſagreeable; and ſtill nearer, it will riſe to pain. No man ſuppoſes the pain inflicted by a ſword to exiſt in the ſword, or anywhere elſe but in a ſentient being. It is equally abſurd to ſuppoſe pain to exiſt in fire, or anywhere elſe but in a ſentient being. But that which at one diſtance is pain, at another is only agreeable warmth; and ſince warmth and pain are only different degrees of the ſame feeling, it is equally abſurd to ſuppoſe the one as the other in the fire. What then is the object of ſenſe when we feel heat? There is obviouſly no object beyond the preſent ſenſation.

37 Their external cauſes.

But has the ſenſation of heat no cauſe independent of us? Undoubtedly it has, and experience teaches us that the cauſe is in the fire. We know that we cannot produce the ſenſation of heat in ourſelves by any mental energy of our own; and we are intuitively certain, that nothing can begin to exiſt without ſome cauſe. A man on the top of a mountain covered with ſnow, may imagine or remember what he felt when in the neighbourhood of fire, and thus have in his mind what is called an *idea* of heat; but that idea will not warm him (E) like the actual ſenſation, which no exertion of his own can in ſuch circumſtances produce. When he leaves the mountain, however, and approaches the fire, he feels the ſenſation actually produced, and produced as often as he makes the experiment. He is, therefore, under the neceſſity of inferring, that in the fire there is ſome power or quality which, acting either mediately or immediately upon his ſenſe of touch, excites the feeling which is called *heat*. What that power is, we ſhall perhaps never be able to diſcover; but it is ſelf-evident, that it is neither heat nor the reſemblance of

(E) ——Who can hold a fire in his hand,
By thinking on the froſty Caucaſus?
Or cloy the hungry edge of appetite,
By bare imagination of a feaſt?
Or wallow naked in December's ſnow,
By thinking on fantaſtic ſummer's heat?
Oh no! the apprehenſion of the good
Gives but the greater feeling to the worſe.
K. Richard II.

Objects of the respective Senses.

of heat, though in vulgar language it is known by that name.

The same reasoning holds goods with respect to cold. There is at certain times, and in certain countries, some power in the air which congeals water and causes cold; but that power is as different from the sensation of cold, as the power of fire is different from the sensation of heat, or the point of a sword from a flesh wound.

38 The perceptions of extension and figure, &c. not immediate.

By the sense of touch we perceive extension, figure, solidity, &c. but we do not perceive them *immediately* as we perceive heat and cold; for extension, figure, and solidity, are not sensations. Those perceptions then must be acquired; and more clearly to ascertain the manner in which we acquire them, let us suppose a man from his birth destitute of the sense of sight and the power of local motion, but possessed of intellect and every other faculty which we enjoy.—Such a person, it is obvious, would be capable of every sensation and perception which is *original* to us, except the perception of colours; but we doubt whether it would be possible to give him perceptions of extension, figure, and solidity. Let us try; and as he cannot move a single limb or member of himself, let us suppose a solid substance of small dimensions to be gently pressed against any part of his body; what would such pressure communicate to him? We think it could communicate nothing but a new sensation, to which, as it is neither pleasing nor painful, no name has hitherto been given, except the general one of *feeling*. This sensation he would not know whether to refer to an external or internal cause; or rather he could have no notion whatever of an external cause, though he would at the same time be conscious that the new sensation was not excited by any energy of his own will. Were the pressure to be gradually increased till it rose to pain, our blind man would still be conscious of nothing but a sensation, which could not lead him to the notion of extension, figure, or solidity, because mere sensations cannot be conceived as either solid or extended. Let us next suppose the pressure to be applied successively to different parts of his body; he would now indeed be conscious of successive sensations, but he could not assign to them either extension or *place*: for it has been already shown that the external parts of the body are not themselves sentient; and it shall be shown afterwards, that to a man who has never perceived motion, place is absolutely inconceivable. Lastly, Let us suppose the dimensions of the pressing substance to be greatly enlarged: what would then follow? nothing, we apprehend, but an increase of pain: for though his whole body were pressed *ab extra*, the pressure could affect the individual being which is sentient, not more extensively, but only more violently. It appears, therefore, that a man blind from his birth, and destitute of the power of local motion, could never be made to perceive extension, figure, or solidity.

39 How they are acquired.

Let us now suppose this man to receive by a miracle the use of his limbs, and to be suddenly prompted, by some instinctive impulse, to arise and walk. So long as he met with no obstacle in his way, he would not, we apprehend, acquire by this exercise any correct notions of extension or figure; but were a stone or log of wood of considerable dimensions to be laid across his usual walk, the case would soon be altered. He would feel himself interrupted in his course, and he would at the same instant recognize his wonted sensations of touch. After being twice or thrice thus interrupted, he would learn from experience that the interruption or resistance proceeded from the same cause which in this instance communicated to him the sensation of feeling; and were he to run his hand along the surface of the log or stone, he would perceive the resistance and the sensation continued. As every effect must have an adequate cause, this continued resistance would compel him to believe the continuity of something external in every direction in which he felt his hand resisted; but such continuity of being is all that is meant by the word extension. At the very same time, and by the very same means, he would gradually acquire the perception of figure; for by running his hand in every direction over the surface of the obstacle which opposed him, he would soon perceive it on all sides limited; but the limits of extension is a phrase of precisely the same import with figure. It appears, therefore, that without the power of local motion, men could never, by the sense of touch, acquire the notions of extension and figure; and the same will be found to be the case with respect to hardness and softness.

40 Hardness and softness, how perceived.

When we press our hand gently against a stock or a stone, we feel a sensation which is neither painful nor pleasing. When we press it more violently, the sensation becomes painful, and we experience in the object a resistance which we have not power to overcome. When we press butter or pomatum very gently, we have a sensation in all respects similar to that which we felt when we gently touched the stock or the stone. But when we press the butter with violence, we feel no pain, and experience little resistance; for the parts of which it is composed give way before the hand, though the parts of the stock or the stone remained fixed and immoveable. That the parts of one body should thus resist a pressure to which the parts of another so readily yield, must proceed from some difference in the texture of the two bodies: for by the sense of touch we perceive the effects to be different; and are therefore certain that they must proceed either from different causes, or from the same cause operating with different degrees of force. That particular texture which makes the parts of a stone resist the pressure of touch, we call hardness; and the texture which makes the parts of butter or pomatum give way to touch, we call softness. But what hardness and softness are in themselves, touch cannot inform us; for they are neither sensations, nor similar to sensations. We acquire, however, by experience, so complete notions of hardness and softness, that every one who understands the English language perfectly knows the meaning of these words as soon as he hears them; and when he is told that one body is hard and another soft, he knows with absolute certainty that the meaning of the assertion is, that the parts of the body which is said to be hard are held together by some unknown cause operating forcibly, and that the parts of the other are held together by the same or a similar cause operating with less force.

41 Roughness and smoothness.

We acquire the notions of roughness and smoothness in the very same way and by the very same means that we

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we acquire ideas of extension and figure. To describe the process at large would certainly be superfluous; for if what we have said concerning our perceptions of extension and figure be just and intelligible, every one will, without farther assistance, discover for himself how he perceives roughness and smoothness. *Motion* shall be considered among the adjuncts of body; but in order to understand what body itself is, it will be necessary, before we dismiss the sense of touch, to inquire how we come by the notion of solidity.

42 Solidity, what; and how perceived.

Solidity is one of those notions, or, in the language of Locke, one of those ideas, which are commonly said to be acquired by the sense of touch. That touch gives the first hint towards our notion of solidity, is certainly true; but that hint must be afterwards improved by the intellect, or we never could have an adequate knowledge of what is meant when any thing is said to be absolutely solid. We know by experience, that we can at pleasure open and shut our empty hand without meeting with any resistance. We know likewise, that when we grasp an ivory ball of three or four inches diameter, no force which we can exert will bring together the several parts of the hand, which were easily brought together when we grasped nothing. In this way do we acquire our first notion of solidity; for that word denotes nothing more in this instance than the power or property of the ball, by which our fingers are excluded from the place which it occupies. Solidity differs from hardness in this respect, that hardness results from the strong cohesion of the parts of a hard body, which renders it difficult to change the places of those parts, as they respect one another; whereas solidity respects the whole mass, and is as essential a quality of water as of adamant. A drop of water, indeed, placed between two plane surfaces of marble, will not like adamant preclude their contact; because the parts of a drop of water, cohering but loosely to one another, give way to the pressure, and escape in every lateral direction. But if a drop of water be confined on all sides, as in a globe of gold, we know from experiment that no force will bring the sides of the globe together without forcing the water through the pores of the metal; and hence we infer solidity to be essential to every corporeal substance.

Thus then it appears, that of the objects perceived by touch not one is *immediately* perceived except heat, cold, and other sensations. The sensations, as they are not excited by any internal energy of our own, lead us indeed to something external as their cause; and by comparing the different sensations with each other, and observing what effects their external causes have upon our own motions, we are naturally led to conceive these causes as extended, figured, solid, hard or soft, rough or smooth, &c.; but it is obvious that this conception is the result of experience, and a process of mental reasoning.

43 Nothing but mere sensations the object of smell,

On the senses of taste, smell, and hearing, it is needless to say much. The immediate objects of these are confessedly sensations which have no existence but when they are perceived; though experience teaches us to refer them all to external objects as their respective causes. With respect to smell, this has been made sufficiently evident in the preceding section, and it is not less evident with respect to taste and hearing.

44 Taste, and

Certain bodies applied to the tongue and palate, and moistened with the saliva, excite certain sensations which we call tastes. These sensations, however, are not in the bodies; nor can they have any existence but in a sentient being. They are produced in consequence of impulses on the nerves of the tongue and palate, exciting certain agitations in the brain; but the sensation itself is neither impulse nor agitation. Some substances excite tastes which are agreeable, and others such as are disagreeable; and there are not a few which excite no taste at all. Bodies, which applied to the tongue and palate of one man produce tastes that are agreeable, applied to the same organs of another man give him tastes which are disagreeable; and we have all experienced, that the same substance, which, when the organs are sound, excites a sweet or pleasant taste, has, when the organs were disordered, excited a taste which was bitter or unpleasant. These facts, which cannot be controverted, afford the fullest evidence, if evidence were wanted, that taste, as we feel it, is no quality of bodies, nor has any existence out of the mind.

The organ of hearing is the *ear*, and its object is sound. It is well known, that sound is produced by certain vibrations of the air striking the tympanum of the ear, and that these vibrations are caused by the sonorous body. Sound, however, is not vibration, nor the idea of sound the idea of vibration. Sound considered by itself is a mere sensation, which can have no existence but in a sentient being. We know by experience, that it is caused by something external; but we know likewise that the effect has no resemblance to the cause. Previous to experience we could not refer sound to any external cause; far less could we discern whether it proceeded from an object above us or below us, on our right hand or on our left. It appears to us self-evident, that if a man born deaf were suddenly made to hear, he would consider his first sensation of sound as originating wholly within himself. Between that sensation and the sensations of touch, taste, smell, and sight, there is no resemblance; nor are there any relations among them, which, previous to experience, could induce him to trace them all to external objects as their several causes. Our deaf man might have learned to refer all his other sensations to their true causes, in some such way as we have described under the sense of touch; but sound would be something so new to him, and so totally different from touch, taste, and smell, that he could attribute it to nothing external. 45 Hearing.

46 It is by experience that we distinguish different sonorous bodies by their respective sounds.

Experience, however, would soon teach him, that the ear is its organ, and the sonorous body its cause; and he would in time learn to distinguish one sound, that of a trumpet for instance, from another, suppose the sound of a bell; and to attribute each to its proper cause, even when neither the trumpet nor the bell was perceived by his other senses. With respect to sounds which we have been accustomed to hear, this is done so instantaneously, that some philosophers have imagined it to be the effect of an instinctive principle in our nature, totally different from experience, and independent of reason. But the fact is not so. Long before we are capable of making sensation and perception objects of reflection, we have heard the sound produced by the ringing of a bell, and seen the object which produced the sound so often, that, when we hear a similar sound

Objects of the respective Senses. found again, we instantly refer it to a *bell*, though we see not the bell from which it proceeds: but this is the effect of habit, and not of instinct. Had we never perceived a bell while ringing by either of our senses of sight or touch, we could not by the sense of hearing acquire any notion of the figure or texture of the body from which the cause of the sound proceeds, though we had heard that sound every day of our lives. It is, indeed, by experience only that we learn to distinguish by the ear whether a sonorous body be before or behind us, on our right hand or on our left; for we find it always difficult to say from what precise quarter a strange sound proceeds; and this difficulty would be heightened to impossibility, had not all sounds something in common. Dr Sparrman relates, that when he first heard the roaring of a lion, he did not know on what side of him to apprehend danger, as the sound seemed to proceed from the ground, and to enclose a circle of which he and his companions stood in the centre. The same thing has happened to every man, when the sound was such as he had never heard before; even though it was neither so loud nor so terrific as the roaring of a lion in a desert wilderness: but with respect to sounds which we are daily hearing on each side of us, we soon learn to distinguish with tolerable accuracy whether they be before or behind us, above or below, on our right hand or on our left. All this, however, is the effect, not of instinct, but of experience improved into habit.

47

Sight originally perceives nothing but colours, which are mere sensations.

Sight is justly considered as the noblest and most comprehensive of all our senses. The reason is obvious: for when a full grown man opens his eyes, he perceives houses, trees, rivers, the earth, sun, and moon, &c. and to each of these objects belong figure, extension, colour, &c. which are all perceived instantly by means of this sense. Yet it is certain, that the sense of sight does not originally communicate to us so many perceptions; and there is abundant evidence, that an infant cannot at first, or for some weeks after its birth, distinguish by vision one object from another. *Colour* is the proper object of sight, and for some time its only object; but colour as perceived by us is a mere sensation, which can have no existence but in a sentient being. If this proposition stood in need of proof, we might observe that there are men, and even whole families, who possess the sense of sight in a degree of perfection sufficient for all the purposes of life, and yet cannot distinguish certain colours from each other; blue, for instance, from green, or perhaps from red: and there is no man who can distinguish between some particular shades of blue and green by the feeble light of a candle. Were colours the real qualities of body, this mistake of one for another could never be experienced. No man who possesses the sense of touch ever confounded hardness with softness, a sphere with a cube, or an ell with an inch. The reason is, that hardness and softness, figure, and extension, are the qualities of things external; whereas colour being a mere sensation, is nothing but an affection or modification of the sentient being. But it is obvious, that sentient beings, according as they differ from one another, may be differently affected by the same external cause; so that one man may perceive that to be green which all other men perceive to be blue. The immediate external cause of the sensation of colour, is the rays of light reflected from the body, which in common language is said to be coloured. These rays falling upon the pupil of the eye, are refracted differently, according as their incidence is more or less oblique into points on the retina, where they form a picture of the external object; and from the picture, by means of the optic nerve, is communicated to the brain some impulse or agitation, which produces vision or the perception of colour. As rays of light are corporeal substances, it is obvious that they can act upon body only by impulse; but between impulse and the various sensations of *red*, *green*, *blue*, &c. there is no resemblance. For the laws of reflection and refraction, and for the structure of the eye, see OPTICS and ANATOMY. That which we have to inquire into at present is, how we learn, by means of the sense of sight, to perceive the figure, magnitude, motion, and distance of external objects, or indeed to distinguish one object from another.

A ray of light proceeding, as all rays do, in a straight line, must, however great its length, affect the eye, retina, and optic nerve, as if it were a single point. From this obvious and undeniable fact, Bishop Berkeley predicted *, that a man born blind, who should be suddenly made to see, would at first perceive nothing without him, would distinguish neither the distance, size, figure, nor situation, of external objects; that he would only see in his eyes themselves, or, to speak more properly, would only experience new modifications in his mind, until joining *touch* to *sight*, he formed thus a communication with the external world, and learned, by the simultaneous exercise of the two senses, that natural language in which the *visible* is the sign of the *tangible*. This truth, which was discovered by the bishop merely by contemplating in his own mind the nature of sensation and the known laws of optics, after having been laughed at for more than 20 years as one of the many dreams of a visionary genius, was completely confirmed by the case of the famous patient whom Cheselden cured of a cataract; and that too, though the cataract does not produce total blindness: which makes it evident, that the first visual perceptions of the patient after his recovery could not be wholly new and unmixed. It may indeed be confirmed at any time by a simple experiment made upon an infant. For several weeks after birth, a child shuts not its eyes upon the sudden approach of an object to them, nor shows the least symptom of distinguishing one distance from another; and it is easy by a little attention to observe, how it gradually learns to distinguish objects at greater and greater distances. Indeed colour, or the immediate object of sight, being a mere sensation or affection of the mind, can have no natural relation whatever to any thing external.

* *Essay towards a new Theory of Vision.*

48

Perception of distance by sight, how acquired.

It is plain, therefore, that distance is in its own nature imperceptible to the eye, and yet it is often perceived by sight. How is this done? We think, in the following manner. Distance is one mode of extension, which, we have already seen, is perceived by means of touch. Of short distances, our first ideas are doubtless acquired by the stretching out and drawing back of our arms; and those ideas are soon so connected with certain sensations which we have in actual vision, that the latter instantly suggests the former. Thus,

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Thus, it is a fact known by experience, that when we look at a near object with both eyes, according as it approaches or recedes from us, we alter the disposition of our eyes, by lessening or widening the interval between the pupils. This disposition, or turn of the eyes, is attended with a sensation of which every man is conscious at the time of vision; and this sensation seems to us to be that which in this case suggests the idea of greater or less distance to the mind. Not that there is any natural or *necessary* connexion between the sensation of which we are conscious, and greater or less distance; for the sensation is wholly internal, and the distance is external. But because the mind has, by constant *experience*, found the different sensations occasioned by different dispositions of the eyes to correspond to different degrees of distance in the object, there has grown a habitual or customary connexion between those sensations and the notions of greater or less distance. So that the mind no sooner perceives the sensation arising from the different turn it gives the eyes in order to bring the *pupils* nearer or farther asunder, than it is instantly impressed with a certain notion of the distance which was wont to be connected with that sensation. Again, An object placed at a certain distance from the eye, to which the breadth of the pupil bears a sensible proportion, being made to approach nearer, is seen more confusedly; and the nearer it is brought, the confusion is always the greater. The reason of all this is known to every optician: but it being constantly experienced by those who never dipt into optics, there arises in the mind of every man a habitual connexion between the several degrees of confusion and distance; the greater confusion still implying the less distance, and the less confusion the greater distance. It is of no avail to say, that between confused vision and distance, great or small, there is no necessary connexion: for there is as little connexion between a blush in the face and the mental feeling of shame; and yet no sooner does a man of observation perceive that particular colour in the face of another, than it suggests to him the notion of that feeling or passion with which he has constantly observed it accompanied.

In these ways, however, we perceive only small distances. Of distances more remote our judgement is formed from other data; and happily these data are not far to seek. It is a fact known to every man who is not totally ignorant of the science of optics, that a greater number of rays fall upon the eye when reflected from a body near at hand, than can fall from the same body at a distance; and as those rays operate by impulse, it is self-evident that the impression must be stronger, and of course the sensation or colour more vivid, when the body is near than when it is distant. Now having acquired the notion of the true distance of objects by motion and the sense of touch, and finding by uniform experience, that as they are near or far off, the sensation or colour which they excite in the mind through the organ of vision is more or less vivid, those degrees of sensation come to be so closely associated with the respective distances of the object, that the one instantly suggests the other.

49 How figure is perceived by sight.

It is just so that we perceive figure by sight. Having experienced by the sense of touch that one surface is a square and another a circle, that one body is a cube and another a sphere; and finding our sense of sight differently affected by the square and the circle, by the cube and the sphere; these different affections come to be so closely connected in our minds with the figures of the respective bodies, that long before we are capable of reasoning on the subject the one is never present to us without suggesting the other. Nay, so complete in this case is the connexion or association, that we cannot even in idea abstract the colour from the figure; though it is certain that colour is a mere sensation, and figure an external quality; that colour alone is immediately perceivable by the eye, and the notion of figure suggested by the colour. We are aware that it has been affirmed, and affirmed with great vehemence, that figures of two dimensions are immediately perceived by the eye, and perceived with greater accuracy than by the sense of touch. But they who insist upon this doctrine affirm likewise, contrary to experience and the clearest reasoning, that the immediate objects of sight are external, and that colour is a quality of bodies. In the arguments too by which they support their hypothesis, they seem to confound sight as an affection of the mind, with the picture on the bottom of the eye, as if the retina were the sentient being; whereas the retina and picture are no more than instruments of sensation. It is indeed a fact, that the picture has the same figure nearly with the plane of the object which is presented to the eye; as when the object is a sphere, the picture is a circle variously shaded in colour. It is likewise a fact, that the picture is enlarged in proportion as the object is brought near, and diminished as it is carried to a distance. But these facts are known only to persons skilled in optics; and therefore it is evident, that though calculations may be raised from them by mathematicians to determine the distance and figure of external objects, they cannot possibly be the data from which distance and figure are inferred by the vulgar, who know not that such pictures on the retina exist. Besides all this, it is universally known, that a painter, by laying on his colours properly, can make a plain square surface appear to the eye in certain positions as an oblong or as a cube, and a plain circular surface as a concave or a convex hemisphere. But not one of these things could possibly be done, were figure, or indeed any thing else than colour, the immediate object of vision.

50 Magnitude.

As we see distance and figure, so we see magnitude; and we see both in the same way that we see shame or anger in the looks of a man. The impression made upon the bottom of the eye by rays reflected from a large magnitude, must necessarily be different from the impression made by rays reflected from a magnitude that is less. This is self-evident; and since the impression *ab extra* is in some way or other the cause of that sensation, which is all of which we are originally conscious in vision, it is obvious that the sensation, like every other effect, must correspond to the cause from which it proceeds. Being therefore conscious of different sensations; and having, at an earlier period than we distinctly remember, learned by experience to refer them to different magnitudes; no sooner is each sensation excited than it suggests the notion, or, if you please, the perception, of that magnitude with which it is connected. So completely is this association fixed in the mind, that when we look at a known object, its real

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51 Visible sensations a kind of natural language. Upon the whole, then, we think ourselves entitled to conclude, that the proper and original objects of vision constitute an universal language of the Author of Nature, by which we are instructed how to regulate our actions, in order to attain those things that are necessary to the preservation and well-being of our bodies, as also to avoid whatever may be hurtful or destructive to them. It is principally by the information of this language that we are guided in all the transactions and concerns of life: And the manner in which it signifies and marks to us the objects which are at a distance, is similar to that of languages and signs of human appointment, which do not suggest the things signified by any likeness or identity of nature, but only by a habitual connexion, which experience has made us to observe, between them. This language of the eye, like the language of the tongue, suggests by one sensation what may be resolved into a variety of perceptions. A tree is composed of a trunk, branches, leaves; it has colour, figure, size; and all these things are at once suggested to the mind by the two words *spreading oak*. Just so it is with respect to vision: the sensation received by the eye suggests at once the *trunk*, *branches*, *leaves*, *colour*, *figure*, and *size* of the oak, and suggests them all as the qualities of one object.

Chap. II. *Of* Retention *and* Ideas.

52 Sensations and perceptions remain for a very short time after the removal of their objects. FROM the experiment with the burning coal mentioned in N° 31. it is apparent, that sensations excited through the eye, together with their correspon'ing perceptions, remain in the mind for a short time after the external exciting cause is removed. The same thing appears from another experiment which was first made by Sir Isaac Newton, and which every man may repeat for his own satisfaction. It is universally known*, that a proper mixture of the seven original colours, *red*, *yellow*, *green*, *blue*, &c. constitutes that uniform appearance which we call *white*. But when these colours are made to pass in a rapid consecution before the eye, they excite the very same perception as when they are properly mixed, which is a satisfactory proof that the impression made by each separate colour remains in the brain until a revolution of all the colours be completed; for nothing but the impression of all the colours at *once* can produce the sensation and perception of *white*. Indeed no person capable of paying the proper attention to these things, can keep his eye fixed upon a luminous object, and afterwards shut it, without experiencing that the sensation and perception remain for some time after the external object is shut out, and that they go off gradually till they leave behind them the mental appearance, which is properly called an *idea* of the object.

* *Hartley on Man.*

Retention and Ideas. The same continuance of the sensation after the removal of its cause is equally observable in the sense of hearing; for every sound which we hear is reflected by the neighbouring bodies; and therefore consists in reality of a variety of sounds succeeding each other at different distances of time, according to the distances of the several reflecting bodies. Yet this causes no confusion or apparent complexity of sound, unless when the distance of the reflecting bodies is very considerable, as in spacious buildings.

With respect to the continuance of the sensation of touch, doubts have been started; but for these there is as little room as for doubting the continuance of the sensations of seeing and hearing. The continuance of heat after the heating body is removed, and of the smart of a wound after the instant of infliction, are proofs that every sensation of touch does not vanish with its cause. A man unused to the motion of a ship or a coach, after having been a day at sea or on the road, feels or imagines he feels the rolling of the ship or the jolting of the coach after he is in bed and actually at rest. Of these facts we know not what other account can be given, than that the agitation in the brain, which is the immediate cause of the sensation of touch, remains for some time after the external cause of the agitation is removed.

As to the senses of taste and smell, Dr Hartley seems to think that there is no clear and direct evidence for the continuance of their sensations after their proper objects are removed: but in this instance the ingenious author does not do justice to his own theory. Let any man eat onions, garlic, or any other thing of a very pungent taste, and immediately wash his mouth with fresh water, so that he may be sure no part of the sapid body remains on his tongue or palate. According to this doctrine, the taste of the onion or garlic should instantly vanish with its object; but the fact is otherwise. Whoever shall make the experiment, will find the sensation to remain a considerable time; not indeed in its original force, but weakened no more than what it must necessarily be by the introduction of a new sensation excited by the water. It is more difficult to ascertain the permanency of smell: but analogy inclines us to believe, that in this particular it resembles the other senses, though we know not how to direct the reader to an experiment which will give him absolute conviction.

Whether the cause of these continued sensations, after the removal of their objects, be in the brain alone, in

Retention and Ideas.

in the mind alone considered as an immaterial being, or in both together, is of very little importance; because, taking the mind and its internal organs as one

53 Hence we have that power or faculty called *memory*.

*metaphysical whole**, it matters not to our present inquiry, where this retentive power resides, as long as it can be proved to exist within us: for it seems evident, that what has the faculty of retaining a sensation when no longer acted upon by the object which excited it, must also have a power to preserve the vestiges of that sensation even after the sensation itself shall be entirely obliterated. This is in fact the case with the mind. When an object which we have once perceived is most remote from our thoughts, we are certain that there is within us a capacity, disposition, tendency, or power, by which a representation of that object may be at any time revived and presented to the intellect. Thus the same inherent power of the mind and its internal organs, which retains a sensation and perception in the absence of the object by which they were excited, can also reproduce that perception, or bring into the view of the intellect something exactly similar to it. The reproduction will not indeed be so lively as the original perception when accompanied with its corresponding sensation, because sensation and actual perception are affected by a double cause, the action of the external object upon the organ, nerves, and brain, and the corresponding energy of the mind or sentient principle; whereas, in the reproduction, the mind seems to act solely by its own power, and certainly without the assistance of external objects. This reproductive power is commonly called *memory*. By many of the ancient philosophers, and by *M. Shcwab*, with one or two others among the moderns, it is called *imagination*. We do not choose either to revive antiquated modes of expression, or to introduce innovations of our own; but as we cannot disapprove of the ancient phraseology, after the definitions which the reader will by and by find of *imagination*. *memory*, and *recollection*, as given by Mr Harris, we have prefixed to this chapter the general title of *retention*, which comprehends them all.

* See *An Essay on the Reduction of the Faculties of the Mind, by M. Schwab.*

54 The opinions of philosophers respecting memory.

When one recalls an object of sight by the power of memory, it appears to him precisely the same as in the original survey, only less distinct, and with a conviction (which is perhaps the result of experience) that the real object is not immediately before him. How is an object recalled by the power of memory? Does the man endeavour to form in his mind a picture or representative image of the object? Let us listen to the answers given by different philosophers to this question.

55 The Peripatetics and Platonists

The sentiments of the Peripatetics, as expressed by *Alexander Aphrodisiensis*, one of the earliest commentators on *Aristotle*, are thus translated by Mr Harris in his Hermes.—"Now, what fancy or imagination is, we may explain as follows: We may conceive to be formed within us, from the operation of the senses about sensible subjects, some impression (as it were), or picture in our original sensorium, being a relict of that motion caused within us by the external object; a relict which, when the external object is no longer present, remains, and is still preserved, being as it were its image; and which, by being thus preserved, becomes the cause of our having memory. Now such a sort of relict, (and as it were) impression, they call *fancy* or *imagination* (E)." A passage from Alcinous *of the doctrines of Plato*, as rendered into English by Dr Reid †, shows, that in this theory, as in that of perception, the Platonists agreed with the Peripatetics. "When the form or type of things is imprinted on the mind by the organs of the senses, and so imprinted as not to be deleted by time, but preserved firm and lasting, its preservation is called *memory*."

† *Essays on the Intellectual Powers of Man.*

Mr Harris, who was deeply read in the ancient philosophy, and who considered the authority of Aristotle and Plato as superseding all reasoning and all inquiry, after justly observing, that if the soul had no other faculties than the senses, it could never acquire the least idea of *time*, thus expresses himself on the subject before us:—"But happily for us we are not deserted here. We have, in the first place, a faculty called *imagination* or *fancy*; which, however as to its *energies* it may be subsequent to sense, yet is truly prior to it both in *dignity* and *use*. This it is which *retains the fleeting forms of things*, when things themselves are gone, and *all sensation* is at an end. That this faculty, however connected with sense, is still perfectly different, may be seen from hence. We have an *imagination* of things that are gone and extinct; but no such things can be made objects of *sensation*. We have an easy command over the objects of our *imagination*, and can call them forth in almost what manner we please; but our *sensations* are necessary when their objects are present, nor can we controul them but by removing either the objects or ourselves. As wax would not be adequate to its business of signature, had it not a power to retain, as well as receive; the same holds of the SOUL, with respect to *sense* and *imagination*. SENSE is its *receptive* power: IMAGINATION its *retentive*. Had it sense without imagination, it would not be as wax but as water; where, though all impressions may be instantly made, yet as soon as made they are entirely lost. Thus then, from a view of the two powers taken together, we may call SENSE (if we please), *a kind of transient imagination*; and IMAGINATION, on the contrary, *a kind of permanent sense*."

56 distinguish properly between imagination and memory, &c.

Great part of the office which is here given to imagination, is in common English attributed to memory; but between these two faculties, as well as between them and recollection, the author accurately distinguishes thus:—"When we view some *relict* of sensation reposed within us, *without thinking of its rise*, or *referring it to any sensible object*, this is FANCY or IMAGINATION. When we view some such *relict*, and *refer it withal to that sensible object which in time past was its*

(E) The original is as follows: Τι τοινυν εστιν ἡ φαντασια ωδε αν γνωρισαιμεν δει νοειν εν ημιν απο των ενεργειων των περι τα αισθητα, οιον τυπον τινα αναζωγραφημα εν τω πρωτω αισθητηριω, εγκαταλειμμα τι της υπο του αισθητου γινομενης κινησεως, ὃ και μηκετι του αισθητου παροντος υπομενει τε και σωζεται, ον ωσπερ εικων τις αυτου, ον και της μνημης ημιν σωζομενον αιτιον γινεται το τοιουτον εγκαταλειμμα, και τον τοιουτον ὥσπερ τυπον, φαντασιαν καλουσιν. *Alex. Aphrod. de Anima*, p. 135. *Edit. Ald.*

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its cause and original, this is MEMORY. Lastly, The *road which leads to memory through a series of ideas however connected, whether rationally or casually*, this is recollection."

57 Objections to their theory.

Of this theory we shall only remark, that if we could understand the words *picture* and *form* in a metaphorical sense, as candour obliges us to understand Locke's *images* in the mind, the doctrine of *Alexander Aphrodisiensis* would be very little wide of the truth. Experience teaches us that memory as well as perception depends upon the state of the brain; and as it is undeniable, that when a man to-day contemplates an object which he perceived yesterday, or at any former period, he has a view of it in all respects similar to the original perception, only fainter and less distinct, it is extremely probable, that an impression *ab extra*, which produces a sensation and perception, leaves behind it some *tendency* in the brain, to vibrate as in the actual sensation, and that this *tendency* is carried into *effect* by the internal energy of the mind itself. But in the Peripatetic philosophy, *pictures* and *forms* in the *sensorium* were considered as real things, and by no means as metaphorical expressions. This is evident from their being constantly compared to the impression of a seal upon wax, and from their converting the *materia prima* from something, which can neither be seen nor felt, into visible and tangible body, of which we shall treat afterwards. Now it being certain that on a being immaterial, no corporeal *form* can be impressed, and repeated dissections having shown that no such forms are in fact impressed on the brain, this whole theory is at once overturned.

58 Locke's doctrine concerning memory

Modern philosophers having denied that there are real *images* or *forms* in the mind during the immediate act of perception, cannot consistently with themselves admit such images in the act of retention, or when those things which were formerly objects of perception are recalled to the mind by the power of memory. Mr Locke's doctrine is, "that the mind retains these simple ideas which it first received from sensation or reflection, two ways: first, by keeping the idea, which is brought into it, for some time actually in view, which is called CONTEMPLATION: and secondly, by the power which we have to revive again in our minds those ideas, which, after imprinting, have disappeared, or have been, as it were, laid out of sight; as when we conceive heat or light, yellow or sweet, the object being removed. This (he says) is MEMORY; which is, as it were, the storehouse of our ideas †.

† *Essay*, book ii. chap. 10.

To explain this more fully, he immediately adds the following observation:—"But our ideas being nothing but actual perceptions in the mind, which cease to be any thing when there is no perception of them, this laying up of our ideas in the repository of the memory, signifies no more than this, that the mind has a power, in many cases, to revive perceptions which it has once had, with this additional perception annexed to them, that it has had them before. And in this sense it is, that our ideas are said to be in our memories, when indeed they are actually nowhere; but only there is an ability, in the mind, when it will, to revive them again, and, as it were, paint them anew on itself, though some with more some with less difficulty, some more lively and others more obscurely. And thus it is, by the assistance of this faculty, that we are said to have all those ideas in our understandings, which, though we do not actually contemplate them, yet we can bring in sight, and make appear again, and be the objects of our thoughts, without the help of those sensible qualities which first imprinted them there."

To attempt a defence of the accuracy of this language would be vain; but as the author's meaning is sufficiently obvious, his expressions may be easily and certainly corrected. Had Locke said—"But our ideas being nothing but scenes or appearances in the mind, which cease to be any thing when there is no perception of them, this laying up of our ideas in the repository of the memory signifies no more but this, that the mind has a power, in many cases, to revive scenes which it has once viewed, with this additional perception annexed to them, that it has viewed them before;" there would have been no room for the many petulant remarks which have been made upon the passage.

59 objected to.

But against this account of memory, a much heavier charge has been brought than that which regards the propriety of the language. It has been said, that the additional perception, which, according to Locke, attends the revival of our ideas by the power of memory, "would be a fallacious perception, if it led us to believe that we had them before, since they cannot have two beginnings of existence: nor can we believe them to have two beginnings of existence; we can only believe that we had formerly ideas or perceptions very like to them, though not identically the same." Let us examine this question somewhat narrowly: for if it be really true, that in the sense in which the word *same* is here used, we cannot twice contemplate the same idea, all confidence in memory would seem to be at an end.

60 The objection obviated.

Suppose a man to stand on some of the rising grounds about Edinburgh, the Caltonhill for instance, and from that eminence to view the glorious prospect of the coast of Fife, the ocean, the frith of Forth, and the little islands scattered in the frith. Let him go away, and return next day to the same place, and look the same way: we would ask whether he has the same *view* or *perception* which he had the day before? The man must surely be very captious who would say that he has not: and yet it is certain that the energy of mind by which he perceives on one day cannot be identically the same with that by which he perceived on another; nor are the rays of light which fall upon his eyes on the second day, identically the same with those which fell upon his eyes and occasioned vision on the first day. Let the same man now shut his eyes, and contemplate the various objects at which he had been just looking. They will appear to him in all respects the same as when viewed by means of his organs of sight, only fainter and less distinct, with this additional conviction, that the immediate objects of his present contemplation are not real external things, but *ideas* or *mental representations* of those things which had so lately been the objects of his sight. Let him think no more about the matter for some days, and then exert his powers of memory. We have no hesitation to say, that in the sense of the word *same*, as used by Mr Locke, the very same ideas will recur-

recur and be present to his intellect which were present to it at the former contemplation. The second energy of memory or imagination, or whatever it may be called, is not indeed identically the same with the first; nor is that agitation or motion, or whatever other affection of the brain is necessary to memory, identically the same at the second time as at the first: but the mind exerting itself in the very same manner at the one time as at the other, produces the same kind of agitation in the brain, and is itself affected in the very same way at the second as at the first exertion. Whence it follows, that the second *ideal scene* will be as much the same with the first, as the second *actual perception* is the same with the first; and the two ideal scenes, and the two actual perceptions, are respectively said to be the same with each other, only because they impress the mind with a conviction that they were occasioned by the same external objects.

But though we think Locke's doctrine, with respect to memory, may be thus easily vindicated from the charge of fallaciousness, we must acknowledge that to us it appears not to be of much value. It teaches nothing, but that the mind has a power to retain ideas of those objects which it formerly perceived, and in many instances to recal them as occasion may require. But these are truths known to all mankind, to the clown as well as to the philosopher.

61 The opinion of Hume.

Philosophers in general have paid less regard to the retentive faculties of the mind than to its original powers of perception. Perhaps they imagined, that as memory depends upon perception, and in some respects appears to resemble it, a competent knowledge of the nature of the former faculty would lead to that of the second. Be this as it may, Mr Hume, who was at some pains to detail his notions of perception, has in his Philosophical Essays only dropt concerning memory and imagination a few hints, so loosely thrown together, that, if he had not elsewhere expressed himself with more precision, it would have been difficult to discover his real meaning. According to him, that which is commonly called the *perception of an external object*, is nothing but a strong impression upon the mind; and that which is called the *remembrance of a past object*, is nothing but a present impression or idea weaker than the former. Imagination is an idea weaker than the idea or impression which he calls *memory*. This seems to be a wonderful abuse of language. Impressions are not perceptions; and, if possible, they can still less be called *ideas*, which are but secondary perceptions. It is likewise far from being true, that an idea of imagination has necessarily less vivacity than an idea of memory. We have seen Mr Hume, and have at the present moment an idea of his form and dress: we can likewise imagine to ourselves a centaur; and though a centaur was never seen, and therefore cannot be *an impression repeated by memory*, our idea of the monster is much more lively and distinct than that of the philosopher.

62 Of Dr Reid.

Dr Reid having observed of memory *, that it is by it we have an immediate knowledge of things past; that it must have an object; that in this respect it agrees with perception, but differs from sensation, which has no object but the feeling itself; and that every man can distinguish the thing remembered from the remembrance of it—proceeds to inquire what memory is. And, "First (says he), I think it appears that memory is an original faculty given us by the Author of our being, of which we can give no account but that we are so made. The knowledge (continues he) which I have of things past by my memory, seems to me as unaccountable as an immediate knowledge would be of things to come (F); and I can give no reason why I should have the one and not the other, but that such is the will of my Maker. I find in my mind a distinct conception and a firm belief of a series of past events; but how this is produced I know not. I call it *memory*; but this is only giving a name to it; it is not an account of its cause. I believe most firmly what I distinctly remember; but I can give no reason of this belief. It is the inspiration of the Almighty which gives me this understanding. When I believe the truth of a mathematical axiom or of a mathematical proposition, I see that it must be so: every man who has the same conception of it sees the same. There is a necessary and an evident connexion between the subject and the predicate of the proposition; and I have all the evidence to support my belief which I can possibly conceive. When I believe that I washed my hands and face this morning, there appears no necessity in the truth of the proposition. It might be or it might not be. A man may distinctly conceive it without believing it at all. How then do I come to believe it? I remember it distinctly. This is all I can say. This remembrance is an act of my mind. Is it impossible that this act should be, if the event had not happened? I confess I do not see any necessary connexion between the one and the other. If any man can show such a necessary connexion, then I think that belief which we have of what we remember will be fairly accounted for: but if this cannot be done, that belief is unaccountable; and we can say no more but that it is the result of our constitution. Our original faculties are all unaccountable: Of these memory is one. He only who made them comprehends fully how they are made, and how they produce in us not only a conception, but a firm belief and assurance, of things which it concerns us to know."

On this account of memory we shall make no remarks. There is a certain sense of the words, in which every thing which the author has said on the subject is undoubtedly

* *Essays on the Intellectual Powers of Man.*

(F) If memory depends upon the state of the brain as it has been affected in past perceptions, this appears to us a strange position. Perhaps the excellent author means nothing more, than that it is as unaccountable to us, that impressions on the brain should cause perception, and the vestiges of those impressions should cause remembrance, as how the mind might not perceive things to come without the intervention of impressions on the brain. If this be his meaning, no man will controvert it: for it is impossible to discover the nature of that relation which subsists between an impression and perception; but that there is such a relation, we know from experience.

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undoubtedly juſt; and it would be very uncandid to take his words in any other ſenſe. But though memory, as it is the reſult of that conſtitution which was given us by God, and not the offspring of habit or human contrivance, is unqueſtionably an original faculty; and though it is therefore impoſſible to account for it ſo fully as to ſilence every inquiry which may be made, yet we could wiſh that Dr Reid had beſtowed a little more pains upon it, in order to diſcover if poſſible in what reſpects it reſembles or differs from perception. He has well obſerved, that there are laws of nature by which the operations of the mind are regulated, as well as laws of nature which govern the material ſyſtem. As the latter are the ultimate concluſions which the human faculties can reach in the philoſophy of bodies, ſo the former are the ultimate concluſions which we can reach in the philoſophy of minds. The more general that theſe laws are in both caſes, the more uſeful they are and the more ſatisfactory: for as they are themſelves inexplicable, the fewer they are in number, and the more comprehenſive each, the fewer will thoſe phenomena be for which we can give no account. Thus, as we know not what makes the planets tend to the centre of the ſun, or heavy bodies tend to the centre of the earth, we can give no other account of theſe phenomena, but that, as they appear to be of the ſame kind, it is reaſonable to conclude that they proceed from ſimilar cauſes. What the cauſe is of this tendency of bodies towards each other, we know not. We call it *gravitation*, and employ it to account for all phenomena of the ſame kind. In like manner it is univerſally allowed, that as we know not how mind and matter operate upon each other, there is ſomething in perception wholly unaccountable. That perception follows ſenſation; and that there is no ſenſation which is not occaſioned by ſome affection of the brain, proceeding from ſome impreſſion *ab extra*; we have the evidence of experience: but how a particular affection of the brain ſhould excite a ſenſation in the mind, we know not; though we may here, as in the corporeal ſyſtem, attribute ſimilar effects to the ſame or ſimilar cauſes. Thus, if when we exert an act of memory we have the ſame appearance of things as in the original act of perception, the rules of philoſophizing authorize us to refer both phenomena to the ſame general law; juſt as they authorize us to refer the motion of the planets and of projectiles to the ſame general law. On the other hand, if we perceive no ſimilarity between memory and perception, we have made no progreſs in the philoſophy of mind; for in that caſe we have diſcovered two phenomena proceeding from two cauſes totally different from each other, and both inexplicable. Although we ſcarcely hope to throw any light upon a ſubject which Dr Reid has not attempted to illuſtrate, we ſhall ſtate a few facts reſpecting the memory, and ſubmit to the reader the concluſions to which we think theſe facts lead.

63 The appearance of ſenſible objects when recalled by the power of memory.

1. Objects once perceived by the ſenſes, when recalled to the mind by the power of memory, appear preciſely the ſame as in the original perception, only leſs diſtinct *. For example, having ſeen yeſterday a ſpreading oak growing on the bank of a river, and having heard a ſhepherd play, and handled a ſquare ſtone, we endeavour to recal to our mind theſe objects which are now abſent. How is this operation performed? Do we endeavour to form in our minds pictures of them or repreſentative images? or, does our intellect ſurvey the types or forms which, according to Ariſtotle, thoſe objects left in the imagination when originally perceived? Neither of theſe things is done. We conceive ourſelves as ſtanding in the ſame place where we ſtood yeſterday; upon which we have perceptions of the objects ſimilar in all reſpects to the perceptions which we had when we employed our eyes, our ears, and our hands. The tree appears, as it were, before us; faint indeed, but attended with all the objects which we obſerved around it yeſterday: we ſeem to hear the ſound of the pipe confuſedly, and at a diſtance; to move our hands over the ſtone, and to feel the ſame ſurfaces and the ſame angles which we felt in the original perception. In this recollection we are not conſcious of pictures or images more than in the original ſurvey. The perceptions ſeem to be of the tree and river themſelves, of the ſound itſelf, and of the ſtone itſelf, exactly as at the firſt; and yet we are ſatisfied that in the act of remembrance we perceive no ſuch object as a *real* tree, pipe, or ſtone. That theſe are facts, every man muſt be convinced who attends to the energies of his own mind when exerting the powers of retention: and therefore it is, in our opinion, with no impropriety that Mr Harris ſays, we may call SENSE, if we pleaſe, *a kind of tranſient imagination*; and IMAGINATION, on the contrary, *a kind of permanent ſenſe*; for if theſe two faculties, as far as the mind or intellect is concerned, be not the ſame, they ſeem to reſemble each other much.

* *Appendix to Elements of Criticiſm.*

64 What ideas remain longeſt in the memory.

2. The *primary* perception of a *viſible* object is more complete, lively, and diſtinct, and remains longer in the *ſenſorium*, than that of any other object. We know likewiſe by experience, that an *idea* or *ſecondary* perception of a viſible object is as much more complete, lively, and diſtinct, than the idea of any other object, as was the *primary* perception; and that we remember things which we have ſeen for a longer time than ſounds which we have heard, or than tangible objects which we have only handled. Yet there ſeems to be a conſtant decay of all our ideas, even of thoſe which are ſtruck (G) deepeſt and in minds the moſt retentive; ſo that if they be not frequently renewed by repeated exerciſe of the ſenſes, or by reflection on thoſe objects which at firſt occaſioned them, the print (G) wears out,

(G) Theſe expreſſions, which mention ideas as things which are *deep ſtruck*, and as *prints which wear out*, are the expreſſions of Locke. We hope it is needleſs to warn our readers, that they are uſed by us, as they were by him, in a metaphorical ſenſe. On theſe ſubjects it is impoſſible to write without metaphor; which, while the meaning is obvious, no man will condemn, who reflects that the words of language were not invented by metaphyſicians, and are for the moſt part *literally* ſignificant only of ſenſible objects.

out, and at last there remains nothing to be seen. Concerning ideas, it is easy to remark, that those remain longest and clearest in the memory which are derived from two or more senses, especially if the sense of sight be one of the number, or which are oftenest refreshed by a return of the objects which produced them. Hence a man has a longer and more distinct remembrance of what he has seen than of what he has only heard, of what he has both seen and felt than of what he has only seen; and the ideas which we have of heat and cold, of hunger and thirst, and of all those things which most frequently affect our senses, are extremely clear, and are never quite lost whilst the mind retains any ideas at all.

65 Memory a kind of habit.

3. Memory appears to be a kind of habit, which is not always in exercise with regard to things we remember, but is ready to suggest them when there is occasion. The most perfect degree of this habit is, when the thing presents itself to our remembrance spontaneously, and without labour, as often as there is occasion. A second degree is, when the thing is forgotten for a longer or shorter time, even when there is occasion to remember it, and yet at last some incident, such as a violent passion *, which agitates the whole mind and sensorium, tumbles the idea, as it were, out of its dark corner, and brings it into view without any search. A third degree is, when we cast about and search for what we would remember, and after some labour find it out. This searching faculty of the soul is by Aristotle called αναμνησις, by Dr Reid and others *reminiscence*, and by Mr Harris *recollection*. Should it be said, that what we *will* to remember we must already conceive, as we can will nothing of which we have not a conception; and that, therefore, a *will* to remember a thing, seems to imply that we remember it already—we answer, with Dr Reid, that when we will to remember a thing, we must indeed remember something relating to it; but we may have no positive idea or conception of the thing itself, but only of the relation which it bears to that other thing which we do remember. Thus, one remembers that a friend charged him with a commission to be executed at such a place, but he has forgotten what the commission was. He applies himself to discover it; and *recollects* that it was given by *such a person*, upon *such an occasion*, in consequence of such a *conversation*: and thus by a train of thought he is led to the very thing which he had forgotten and wished to remember. To this operation it is not always necessary that the relations between the various ideas which the mind turns over be very close, or have their foundation in nature; for a casual connexion is often sufficient. Thus, from seeing a garment, we think of its owner; thence of his habitation; thence of woods; thence of timber; thence of ships; thence of admirals; thence of cannons, iron, furnaces, and forges," &c.

* *Reid's Essays on the Intellectual Powers of Man*, *Locke's Essay*, &c. and *Harris's Hermes*.

66 In recollection one idea suggests another, and why.

That, in the process of recollection, one idea should suggest another, may be easily accounted for. When, in perception, our minds are exposed to the influence of external objects, all the parts and properties, and even the accidental variable adjuncts of these objects, are perceived by full-grown men at the same time; so that the whole group makes but one impression upon our organs of sense, and consequently upon the mind. By these means all the parts of the simultaneous impression †, and consequently of the perception occasioned by that impression, are so intimately associated or linked together, that the idea of any one of them recurring at any future period, generally introduces the ideas of all the rest. But as the necessary parts and properties of any thing are more closely linked together, and occur more frequently than any particular variable adjuncts, it is obvious, that by the idea of any one of these properties, the idea of the rest, and of the object itself, will be more readily introduced than by the idea of any variable adjunct. It seems, however, to be certain, that we have no power of calling up any idea at pleasure, but only such as have a connexion, either in nature or by means of former associations, with those that are at any time present to the mind. Thus the sight, or the idea, of any particular person, generally enables us to recollect his name, because his name and his person have been constantly associated together. If that fail to introduce the name, we are at a loss and cannot recollect it at all till some other associated circumstance help us. In naming a number of words in a sentence, or lines in a poem, the end of each preceding word or line being connected with the beginning of the word or line which succeeds it, we can easily repeat them in that order; but we are not able to repeat them backwards with any ease, nor at all till after many fruitless efforts. By frequent trials, however, we acquire at last a facility in doing it, as may be found by making the experiment on the names of number from one to twenty. It is, indeed, probable, that in the wildest flights of *fancy*, no single idea occurs to us but such as had a connexion with some other idea, perception, or notion, previously existing in the mind, as shall be shown more fully in a subsequent chapter.

† *Hartley on Man.*

67 Memory depends on the state of the brain.

4. "Memory appears to depend entirely or chiefly upon the state of the brain *. For diseases, concussions of the brain, spirituous liquors, and some poisons, impair or destroy it; and it generally returns again with the return of health, from the use of proper medicines and methods. It is observable, too, that in recovering from concussions and other disorders of the brain, it is usual for the person to recover the power of remembering the then present common incidents for minutes, hours, and days, by degrees; also the power of recalling the events of his life preceding his illness. At length he recovers this last power perfectly; and at the same time forgets almost all that past in his illness, even those things which at first he remembered for a day or two. Now the reason of this seems to be, that upon a perfect recovery the brain recovers its natural state, and all its former affections and tendencies; but that such affections or tendencies as took place during the preternatural state, i. e. during the patient's illness, are obliterated by the return of the natural state." All this we are induced to believe; because, though it is a fact incontrovertible, that in certain diseases the memory is impaired, and recovers its vigour with the return of health, it is not conceivable that the mind itself should suffer any change by diseases, concussions, or spirituous liquors, &c.

* *Hartley on Man.*

From these facts we are strongly inclined to conclude,

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clude, that the power of the *mind*, or *immaterial* (H) *principle*, by which it remembers past events, differs not from that by which it perceives present objects. In perception, impressions are made upon the organs of sense, which are communicated to the brain; and, by some unknown means, occasion sensations which are followed by the perception of the external object. When by the power of memory we recal past objects of sense, the mind has the same view of them as in the original perception, except that they appear fainter, less distinct, and generally more distant. We have, therefore, reason to conclude, that in the act of remembrance the brain is affected in the same way, though not so forcibly, as in perception. That memory depends as much as perception upon the state of the brain, is confirmed by daily experience; and therefore there cannot be a doubt but that external objects, operating upon the senses, nerves, and brain, leave some permanent effect behind them. What that effect precisely is we cannot know, and we need not desire to know; but that they leave *some* effect we have as good evidence as that the planets are moved round the sun by forces of the same kind with those by which projectiles are moved on the earth. Could we suppose that they leave real *prints* or *impressions* behind them, which we confess to be very little probable, memory would seem to be nothing but the perceptive power of the mind turned to those impressions. If the permanent effect of impressions by external objects be, as Dr Hartley supposes, only a tendency in the brain to vibrate as in the original perception, remembrance will result from the mind's operating upon the brain as in actual perception; and the reason that ideas of memory are fainter than perceptions of sense, is, that the former are produced by a single, and the latter by a double, operation.

68 External objects operating on the senses leave some permanent effect in the brain.

69 Why the memory advances to perfection, and then gradually decays.

This theory appears to be greatly confirmed by the following well known facts, that children soon commit to their memory any thing which they understand, and as soon forget it; that the powers of memory gradually advance to perfection, and then gradually decay; and that old men remember more distinctly what they perceived in their youth, than what they perceived a year ago. For if the memory belonged wholly to the pure intellect, and had no dependence upon the brain, it is not easy to conceive how it should advance towards a state of perfection and afterwards decay. A being which is unextended and indivisible, can suffer no change either in its essence or in its faculties: the ideas which it had once retained, it would retain for ever. But if memory be occasioned by some relict of sense left in the brain, it is easy to see how all those changes should take place: and therefore, though we have the weight of Dr Reid's authority against us, we cannot help thinking that Aristotle was in the right, when he imputed the shortness of memory in children to this cause, that their brain is too moist and soft to retain impressions made upon it; and that he was likewise in the right, when he imputed the defect of memory in old men to the hardness and rigidity of the brain, which hinders it from receiving any durable impression.

Another argument to prove, that in remembrance the mind acts upon something left in the brain by the impressions of sense, is this, that nothing can act but where it is present. The truth of this axiom is acknowledged by Dr Reid, and we believe by all mankind except Dr Priestley and one or two others, whose paradoxes we shall consider afterwards. Now it is confessed, that in recollection at least the mind is active; and therefore it must act, *not* upon an object which has now perhaps no existence, and certainly no immediate existence, *but* upon something left by that object in the brain or sensorium, to which the mind is intimately present.

70 By what means we never confound memory with perception.

But if this be so, we may be asked how it comes to pass that men never confound memory with perception, nor fancy that they perceive things which they only remember? If perception be an inference drawn from certain sensations excited by an impression on the brain, and if remembrance result from the mind's operating upon relicts of those impressions, one would think it natural to suppose, that in both cases we have actual perceptions, though in the one case the perception must be more vivid and distinct than in the other. To this we answer, That previous to all experience, perception and memory are very probably confounded; and that we believe a man brought into the world with all his faculties in their full *natural* perfection, would not instantly be able to distinguish what he remembered from what he perceived. This we know to be the case with respect to imagination, a faculty which strongly resembles memory; for in dreams, and sometimes even in waking reveries, we fancy that we actually perceive things which it is certain we can only imagine. A very short experience, however, would enable this newly created man to make the proper distinction between remembrance and perception. For let us suppose him to be brought into a dark room, and soon afterwards a candle to be introduced. The candle would give him a visible sensation, though not at first the perception of an external object. Let the candle after some time be carried out: the man would retain a visible *idea*, which he might confound with the actual sensation. But if, whilst this idea remained in his mind, the candle were brought back, he would instantly feel a difference between the real sensation and the idea, when both were together present to his mind. And having, in some such manner as we have already described, acquired the power of perceiving external objects by means of his senses, he would soon discover, without any effort of his own, the difference between actual perceptions and the ideas treasured up in his memory.

(H) Through the whole of this and the preceding chapters, we have taken it for granted, that the sentient principle in man is not material. This is the *common*, and, as shall be shown afterwards, the most *probable* opinion; but whether it be absolutely certain or not, makes no difference on the theories of sensation and perception. These are obviously neither figure nor motion, and therefore not subject to the laws which govern the material world.

Retention and Ideas.

71 The order of succession in which objects recur to the memory.

The only remaining difficulty which seems to encumber this theory of remembrance, is, to account for the order of succession in which objects recur to the memory, and to which we give the name of *time*.—But this difficulty will vanish when we have ascertained what *time* is. At present it is sufficient to observe, that our perceptions of external objects remain a certain space of time in the mind; that this time is different, according to the strength and other circumstances of the impression which occasioned the perception; and that traces of those perceptions, i. e. *ideas*, may be recalled after the intervention of other trains of ideas, and at very different intervals. If one look upon a house, and then shut his eyes, the impression which it made upon his mind will not instantly vanish: he can contemplate the house almost as long as he pleases; and, by the help of various associated circumstances, he may recal the idea several years afterwards, and refer it to the original perception.

72 Brutes have memory, and

Before we dismiss the subject of retention, it may not be improper to take notice of the retentive powers of inferior animals. Aristotle, Locke, Dr Reid, and almost every philosopher of eminence both among the ancients and moderns, have maintained, that inferior animals have memory as well as men; and indeed we do not perceive how the fact can be denied of the more perfect animals, and those with whose operations we are best acquainted. A dog knows his master again after a long absence; a horse will trace back a road which he has but once travelled, often with more accuracy than his rider; and it is well known that many species of singing birds have a capacity to learn tunes from the human voice, and that they repeat the notes again and again, approaching nearer and nearer to perfection, till at last they sing the tune correctly. These phenomena can be accounted for only by supposing, that in the brains of the several animals traces are left by perception, of the same kind with those which perception leaves in the brain of man, and which are the cause or occasion of his remembrance. With respect to this point, the learned author of *Ancient Metaphysics* differs from his master Aristotle. He allows that brutes have imagination, but denies that they have memory: for (says he) "memory necessarily implies a sense of *time*, and what is *first* and *last*; but brutes have no idea of time, or of first and last; and it is certain that they have not consciousness or reflection, by which only they could review their own operations. At the same time he admits, that imagination in the brute serves the purpose of memory in us; for whenever he sees the object that is painted on his *phantasia*, he knows it again, but without any perception of the time when he first saw it." But that a brute, when he sees the object which is painted on his phantasia, should know it *again* without referring it to a former perception, is plainly impossible. The recognisance of any thing consists in a consciousness of its having been perceived before; and nothing more than such recognisance is essential to memory. The author's mistake seems to lie in supposing that memory necessarily implies a sense of some determinate portion of past time; but we surely remember many things of which we can only say that we have formerly perceived them, without being able to ascertain the precise period at which we had such perceptions. A child has the use of memory sooner than he acquires the faculty of speech; but he must have spoken and even reasoned before he can have an accurate notion of time, which, as shall be shown afterwards, arises from comparing the fleeting succession of our own ideas with the permanence of ourselves and other objects. The author's distinction between memory and imagination seems to be on all accounts improper. Aristotle has said, and said truly, that there is memory of *ideas* as well as of sensible objects; meaning by ideas general conceptions or propositions: but this reviver of his philosophy is inclined to say, "that *memory* is only of *ideas*, consequently belongs only to man; and that *imagination* is only of sensible objects, and consequently belongs both to man and brute."—But surely man *remembers* what he has *seen* and *felt* as well as what he has *conceived* or *thought*; and if imagination and memory be properly distinguished by Mr Harris, the reverse of this writer's doctrine must be true, viz. that imagination belongs only to *man*, and memory of sensible objects both to *man* and *brute*.—We can contemplate in imagination the idea of a *centaur* or a *golden mountain*; but we cannot be said to remember them, for they were never perceived. That a dog can contemplate in his imagination the idea of a *centaur* or of a *golden mountain*, we have not the least reason to suppose; but were he not capable of viewing relicts of sense reposed with him, and referring them to their original causes, he could not possibly recognise his master after a day's absence.

73 the power of recollection.

Dr Reid and the same author agree with Aristotle, in thinking it probable that brutes have not reminiscence, or the power of recollection; but there are many well-attested facts which seem to prove the contrary. We shall mention one which fell under our own observation. One of the persons concerned in this work was, when a young man, absent for five months from the house of his father. Upon his return, a dog of that species which is commonly called the *shepherd's cur*, and which had been in the possession of his father only a few months before his departure, gazed at him for a few minutes as at any other stranger. The animal then began to walk round him with looks which soon attracted his notice. This made him call the dog by the name which he bore in the family, and stretch out his hand to caress him, when the creature instantly leaped upon him with all that appearance of attachment which these animals so commonly exhibit upon the return of their master after a few days absence. If this was not recollection, we should be glad to know what it was, for we cannot distinguish it from recollection in men. Indeed, if dogs and some other animals possess, as Aristotle, Locke, and others, allow them to possess, the power of memory, and something of ratiocination; and if, as Dr Reid expressly says *, "they expect events in the same order and succession in which they happened before;" it is not conceivable that they can be wholly destitute of reminiscence, or the power of recollection.

* *Essays on the Intellectual Powers of Man.*

74 Memory capable of improvement.

That memory is a faculty of the first importance, cannot be denied; since it is obvious, that, without the power of retaining the ideas and notions which we receive by the senses and other faculties, we never could make any progress in the acquisition of knowledge, but should begin every day, nay every hour, in the

same

Of Simple Apprehenſion and Conception. ſame ſtate of ignorance in which we are born. That it is a faculty capable of improvement by exerciſe, and that there are ſome methods of exerciſe better adapted for this purpoſe than others, has been ſhown elſewhere. See MEMORY.

CHAP. III. *Of* SIMPLE APPREHENSION *and* CONCEPTION.

75 Ideas of ſenſation the firſt materials of human knowledge. THE ideas received into the mind by the ſenſes, and treaſured up in the memory and imagination, are the original materials of human knowledge. It is by comparing thoſe ideas with one another, or by analyzing them into their firſt principles, that we acquire all our knowledge in mathematics and philoſophy, and indeed all the knowledge which regulates our conduct through life. It muſt, therefore, be of importance to trace the progreſs of the mind in her various operations upon theſe materials; beginning, as ſhe certainly begins, with that which is moſt ſimple, and proceeding regularly to thoſe which are more complex and difficult.

76 Simple apprehenſion of ideas. Now the firſt operation of the mind about her ideas appears plainly to be that which logicians term *ſimple apprehenſion*. Having yeſterday obſerved a *tree* or any other object, if we contemplate the idea of that tree to day as it remains in the imagination, without comparing it with any other idea, or referring it to any external object, we perform the operation which is called *ſimple apprehenſion*. We conſider ſimple apprehenſion as an *operation*, becauſe the mind in the apprehenſion of her own ideas is certainly active; ſhe turns them, as it were, round and round, and views them on every ſide.

77 different from conception. *Simple apprehenſion* is a phraſe which is commonly taken to be of the ſame import with the word *conception*; and in the ordinary affairs of life no confuſion can ariſe from an indiſcriminate uſe of the two words: but in this article we think it expedient to employ the phraſe *ſimple apprehenſion*, to denote the view or contemplation of thoſe ideas only which the mind by ſenſation has actually received from external objects; and the word *conception* to denote the view, not only of thoſe ideas, but alſo of ſuch as the mind fabricates to herſelf. Thus, a man may *conceive* a centaur, but we would not chooſe to ſay that he may *apprehend* a centaur: not that there is any impropriety, perhaps, in this laſt expreſſion; but as there is certainly a difference between *apprehending* the idea of what has been ſeen or felt, and *conceiving* that which never exiſted, perſpicuity requires that theſe different operations be expreſſed by different names.

78 In what ſenſe it is true that we can conceive objects which never exiſted. We have ſaid that the mind may conceive what never exiſted: and every man may eaſily ſatisfy himſelf that what we have ſaid is true: but though this has been frequently called the creative power of the mind, it has in fact no reſemblance to *creation*. The materials of all our moſt complex and fantaſtic conceptions are furniſhed to our hands by ſenſation and reflection; nor can we form one ſimple idea which was not originally received by ſome of our ſenſes from external objects, or, as ſhall be ſhown afterwards, one intellectual notion which was not acquired by reflecting on the operations of our own minds. To explain the proceſs of fantaſtic conception, it is to be obſerved, that in every ſenſible object we perceive at once ſeveral things, ſuch as *colour*, *figure*, *extenſion* and *motion* or *reſt*, &c. Theſe are the objects of different ſenſes: but they are not, at leaſt by full-grown men, perceived in ſucceſſion, but all at once; whence it comes to paſs that the memory, or the imagination, retains not ſeveral diſtinct and disjointed ideas, but the idea of *one coloured*, *figured*, and *extended object*. But when we compare various objects, or the ideas of various objects, together, we find that in ſome reſpects they agree and in others diſagree; i. e. that ſeveral objects affect ſome of our ſenſes in the ſame way, and other ſenſes differently. Thus one globe is black, and another white; one black ſubſtance is circular and hard, and another ſquare and ſoft. In the firſt inſtance, the two globes affect our ſenſe of touch in the ſame way, and our ſenſe of ſeeing differently; in the ſecond, the two black ſubſtances affect our ſenſe of ſight in the ſame way, and our ſenſe of touch differently.

From obſerving this difference among objects by means of the different ſenſations received from them, the mind learns to analyze its original ideas, which are copies of thoſe ſenſations, into their firſt principles, and to combine thoſe principles in ſuch a manner as to form complex ideas of objects which were never actually perceived by the ſenſes. Of the ſimple and unmixed principles which compoſe thoſe complex ideas, there is not indeed one which was not originally received by ſome ſenſe; ſo that the whole difference between complex ideas fabricated by the mind, and thoſe which are the relicts of ſenſation, conſiſts in the order in which the conſtituent ſimple ideas of each are put together. Thus, no man ever ſaw a mountain of pure gold; and therefore the idea of ſuch a mountain can be in no human mind as a relict of ſenſation; but we have all ſeen pieces of gold of different ſizes, and we have all ſeen mountains; and nothing is more eaſy than to *conceive* a piece of gold extended on all ſides to the ſize of a mountain, and riſing out of the earth. Again, Though no perſon ever ſaw a centaur, yet it is eaſy to *conceive* the upper parts of a man joined to the breaſt and ſhoulders of a horſe. In theſe inſtances, the complex conceptions are of things which it is in the higheſt degree probable never had a real exiſtence, and which it is certain we never *perceived* as exiſting: but the ſimple ideas of which they are compoſed are the relicts of actual ſenſations; for every one has perceived as really exiſting the body of a horſe and the upper parts of a man, and when conceiving a centaur he only perceives them to exiſt united. That we have not in the imagination one ſimple and unmixed idea which was not left there as a relict of ſenſe, every man will be convinced who ſhall try to conceive a ſimple colour or taſte which is totally different from all the colours and taſtes, and all the ſhades and varieties of them, which he has received by ſenſation; but his ſimple ideas, though all received from without, he may put together in numberleſs manners, differing from any order in which he has ever actually perceived the qualities of external objects exiſting. 79

This power of conception limited to poſſible exiſtence. Yet even this power of the mind is limited. It is impoſſible to put together a number of *contrary* and *inconſiſtent* ideas, in ſuch a manner as to form of them one complex conception. No man, for inſtance, can conceive a thing to be at once white and black, round and ſquare, hard and ſoft, in motion and at reſt.—Hence it is a maxim among philoſophers almoſt univerſally received, that though we can conceive many things which never *actually* exiſted, yet we can form no ideas but of ſuch things as *might poſſibly exiſt*. A centaur never exiſted, but it may be conceived; for it is by no means impoſſible that the head of a man might be joined to the body of a horſe: but black ſnow cannot be *conceived;* for in the complex idea denoted by the word *ſnow* whiteneſs is an eſſential part, and nothing can be conceived to be both black and white at the ſame time. From this undoubted fact, that we cannot conceive impoſſible exiſtence, the power of conception has by ſome writers in certain inſtances been made a teſt of truth. "In every idea is implied (ſays Dr Price*) the poſſibility of the exiſtence of its object; nothing being clearer, than that there can be no idea of an impoſſibility, or conception of what cannot exiſt." "It is an eſtabliſhed maxim in metaphyſics (ſays Hume), that whatever the mind conceives, includes the idea of poſſible exiſtence; or, in other words, that nothing we imagine is abſolutely impoſſible †." In a word, it has been admitted by all philoſophers, from Pythagoras to Dr Reid, to be an axiom as evident and undeniable as any in Euclid, that whatever we can diſtinctly conceive is poſſible, though many things may be poſſible, nay, may really exiſt, of which we can form no conception.

* *Review of the principal Queſtions and Difficulties in Morals.*

† *Eſſays.*

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The ſingular opinion of Dr Reid reſpecting our power of conception

This axiom has been denied by the author of the Eſſays on the Intellectual Powers of Man; who affirms, that "any two ſides of a triangle may be conceived to be equal to the third," as diſtinctly as "any two ſides of a triangle may be conceived to be greater than the third." This aſſertion from ſuch a man ſurpriſed us as much as any paradox which we ever read: for nothing is more certain, than that *we* ourſelves can form no conception of a triangle of which two of the ſides are only equal to the third. We can, indeed, reſolve the propoſition into its different parts, and form the diſtinct and independent ideas of a *triangle, two ſides*, and *one ſide;* and we can likewiſe form the general notion of *equality:* but to combine theſe ideas and this notion into one individual complex conception, we find to be abſolutely impoſſible. A man who knows nothing of triangles, if ſuch a man there be, might *believe* Dr Reid that it is a figure of which one of its ſides is equal to the other two; but ſuch a perſon would have no *conception* of the *figure itſelf*, but only a confidence in the doctor's veracity.

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controverted.

What is it to *conceive* a corporeal thing to exiſt? Is it not to fancy that we view it on all ſides, as what may be ſeen, or felt, or ſmelt, or taſted? The doctor, indeed, repeatedly reprobates as the ſource of much error the notion of ideas as images in the mind; and if ideas be taken as real material figures, he is certainly in the right: But we appeal to the common ſenſe of mankind, whether every perſon who diſtinctly *conceives a triangle*, is not at the time conſcious that his mind is affected in a manner ſimilar, though not ſo forcibly, as when he actually views a triangle with his eyes? What other men may feel, they know beſt; but we are as certain that this is the caſe with reſpect to ourſelves, as we are certain of our own exiſtence. That this affection of the mind is occaſioned by ſome agitation in the brain, of the ſame kind with that which occaſions actual perception, is highly probable; but whatever be the cauſe, the fact is undeniable.

The doctor's words, indeed, taken by themſelves, would lead one to think, that by *conception* he means in this caſe nothing more than the underſtanding of the terms of a propoſition: but if that be his meaning, there was no room for controverſy; as the great philoſophers *Cudworth, Clarke, Price*, and *Hume*, whoſe opinion he is combating, would have been as ready as himſelf to allow, that when a man is thoroughly maſter of any language, he will find no difficulty in underſtanding the meaning of any particular words in that language, however abſurdly theſe words may be put together. When Dr Price ſays, that "in every idea is implied the poſſibility of the exiſtence of its object, nothing being clearer than that there can be no idea of impoſſibility or conception of what cannot exiſt," his meaning evidently is, that we cannot mentally contemplate or fancy ourſelves viewing any thing corporeal, which we might not actually view with our eyes, or perceive by ſome other ſenſe (K). This is the true meaning of *conception*, which is ſomething very different from underſtanding the ſeparate meaning of each word in a propoſition.

The learned profeſſor, however, appeals to the practice of mathematicians for the truth of his opinion: and if they be on his ſide, we muſt give up the cauſe; for in no ſcience have we ſuch clear ideas, or ſuch abſolute certainty, as in mathematical reaſonings. But it is to be obſerved, that the word *conception* is with

(K) Dr Price may be thought by ſome to have contradicted in this paſſage what he had aſſerted in a former. He is a ſtrenuous advocate for abſtract and general ideas even of material objects; but thoſe among the moderns who contend the moſt zealouſly for theſe, contend for them only as conceptions of the mind which can have no poſſible exiſtence out of it. Were this likewiſe the opinion of Dr Price, he would certainly have fallen into a direct contradiction; but this is not his opinion. His notion of abſtract ideas ſeems to be the ſame with that of Plato, who conſiders ideas not only as the poſſibilities of exiſtence, but as things actually exiſting from eternity, uncreated and independent even of the Supreme Mind. That Dr Price carries the matter thus far, we are unwilling to believe; but he certainly conſiders general ideas as real exiſtences independent of *our* minds, though the immediate objects of our underſtanding. That in this notion he is miſtaken, we ſhall endeavour to prove in the next chapter. It is enough for our preſent purpoſe to have ſhown that he does not contradict himſelf; and that he might with great propriety affirm on his own principles, as well as upon the principles of thoſe who admit not of univerſal ideas, that in every idea is implied the poſſibility of its object.

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with no propriety applied to *abstract truth*, but to *real* or *possible* existence; nor can we be said to conceive distinctly a *real* or *possible* object, unless we be able to turn it round and round, and view it on all sides.—The faculties which are conversant about *abstract truth* are the judgement and the reason; and truth itself consists in the agreement, as falsehood does in the disagreement, of two or more ideas or terms compared together. If those ideas about which the judgement is to be made can be immediately brought together, without the intervention of a third idea, it is impossible that we should *judge*, or, if Dr Reid will have it so, *conceive* that to be *true* which is *really false*. If the two ideas cannot be immediately brought together, it is impossible that we should form any *judgement* or *conception* at all about their *agreement* or *disagreement*: but we may *suppose* or *admit*, for the sake of argument, that they agree or disagree; and if that supposition conduct to a manifest absurdity, we then *know* that the supposition was false. It is, therefore, perfectly agreeable to the maxim of Price and Hume, that mathematicians should in many cases prove some things to be possible and others impossible, which without demonstration would not have been believed; because if the ideas compared cannot be immediately brought together, no *judgement* previous to the demonstration can be formed of the truth or falsehood of the proposition; and if it concern not real or possible existence, it is a proposition with which *conception* has nothing to do.

"But (says Dr Reid) it is easy to *conceive*, that, in the infinite series of numbers and intermediate fractions, some one number, integral or fractional, may bear the same ratio to another as the side of a square bears to its diagonal." We are so far from thinking this an easy matter, that if the word *conceive* be taken in the sense in which it is used by the philosophers whose opinion he is combating, we must confess that we can form no adequate conception at all of an infinite series. When we make the trial, we can only bring ourselves to *conceive* the real numerical figures 1, 2, 3, &c. or the fractional parts $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, &c.; and even here our *conception* reaches but a small way. We have reason to believe, that minds of a larger grasp can conceive at once more of the series than we can; and that the Supreme Mind conceives the whole of it, if the whole of a mathematical infinity be not a contradiction in terms: but surely no man will say that he can conceive an infinite series as he conceives a centaur, and have an adequate and distinct view of it at once. If, by conceiving that in an infinite series some one number may bear the same ratio to another that the side of a square bears to its diagonal, the doctor only means that such a *supposition* may be made, his observation is not to the purpose for which it is brought; for the question is not about our power to make suppositions of this kind, but about our power to raise in our imaginations an adequate and distinct mental view of possible or impossible existence. "To suppose (says Johnson), is to advance by way of argument or illustration, without maintaining the truth of the position." In this sense a man may *suppose* that in an infinite series there may be some one number which bears the same ratio to another that the side of a square bears to its diagonal: but such a supposition contains in it nothing that is *positive*, which conception always does; it is only admitting, for the sake of argument, a position, of the truth or falsehood of which the person who makes the supposition knows nothing.—He is only talking of ratios as a blind man may talk of colours. A man born blind may be made to comprehend many of the laws of optics, and may make suppositions about colours, and reason from such suppositions to a certain extent, as clearly and justly as one who sees; but will any person say that a man blind from his birth can conceive *red* or *green*? It is much the same with respect to an infinite series. We can follow such a series so far, and may know the ratio by which it increases or decreases, and reason from what we know with the utmost certainty: but no man ever *conceived the whole of an infinite series* as he conceives an individual object; nor can any reasonings upon the nature of it be applied to the question of conceiving impossible existence.

But "mathematicians often require us (says Dr Reid) to conceive things that are impossible, in order to prove them to be so. This is the case in all their demonstrations *ad absurdum*. Conceive (says Euclid) a right line drawn from one point of the circumference of a circle to another, to fall without the circle. I conceive this, I reason from it, until I come to a consequence that is manifestly absurd, and from thence conclude that the thing which I conceived is impossible." If it be indeed true, that Euclid desires his readers to conceive a mathematical circle with a line drawn from one point of its circumference to another, and that line lying without the circle—if he really desires them to form such a complex conception as this, we have no hesitation to affirm, that he requires them to do what is manifestly impossible. The writer of this article has not in his custody any copy of the Elements in the original Greek, and therefore cannot say with certainty what are Euclid's words, nor is it of much importance what they be; for on a question which every man may decide for himself, by looking into his own mind, the authority of Euclid is nothing.—The proposition to which the doctor refers, is the second of the third book; and, in the edition of Simpson, is expressed thus: "If any two points be taken in the circumference of a circle, the straight line which joins them shall fall within the circle." Every mathematician who can form an adequate conception of a circle and a straight line, perceives the truth of this proposition instantly, for it results necessarily from his conception; but he who has not an adequate conception of a circle, *may* stand in need of a demonstration to show him the truth: for it is to be observed, that demonstration does not *make truth*; it only points it out to those who cannot perceive it intuitively, just as a microscope does not make the hairs on a mite's back, but only brings them within the field of vision.

Were a man who never examined a mite through a microscope, and who has no adequate ideas of the insect kingdom, to be asked whether there be hairs on a mite's back? he would probably answer that he did not know, but he could *conceive* no such hairs. In like manner, were a man who has no adequate conception of a mathematical circle, to be asked whether a straight line, which joins any two contiguous points in the circumference, could lie *without* the circle? he would probably

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bably anſwer that he did not know. Now it is to be remembered, that the reader of the Elements can have no very adequate conception of a circle when he comes to the ſecond propoſition of the third book. The definition of a circle was indeed given him in the introduction to the firſt book; but of that definition he has hitherto had occaſion to make very little uſe, ſo that his idea of a circle will be little more accurate than that of an illiterate clown, who has no other idea of the figure than what he takes from a halfpenny or a ſhilling. Dr Reid himſelf has elſewhere * well obſerved, that "when a youth of moderate parts begins to ſtudy Euclid, every thing at firſt is new to him. His apprehenſion is unſteady; his judgement is feeble, and reſts partly upon the evidence of the thing, and partly upon the authority of his teacher: but every time he goes over the definitions, the axioms, the elementary propoſitions, more light breaks in upon him; the language becomes familiar, and conveys clear and ſteady conceptions." In this ſtate he certainly is when he reads for the firſt time the ſecond propoſition of the third book: his conception of a circle can then be neither clear nor ſteady. Our young geometrician, however, muſt allow, that the propoſition is either true or falſe; and if he has read the preceding books with any advantage, he muſt have clear and ſteady conceptions of angles and triangles, and be able to demonſtate many of their properties. "Well (ſays Euclid), though you have no adequate conception of a circle, you are well acquainted with plane angles and triangles, and many of their properties: let us ſuppoſe, if that be poſſible, that my propoſition is falſe, and I will ſhow you that the ſuppoſition is abſolutely inconſiſtent with what you know to be demonſtrable or ſelf-evident truth." This is all which Euclid can be ſuppoſed to require, when, in the words of his excellent tranſlator, he ſays, "If it (viz. the ſtraight line) do not fall within (the circle), let it fall, if poſſible, without." He could not poſſibly deſire a man who has an adequate idea of a circle, to form the poſitive and complex conception of that figure, with a ſtraight line touching two points of the circumference, and yet lying on the outſide of the circumference; becauſe all his figures and lines are mere conceptions, and not real material things; and ſuch a requeſt would have been the ſame thing as if he had ſaid, Conceive what cannot be conceived (L).

† See *Lord Kames's Sketches of the Hiſtory of Man*; Appendix to the firſt Sketch on the Sciences.

Of Abſtraction and general Ideas.

We have inſiſted the longer on this point, becauſe we think it of the higheſt importance: for were it indeed true, that we could conceive impoſſible exiſtence, the conſequences would be very melancholy. Theſe conſequences it is needleſs to enumerate. Our readers will perceive, that if we could put together inconſiſtent ideas of ſenſible objects, and view them ſo united as one conſiſtent whole, nothing is clearer than that our faculties would be contrived to deceive us, and we would be doomed to cheerleſs and univerſal ſcepticiſm.

Chap. IV. *Of* Abstraction *and* general Ideas.

82 Every ſenſible object and every idea are individual.

Every ſenſible object is an individual, and differs in many reſpects from every other object. As ſuch it is perceived by the ſenſes; and ideas being nothing more than relicts of ſenſation preſerved in the imagination or memory, every idea muſt of courſe be an individual, as much as the object to which it refers. But all ſcience, whether mathematical, moral, or metaphyſical, is converſant about general truths; and if truth conſiſt, as we have already obſerved, and ſhall more fully evince afterwards, in the agreement or coincidence of ideas, how, it may be aſked, can general truth reſult from the compariſon of particular ideas? To get rid of this difficulty, many philoſophers, both ancient and modern, pretend that the mind is furniſhed with *general ideas*, from a compariſon of which reſult general propoſitions applicable to many individuals. Philoſophers, indeed, have differed in opinion reſpecting the ſource of thoſe ideas, ſome of the ancients deriving them immediately from the Supreme Mind to the human, whilſt almoſt all the moderns ſays that they are framed by abſtraction, and therefore call them *abſtract ideas*.

83 The doctrine of abſtract ideas ſtated, and

The doctrine of *abſtract* ideas has been ſo fairly ſtated, and, in our opinion, ſo completely overturned, by Biſhop Berkeley, that we ſhall content ourſelves with abridging what he has ſaid on the ſubject, and obviating

(L) Principal Campbell, treating of the commonly received doctrine of abſtraction, and having ſhown, that though Locke has in one paſſage of his immortal work expreſſed himſelf on the ſubject in terms unintelligible, his ſentiments on the whole differed little from thoſe of Berkeley and Hume, adds, "Some of the greateſt admirers of that eminent philoſopher ſeem to have overlooked entirely the preceding account of his ſentiments on this ſubject; and, through I know not what paſſion for the paradoxical (I ſhould rather ſay the impoſſible and unintelligible), have ſhown an amazing zeal for defending the propriety of the haſty expreſſions which appear in the paſſages formerly referred to. Has not the mind of man (ſay they) an unlimited power in moulding and combining its ideas? The mind, it muſt be owned, hath an unlimited power in moulding and combining its ideas. It often produces wonderful forms of its own out of the materials originally ſupplied by ſenſe; forms indeed of which there is no exemplar to be found in nature:—centaurs and griffins,

Gorgons and hydras, and chimeras dire.

But ſtill it muſt not attempt abſolute impoſſibilities, by giving to its creature contradictory qualities. It muſt not attempt to conceive the ſame thing to be black and white at the ſame time; to be no more than three inches long, and yet not leſs than three thouſand; to conceive two or more lines to be both equal and unequal; the ſame angle to be at once acute, obtuſe, and right;" or, we may add, the two ſides of a triangle to be not greater than the third. See *Philoſophy of Rhetoric*, vol. ii. p. 108, &c.

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obviating some cavils which have lately been urged against his reasoning. "It is agreed on all hands (says that learned and ingenious prelate †), that the qualities or modes of things do never really exist each of them apart by itself and separated from all others; but are mixed, as it were, and blended together, several in the same object. But, we are told, the mind being able to consider each quality singly, or abstracted from those other qualities with which it is united, does by that means frame to itself abstract ideas. For example: There is perceived by sight an object extended, coloured, and moved: this mixed or compound idea, the mind resolving into its simple constituent parts, and viewing each by itself exclusive of the rest, does frame the abstract ideas of extension, colour, and motion. Not that it is possible for colour or motion to exist without extension; but only that the mind can frame to itself by *abstraction* the idea of colour exclusive of extension, and of motion exclusive of both colour and extension. Again, The mind having observed, that in the particular extensions perceived by sense, there is something common and alike in all, and some other things peculiar, as this or that figure or magnitude, which distinguish them from one another; it considers apart, or singles out by itself, that which is common, making thereof a most abstract idea of extension, which is neither line, surface, nor solid, nor has any figure or magnitude, but is an idea entirely prescinded from all these. So likewise the mind, by leaving out of the particular colours perceived by sense that which distinguishes them one from another, and retaining that only which is common to all, makes an idea of colour in abstract, which is neither red, nor blue, nor white, nor any other determinate colour. And as the mind frames to itself abstract ideas of qualities or modes, so does it by the same precision or mental separation attain abstract ideas of the more compounded beings, which include several coexistent qualities. For example: The mind having observed that *Peter*, *James*, and *John*, resemble each other in certain common agreements of shape and other qualities, leaves out of the complex or compounded idea it has of *Peter*, *James*, and any other particular man, that which is peculiar to each, retaining only what is common to all, and so makes an abstract idea wherein all the particulars equally partake, abstracting entirely from and cutting off all those circumstances and differences which might determine it to any particular existence. After this manner, it is said, we come by the abstract idea of *man*, or, if you please, humanity or human nature, in which, it is true, there is included colour, because there is no man but has some colour; but then it can be neither *black*, nor *white*, nor any *particular* colour, because there is no one particular colour wherein all men partake. So likewise there is included stature; but then it is neither tall stature, nor low stature, nor middle stature, but something abstracted from all these; and so of the rest. Moreover, there being a great variety of other creatures that partake in some parts, but not all, of the complex idea of *man*; the mind, leaving out those parts which are peculiar to man, and retaining those only which are common to all the living creatures, frameth the idea of *animal*; which abstracts not only from all particular men, but also from all birds, beasts, fishes, and insects. The constituent parts of that abstract idea of animal, are body, life, sense, and spontaneous motion. By *body*, is meant body without any particular shape or figure, there being no one shape or figure common to all animals, without covering either of hair or feathers or scales, &c. and yet not naked; hair, feathers, scales, and nakedness, being the distinguishing properties of particular animals, and for that reason left out of the *abstract idea*. Upon the same account, the spontaneous motion must be neither walking, nor flying, nor creeping: it is nevertheless motion; but what that motion is, it is not easy to conceive.

† *Introduction to the Principles of Human Knowledge.*

84 controverted; and

"Whether others have this wonderful faculty of *abstracting their ideas* (continues the bishop), they best can tell; for myself, I find indeed that I have a faculty of imagining or representing to myself the ideas of those particular things which I have perceived, and of variously compounding and dividing them. I can imagine a man with two heads, or the upper parts of a man joined to the body of a horse. I can consider the hand, the eye, the nose, each by itself abstracted or separated from the rest of the body. But then, whatever hand or eye I imagine, it must have some particular shape, and some particular colour.—Likewise the idea of man that I frame to myself, must be either of a white, or a black, or a tawney, a straight or a crooked, a tall or a low, or a middle-sized man. I cannot by any effort of thought conceive the abstract idea above described. To be plain, I own myself able to abstract in one sense, as when I consider some particular parts or qualities separated from others with which, though they are united in some objects, yet it is possible they may really exist without them. But I deny that I can abstract one from another, or conceive separately those qualities which it is impossible should exist so separated; or that I can frame a general notion by abstracting from particulars in the manner aforesaid; and there are grounds to think most men will acknowledge themselves to be in my case."

85 shown to be absurd.

To think this, there are indeed such good grounds, that it is probable some of our readers, little conversant with the writings of modern metaphysicians, are by this time disposed to suspect, that the bishop in his zeal may have misrepresented the doctrine of *abstraction*; as no man in his senses, who is not perverted by some darling hypothesis, can suppose himself capable of tagging together such monstrous inconsistencies, as magnitude which is neither large nor small, and colour which is neither white, red, green, nor black, &c. But that the ingenious prelate, in his account of this process of *lopping* and *pruning*, as Mr Harris contemptuously, but most properly, terms it, has not exaggerated in the smallest degree, is apparent from the following account of *abstraction* given by Mr Locke. "*Abstract ideas* (says that writer) are not so obvious or easy to children, or the yet unexercised mind, as particular ones. If they seem so to grown men, it is only because by constant and familiar use they are made so: for when we nicely reflect upon them, we shall find that general ideas are fictions and contrivances of the mind that carry difficulty with them, and do not so easily offer themselves as we are apt to imagine. For example, does it not require some pains and skill to form the general idea of a

triangle

triangle (which is yet none of the moſt abſtract, comprehenſive, and difficult)? for it muſt be neither oblique nor rectangle, neither equilateral, equicrural, nor ſcalenon, but *all and none of theſe at once.* In effect, it is ſomething imperfect that cannot exiſt, an idea wherein ſome parts of ſeveral different and *inconſiſtent* ideas are put together." "Surely (to uſe the words of Principal Campbell *) the bare *mention* of this hypotheſis is equivalent to a confutation of it, ſince it really confutes itſelf." But if any man has the faculty of framing in his mind ſuch an idea of a triangle as is here deſcribed, it would be vain in us to diſpute with him; for we are poſſeſſed of no ſuch faculty, and therefore would fight on unequal terms. All we have to deſire is, that the reader would fully and certainly inform himſelf whether he has ſuch an idea or not; and this can be no hard taſk to perform. What is more eaſy for any one than to look a little into his own thoughts, and there try whether he has, or can attain to have, an idea of *colour* ſeparated from all *extenſion*; of *extenſion*, which is neither *great* nor *ſmall*; of *taſte*, which is neither *ſweet* nor *bitter*, nor *acid*, nor *agreeable*, nor *diſagreeable*; or the general idea of a triangle, which is neither *oblique* nor *rectangle*, *equicrural*, *equilateral*, nor *ſcalenon*, *but all and none of theſe at once* (M)?

* *Philoſophy of Rhetoric.*

86
Abſtract conceptions the ſame with abſtract ideas.

Dr Reid having denied that there are or can be in the mind any *ideas* of ſenſible objects, rejects of courſe the doctrine of *abſtract general ideas*, whilſt he maintains in fact the ſame thing, only ſubſtituting the word *conception* for the word *idea*. "What hinders me (ſays he) from attending to the whiteneſs of the paper before me, without applying that colour to any other object?" We know nothing indeed which can hinder any man from performing this operation, which is daily and hourly performed by infants; but will the doctor ſay, that he can attend to colour, or conceive it, abſtracted from the paper and every other ſurface? We are perſuaded he will not, though he immediately adds, "the whiteneſs of this individual object is an *abſtract conception*." Now we ſhould rather have thought, that, conſiſtent with his own notions of colour, he would have called the whiteneſs of the paper a *concrete quality*, and his own conception of it a *particular* and *concrete conception*. If he conceives the whiteneſs as ſeparated from the paper, it is no longer the whiteneſs of that individual object: and he muſt either conceive it as abſtracted from *all* objects, which is plainly impoſſible: or he muſt conceive it as inhering in ſome other object; and then neither the quality of whiteneſs, nor his conception of it, is abſtract in general, but concrete and particular. He affirms, however, "that in abſtraction, ſtrictly ſo called, he can perceive nothing that is difficult either to be underſtood or practiſed." This is going much farther into the doctrine than Mr Locke went; for he owned that there was much difficulty in it. Let us ſee how it becomes ſo eaſy to Dr Reid. "What can be more eaſy (ſays he) than to diſtinguiſh the different attributes which we know to belong to a ſubject? In a man, for inſtance, to diſtinguiſh his ſize, his complexion, his age, his fortune, his birth, his profeſſion, and twenty other things that belong to him." All this indeed, and much more, we can do with the utmoſt eaſe; but this is not abſtraction, ſtrictly ſo called, nor any thing like abſtraction. We diſtinguiſh the ſize, the complexion, the age, &c. of the man, from *one another:* but ſtill we conceive them all as *his* qualities; nor is it poſſible, at leaſt for us, *to abſtract them from him*, without conceiving them as the qualities of ſome *other* man; ſo that *our* conceptions are all concrete and particular. "It ought likewiſe to be obſerved (ſays the Profeſſor), that attributes may with perfect eaſe be diſtinguiſhed and *disjoined* in our conception, which cannot be *actually ſeparated* in the ſubject." They may be ſo in his conception, but certainly not in ours; for *we* can conceive nothing which may not actually exiſt. "Thus (continues he) I can in a body diſtinguiſh its ſolidity from its extenſion, and its weight from both. In extenſion, I can diſtinguiſh length, breadth, and thickneſs; yet none of theſe can be ſeparated from the body, or from one another. It is therefore *certain*, that attributes, which in their nature are abſolutely inſeparable from their ſubject and from one another, may be disjoined in our conception; one *cannot exiſt* without the other, but one *can be conceived* without the other." So far is this from being a matter of *certainty*, that in every poſſible ſenſe in which we can underſtand the word *conception*, it appears to us as evidently *falſe*, as that *three* and *two* are equal to *nine*. It is indeed not difficult to diſtinguiſh *in* a body its ſolidity from its extenſion, and its weight from both: but can we diſtinguiſh them *out* of the body? or, to ſpeak in plain language, can we conceive *ſolidity* as ſeparated from *all extenſion* and *all weight?* Unleſs this can be done, and by *us* it cannot be done, there is no *abſtraction ſtrictly ſo called*. It is indeed eaſy to conceive *ſolidity* or *extenſion* abſtracted from *any one* individual object: but how is it done? Why, by transferring your attention to ſome other *individual object*. Thus, we can eaſily conceive *ſolidity* or *extenſion* ſeparated from a guinea, for inſtance; but it is only by transferring our thoughts to another body, *a piece of ſilver*, or a *ball of lead*, &c. and our conceptions in both caſes are *particular* and *concrete*.

As we think this opinion of Dr Reid's reſpecting ABSTRACTION both ill-founded and of dangerous conſequences, we have expreſſed our diſſent from it in ſtrong terms; and in doing ſo we have only followed the example ſet us by himſelf when diſſenting from the theories of Hume and Berkeley. But we are ſo thoroughly

(M) "If ſuch an extraordinary faculty (abſtraction) were poſſible, I cannot for my part conceive what purpoſe it could ſerve. An idea hath been defined by ſome logicians, the form or reſemblance of a thing in the mind; and the whole of its power and uſe in thinking is ſuppoſed to ariſe from an exact conformity to its archetype. What then is the uſe or power of that idea, to which there neither is nor can be any archetype in nature, which is merely a creature of the brain, a monſter that bears not the likeneſs of any in the univerſe?" *Philoſophy of Rhetoric*, vol. ii. p. 110.

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roughly convinced that the doctor's acuteneſs is ſuperior to our own (M), that we are not without our fears that we may have miſtaken his meaning. We are conſcious that we have not wilfully miſrepreſented it; and to enable our readers to judge for themſelves between him and us, we ſhall lay before them his definition of *general conceptions* in his own words.

87 Terms, how they are

That there are in every language *general terms*, is known to all mankind; for ſuch are all ſubſtantives, proper names excepted; and all adjectives. But "it is impoſſible (ſays the doctor*) that words can have a general ſignification, unleſs there be conceptions in the mind of the ſpeaker and of the hearer, of *things* (N) that are *general*. It is to ſuch that I give the name of *general conceptions*: and it ought to be obſerved, that they take this denomination, not from the act of the mind in conceiving, which is an individual act; but from the object or thing conceived, which is general." Now, whatever is conceived, muſt be either *external* to the mind, or *preſent* with it. But the doctor himſelf acknowledges, "That all the objects we perceive are individuals. Every object of ſenſe, of memory, or of *conſciouſneſs*, is an individual object. All the good things we enjoy or deſire, and all the evils we feel or fear, muſt come from individuals; and I think I may venture to ſay, that every creature which God has made in the heavens above, or in the earth beneath, or in the waters under the earth, is an individual." If this be ſo, and no man can call it in queſtion, it is obvious that we can have no *general* conception of any thing *external*. The *act* of conceiving is *an individual act*; and therefore the only thing which can be *general*, muſt be ſomething preſent with the mind, and different from the *mere act of conceiving*: But what can this be, if not what Berkeley and others call an *idea*? and how can we have an *idea* of which we are not *conſcious*? yet every thing of which we are conſcious Dr Reid himſelf acknowledges to be an *individual*.

* *Eſſay on the Intellectual Powers of Man.*

88 Of general ſignification.

But if the doctrine generally received reſpecting abſtract ideas be ſo very abſurd as it has appeared in our repreſentation, how comes it to be ſo prevalent among the acuteſt philoſophers? To this we anſwer, that thoſe philoſophers have certainly in this inſtance been impoſed upon by the ſtructure of language. Every adjective and every ſubſtantive, proper names excepted, are words of general ſignification; and all ſcience is converſant about general truth; but as words are ſaid to be ſignificant, not of things, but of ideas; and as truth reſults from the agreement or coincidence of ideas; it has been haſtily ſuppoſed, that without general ideas there could have been neither general terms nor general truth. This is plauſible, but it is not ſolid. Every object which affects our ſenſes is an individual object; but we perceive that two or more objects which affect ſome of our ſenſes very differently, affect others of them in preciſely the ſame way. Thus, the paper upon which one writes, the ſnow which he perceives from his window, and the milk which he may uſe at breakfaſt, affect his ſenſes of touch and taſte very differently, but they preſent the ſame appearances to his eye. This diverſity in the one caſe he believes to proceed from different powers or qualities in the ſeveral objects; and the ſameneſs of appearance in the other, from ſimilar qualities in theſe objects. To the ſimilar qualities, though he can frame no idea of them abſtracted from every individual object, he gives one common name; and calls every object which preſents the ſame appearance to his eye that ſnow does, a *white* object; where the word *white* does not ſtand for an abſtract idea, but for a quality inherent in one or more objects. Hence the origin of adjectives in language, which denote more than can be expreſſed by any claſs of ſubſtantives; for every adjective, beſides the power of a name, includes in itſelf the force of a conjunction. See GRAMMAR.

The other claſs of general terms comprehends ſubſtantives; of which the origin is as follows: The objects about which we have occaſion to ſpeak or write are ſo numerous and ſo fluctuating, that if every individual had a proper name, a complete language could never be formed. But as there are not perhaps in nature two objects that appear to us ſimilar in all reſpects, ſo are there not in nature two objects which affect *all* our ſenſes differently. The mind, therefore, either actually perceiving two or more objects at once, or contemplating the *ideas* left by two or more objects in the memory, perceives, by its intellective power, in what reſpects they agree and in what they diſagree. If the agreement be ſtriking, and in more qualities than one, it combines the ſeveral individuals into one claſs or ſpecies, giving to the whole a common name, which equally denotes the ſpecies and every individual belonging to it. Thus, obſerving that Peter, James, and John, agree in having the ſame erect form, in walking on two legs, in having hands, &c. and in being endowed with reaſon, we combine theſe three, and all other individuals which we perceive to agree in the ſame ſtriking and important qualities, into one ſpecies, to which we give the name of *man*—a word which equally denotes the whole ſpecies and every individual of it. Again, Contemplating ſeveral figures, which all agree in the circumſtance of being bounded by three ſtraight lines meeting one another ſo as to form three angles, we call the whole claſs of figures and each individual by the name of *triangle*—though it may be impoſſible to contemplate any number of triangles without perceiving that all the angles of one are acute; that one angle of another is a right angle; and that in the third there is one angle obtuſe; but the word *triangle*, unleſs it is limited in its ſignification by the addition of an adjective, is equally expreſſive of an acute-angled triangle, a right-angled triangle, and an obtuſe-angled triangle. By thus arranging individuals according to their moſt conſpicuous qualities, we may combine all the objects exiſting into ſo many claſſes or ſpecies, which ſhall be afterwards known by as many names; but of each ſpecies we neither have, nor can have,

(M) Notwithſtanding this declaration, which is made with the greateſt ſincerity, we do not apprehend that we are guilty of preſumption when we examine the doctor's opinions. Berkeley and Hume were certainly as acute as any metaphyſician who has ſucceeded them; yet their opinions have been canvaſſed without ceremony, and to much advantage. *Aliquando bonus dormitat Homerus.*

(N) He tells us ſoon afterwards, that there are *no things general.* How is the one paſſage to be reconciled with the other?

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have, any other idea than that of a multitude of ſimilar individuals.

As our acquaintance with nature enlarges, we diſcover reſemblances, ſtriking and important between one ſpecies and another, which naturally begets the notion of a higher claſs called a *genus*. From comparing man with beaſts, birds, fiſhes, and reptiles, we perceive that they are all alike poſſeſſed of life, or a principle of ſenſation and action, and of an organized body: hence we rank them all under a higher claſs or genus, to which we give the name of *animal;* which equally denotes the whole *genus*, each ſpecies comprehended under the *genus*, and every *individual* of every *ſpecies*. Thus, *animal*, is a *genus; man*, *beaſt*, *bird*, are ſo many *ſpecies* comprehended under that *genus;* and *Peter*, *James*, and *John*, are *individuals* of the ſpecies *man*. *Peter*, *James*, and *John*, are proper names, denoting each an *individual; man*, *beaſt*, *bird*, are *ſpecific* terms, denoting each a *whole ſpecies* compriſing many *individuals;* and *animal* is a *general term*, becauſe it denotes a *whole genus*, comprehending under it *ſeveral ſpecies*, of which each conſiſts of *many individuals;* and the general term denotes either the whole *genus*, all the *ſpecies*, or any *individual* of all the ſpecies. This is the whole myſtery of *abſtraction:* they are merely *terms*, that in ſtrictneſs of ſpeech are *general* and *abſtract;* and even thoſe are general only as *ſigns*, of which the full ſignification cannot always be repreſented by any conceivable *idea*.

89 Names and ideas often uſed as mere ſigns,

"It is a received opinion (ſays Biſhop Berkeley), that language has no other end but the communicating of our ideas, and that every ſignificant name ſtands for an idea. This being ſo; and it being withal certain, that names, which yet are not thought altogether inſignificant, do not always mark out particular conceivable ideas; it is ſtraightway concluded that they ſtand for abſtract notions. That there are many names in uſe amongſt ſpeculative men, which do not always ſuggeſt to others determinate particular ideas, is what nobody will deny: and a little attention will diſcover, that it is not neceſſary, even in the ſtricteſt reaſonings, that ſignificant names, which ſtand for ideas, ſhould every time they are uſed excite in the underſtanding the ideas they are made to ſtand for. In reading and diſcourſing, names are for the moſt part uſed as letters in algebra; in which, though a particular quantity be marked by each letter, yet to proceed right, it is not requiſite that in every ſtep each letter ſuggeſt to our thoughts that particular quantity it was appointed to ſtand for." The ſame thing is true of ideas, which as well as names are often uſed merely as ſigns repreſenting a whole claſs; and on that account they may be called *general*, though every idea is in itſelf ſtrictly particular. Thus, "An idea, which conſidered in itſelf is particular, becomes general by being made to repreſent or ſtand for all other particular ideas of the ſame ſort. To make this plain by an example, ſuppoſe a geometrician is demonſtrating the method of cutting a line in two equal parts: He draws, for inſtance, a black line of an inch in length: this, which in itſelf is a particular line, is nevertheleſs, with regard to its ſignification, general; ſince, as it is there uſed, it repreſents all particular lines whatſoever: ſo that what is demonſtrated of it is demonſtrated of all lines, or, in other words, of a line in general. And as that particular line becomes general by being made a ſign, ſo the *name* line, and the *idea* of a line in the imagination, either of which taken abſolutely is particular, by being ſigns are made general likewiſe. And as the former owes its generality, not to its being the ſign of an abſtract or general line, but of all particular right lines that may poſſibly exiſt; ſo the latter, the name and the idea, muſt be thought to derive their generality from the ſame cauſe, namely, the various particular lines which each of them indifferently denotes." Again, When one demonſtrates any propoſition concerning triangles, it is to be ſuppoſed that he has in view to demonſtrate an univerſal truth; yet the particular triangle which he conſiders muſt be either equilateral, iſoſceles, or ſcalenon; for a plain triangle, which is none of theſe, can neither exiſt nor be conceived. But whether it be of this or that ſort is of no importance, as any of them may equally ſtand for and repreſent all rectilineal triangles, and on that account be denominated *univerſal*.

This doctrine reſpecting names and ideas being uſed merely as *ſigns*, has been adopted by almoſt every ſubſequent philoſopher; and by Principal Campbell it has been illuſtrated with perſpicuity and acuteneſs every way worthy of the author of the Diſſertation on Miracles. "In confirmation of this doctrine (ſays he *), it may be obſerved, that we really think by *ſigns*, as well as ſpeak by them. All the truths which conſtitute ſcience, which give exerciſe to reaſon, and are diſcovered by philoſophy, are general; all our ideas, in the ſtricteſt ſenſe of the word, are particular. All the particular truths about which we are converſant are properly hiſtorical, and compoſe the furniture of memory. Nor do I include under the term *hiſtorical* the truths which belong to natural hiſtory; for even theſe too are general. Now, beyond particular truth or hiſtorical facts, firſt perceived and then remembered, we ſhould never be able to proceed one ſingle ſtep in thinking any more than in converſing, without the uſe of ſigns.

* *Philoſophy of Rhetoric.*

"When it is affirmed that *the whole is equal to all its parts*, there cannot be an affirmation which is more perfectly intelligible, or which commands a fuller aſſent. If, in order to comprehend this, I recur to ideas, all that I can do is to form a notion of ſome individual whole, divided into a certain number of parts of which it is conſtituted; ſuppoſe of the year, divided into the four ſeaſons. Now all that I can be ſaid to diſcern here is the relation of equality between this particular whole and its component parts. If I recur to another example, I only perceive another particular truth. The ſame holds of a third and of a fourth. But ſo far am I, after the perception of ten thouſand particular ſimilar inſtances, from the diſcovery of the univerſal truth, that if the mind had not the power of conſidering things as ſigns, or particular ideas as repreſenting an infinity of others, reſembling in one circumſtance though totally diſſimilar in every other, I could not ſo much as conceive the meaning of an univerſal truth. Hence it is that *ſome ideas*, to adopt the expreſſion of Berkeley, *are particular in their nature, but general in their repreſentation*."

90 which, though particular in themſelves, ſerve to demonſtrate general truths; becauſe

But if in univerſal propoſitions, ideas particular in themſelves be uſed only as the ſigns of others, it may be demanded, how we can know any propoſition to be true of all the ideas which are repreſented by the ſign?

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sign? For example, having demonstrated that the three angles of an isosceles rectangular triangle are equal to two right ones, how can we conclude that this affection therefore agrees to all other triangles which have neither a right angle nor two equal sides? To this question Bishop Berkeley and Principal Campbell give the following answer: Though the idea we have in view whilst we make the demonstration be that of an isosceles rectangular triangle, whose sides are of a determinate length, we may yet be certain that the demonstration extends to all other rectilineal triangles of what sort or bigness soever; for this plain reason, that neither the equality nor determinate length of the sides, nor the right angle, are at all concerned in the demonstration. It is true, the idea or diagram we have in view includes all these particulars; but then there is not the least mention made of them in the proof of the proposition. It is not said the three angles are equal to two right angles, *because* one of them is a *right angle*, or because the sides comprehending it are of equal length; which sufficiently shows that the right angle might have been oblique and the sides unequal; and for all that the demonstration have held good. In every one of Euclid's theorems, a particular triangle, and a particular parallelogram, and a particular circle, are employed as signs to denote all triangles, all parallelograms, and all circles. When a geometrician makes a diagram with chalk upon a board, and from it demonstrates the property of a straight-lined figure, no spectator ever imagines that he is demonstrating a property of nothing else but that individual white figure, five inches long, which is before him.—Every one is satisfied that he is demonstrating a property of all of that order, whether more or less extensive, of which it is both an example and a sign; all the order being understood to agree with it in certain characters, however different in other respects. Nay, what is more, the mind with the utmost facility extends or contracts the representative power of the sign as the particular occasion requires. Thus the same equilateral triangle will with equal propriety serve for the demonstration, not only of a property of all equilateral triangles, but of a property of all isosceles triangles, or even of a property of all triangles whatever. Nay, so perfectly is this matter understood, that if the demonstrator in any part should recur to some property belonging to the particular figure he hath constructed, but not essential to the kind mentioned in the proposition, and which the particular figure is solely intended to represent, every intelligent observer would instantly detect the fallacy: So entirely for all the purposes of science doth a particular serve for a whole species or genus. Now, why one *visible* individual should in our reasonings serve without the smallest inconvenience as a sign for an infinite number, and yet one *conceivable* individual, or a particular idea of imagination, should not be adapted to answer the same end, it will, we imagine, be utterly impossible to say (N).

It must, however, be confessed, that there is a considerable difference in kind, between *ideas* used as signs and the *general* terms of any language. Amongst all the individuals of a species, or even of the highest genus, there is still a natural connexion, as they agree in the specific or generic character; and when the mind makes use of any positive idea as the sign of the species or genus, that idea appears in the imagination as an exact resemblance of some one individual. But the connexion which subsists between words and things, or even between words and ideas, is in its origin arbitrary; and yet its effect upon the mind is much the same with that of the natural connexion between ideas and things. For having often had occasion to observe particular words used as signs of particular things, and specific terms used as signs of a whole species, we contract a habit of associating the sign with the thing signified, insomuch that either being presented to the mind necessarily introduces or occasions the apprehension of the other. Custom in this instance operates precisely in the same manner as natural resemblance in the other; so that certain sounds, and the ideas of things to which they are not naturally related, come to be as thoroughly linked in our conceptions as the ideas of things and things themselves. Nay, so completely are they linked together, that we often use, through long chains of reasoning, certain sounds or words, without attending at all to the ideas or notions of which they are signs. "I believe (says the author of *A Treatise on Human Nature*), that every one who examines the situation of his mind in reasoning will agree with me, that we do not annex distinct and complete ideas to every term we make use of; and that in talking of *government*, *church*, *negotiation*, *conquest*, we seldom spread out in our minds all the simple ideas of which the compound notions signified by these terms are composed. It is, however, observable, that notwithstanding this imperfection, we may avoid talking nonsense on these subjects, and may perceive any repugnance among the ideas as well as if we had a full comprehension of them." This remark generally holds true; but then it is to be observed, that all the words used as signs, and which yet do not denote any one conceivable determinate *idea*, must be capable of definition. Thus, in matters that are perfectly familiar, in simple narration, or in moral observations on the occurrences of life, a man of common understanding may be deceived by specious falsehood, but is hardly to be gulled by downright nonsense or a repugnance

(N) Were it possible to frame an *abstract general idea* of a triangle, which is neither equilateral, isosceles, nor scalenon, even *that idea* must be used merely as a sign as much as any particular triangle whatever; and the question might still be asked, How we can know any proposition to be true of all the triangles represented by the sign? For example: having demonstrated that the three angles of an ideal triangle, which is neither equilateral, isosceles, nor scalenon, are equal to two right angles, how can we conclude that this affection agrees to triangles which are equilateral, &c.? To this question it is not easy to conceive what answer could be given other than that of Berkeley and Campbell, in the case of using particular and conceivable triangles as signs.

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nance of ideas. Almoſt all the poſſible applications of the terms (in other words, all the acquired relations of the ſigns) have become cuſtomary to him. The conſequence is, that an unuſual application of any of them is inſtantly detected: this detection breeds doubt, and this doubt occaſions an immediate recourſe to *definition;* which, proceeding through ſpecies and genera, reſolves complex terms into others leſs complex, till it ends at laſt in ſimple ideas and relations, which can neither be defined nor miſunderſtood (O). See LOGIC.

91 It is not the *matter* but the *power* of the ſign that is regarded by the mind.

Thus then we ſee, that though there are no ideas, properly ſpeaking, general and abſtract, a man may, by *terms* and *particular* ideas, uſed as *ſigns*, arrive at the knowledge of general truth. In neither caſe is it the *matter*, if we may be allowed the expreſſion, but the *power* of the ſign that is regarded by the mind. We find, that even in demonſtrative reaſonings, ſigns the moſt arbitrary, or mere ſymbols, may be uſed with as little danger of error as ideas or natural ſigns. The operations both of the algebraiſt and arithmetician are ſtrictly of the nature of demonſtration. The one employs as *ſigns* the letters of the alphabet, the other certain numerical characters. In neither of theſe arts is it neceſſary to form ideas of the quantities and ſums ſignified; in ſome inſtances it is even impoſſible without reſolving the quantity or ſum into parts, in a manner analogous to definition; and then the mind comprehends not the whole quantity or number at once, but the ſeveral parts of which it is compoſed, which it connects (P) by the relation of junction or addition. Yet without this reſolution, the equations and calculations carried on by means of the letters and figures ſignificant of the whole quantity or the whole ſum, are not the leſs accurate or convincing. And ſo much for *abſtraction*, *generalization*, and the power of *ſigns*, whether *natural* or artificial.

CHAP. V. *Of the* ASSOCIATION *of* IDEAS.

92 A continued train of thought in the mind.

EVERY man whilſt awake is conſcious of a continued train of thought ſpontaneouſly ariſing in his mind and paſſing through it; nor could a ſingle now or inſtant be pitched upon in which ſome idea is not preſent in his memory or imagination. No one idea, however, unleſs detained by a voluntary exertion of the mind, or unleſs productive of intenſe pleaſure or pain, remains long in the imagination; but each haſtens off the ſtage to make way for another, which takes its turn and is ſucceeded by a third, &c. We are not to imagine that this train of thought is altogether fortuitous and incoherent. "It is evident (ſays Mr Hume *), that there is a principle of connexion between different thoughts or ideas of the mind; and that, in their appearance to the memory or imagination, they introduce each other with a certain degree of method and regularity. In our more ſerious thinking or diſcourſe this is ſo obſervable, that any particular thought which breaks in upon the regular track or chain of ideas is immediately remarked and rejected. Even in our wildeſt and moſt wandering reveries, nay, in our very dreams, we ſhall find, if we reflect, that the imagination ran not altogether at adventures, but that there was ſtill a connexion upheld among the different ideas which ſucceeded each other. Were the looſeſt and freeſt converſation to be tranſcribed, there would immediately be obſerved ſomething which connected it in all its tranſitions: Or, where this is wanting, the perſon who broke the thread of diſcourſe might ſtill inform you, that there had ſecretly revolved in his mind a ſucceſſion of thoughts, which had gradually led him from the ſubject of converſation. Among different languages, even where we cannot ſuſpect the leaſt connexion or communication, it is found, that words expreſſive of ideas the moſt compounded, do yet nearly correſpond to each other; a certain proof that the ſimple ideas comprehended in the compound ones, were bound together by ſome univerſal principle, which had an equal influence on all mankind."

* *Eſſays.*

Aſſociation of Ideas.

93 Principles of aſſociation.

That theſe obſervations are well founded, every man may be ſatisfied by looking attentively into his own thoughts; but when the author reduces the principles of this aſſociation of ideas to *three*, viz. *reſemblance*, *contiguity* in time and place, and *cauſe* or *effect*, he certainly contracts them within too narrow a compaſs. That theſe principles often ſerve to connect ideas, will not indeed be denied. A picture leads our thoughts to the original: the mention of one apartment in a building introduces an inquiry or diſcourſe concerning the others: and if we think of a wound, we can hardly forbear reflecting on the pain which follows it. But ſurely ideas ſometimes ſucceed each other without *reſemblance*, without *contiguity* in time or in place, and without being connected by the relation of a *cauſe* to its *effect*. Beſides all this, there are other aſſociations than of *ideas*. Ideas are aſſociated with paſſions and emotions, and paſſions and emotions are aſſociated together. A particular idea is aſſociated with a proper name, and often with the general name of the ſpecies. General conceptions, ſuch as thoſe which Mr Locke calls mixed modes (ſee MODE), are aſſociated with ſigns both audible and viſible, and ſigns are aſſociated with each other. Surely virtue, as it conſiſts in action and intention, does not reſemble the *ſound* virtue, is not *contiguous* to it in time or in place, and is neither its *cauſe* nor its *effect;* nor is it conceivable, that the arbitrary ſigns of different things ſhould have any natural relation to one another.

But were the enumeration complete, the bare mention of theſe principles does not account for the phenomena:

(O) For a farther view of this ſubject, ſee ſome excellent obſervations on the common doctrine concerning abſtraction by Profeſſor Dugald Stewart of Edinburgh. *Elements of the Philoſophy of the Human Mind.*

(P) No man, we think, will pretend that he can perceive at one view a million of individual men, or that he can imagine or conceive at once a million of ideal men: yet he may divide the million into parts, which, in the one caſe may be eaſily viewed, and in the other may be eaſily conceived, in ſucceſſion. Thus, 100+100+100, &c.

Affociation of Ideas.

nomena: For, granting the fact, it may ftill be afked, Why does a picture lead our thoughts to the original; or the mention of one apartment in a building introduce an inquiry concerning the others? To thefe queftions our author has given no anfwer; nor are we acquainted with any writer who can be faid to have attempted it, except Dr Hartley and his ingenious editor. There may be fome of our readers whom the names of thefe men will prejudice againft their theory; but, doubtlefs, the greater part are willing to adopt truth, or to examine an ingenious fpeculation, from whatever quarter it comes. To fuch as feel themfelves otherwife difpofed, we beg leave to fay, that if they allow the name of *Prieftley* to difguft them at what follows, they will furnifh him with a new proof of the truth of the doctrine which they reject.

94
How they operate.

That *ideas* fhould be affociated together, feems to be inevitable from the manner in which the mind acquires them. All our ideas, properly fpeaking, are of fenfible objects, and by far the greater part of them of *vifible* objects. But every fenfible object conveys at once various fenfations and perceptions to the mind, which appear not only united in fact, but infeparable in imagination. Thus, when a man looks at any particular object, a tree for inftance, he perceives the *trunk*, *branches*, *leaves*, *fize*, *fhape*, and *colour*, &c. of the whole at *once*: he does not firft perceive the *figure* of the trunk, then its *fize*, then its *colour*, then the *branches*, &c. all in fucceffion; but a perception of the *whole* is conveyed to the mind by one fimultaneous impreffion (Q). We have already feen, that the fenfes, in fact, convey nothing to the mind but their refpective fenfations; and that the perception of the external object inftantly follows the fenfation. We have likewife feen, that fenfation is occafioned by fome impreffion, concuffion, or vibration, given to the nerves and brain, and by them communicated to the mind or percipient being. We have likewife feen, that memory depends as much upon the brain as original fenfation, and is always attended or occafioned by fimilar concuffions or vibrations, &c. Thefe are facts proved by univerfal experience, and which, we believe, no thinking man has ever called in queftion. It follows, therefore, that every actual fenfation muft leave fome effect in the brain, either an actual print, which feems to be impoffible, or a tendency to vibrate or be agitated in the fame way as when the original impreffion was made. This being the cafe, it is natural to conclude, that when any part of the original perception is revived in the memory, the whole perception fhould be revived at once, fo as that we cannot have an idea of the trunk of a tree without perceiving the ideas of the branches affociated with it. This is indeed not merely natural, but the contrary feems to be impoffible; for as the original agitation or vibration was occafioned by the whole tree, it is evident, that whatever effect or tendency that agitation or vibration left behind it, muft be left by the whole vibration, and therefore be equally related to the whole tree.

But no object ftands fingle in nature. When we view a tree, or any thing elfe, we always notice, however tranfiently, the field where it grows and the objects around it. Thefe too leave effects in the brain at the fame time that the tree does fo; and therefore make their appearance with it in the memory or imagination: but if the tree was the object to which we principally attended during the actual fenfation, the idea of it will be much more vivid than the idea of its adjuncts, and remain much longer in the imagination or memory; becaufe the original fenfation by which it was perceived, was ftruck much deeper than the fenfations by which its adjuncts were perceived. All this muft be intelligible to every one who attends to what we have already faid of fenfation, perception, and memory.

Thus we fee why a picture leads our thoughts to the original, and why the mention of one apartment in a building introduces an inquiry concerning the others. It is not merely becaufe the picture *refembles* the original, and becaufe the apartments of a building are *contiguous*. Between a plain furface, varioufly coloured and fhaded, and the contour of the human face, there is certainly very little real refemblance, as any man may be convinced who places his eye within fix inches of a good picture. But the painter, having by his fkill in perfpective, contrived to lay his colours on the plain canvas in fuch a manner as that they reflect the fame rays of light with the original, provided the fpectator ftand at the proper diftance; thefe rays proceeding from the picture fall upon the eye in the fame direction, and therefore give to the nerves and brain the very fame impulfe which was given by the original. When one apartment of a building is mentioned, we inquire concerning the others from the very fame caufe that, when we think of the trunk of a tree which we have feen, we cannot avoid thinking likewife of its branches.

95
Affociation gives meaning to the words of language;

But the principle of affociation takes place among things not naturally connected, as the apartments of a

(Q) This is certainly the cafe with adults, but it may be doubted whether it be fo with very young children. It has been fhown already, that the fenfation communicated by the eye from any vifible object, has not the leaft refemblance to that object; and that in looking at a tree or any thing elfe, a full-grown man pays not the leaft attention to the appearance which the tree really makes to his eye; nay, that he is not even confcious of that appearance farther than as it confifts in colour. It is by the fenfe of touch only that we acquire ideas of figure, even of plain figure; and we imagine that we perceive them by the eye only becaufe different figures, as diftinguifhable by touch, are fo clofely affociated with their correfponding vifible fenfations, that long before we are capable of inquiry, thefe two things are infeparable in the imagination. It is otherwife with children, who, when they firft begin to diftinguifh objects by the fenfe of fight, appear to do it, with great deliberation, as if they firft felt the proper fenfation of light and colour fo or fo modified, and afterwards acquired, by fomething like a mental inference, a notion of the figure at which they are looking.

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a building and a substance and its attributes and adjuncts. It is association which is the original source of all the general or complex conceptions which we have, and which even gives meaning to the words of every language. Between sounds considered in themselves, and things, or the ideas of things, every one knows that there is no natural connexion; yet the idea of every known object is in the mind of every man so strictly associated with the name that it bears in its native tongue, that the presence of the one always suggests the other. It cannot indeed be otherwise, if we attend to the manner in which a child learns to affix a meaning to the words which he hears. —A child knows his mother and nurse, and indeed almost every visible object in the family, long before he acquires the power of articulation. The impressions made by these objects, and repeated daily and hourly on his brain, every one of which excites a sensation, must soon become so deep as not to be easily effaced. Numbers of them too are associated together, so that the presence of one introduces the other. It has been already observed, that ideas of sight are the most vivid and the most lasting; but the child hearing the same sound often repeated, even that sound comes in time to leave in his memory a permanent idea. He then hears the sound *nurse*, for instance, uttered at the time when he is looking earnestly at the person of the nurse, with whom he is well acquainted, and to whom he is strongly attached; and having the two ideas repeatedly excited together, they soon become so associated, that the one necessarily excites the other: the *word nurse* calls into view the *idea* of the *woman* treasured up in his imagination.

But we need not have recourse to children for the proof of our assertion. It is obvious that the name of every simple and uncompounded idea can be significant only by association. Of a complex conception the name may be made intelligible by a definition; but simple ideas cannot be defined, and between ideas and sounds there is no natural connexion, so as that the one previous to association should suggest the other. Even of complex conceptions and mixed modes, the meaning of the names is generally acquired by association; for though it is certainly true, that all such names are capable of definition, they are yet used with sufficient propriety by thousands who know not what a definition is. Were a plain unlettered man asked to define virtue, it is not probable that he could do it so as to make himself understood; yet having ideas of the *practice of justice, charity, fortitude,* &c. strictly associated in his mind with the *word virtue*, he may know the general meaning of that word as well as the most acute grammarian or the most profound philosopher.

An *alms* is a donation to a poor man; but a child who never heard of this definition knows perfectly what an *alms* is, from having often seen his parents give money to a beggar, and call what they were doing by the name *alms*. The sound of the word, after having seen the first alms given, will excite in his mind an idea of the *individual* object who received it, and of the *action* of him by whom it was given; but after having seen several poor men relieved, he comes to associate with the word *alms* any thing given to any person who needs it or appears to be in want.

So completely does this association take place between ideas or clusters of ideas, and the words by which they are expressed, that even men of letters hear and understand perfectly many words without reviewing in their minds all the ideas and relations of which they are the signs. It has been already observed, that in talking of *government, church, negotiation, conquest*, we seldom spread out in our minds all the simple ideas of which the compound notions signified by these terms are composed; and we now add, that the terms may be used with sufficient propriety, and be perfectly understood by those who never attempted to analyze the notions of which they are significant into their primary and constituent parts. Every man has read numberless details of the transactions of one court with another; he has heard such transactions universally called by the term *negotiation*. The term and the transactions signified by it are so closely associated in his mind, that they are in a manner inseparable; and by this association he knows the meaning of the term better than he could have done by the most complete definition; which, perhaps, he would find it difficult to give, or even to comprehend.

97 and is the source of our first notions of virtue.

We have said that the *meaning* of the word *virtue* is acquired by association, by having often heard that sound applied to certain *actions*; but it is extremely probable, that the very *notion* of virtue, simple and uncompounded as it appears to be, is acquired in the very same manner. The *first* rudiments of the notions of *right* and *wrong* and *obligation* seem to be acquired by a child when he finds himself checked and controuled by superior power. At first he feels nothing but mere *force*, and consequently has no notion of any kind of restraint but that of necessity. He finds he cannot have his will, and therefore he submits. Afterwards he attends to many circumstances which distinguish the commands of a *father*, or of a *master*, from those of any other person. Notions of *reverence, love, esteem*, and *dependence*, are connected with the idea of him who gives those commands; and by degrees the child experiences the peculiar *advantages* of filial subjection. He sees also that all his companions, who are noticed and admired by others, obey their parents; and that those who are of a refractory disposition are universally disliked. These and other circumstances now begin to alter and modify the notion of mere necessity, till by degrees he considers the commands of a parent as something that *must not* be resisted or disputed, even though he has a power of doing it; and all these ideas coalescing, form the notions of *moral right* and *moral obligation*, which are easily transferred from the commands of a parent to those of a magistrate, of God, and of conscience. This opinion of the gradual formation of the ideas of moral right and wrong, from a great variety of elements associated together, perfectly accounts for that prodigious diversity in the sentiments of mankind respecting the objects of moral obligation; nor do we see that any other hypothesis can account for the facts. If the notion of moral obligation were a simple uncompounded idea, arising from the view of certain actions or sentiments; or were it acquired, as it certainly might be, by a chain of reasoning from the nature of God and the nature of man; why should it not in the one case be as invariable as the perception of colours or sounds, and in the other

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other as our judgements of mathematical or phyſical truths? But though the ſhape and colour of a flower appear the ſame to every human eye; though every man of common underſtanding knows, that if a billiard ball be ſtruck by another, it will move from its place with a velocity proportioned to the force of the impulſe; and though all mankind who have but dipt into mathematics, perceive that any two ſides of a triangle muſt be greater than the third ſide; yet one man practiſes as a moral duty what another looks upon with abhorrence, and reflects on with remorſe. Now a thing that varies with education and inſtruction, as moral ſentiments are known to do, certainly has the appearance of being generated by a ſeries of different impreſſions and aſſociations in ſome ſuch manner as we have endeavoured to deſcribe. Let not any man imagine that this account of the origin of moral ſentiments endangers the cauſe of virtue; for whether thoſe ſentiments be inſtinctive or acquired, their operation is the very ſame, and in either caſe their rectitude muſt often be tried by the teſt of reaſon, ſo that the intereſts of virtue are equally ſafe on this as on any other ſcheme. See *Moral Philoſophy*.

97 It ought, therefore, to be attended to in the education of youth.

This principle of aſſociation has ſo great an influence over all our actions, paſſions, reaſonings, and judgements, that there is not perhaps any one thing which deſerves more to be looked after in the education of youth. Some of our ideas—ſuch as thoſe of a ſubſtance and its attributes, a genus and the ſpecies contained under it, a ſpecies and its ſeveral individuals, have a real connexion with each other in nature. Theſe it is the office of our reaſon to trace out and to hold together in that union and order in which nature preſents them to the view of the mind; for ſuch aſſociations conſtitute perhaps the greateſt part of neceſſary and of uſeful truths. But there are others formed by cuſtom and caprice, which are too often the ſources of error, ſuperſtition, vice, and miſery—of errors the more dangerous, and of vice the more deplorable; that if the aſſociations have been long formed without an attempt to diſſolve them, they generally become at laſt too ſtrong to be broken by the moſt vigorous effort of the beſt-diſpoſed mind. Thus, let a fooliſh maid * amuſe or rather frighten children with ſtories of ghoſts appearing in the dark, let her repeat theſe fictions till they have made a deep impreſſion on the young minds, and the notion of ghoſts will in time become ſo cloſely aſſociated with the idea of darkneſs, that the one ſhall always introduce the other; and it may not be in the power of the children, after they have become men, and are convinced in their judgements of the falſehood and abſurdity of the tales which originally frightened them, to ſeparate entirely the notion of ghoſts from the idea of darkneſs, or with perfect eaſe to remain alone in a dark room. Again, Let the idea of *infallibility* be annexed to any perſon or ſociety, and let theſe two inſeparably united conſtantly poſſeſs the mind; and then one body in ten thouſand places at once ſhall, unexamined, be ſwallowed for an incontrovertible fact, whenever that infallible perſon or ſociety dictates or demands aſſent without inquiry.

* *Locke's Eſſay*, and his *Conduct of the Underſtanding*.

Some ſuch wrong and unnatural combinations of ideas will be found to eſtabliſh the irreconcilable oppoſition that we find between different ſects in philoſophy and religion; for we cannot imagine every individual of any ſect to impoſe wilfully on himſelf, and knowingly to reject truth offered by plain reaſon. That which leads men of ſincerity and good ſenſe blindfold, will be found, when inquired into, to be ſome early and wrong aſſociation. Ideas independent and of no alliance to one another, are by education, cuſtom, and the conſtant din of their party, ſo linked together in their minds, that they can no more be ſeparated from each other than if they were but one idea; and they operate upon the judgement as if they really were but one. This gives ſenſe to jargon, the force of demonſtration to abſurdities, and conſiſtency to nonſenſe: it is the foundation of the greateſt and moſt dangerous errors in the world; for as far as it obtains, it hinders men from ſeeing and examining.

98 The principle of aſſociation operates in our perception of external objects;

Before we diſmiſs the ſubject of aſſociation, it may be proper to inquire, how far it is agreeable to the account which we have given of the manner in which external objects are perceived by means of the ſenſes, and the ideas of ſuch objects retained in the memory. —It has been proved, we think, by arguments unanſwerable, that by the organs of ſenſe nothing is conveyed immediately to the mind but ſenſations which can have no reſemblance to external objects, and that the perception of an object may be reſolved into a proceſs of reaſoning from effects to cauſes.—But children, it will be ſaid, do not reaſon from effects to cauſes, and yet they ſoon acquire the faculty of perceiving and diſtinguiſhing the objects with which they are ſurrounded. This is an undoubted truth, and it can be accounted for only by the principle of aſſociation. A child has as much the uſe of his ſenſes as a full-grown man. By his eye he has the ſenſation of colour; by his noſe, that of ſmell; by his ear he has the ſenſation of ſound; and by his hand he feels heat and cold, reſiſtance and bounded reſiſtance. Every object which is preſented to him, impreſſes his mind with various ſenſations: and theſe ſenſations combined together are probably all that he perceives for ſome years; for there is no reaſon to imagine that a boy of one or two years old has the ſlighteſt notion of what we mean by ſolidity, hardneſs, ſoftneſs, or indeed of that which is termed *ſubſtance*. Yet when two or more objects are preſent, he may eaſily diſtinguiſh the one from the other, becauſe the ſenſations excited by the one muſt differ from thoſe excited by the other, as much as the real qualities of the one are different from the real qualities of the other; and by diſtinguiſhing between his own ſenſations, he in effect diſtinguiſhes between the objects which produce theſe ſenſations. His ſenſations too being frequently excited, leave behind them ideas in his memory or imagination; and thoſe ideas, from having been imprinted together and never ſeparated, become in time ſo cloſely aſſociated, that whenever one of them is called into view, the others neceſſarily make their appearance with it. Thus a child has a ſet of combined ſenſations excited in his mind by the preſence of his nurſe; he has a different cluſter excited, ſuppoſe, by the preſence of his mother. Theſe are often repeated, and leave deep traces behind them; ſo that when the mother or the nurſe makes her appearance, ſhe is immediately recogniſed as a known object; or, to ſpeak more correctly, the child feels the very ſame ſenſations

tions which he has felt before, from which he has experienced pleaſure, and of which he has the ideas treaſured up in his memory or imagination. A ſtranger, on the other hand, muſt affect him with a ſet of new ſenſations, and of courſe will be diſtinguiſhed from a known object as accurately as if the child were poſſeſſed of the notions of ſolidity, ſubſtance, qualities, and diſtance. A man born blind, who knew not that ſuch things as fire and ſnow had ever exiſted, would yet diſtinguiſh the one from the other the moment that he ſhould be brought within their influence. He could not indeed apply their names properly, nor ſay which is the fire and which the ſnow, nor would he at firſt have any notion of either of them as a real, external, and diſtant object; but he would certainly diſtinguiſh his own ſenſations, the ſenſation of heat from that of cold. It is juſt ſo with a child: At firſt he perceives nothing but different ſenſations. Theſe he can diſtinguiſh; and as they are cauſed by different objects, in diſtinguiſhing between the ſenſations he will appear to diſtinguiſh between the objects themſelves. In a ſhort time, however, he acquires, by the following proceſs, ſome inaccurate notions of diſtance. He looks, for inſtance, earneſtly in his nurſe's face, and at the ſame time touches her cheek perhaps by accident. He repeats this operation frequently, till the ſenſation communicated by his eye comes to be aſſociated with that of his touch, and with the extending of his arm; and being all treaſured up as aſſociated ideas in the memory, the ſight of his nurſe makes him ever afterwards ſtretch out his hands with a deſire to touch her. All this while there is not the ſlighteſt probability that the child has any notion of *ſubſtance* or *qualities*, or of any thing beyond his own *ſenſations*, and the means by which he has experienced, that ſenſations which are pleaſant may be obtained, and that ſuch as are painful may be avoided. The preciſe time at which a child begins to think of external things we cannot pretend to aſcertain; but we are perſuaded that it is later than many perſons imagine, and certainly not till he has made conſiderable progreſs in the exerciſe of reaſon. Prior to that period the things which men know to be bodies, are known to children only as ſenſations and ideas ſtrongly bound together by the tie of aſſociation.

99 and ſeems to diſtinguiſh memory from imagination;

But if aſſociation be of ſuch importance in the act of ſenſation, it is of ſtill greater in that of retention; for it ſeems to conſtitute the whole difference that there is between imagination and memory. By many of the ancients, as well as by ſome modern philoſophers, theſe two faculties ſeem to have been confounded with each other; but between them there is certainly a great difference, though they likewiſe reſemble each other in ſome reſpects. An idea of memory, conſidered by itſelf, makes the very ſame appearance to the intellect as an idea of imagination. We contemplate both as if they were actual, though faint and diſtant perceptions: but the one is attended with the conviction, that it is the idea of an object which has really been perceived at ſome period of paſt time; whilſt the other is attended with no conviction, except that the idea itſelf is actually preſent to the mind. Mr Hume has ſaid, that ideas of memory differ from thoſe of imagination only in being more vivid and diſtinct; but certainly this is not always the caſe. An idea of imagination has ſometimes been taken for a real perception, which an idea of memory can never be. The difference between theſe two kinds of ideas, we are perſuaded, ariſes chiefly, if not wholly, from aſſociation. Every idea of memory is aſſociated with many others, and thoſe again with others down to the very moment of the energy of remembrance; whereas ideas of imagination are either the voluntary creatures of the fancy at the moment of their appearance, in which caſe we ſhould call them conceptions; or they are ideas which we have actually received from ſenſation, but which, on account of ſome link being broken in the vaſt chain of aſſociation, we cannot refer to any real objects. What gives probability to this conjecture is, that ideas often appear in the mind which we know not whether to refer to the memory or imagination, nothing being more common than to hear a perſon ſay, I have in my head the idea of ſuch or ſuch an object; but whether I remember or only imagine the object, I am very uncertain. Afterwards, however, by turning the idea over and over in the mind, he finds other ideas make their appearance, till at laſt cluſters of them come into view, and aſſociate ſo cloſely with the principal idea, which was the object of doubt, as to convince the judgement that it is an idea of memory.

100 and to be the ground of our belief of what we remember.

It has been aſked, Why we believe what we diſtinctly remember? and to that queſtion it has been ſuppoſed that no anſwer can be given. But it appears to us, that aſſociation is the ground of belief in this as it will be found to be in other inſtances; and that a man believes he waſhed his hands and face in the morning, becauſe the idea of that operation is ſo ſtrongly linked in his mind to the whole train of ideas which have ariſen in it through the day, that he cannot ſeparate the firſt from the laſt, that which was a ſenſation in the morning from the ſenſations which are preſent at the inſtant of remembrance. As thoſe ideas are aſſociated by nature, each muſt paſs in review in its proper order; ſo that in ſo ſhort a ſpace of time there is no danger, and hardly a poſſibility, of taking the firſt for the laſt, or the laſt for the firſt. Nay more, we will venture to hazard an opinion, that every paſt event of a man's life, which he diſtinctly remembers, is tied by the chain of aſſociation to his preſent perceptions. That this is poſſible is certain, ſince it is not difficult to conceive how it may be done. The principal events of a ſingle day may ſurely be ſo linked together as to be all diſtinctly reviewed in a cluſter of ideas on the morrow. Of theſe events ſome one or other muſt be the moſt important, which will therefore make its appearance as an idea more frequently than the reſt, and be more cloſely aſſociated with the events of next day. Some event of that day will, for the ſame reaſon, be more cloſely aſſociated with it than the others; and theſe two, dropping perhaps all the reſt of their original companions, will paſs on together to the third day, and ſo on through weeks, and months, and years. In the compaſs of a year, ſeveral things muſt occur to make deep impreſſions on the mind. Theſe will at firſt be aſſociated together by events of little importance, like the occurrences of a ſingle day. Whilſt theſe feeble chains, however, continue unbroken, they will be ſufficient to link the one

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one important event to the other, and to bring them both into view at the ſame time, till at laſt theſe two, from appearing ſo often together, will in time unite of themſelves, and the intermediate ideas be completely effaced. Thus may two or three important events of one year be aſſociated with ſuch a number of ſimilar events of another year, ſo that the ideas of the one ſhall always introduce to the mind the ideas of the other; and this chain of aſſociation may paſs from the earlieſt event which we diſtinctly remember through all the intermediate years of our lives down to the inſtant when memory is exerted.

To this account of memory it may perhaps be objected, that it gives us no diſtinct notion of time. Every thing that is remembered is neceſſarily believed to have been preſent in ſome portion of paſt time; but aſſociation brings into view nothing but a ſeries of events. This objection will be ſeen to have no weight when we have inquired into the nature of time, and aſcertained what kind of a thing it is. It will then perhaps appear, that duration itſelf, as apprehended by us, is not diſtinguiſhable from a ſeries of events; and that if there were no train of thought paſſing through our minds, nor any motion among the objects around us, time could have no exiſtence. Meanwhile, whatever become of this opinion, we beg leave to obſerve, that our theory of remembrance is perfectly conſiſtent with the commonly received notions reſpecting time; and indeed, that it is the only theory which can account for numberleſs phenomena reſpecting paſt duration. It is univerſally allowed, that if motion or a ſucceſſion of events, do not conſtitute time, it is the only thing by which time can be meaſured. Now it is a fact which no man will deny, that the diſtance of time from the preſent *now* or inſtant to the earlieſt period which he diſtinctly remembers, appears to his view extremely ſhort, much ſhorter than it is ſaid to be in reality; and that one year, when he looks forward, appears longer than two, perhaps longer than ten, when he looks backward. Upon our principles this fact is eaſily accounted for. We remember nothing which is not linked by a chain of aſſociations with the perceptions of the preſent moment; and as none but a few of the moſt important events of our lives can be linked together in this manner, it hence follows, that events which, in the order of ſucceſſion, were far *diſtant* from each other, muſt thus be brought *together* in the memory, and the whole chain be contracted within very ſhort limits. But when we figure to ourſelves a ſeries of future events, we employ the active power of fancy inſtead of the paſſive capacity of retention; and can therefore bring within the compaſs of one periodical revolution of the ſun a longer ſeries of imaginary events ſucceeding each other, than is preſerved of real events in our memory from the earlieſt period of our exiſtence: So perfectly does our theory accord with this well-known fact. On the other hand, if memory be an original faculty of the mind totally independent of aſſociation,

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and of which no other account is to be given than that it neceſſarily commands our belief, why is it a faculty which, with regard to duration, thus uniformly deceives us? and how comes it to paſs, that to a man whoſe memory is tenacious, who has read much, ſeen many countries, and been engaged in various occurrences, any determinate portion of paſt time always appears longer than to another man whoſe memory is feeble, and whoſe life has been waſted in eaſe and idleneſs? To theſe queſtions we know not what anſwer can be given upon any other principle than that which makes the evidence of memory depend upon aſſociation. But if we remember nothing but what is linked to the perception or idea which is preſent with us at the time of remembrance, and if duration be meaſured by the ſucceſſion of events, it is obvious that any portion of paſt time muſt neceſſarily appear longer to him who has many ideas aſſociated in his mind than to him who has but few.

101 The importance of aſſociation in the philoſophy of the human mind.

There is not perhaps a ſingle fact of greater importance in the philoſophy of the human mind than the *aſſociation of ideas*; which, when thoroughly underſtood, accounts for many of thoſe phenomena which ſome late writers of name have, with injury to ſcience and with danger to morality, attributed to a number of diſtinct and independent inſtincts. It is for this reaſon that we have conſidered it ſo minutely, and dwelt upon it ſo long; and in addition to what we have ſaid on the ſubject, we beg leave to recommend to our more philoſophical readers the diligent ſtudy of Hartley's Obſervations on Man (R). In that work we think ſeveral things are taken for granted which require proof; and ſome which, we are perſuaded, have no foundation in nature: but, with all its defects, it has more merit than any other treatiſe on the ſenſitive part of human nature with which we are acquainted.

Chap. VI. *Of* Consciousness *and* Reflection.

102 Conſciouſneſs, what it is, and what are its objects.

Sensation, remembrance, ſimple apprehenſion, and conception, with every other actual energy or paſſion of the mind, is accompanied with an inward feeling or perception of that energy or paſſion; and that feeling or perception is termed *conſciouſneſs*. *Conſciouſneſs* is the perception of what paſſes in a man's own mind at the *inſtant* of its paſſing there; nor can we *ſee*, *hear*, *taſte*, *ſmell*, *remember*, *apprehend*, *conceive*, employ our faculties in any manner, enjoy any pleaſure, or ſuffer any pain, without being *conſcious* of what we are doing, enjoying, or ſuffering. *Conſciouſneſs* is only of things *preſent* *; and to apply it to things *paſt*, is to confound *conſciouſneſs* with memory or *reflection*. One cannot ſay that he is conſcious of what he has ſeen or heard and now remembers: he is only conſcious of the act of remembrance; which, though it reſpects a paſt event, is itſelf a preſent energy. It is likewiſe to be obſerved, that conſciouſneſs is only of things in the mind or conſcious being, and not of things external. It is improper in any perſon to ſay that he is *conſcious* of

* *Reid's Eſſays on the Intellectual Powers of Man.*

(R) Since this was written Mr Stewart's *Elements of the Philoſophy of the Human Mind* have been publiſhed; in which the reader will find many excellent remarks on the nature and influence of the aſſociating principle.

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of the table before him: he perceives it, he *sees* it, and he may with great propriety say that he is *conscious* he perceives or sees it; but he cannot say that he is conscious of the table itself, for it is only his immediate energy of perception that can be the object of consciousness. All the operations of our minds are attended with consciousness; which is the only evidence that we have or can have of their existence. Should a man take it into his head to think or to say that his consciousness may deceive him, and to require a proof that it cannot, we know of no proof that can be given him: he must be left to himself as a man that denies first principles, without which there can be no reasoning. Every attempt to prove this point, or to set it in a clearer light, would only serve to render it more dark and unintelligible. I *think*, I *feel*, I *exist*, are first truths, and the basis of all human knowledge.

103 Des Cartes's argument from consciousness for his own existence.

This has given rise to the question, whether Des Cartes did not fall into an absurdity when, inferring his own existence from his actual thought, he said, *Cogito, ergo sum.* This argument has been called a pitiful sophism, and a *petitio principii;* because, before a man take it for granted that he thinks, he must also, it is said, take it for granted that he exists, since there cannot be thought where there is no existence. Now it must be confessed, that if Des Cartes pretended by this argument to give us a fresh conviction of our own existence, his endeavours were useless and puerile; because a man capable of being convinced by the arguments of another, must have a previous conviction of his own existence: but the argument itself is certainly neither a sophism nor a *petitio principii.* Those * who defend Des Cartes assert, and there is no reason to doubt the truth of their assertion, that his only view in urging such an argument was not to prove the truth of our existence, but to exhibit the order of that process by which we arrive at the knowledge of the fact; and this he has very clearly done by analyzing the truth into its first principles. A stone exists as well as the human mind; but has the stone any knowledge of its own existence? No man will say that it has; neither should we have any knowledge of ours, did we think as little as the stone. We certainly *might* exist without thinking, as it is probable we do in very sound sleep; and in that state our existence might be known to other beings, but it could not possibly be known to ourselves: for the only things of which the mind is conscious, or has immediate knowledge, are its own operations. I *exist* is therefore a legitimate inference from the proposition I *think;* and the observation that it is so may be useful to show us the procedure of the mind in the acquisition of knowledge; but it has little merit as an argument, and still less as a discovery, though, being strictly true and just, it should never have been exposed to ridicule.

* See *Buffier's First Truth.*

104 Reflection, what it is, and how different from consciousness.

It is to be observed, that we are conscious of many things to which we give very little attention. We can hardly attend to several things at the same time; and our attention is commonly employed about that which is the *object* of our thought, and rarely about the thought itself. It is in our power, however, when we come to the years of understanding, to give attention to our own thoughts and passions, and the various operations of our minds. And when we make these the objects of our attention, either while they are present, or when they are recent and fresh in our memory, we perform an act of the mind which is properly called *reflection.* This *reflection* ought to be distinguished from *consciousness* *; with which it is confounded sometimes by Locke, and often by the learned author of Ancient Metaphysics. All men are *conscious* of the operations of their own minds at all times while they are awake, nor does it appear that brutes can be wholly destitute of consciousness; but there are few men who *reflect* upon the operations of their minds, or make them the objects of thought; and it is not probable that any species of brutes do so.

* *Reid's Essays on the Intellectual Powers of Man.*

From infancy, till we come to the years of understanding, we are employed solely about sensible objects. And although the mind is conscious of its operations, it does not attend to them; its attention is turned solely to the objects about which these operations are employed. Thus, when a man is angry, he is *conscious* of his passion; but his *attention* is turned to the *person* who offended him and the *circumstances* of the *offence,* while the *passion of anger* is not in the least the object of his attention. The difference between *consciousness* and *reflection,* is like the difference between a superficial view of an object which presents itself to the eye, while we are engaged about something else, and that attentive examination which we give to an object when we are wholly employed in surveying it. It is by consciousness that we immediately acquire all the knowledge which we have of mental operations; but attentive reflection is necessary to make that knowledge accurate and distinct. *Attention* is a voluntary act; it requires some exertion to begin and continue it; and by great exertion it may be continued for a considerable time; but *consciousness* is involuntary, and of no continuance, changing with every thought. The power of reflection upon the operations of their own minds does not at all appear in children. Men must have come to some ripeness of understanding before they are capable of it. Of all the powers of the human mind it seems to be the last that unfolds itself. Most men seem incapable of acquiring it in any considerable degree; and many circumstances conspire to make it to all men an exercise of difficulty. The difficulty, however, must be conquered, or no progress can be made in the science of our own or of other minds.

105 All our notions of mental energies got by reflection.

All the notions which we have of mind and of its operations are got by reflection; and these notions are by Mr Locke called *ideas of reflection.* This term we think extremely ill chosen; and we believe it has been the source of much error and confusion among Locke's followers. A man, by attending to the operations of his own mind, may have as distinct *notions* of remembrance, of judgement, of will, of desire, as of any object whatever: but if the secondary perception of a sensible object, that appearance which it has to the mind when viewed in the memory or imagination, be properly called an *idea,* it is certain that of the operations of the mind itself there can be no ideas; for these operations, when reflected on, make no appearance without their objects either in the memory or in the imagination. Nothing is more evident, in fact, than that we have no *ideas,* in the original and proper meaning of the word, but of sensible objects upon which the mind exerts its first operations. Of these operations we have indeed a consciousness;

Of Consciousness and Reflection. consciousness; but abstracted from their objects we cannot frame of them any idea or resemblance. We are *conscious* to ourselves of *thinking, willing, remembering, discerning, reasoning, judging,* &c. but let any one look into himself, and try whether he can there find any *idea* of *thinking* or *willing*, &c. entirely separate and abstracted from the *object* of thought or will. Every man who has seen a tree or house, will find in his mind ideas of these objects, which he can contemplate by themselves, independent of every thing else; but no man can contemplate the *idea* of thinking or desiring without taking into view the thing thought on or desired. It is plain, therefore, that the energies of *thinking, willing,* and *desiring*, with all their various modifications, are not themselves *ideas*, or capable of *communicating* ideas to be apprehended, as the ideas of bodies are apprehended by the pure intellect. They are the *actions* and *workings* of the *intellect itself* upon ideas which we receive from the objects of sense, and which are treasured up in the memory or imagination for the very purpose of furnishing the intellect with materials to work upon. Between *ideas* and the *energies of thinking* there is as great and as obvious a difference as there is between a *stone* and the *energies* of him by whom it is cast. Ideas are the passive subjects; the energies of thinking are the operations of the agents. Ideas are relicts of sensation, and have a necessary relation to things external; the energies of thinking are relicts of nothing, and they are wholly and originally internal.

106 Our knowledge of the operations of intellect immediate, and not by the intervention of ideas.

That we can in no sense of the word be said to have *ideas* of the operation of the intellect, will be still more evident, if we consider by what means we acquire the knowledge which we have of those operations. It has been already observed, that when our thoughts are employed upon any subject, though we are conscious of thinking, yet our *attention* is commonly employed upon the *object* of our thought, and not upon the *thought* itself; and that if we would give attention to our thoughts and passions, we must do it by a reflex act of the mind, whilst the act of thinking is still recent and fresh in our memory. Thus, if a man wishes to know what perception is, it is not the time to make the inquiry while he is looking at some rare or beautiful object; for though he is *conscious* of the energy of perceiving, the *object* of perception employs all his *attention.* But the time to make this inquiry is either when the object has become familiar to him, or presently after it is removed from his sight. In the former case, he can look upon it without emotion, pay attention to every step in the process of perception, and be immediately conscious what perception is. In the latter case, by turning his attention inwards, and reflecting on what he did or felt when the object was before him, he will find clear and vivid ideas of every thing which he perceived by his sense of sight; but he will find no *idea* of the act of *seeing* or *perceiving.* On the contrary, if he be capable of sufficient attention, he will observe that his intellect is employed in the very same manner upon the *ideas* that it was upon the original *sensations;* and of that employment, and the manner of it, he will be equally conscious as he was of the original energy exerted in sensation. There is indeed this difference between the two, without which reflection could make no discoveries, that the most vivid ideas being still faint when compared with actual sensations, the intellect is not so wholly engrossed by them, as it was by the original objects, nor is it so rapidly carried from idea to idea as it was from sensation to sensation. It is thus at leisure to attend to its own operations, and to know what they are; though to form *ideas* of them as separate from their objects, is absolutely impossible. Every man capable of paying attention to what passes within himself when he sees, hears, and feels, &c. may have very accurate *notions* of *seeing, hearing,* and *feeling,* &c. but he cannot have *ideas* of them as he has of the *objects* of *sight, hearing,* and *touch.*

The same is the case with respect to the exertion of our reasoning faculties. A man must have distinct and clear *ideas* to reason upon, but he can have no *idea* of reasoning itself, though he must be conscious of it, and by attention may know what it is. When a man sits down to study for the *first time* a proposition in the Elements of Euclid, he certainly employs his reasoning faculty, and is conscious that he is doing so; but his attention is wholly turned to the diagram before him, and to the several ideas which the diagram suggests. Afterwards, when he has mastered the proposition, he may go over it again, with a view to discover what reasoning is; but he will not find he has any *idea* of reasoning as he has of the diagram. He will only exert that faculty a second time, and perceive one trunk linked to and depending upon another in such a manner that the whole taken together forms a complete demonstration. In a word, the operations of our own minds, when attention is paid to them, are known immediately by consciousness; and it is as impossible that we should have ideas of them, as that a living man should be a picture upon canvas. He who attends to what passes in his own mind when he perceives, remembers, reasons, or wills, must know by consciousness what these operations are, and be capable of forming very accurate notions of them, as connected with their objects; and he who does not attend to what passes in his own mind will never acquire any notions of them, though he were to read all that has been written on the subject from the days of Pythagoras to those of Dr Reid.

107 There are things which we know partly by sensation and partly by reflection, &c.

As we acquire ideas of external objects by means of our senses; and notions of perceiving, remembering, reasoning, and willing, &c. by reflecting on the operations of our own minds; so there are other things of which we acquire notions, partly by sensation, partly by reflection, and partly by means of that faculty of which it is the more peculiar office to compare ideas and to perceive truth. Such are *substance, body, mind,* with their several qualities, adjuncts, and relations; the knowledge of which, as has been already observed, constitutes what in strictness of speech is termed the science of *metaphysics.* These shall be considered in order, after we have investigated the nature of truth, and inquired into the several sources of evidence; but there is one notion, about the origin and reality of which there have been so many disputes, which in itself is of so great importance, and which will be so intimately connected with all our subsequent inquiries, that it may not be improper to consider it here.—The notion to which we allude is of POWER.

108 Our notion of power how acquired.

Among the objects around us we perceive frequent changes, and one event regularly succeeding another.

Of Confciousnefs and Reflection.

Gold thrown into the fire is changed from a folid to a fluid body. Water expofed to a certain degree of cold is changed from a fluid to a folid body. Night fucceeds to day, and fummer fucceeds to winter. We are confcious of new fenfations in ourfelves every hour. We are likewife confcious of reafoning, willing, and defiring; and we know that by an exertion of will we can rife or fit, ftand ftill or walk, call one idea into view, and difmifs others from our contemplation. Experience teaches us, that it is not occafionally, but always, that gold is changed into a fluid by being thrown into the fire, and water into a folid body by being expofed to a certain degree of cold; that night fucceeds to day, and fummer to winter. Thefe changes have regularly taken place fince the creation of the world; and it has never once been obferved that water was made folid by fire, or gold rendered liquid by cold. Were we not affured by experience that our own voluntary motions are produced by exertions of our minds, of which we are confcious, and that without fuch exertions thofe motions would never have taken place, we fhould probably have confidered the liquefaction of gold as an event equally independent of fire, though uniformly conjoined with it, as night is independent of day, and day of night. But having experienced that we can move or not move our bodies as we pleafe; that when it is our will to fit, we never get up to walk; and that when we wifh to walk, we always do it except prevented by external violence: having likewife experienced, that by a thought, by fome internal and inexplicable exertion of our minds, we can call up in our memory or imagination one idea and difmifs others from our mental view; we are led to believe with the fulleft conviction, that all thofe motions of our bodies which in common language are termed *voluntary*, and that fucceffion of ideas which follows a confcious exertion of the mind, depend upon ourfelves. In other words, we are neceffitated to believe that we have a *power* to move or not move our bodies in many cafes, and a *power* to turn our attention to one idea in preference to others.

It is thus that we acquire the notion of *power* in ourfelves, which we eafily transfer to other objects. Knowing that the various motions of our bodies thus effected proceed from power, we are naturally led to inquire whether the changes which we perceive in other bodies may not proceed from *power* likewife, i. e. from fomething analogous to that power, of the exertions of which we are confcious in ourfelves. Now uniform experience teaching us that gold is liquefied by being thrown into the fire, and that water is made folid by being expofed to cold; we infer with the utmoft certainty that there are *powers* in fire and cold to produce thefe changes, and that without the exertion of fuch *powers* thefe changes would not be produced. We cannot indeed fay of external powers, as we can of our own, in what fubftance they inhere. We know with the utmoft certainty that the voluntary motions of our hands, &c. are produced by a power not inherent in the hands but in the mind, for of the exertion of that power we are confcious; but we do not know whether the power which liquefies gold be inherent in that fenfible object which we call *fire*, or in fomething elfe to which fire is only an inftrument. We learn by obfervation, that the minute particles of fire or heat infinuate themfelves between the particles of gold, and, if we may ufe the expreffion, tear them afunder; but whether they do this in confequence of a *power* inherent in themfelves, or only as inftruments impelled by another *power*, is a queftion which *obfervation* cannot enable us to anfwer.

Were we not confcious of the exertion of our own powers, it feems not conceivable that we could ever have acquired any notion of power at all; for power is not an object of fenfe, nor, independent of its operations, it is indeed an object of confcioufnefs. In external operations, all that we perceive is *one thing*, in which we fuppofe the *power* to refide, followed by another, which is either the *change* or that on which the change is *produced;* but the exertion of the power itfelf we do not perceive. Thus we perceive gold, after it has been fome time in the fire, converted from a folid to a fluid body; but we perceive not by our fenfes either the power or the energy of the power which operates to this converfion. In the exercife of our own powers, the cafe is otherwife. When a man puts his hand to his head, and afterwards thrufts it into his bofom, he not only perceives by his fenfes the change of pofition, but is alfo confcious of the energy or exertion by which the change was produced.

"Suppofe (fays Mr Hume *) a perfon, though endowed with the ftrongeft faculties of reafon and reflection, to be brought on a fudden into this world; he would indeed immediately obferve a continual fucceffion of objects, and one event following another, but he would not be able to difcover any thing farther. He would not at firft by any reafoning be able to reach the idea of caufe and effect; fince the particular powers by which all natural operations are performed never appear to the fenfes. The impulfe of one billiard ball is attended with motion in the fecond. This is the whole that appears to the *outward* fenfes. The mind feels no fentiment or *inward* impreffion from this fucceffion of objects; confequently there is not, in any fingle particular inftance of caufe and effect, any thing which can fuggeft the idea of power or neceffary connexion. From the firft appearance of an object, we never can conjecture what effect will refult from it; but, were the power or energy of any caufe difcoverable by the mind, we could forefee the effect even without experience; and might at firft pronounce with certainty concerning it by the mere dint of thought and reafoning. It is impoffible, therefore, that the idea of power can be derived from the contemplation of bodies in fingle inftances of their operations; becaufe no bodies ever difcover any power which can be the original of this idea."

* *Effays.*

There is a fenfe in which this reafoning is unqueftionably juft. A man who had never been confcious of exerting power in himfelf, would certainly not acquire the notion of power from obferving a continual fucceffion of external objects. The impulfe of one billiard ball being followed by the motion of another, would no more lead him to the notion of power in the former, than the fucceffion of night to day would lead him to the notion of a power in light to produce darknefs. When Mr Hume fays, "that from the *firft* appearance of an object *we* can never conjecture what effect

Of Conſciouſneſs and Reflection.

fect will reſult from it," he uſes language that is ambiguous, and utters an aſſertion which is either true or falſe according to the ſenſe in which it is underſtood. If it be meant, that after having reflected on the operations of our own minds, and learned by experience that motion is communicated by impulſe from one ball of ivory to another, we could not conjecture whether a ſimilar effect would be produced by the impulſe of balls made of other hard bodies which we had never before ſeen, the aſſertion is manifeſtly falſe. A man who had but once ſeen motion communicated in this manner from one *ivory* ball to another, would certainly conjecture that it might be communicated from one *wooden* ball to another; and if he had ſeen it repeatedly communicated from one ball to another of different ſubſtances, he would infer, with the utmoſt confidence, that it might be communicated from ball to ball of whatever ſubſtance compoſed, provided that ſubſtance be hard, or of a ſimilar texture with the balls to the impulſe of which he had formerly paid attention. If by this ambiguous phraſe the author only means, as is probably the caſe, that from the firſt appearance of an object to which we had never before obſerved any thing in any reſpect ſimilar, we could not conjecture what effect would reſult from it; or if his meaning be, that a man ſuddenly brought into the world, who had never acquired ſuch a notion of power as may be had from attention to the energies and operations of our own minds, would not, by obſerving an effect to reſult from one body, conjecture from the firſt appearance of another ſimilar body what effect would reſult from it; in either of theſe caſes his aſſertion is certainly true, and tends to prove, that without the conſciouſneſs of the operations of our own minds we could never acquire a notion of power from the changes perceived by our ſenſes in external objects.

109 Mr Hume attempts to prove that we can have no notion whatever of power,

But Mr Hume, not contented with denying, which he might juſtly do, that we could ever have derived the idea of power merely from obſerving the continual ſucceſſion of external objects, labours hard to prove that we have no notion of power at all, and that when we uſe the word *power*, we do nothing more than utter an inſignificant ſound. To pave the way for the arguments by which ſo extravagant a paradox is to be ſupported, he lays it down as a "propoſition which will not admit of much diſpute, that all our ideas are nothing but copies of our impreſſions; or, in other words, that it is impoſſible for us to *think* of any thing that we have not antecedently *felt* either by our external or internal ſenſes." As this propoſition, however, will admit, it ſeems, of *ſome* diſpute, he takes care, before he applies it to the purpoſe of demoliſhing all power, to ſupport it by two arguments. "Firſt (ſays he), when we analyze our thoughts or ideas, however compounded or ſublime, we always find that they reſolve themſelves into ſuch ſimple ideas as were copied from a precedent feeling or ſentiment. Thoſe who would aſſert, that this poſition is not univerſally true nor without exception, have only one, and that an eaſy, method of refuting it; by producing that idea, which, in their opinion, is not derived from this ſource. Secondly, If it happen, from a defect of the organ, that a man is not ſuſceptible of any ſpecies of ſenſation, we always find that he is as little ſuſceptible of the correſpondent ideas. A blind man can form no notion of colours, a deaf man of ſounds. And though there are few or no inſtances of a like deficiency in the mind, where a perſon has never felt, or is wholly incapable of a ſentiment or paſſion that belongs to his ſpecies; yet we find the ſame obſervation to take place in a leſs degree. A man of mild manners can form no idea of inveterate revenge or cruelty; nor can a ſelfiſh heart eaſily conceive the heights of friendſhip and generoſity."

110 His reaſoning ſophiſtical.

As theſe propoſitions are the engines by which all power is baniſhed from the world, it may not be improper, before we proceed to inquire by what means they perform ſo arduous a taſk, to conſider their own inherent ſtrength; for if they be weak in themſelves, their work, however dexterouſly they may be employed, can have no ſtability. We have already noticed the perverſeneſs of this writer's language, when it confounds *ſenſations* with *impreſſions*; but here it is ſtill more perverſe, for paſſions, ſentiments, and even *conſciouſneſs*, are ſtyled *impreſſions*. When ſenſations are confounded with impreſſions, the effect is only miſtaken for the cauſe, it being univerſally known that ſenſations proceed from impreſſions made upon the organs of ſenſe. When conſciouſneſs is confounded with an impreſſion, one thing is miſtaken for another, to which it is univerſally known to have neither reſemblance nor relation. But, not to waſte time upon theſe fallacies, which, though dangerous if admitted, are yet too palpable to impoſe upon a reader capable of the ſlighteſt attention, let us examine the propoſitions themſelves. The moſt important, and that for the ſake of which alone the others are brought forward, is, that it is impoſſible for us to *think* of any thing that we have not immediately *felt*, either by our external or internal ſenſes." Did Mr Hume then never *think* of a mathematical *point*, or a mathematical *line*? Neither of theſe things is capable of being *felt* either by making an impreſſion upon the organs of ſenſe or as an object of conſciouſneſs; and therefore it is impoſſible that he ſhould ever have had ideas of them ſuch as he doubtleſs had of ſenſible objects; yet in the moſt proper ſenſe of the word *think* (s), he certainly thought of both points and lines; for he appears to have made conſiderable progreſs in the ſcience of geometry, in which he could not have proceeded a ſingle ſtep without a perfect knowledge of theſe things, on which the whole ſcience is built. It is not therefore true, that our thoughts or ideas, when analyzed, always reſolve themſelves into ſuch ſimple ideas as were copied from a precedent feeling or ſentiment; for every mathematical figure of which we can think reſolves itſelf into a point and motion; and a point having

(s) *Thinking*, in the propriety of the Engliſh tongue, ſignifies that ſort of operation of the mind about its ideas wherein the mind is active; where it, with ſome degree of voluntary attention, conſiders any thing.— *Locke*.

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having no parts and no magnitude, cannot possibly be the object of feeling to any of our senses. If, therefore, ideas alone be the objects of thought, we have refuted Mr Hume's position by the very method which he himself lays down; for we have produced an idea which is not derived either from a precedent feeling or a precedent sentiment. By sentiment, we suppose to be here meant that which by other philosophers is denominated consciousness; and of consciousness it is undeniable that nothing is the object but the actual energies of our own minds.

111 Things of which we can have no *ideas* may themselves be the objects of thought.

But ideas are not the only objects of thought. We have already given our reasons for restricting the word *idea* to that appearance which an object of sense, when reflected on, makes either in the memory or imagination. Such was undoubtedly its original signification; and had it never been used to denote other and very different objects, much error and perplexity would have been avoided, which now disgrace the science of metaphysics. Things may *themselves* be the objects of thought; and when that is the case, to think of their *ideas*, were it possible to do so, would be worse than useless; for we may certainly know a man better by looking at himself than by looking at his picture. Of things which are *themselves* the objects of thought, we have either a *direct* or a *relative* knowledge. We know directly the actual operations of our own minds by the most complete of all evidence, that of consciousness; and we have a *relative* notion of mathematical points and lines: but neither of mental energies nor of these external things (T) can we possibly have any *idea*.

112 We have only relative notions of some things,

It is well observed by Dr Reid *, that our notions both of body and mind are nothing more than relative. "What is body? It is, say philosophers, that which is extended, solid, and divisible. Says the querist, I do not ask what the properties of body are, but what is the thing itself? let me first know directly what body is, and then consider its properties. To this demand I am afraid the querist will meet with no satisfactory answer; because our notion of body is not direct, but relative to its qualties. We know that it is something extended, solid, and divisible, and we know no more. Again, If it should be asked, what is mind? It is that which thinks. I ask not what it does, or what its properties are, but what it is? To this I can find no answer; our notion of mind being not direct, but relative to its operations, as our notion of body is relative to its qualities (U)."

* *Essay on the Active Powers of Man.*

113 about which, however, we can reason with the utmost precision:

Our notion of a mathematical point is of the very same kind. What is a point? It is, says Euclid, that which hath no parts and no magnitude. Replies the querist, I ask not either what it has or what it has not, let me first know what it is? To this second question, it might perhaps be answered, that a mathematical point is that which by motion generates a line. But, rejoins the querist, I am not inquiring what it generates; give me a direct idea of the point itself? or, if that cannot be done, as surely it cannot, tell me what its offspring a line is? A line, says Euclid, is length without breadth. I have no idea, replies the querist, of length without breadth. I never felt an *impression* from a sensible object which did not suggest length, breadth, and thickness, as inseparably united; and I can have no idea which is not the *copy* of a *former impression*. To assist the querist's conception, it may be said that lines are the boundaries of a superficies, and that superficies are the boundaries of a solid body; but of a solid body every man has a clear and direct idea, in the most proper sense of the word. Here then are several things, viz. points, lines, and superficies, of not one of which is it possible to form a direct notion; and yet we know them so thoroughly, from the relation which they bear to other subjects, that we can reason about them with a precision and certainty which only the mathematical sciences admit.

114 And such is power.

The great advantage of these sciences above the moral, Mr Hume himself expressly admits: but he attributes it to a wrong cause, when he says it consists in this, that the "ideas of the former being *sensible* are always clear and determinate;" for we see that the notion of a point or of a line is merely relative, and cannot possibly be the copy of a sensation, or, in his language, of a sensible impression. If then we have clear and determinate notions of points and lines, and may reason about them without ambiguity, as he acknowledges we may, what is there to hinder us from having an equally clear and determinate notion of power, or from reasoning about it with as little ambiguity (V); Why says he, we are not conscious of power. And to prove this position, which needs no proof,

(T) By calling mathematical points and lines external things, we do not mean to attribute to them any corporeal existence. We know well that they are merely creatures of the mind, and that if there were no mind, they could have no existence. But twenty men may at the same instant have a notion of the same lines and the same points; and therefore these lines and points have an existence independent of, and external to, any *one* mind, at least to any one *human* mind. The objects, however, of which a man is conscious, are in no sense whatever external, for they are present to no human mind but his own.

(U) The opinions of philosophers concerning corporeal and spiritual substances shall be considered more fully hereafter. In quoting from Dr Reid on another subject, we have been obliged to anticipate his opinion, which will be found to be not more modest than just.

(V) "There are some things of which we can have both a direct and relative conception. I can directly conceive ten thousand men, or ten thousand pounds, because both are objects of sense, and may be seen. But whether I see such an object, or directly conceive it, my notion of it is indistinct; it is only that of a great multitude of men, or of a great heap of money; and a small addition or diminution makes no perceptible change in the notion I form in this way. But I can form a relative notion of the same number of men or of pounds by attending to the relations which this number has to other numbers greater or less. Then I perceive that the relative notion is distinct and scientific; for the addition of a single man, or a single pound, or even of

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proof, he makes many obſervations that, however juſt, might certainly have been ſpared. Of theſe one is, that "a man ſuddenly ſtruck with a palſy in the leg or arm, or who had now loſt theſe members, frequently endeavours at firſt to move them, and employ them in their uſual offices. Here he is as much conſcious of power to command ſuch limbs, as a man in perfect health is conſcious of power to actuate any member which remains in its natural ſtate and condition. But conſciouſneſs never deceives. Conſequently, neither in the one caſe nor in the other are we ever conſcious of any power." This is true; we never are conſcious of any power; but we are frequently conſcious of actual energies: and the man who, after being ſuddenly ſtruck with a palſy, endeavours in vain to move his leg or arm, is as conſcious of energy as he who in health makes the attempt with ſucceſs. Nor let it be imagined that his conſciouſneſs deceives him; for, as Mr Hume juſtly obſerves, conſciouſneſs never deceives. He is certain of the *energy*, but finds by experience that the *inſtrument* of this energy has ſuddenly become diſordered and unfit for its uſual office. In this and this alone conſiſts the difference between the paralytic and the man whoſe limbs are ſound. The one may be as conſcious of energy as the other, and his conſciouſneſs may be equally infallible. What then is this energy? Mr Hume will not ſay that it is an *idea*, for it is not the copy of any antecedent impreſſion; beſides, he has ſomewhere allowed that ideas are never active. Is it then a ſubſtance? Impoſſible! for it is not permanent: and we believe no man will venture to affirm, or even to ſuppoſe, that the ſame ſubſtance can be repeatedly annihilated, and as often created. Is it then the occaſional exertion of ſome ſubſtance? This muſt be the truth; for no other ſuppoſition remains to be made. If ſo, that ſubſtance muſt be poſſeſſed of *power;* for a capacity of exerting actual energy is all that is meant by the word *power*. —"Wherever there is a *capability* of energy or exertion, there muſt be *power;* for though there can be no exertion without power, there may be power that is not exerted *. Thus a man may have *power* to ſpeak when he is ſilent; he may have power to riſe and walk when he ſits ſtill. But though it be one thing to *ſpeak* and another to have the *power* of ſpeaking, we always conceive of the power as ſomething which has a certain relation to the effect; and of every power we form our notion by the effect which it is able to produce. Nor is it only in ſpeaking and moving his limbs that a man is conſcious of energy. There is as much energy, though of a different kind, in *thinking* as in *acting*. Hence the powers of the human mind have been divided into active and ſpeculative. By the former we move the body; and by the latter we ſee, hear, remember, diſtinguiſh, judge, reaſon, and perform upon our notions and ideas every other operation which is comprehended under the general word *to think*."

**Reid's Eſſays on the Active Powers of Man.*

Of Conſciouſneſs and Reflection.

Mr Locke † has introduced into his theory of power another diſtinction than that which we have made between active and ſpeculative powers. Obſerving by our ſenſes, under which on this occaſion memory is certainly included, various changes in objects, we collect, ſays he, a poſſibility in one object to be changed, and in another a poſſibility of making that change, and ſo come by that idea which we call power. Thus we ſay that fire has a power to melt gold, and that gold has a power to be melted. The firſt he calls *active*, the ſecond *paſſive*, power. But to ſay that the *poſſibility* of being changed is *power*, ſeems to be a very improper mode of ſpeaking, and ſuch as may lead to conſequences which the excellent author certainly held in abhorrence. It tends to make unwary readers imagine that the paſſive ſubject is as neceſſary to the exiſtence of power, as the active being of which power is an attribute; but if the univerſe had a beginning, and if its Creator be immutable, two propoſitions which Mr Locke firmly believed, there certainly was power when there was no change, nor any thing exiſting which was capable of change. He owns, indeed, that active power is more properly called power than the other; but we ſee no propriety at all in paſſive power. "It is (in the language of Dr Reid) a powerleſs power, and a contradiction in terms." 115 Locke's paſſive power an improper expreſſion.

† *Eſſay*, book ii. chap. 21.

But though Locke here uſes improper terms, he has other obſervations with which we have the honour fully to agree, and which lead to conſequences the reverſe of that impiety which ſeems to follow from the notion of *paſſive* power. He obſerves, that "we have from body no idea at all of thinking, nor any idea of the beginning of motion. A body at reſt affords us no idea of any active power to move; and when it is ſet in motion itſelf, that motion is rather a paſſion than an action in it. For when the ball obeys the ſtroke of a billiard ſtick, it is not any action of the ball, but a paſſion: alſo, when by impulſe it ſets another ball in motion that lay in its way, it only communicates the motion it had received from another, and loſes in itſelf ſo much as the other received; which gives us but a very obſcure idea of an active power of moving in body, whilſt we obſerve it only to transfer, but not to produce any motion. So that it ſeems to me, we have from the obſervation of the operation of bodies by our ſenſes but a very imperfect obſcure idea of 116 Juſt obſervations of the ſame author reſpecting power as belonging to body or mind.

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of a penny, is eaſily perceived. In like manner, I can form a direct notion of a polygon of a thouſand equal ſides and equal angles. This direct notion cannot be more diſtinct when conceived in the mind, than that which I get by ſight when the object is before me; and I find it ſo indiſtinct that it has the ſame appearance to my eye, or to my *direct* conception, as a polygon of a thouſand and one, or of nine hundred and ninety nine ſides. But when I form a *relative* conception of it, by attending to the relation it bears to polygons of a greater or leſs number of ſides, my notion of it becomes diſtinct and ſcientific, and I can demonſtrate the properties by which it is diſtinguiſhed from all other polygons. From theſe inſtances it appears, that our relative conceptions of things are not always leſs diſtinct, nor leſs fit materials for accurate reaſoning, than thoſe that are direct; and that the contrary may happen in a remarkable degree."

Reid's Eſſays on the active Powers of Man.

Of Consciousness and Reflection.

of active power, since they afford us not any idea in themselves of the power to begin any action either of motion or thought." He thinks it evident, however, "that we find in ourselves a power to begin or forbear, continue or end, several actions of our minds and motions of our bodies, barely by a thought or preference of the mind ordering, or, as it were, commanding, the doing or not doing such or such a particular action. This power which the mind has thus to order the consideration of any idea, or the forbearing to consider it, or to prefer the motion of any part of the body to its rest, and *vice versa* in any particular instance, is that which we call *will*. The actual exercise of that power, by directing any particular action, or its forbearance, is that which we call *volition* or *willing*.

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Whence it follows, that only such beings as have will and understanding can possess real power.

According to Mr Locke, therefore, the only clear notion or idea we have of power, is taken from the power which we find in ourselves to give certain motions to our bodies, or certain directions to our thoughts; and this power in ourselves can be brought into action only by willing or volition. This is exactly our doctrine; where we have endeavoured to prove, that without the consciousness of actual energy in ourselves, we never could have acquired any notion at all of power from observing the changes which take place among external objects. But if this be so, if the *power*, of which alone we know any thing, can be brought into action only by willing or volition, and if will necessarily implies some degree of understanding, as in us it certainly does, it comes to be a question of the first importance, whether any being which possesses not will and understanding can be possessed of real power, or be the efficient cause of any action. This question we feel ourselves compelled to answer in the negative. If *we* had not will, and that degree of understanding which will necessarily implies, it is evident that we could exert no power, and consequently could have none: for power that cannot be exerted is no power. It follows also, that the power, of which alone we can have any distinct notion, can be only in beings that have understanding and will. Power to produce any effect, implies power not to produce it; and we can conceive no way in which power may be determined to one of these rather than the other in a being that has not will. We grow from infancy to manhood; we digest our food, our blood circulates, our heart and arteries beat; we are sometimes sick and sometimes in health: all these things must be done by the power of some agent, but they are not done by our power. And if it be asked how we know this? the answer is, because they are not subject to our will. This is the infallible criterion by which we distinguish what is our doing from what is not; what is in our power from what is not. Human power can be exerted only by will: and we are unable to conceive any active power to be exerted without will. If, therefore, any man affirms that a being may be the efficient cause of an action which that being can neither conceive nor will, he speaks a language which we do not understand. If he has a meaning, he must take the words *power* and *efficiency* in a sense very different from ours; for the only distinct notion, indeed the only notion which we can form, of real efficiency, is a relation between the cause and the effect similar to that between us and our voluntary actions. It seems therefore most probable, that such beings only as have some degree of understanding and will can possess active power, and that inanimate beings must be merely passive. Nothing which we perceive without us affords any good ground for ascribing active power to any inanimate being; and we can as little conceive such a being possessed of power as we can conceive it capable of feeling pain. On the other hand, every thing which we discover in our own constitution, leads us to think that active power cannot be exerted without will and intelligence: and to affirm that it can, is to affirm what to us at least is a contradiction in terms. 118

An objection obviated.

To this reasoning, which is Dr Reid's *, and which to us appears unanswerable, we have heard it objected, that a man born blind has the same evidence for the non-existence of colour that is here urged for the impossibility of power being exerted without will and understanding. If the objection had not been made by a very acute man, we should have deemed it altogether unworthy of notice; for between the two cases supposed to be similar there is hardly any analogy. A man born blind has no notion whatever of colour. If you describe it to him in the best manner you can, and refer it to any of the senses which he possesses; if you say that it is the object of feeling, and that by feeling it one may perceive things at the distance of many miles; the blind man has reason to say that you are uttering a proposition which he knows with the utmost certainty cannot possibly be true. But if you tell him that colour is the object of the sense of sight, a sense which he possesses not; that it has not the least resemblance to the objects of the other senses; and that persons endowed with the sense of sight perceive coloured objects at the distance of many miles; the blind man cannot know whether what you say be true or false, because he has no idea or conception of the things of which you speak. This is not the case with respect to power; for every man who has reflected on the operations of his own mind has a very distinct notion of power, and knows perfectly, that to the actual exertion of the only power which he can conceive, will and understanding are necessary. Should it be said that there may be power altogether different from that of which we have a distinct conception, we think it sufficient to reply, that of a thing which cannot be conceived nothing can be either affirmed or denied: that activity exerted without will and understanding ought not to be called an exertion of *power*, because power is the name already appropriated to the attribute of a being by which he can do certain things if he wills; that as we can form no notion of a real efficient cause which has not will and understanding, so we have no reason to believe that such a cause anywhere exists; and to say that power, such as we can conceive, may be exerted without will and understanding, is as great an absurdity as to say that there may be velocity without space.

* See *Essays on the Active Powers of Man*.

But if active power, in its proper meaning, requires a subject endowed with will and intelligence, what shall we say of those active powers which philosophers teach us to ascribe to matter, the powers of corpuscular attraction, magnetism, electricity, gravitation, and others? These powers, as they are called, shall be considered when we treat of the nature and source of corporeal

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poreal motion. In the mean time, it is sufficient to obferve, that whatever the agents may be in the operations of nature, whatever the manner of their agency or the extent of their power, they depend upon the Firft Caufe, and are all under his controul.

Chap. VII. *Of* Truth, *and the different* Sources *of* Evidence.

Sect. I. *Of Truth.*

By purfuing thefe inquiries in the order which to us appears moft natural, we are now led to the contemplation of thofe faculties of the human mind of which *truth* is properly the object. But what is *truth?* This was a famous queftion among the Greek fophifts; which had been fo often agitated, and to which fo many abfurd anfwers had been given, that it came at laft to be doubted by men of the world whether a fatisfactory anfwer could be given, or indeed whether the matter was worthy of inveftigation. It is well known, that among the ancient philofophers there was a fect called from their principles *Sceptics*, and from their founder *Pyrrhonians*, who openly avowed their opinion that *truth*, like virtue, is nothing but a name; that all things are equally true, or rather equally doubtful; and that it is in vain for man to hope for certainty in any inquiry in which he can be engaged. Such fcepticifm as this no modern philofopher has profeffed; but many have had enough of it to make fober men hefitate about defining truth, and even infinuate that of truth no definition can be given. This furely is a miftake. If truth cannot be defined, it ftill wanders at large and in difguife, and vain muft be the purfuit of every man who endeavours to obtain it; he is purfuing he knows not what.

119 Truth defined.

So obvious and fo folid is this reflection, that almoft every philofopher of merit who has lately written on the nature of evidence has begun his work, if not with a formal definition, with fomething at leaft equivalent to a definition of the object of his purfuit. To repeat all thefe definitions could ferve no other purpofe than to fwell this article to a difproportioned bulk, and to perplex perhaps the mind of the reader. We fhall therefore content ourfelves with that which is given by Mr Wollafton. "Thofe propofitions (fays he) are true which reprefent things as they are: or, truth is the conformity of thofe words or figns by which things are expreffed to the things themfelves." Notwithftanding the objections of a very learned and acute writer (w), this is the beft definition of *truth* which we have met with in any language. It is concife

(w) Dr Tatham having afked, with a contemptuous air, How imperfect and illogical is the definition of truth given by Wollafton? proceeds, though not to define, to defcribe or characterize it himfelf. "Truth (fays he) is of the nature and effence of God, like him *incomprehenfible* in the whole, and *ineffable* in its fublimer parts. For thefe and other reafons it cannot admit of an *adequate definition.* And who, in the beginning of his refearches, fhould prefume to define that which, after all his longeft and beft conducted labours, he can only hope partially, and often imperfectly, to comprehend; and of which an important part can neither be *directly* expreffed nor *directly* underftood? We may indeed efteem ourfelves highly favoured by the Author and Finifher of all truth, if, at the end of our refearches, we fhall be able any way to underftand, to define, and to apply, a few particular portions and detachments of it, and to guard them from ERROR and corruption. When upon a folemn occafion the queftion was put to our Lord by a Roman governor, *What is* TRUTH*?* though it was what he fully and perfectly knew, and what he came purpofely and profeffedly to teach, he did not define it. He knew that definition was never the beft method of inftruction; and that in its common ufe and application it was feldom the friend of truth. Philofophically viewed, words do not conftitute truth; they are only the vocal inftruments by which it is communicated, or the written figns by which it is recorded. By an inquirer, therefore, things are to be examined rather than words defined. By a teacher, things are to be conveyed by words in fome form or other, which are doubtlefs to be explained to the underftanding, if not fufficiently underftood before. But *explanation* is one thing, and *definition* quite another. Explanation is the *firft* office of a teacher: Definition, if it be good, is the *laft* of the inquirer, after the truth be found; and is then the moft *advantageoufly* employed by the teacher, when his previous inftructions have prepared him for it. God is a mind, and TRUTH is confequently an *attribute* of MIND. To the SUN, declaring at his rifing a marvellous inftrument, He, by whom all things were made, hath delegated the power of enlightening the *material* fyftem; whilft he hath referved to HIMSELF the office which is more fuitable to his nature, of giving light and knowledge, by his eternal TRUTH to the *mind* of man. But whether he acts through the inftrumentality of his creatures, or more *immediately* from himfelf, he is uniform and confiftent in his operations; fo that one part of his divine economy is always illuftrative of another. As the SUN fheds his *light* over the material creation to be apprehended by the eye, TRUTH is the *light* fhed down from heaven to be apprehended by the intellect, given to illumine every fubject, natural and moral, corporeal and fpiritual, fo far as they are qualified by their different natures to convey it to the human mind, or rather perhaps fo far as the human mind is qualified to receive it from them." *The Chart and Scale of Truth*, vol. i.

This paffage, of which fome parts are certainly not remarkable for perfpicuity, feems to be defcriptive, not of *truth* in the common acceptation of the word, but of *all knowledge* human and divine, of which indeed no adequate definition can be given. *Truth*, as here ufed, feems to be oppofed to *ignorance;* as ufed by Mr Wollafton and others, it is oppofite to *falfehood.* In this laft fenfe it may certainly be *explained*, if not defined; and if the learned lecturer will allow that Mr Wollafton has given a good *explanation* of the word *truth* as oppofed to *falfehood*, we fhall not quarrel with him or any man about the propriety of an expreffion. We have called it a *definition* of truth; becaufe it was fo called by the author from whom it is taken.

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cise and perspicuous. It comprehends all kinds of truth, as well that which is merely mental, the subject of silent contemplation, as that which is communicated either by written language or by the living voice: and it makes truth itself immutable, as depending not upon the arbitrary constitution of this or that individual, or even of the whole human race (x), but upon the nature of things as established by their Almighty Creator.

120 Every proposition either true or false.

According to this definition, every proposition which can be expressed or apprehended is necessarily either true or false, whether its truth or falsehood be perceived or not either by him who hears or by him who utters it. All propositions are either affirmative or negative; but before any thing can with certainty be affirmed or denied of another, we must know those things as they are in themselves, as well as the established use of the signs by which they are expressed. He who affirms or denies without this knowledge, speaks at random, and has no distinct meaning.

121 Every human faculty concerned in the acquisition of truth.

Every faculty which we possess is in some way or other an instrument of knowledge; for we know by our senses, by our memory, and by our intellect. Every one of our faculties, therefore, is concerned in the acquisition of truth, and furnishes the mind with the materials of propositions. These propositions are indeed of various kinds; but they are all certainly true or certainly false, though the *certainty* of the truth or falsehood of every one it is not always in our power to perceive.

122 Diversity of belief affects not the truth of what is believed.

When a man affirms that red is a quality inherent in a soldier's coat, he utters a proposition which every one of the vulgar firmly believes to be true, but which every philosopher knows to be false. This diversity of belief, however, affects not the truth of the proposition itself. All mankind know that it is either true or false, independent of them or their perceptions; and it is easy, by a few optical experiments and by an explanation of terms, to convince them all, that what they have agreed to call *red* is no quality inherent in external objects, but only a sensation caused by the impulse of certain rays of light reflected from certain objects to the eye of the percipient. The contrariety therefore in this case of vulgar to philosophical belief, does not result from any ambiguity in the nature of truth itself, but from the different means of perception which the clown and the philosopher possess.

Again, Were a man looking at a red and a green object, to affirm that they are both of the same colour, he would affirm what in one sense may be true, what in another is undoubtedly false, and what in a third may be either true or false. If it be his meaning that the two objects give to him the same sensation, he may know with the utmost certainty that what he says is true; if he mean that they affect all mankind precisely as they affect him, he utters what all mankind with the most absolute certainty know to be false; if he mean that the texture of the two bodies (that particular disposition of parts on their surfaces which makes them reflect certain rays of light and absorb others) is exactly similar, so as that the one must reflect the very same kind of rays with the other, he utters what all mankind must *believe* to be false, though still it is *possible* that what he affirms may be true. This diversity of belief affects not the truth itself. The two objects are what they are by whomsoever perceived, or whether perceived or not; the rays of light reflected by each are what they are, whether they fall upon this, upon that, or upon any eye; and the sensation communicated to this singular man is certainly what he is conscious it is, as those of the rest of mankind are with equal certainty what they are conscious of. This being the case, it is obvious and undeniable, that the organs of sight in this individual of the human race are somehow differently formed from those of other men: and the only question which can occasion a doubt in the mind of the sceptic is, whether his or their eyes be so formed as to represent things falsely? for that by the one or the other things are falsely represented, is as evident as that two contradictory propositions cannot both be true. Now, though, for any thing we know it is certainly possible, as to us it appears not to imply any contradiction, that the eyes of but one man are formed in a manner suitable to their objects, whilst the eyes of all other men are formed to deceive them; yet the contrary is so highly probable, that no man really doubts of it any more than he doubts whether three and two be equal to five.

123 Why some truths are said to be absolutely and others morally certain.

This last proposition is indeed said to express a truth absolutely certain, whilst the former expresses a truth which is called morally certain: not that there is any difference or degrees of certainty in the nature of truths themselves; the only difference is in our power of perceiving them. That three and two are equal to five, is

(x) Dr Beattie, in his elegant essay, has given a definition of truth very different from this, though it is possible that his meaning may be the same with Mr Wollaston's. "I account that to be *truth* (says he) which the constitution of our nature determines us to believe; and that to be *falsehood* which the constitution of our nature determines us to disbelieve." But if truth be really *immutable*, as he teaches or wishes to teach, it must depend upon the nature of things, and not upon the instinctive impulse of any particular constitution. It is always difficult, often impossible, to distinguish between the constitution of our nature, as it came from the hand of God, and the same constitution as it is moulded by arbitrary and capricious associations of our own. A sincere member of the church of Rome certainly believes the doctrine of transubstantiation. How he may do so we have already shown. Were all mankind sincere members of that church, it would be said and thought, "that the constitution of human nature determines men to believe transubstantiation:" a doctrine which, though it is rejected by millions, Pere Buffier has laboured hard to reconcile with common sense. Yet it is certain that the same body cannot be in different places at the same time; and that therefore transubstantiation must be false, though believed by all mankind. Our *believing* any thing does not make it true, nor our *disbelieving* any thing make it false. We must, indeed, *act* according to our belief; but in every instance truth and falsehood would have been what they are, though we had never existed.

Of Truth. is ſaid to be an abſolute truth; becauſe we perceive the whole of it as it is in itſelf, and are convinced that every intelligence from the higheſt to the loweſt who underſtands the terms in which it is expreſſed perceives it as we do: whereas of *moral* or *phyſical* truths, as they are called, we only perceive a part, and may therefore miſtake for want of evidence. Thus, in the caſe of the two objects exhibiting the ſame colour to one man, whilſt they exhibit different colours to all other men, could we ſee into the objects themſelves, and comprehend them immediately with our intellect as we comprehend our own ideas, it might, and no doubt would, appear as palpable a contradiction to ſay that the particular diſpoſition of the parts on their ſurfaces, which reflect the rays of light, are the ſame in both, as it is now to affirm that three and two are not equal to five. Between truth and falſehood there is no medium. All truths are in *themſelves* equally certain; and to the Supreme Being, who knows the nature of every thing more fully and intimately than we know our own ideas, they all *appear* equally certain: but yet we may without abſurdity ſpeak of *probable* truth as well as of *certain* truth, provided always that we make the difference to reſult, not from the nature of things, but from the power of our underſtanding, which comprehends the one kind of truth wholly and the other only partially.

124 Why ſome truths are ſaid to be eternal and neceſſary, whilſt others are conſidered as temporary and contingent.

There is another diviſion made of truth into that which is eternal and neceſſary, and that which is temporary and contingent. Though we do not approve of applying the epithets *temporary* and *eternal* to any thing but real exiſtences, yet as this manner of ſpeaking has been uſed by all philoſophers, we ſhall give inſtances of each kind of truth, and endeavour to aſcertain in what the diſtinction conſiſts. "The three angles of a plain triangle are equal to two right angles," is a propoſition expreſſive of a neceſſary and eternal truth. "The world exiſts," is a contingent and temporary truth. Here it is obvious, that if both theſe propoſitions be true, there is no diſtinction between them, ſo far as mere *truth* is concerned; for truth admits not of degrees of compariſon. It is however ſaid, that the firſt propoſition depends not upon time, or will, or any thing elſe; and that the Supreme Being himſelf could not make it falſe: whereas it is certainly poſſible, that he who created the world could annihilate it, and thus reduce what is now a truth to an abſolute falſehood. This difference between the two propoſitions is thought a ſufficient ground for calling the former a *neceſſary* and *eternal* truth, and the latter a *temporary* and *contingent* truth. But is the difference itſelf real? In the preſent inſtance we cannot think that it is: for if the right angles and triangles, which conſtitute the materials of the former propoſition, be real corporeal things, they may be annihilated as well as the reſt of the world; and then the truth of the propoſition will ceaſe, for there can be neither equality nor inequality between nonentities. If the angles and triangles be merely ideas in the mind of a rational being, it is not to be denied that the propoſition muſt be true, independent of all *will*, whenever thoſe ideas exiſt, i. e. whenever right angles and triangles are *thought upon*; but if all reaſonable creatures were to be annihilated, and the Supreme Being never to think of triangles, the propoſition would unqueſtionably ceaſe to be either true or falſe. The world may indeed be annihilated; but it certainly is not annihilated whilſt any one creature exiſts to contemplate even that which is called *neceſſary* and *eternal* truth: and therefore whilſt any truth exiſts in a mind not divine, it muſt be neceſſarily true that the world exiſts; for the individual being by which truth is perceived would then conſtitute the whole world. Of Truth.

But if in a ſomewhat different manner we compare the former of theſe propoſitions with this, "The ſolar ſyſtem conſiſts of the ſun and at leaſt ſeven primary planets," we ſhall at once perceive the difference between neceſſary and contingent truths. Both propoſitions we know to be true at this moment: but there is this difference between them, that a plain triangle can neither actually exiſt at any period of duration, nor be conceived by any one mind divine or human, of which the three internal angles are not preciſely equal to two right angles; whereas the ſolar ſyſtem may eaſily be conceived, and might certainly have been formed, with a ſmaller number of primary planets rolling round the central fire. This needs no proof; as it is well known, that till very lately we conceived the ſyſtem to conſiſt of the ſun and only ſix primary planets; and it has been already ſhown, that whatever we can poſitively conceive may poſſibly exiſt. Thus, then, every propoſition, of which the contrary is clearly and diſtinctly perceived to be impoſſible, is a *neceſſary* truth; and it may likewiſe be ſaid to be *eternal*, becauſe at every period of duration it muſt of neceſſity when thought upon be perceived to be true: On the other hand, every propoſition of which the contrary may be clearly and diſtinctly conceived, is, if true, only a *contingent* truth, becauſe its contrary might have exiſted; and it may likewiſe be called *temporary*, becauſe what might have been falſe in time paſt may yet be falſe in time future.

125 Truth perceived by our rational faculties, which are commonly ſaid to be two, *reaſon* and *judgement*.

Though all our faculties (our ſenſes, our memory, and our intellect), furniſh materials for propoſitions, and are therefore all ſubſervient to the inveſtigation of truth; yet the perception of truth, as it is in itſelf, is commonly aſcribed to our rational faculties; and theſe have by Locke and others been reduced to two—reaſon and judgement. The former is ſaid to be converſant about certain truths, the latter chiefly about probabilities.

126 To which ſome philoſophers have added a third faculty, viz. *common ſenſe*.

Some late philoſophers of great merit, diſſatisfied with this analyſis of the intellect, have added to reaſon and judgement a third faculty, to which they have given the name of *common ſenſe*, and of which the proper object is ſuch truths as neither admit nor ſtand in need of evidence. By *common ſenſe* they mean, "that degree of judgement which is common to men with whom we can converſe and tranſact buſineſs." Whether the introduction of ſuch a term into metaphyſics was proper or improper, we do not think it of importance to inquire. According to this definition of it, which is Dr Reid's, it differs not from the *reaſon* (Y) and *judgement* of Locke; agreeing with the former when its

(Y) This is expreſsly acknowledged by Dr Reid. "It is abſurd (ſays that able and candid writer) to conceive its object is certain truth, and with the latter when it is converſant about probabilities. Nothing indeed is more evident, than that in the aſſent of the mind to every propoſition, ſome energy of the judgement is exerted; and upon every propoſition not ſelf-evident, reaſoning of ſome kind or other muſt be employed to procure that aſſent. Inſtead therefore of perplexing ourſelves and our readers with various analyſes of the human underſtanding, or rather with various names to what after all is perhaps but one individual power, it will ſurely be of more importance to the cauſe of truth to examine the different ſources of evidence by which the aſſent of the reaſon, or judgement, or common ſenſe, is determined.

Under the article Logic it was obſerved, that *intuition*, *experience*, and *teſtimony*, are each a ſufficient *ground* of *judgement;* but they are not the only grounds. *Conſciouſneſs* is certainly one ſource of evidence, perhaps the moſt complete of any; and, in a low degree, *analogy* is another. Of *conſciouſneſs* we have already treated, but of *analogy* we have yet ſaid nothing: and though we might (for an account of *intuition*, *experience*, and *teſtimony*) refer our readers to the article Logic, where they are accurately though conciſely explained, we ſhall, without repeating what has been already ſaid, add a few words on each, as well to complete the preſent article as to ſupply the deficiencies of the former.

Sect. II. *Of Intuitive Evidence and Demonſtration.*

127 Intuitive evidence, what.

Intuitive evidence is that which ariſes from the compariſon of two or more ideas or notions when their agreement or diſagreement is perceived immediately, without the intervention of any third idea or notion. Of this kind is the evidence of theſe propoſitions: One and four make five *; things equal to "the ſame thing are equal to one another; the whole is greater than any of its parts;" and in a word, all the axioms in arithmetic and geometry. All theſe are in reality propoſitions in which the ſubject and predicate appear upon compariſon to be nothing more than the ſame thing taken in different views or expreſſed by different terms. In fact, they are all in ſome reſpect reducible to this axiom, "Whatever is, is." We do not ſay that they are deduced from it; for they have in themſelves that original and intrinſic evidence which makes them, as ſoon as the terms are underſtood, to be perceived intuitively. And if they be not thus perceived, no deduction of reaſon will ever confer on them any additional evidence. But though not deduced from the general axiom, they may be conſidered as particular exemplifications of it; inaſmuch as they are all implied in this, that the properties and relations of our clear and adequate ideas can be no other than what the mind clearly perceives them to be.

128 Every demonſtration a ſeries of propoſitions intuitively evident.

It may perhaps be thought, that if axioms were propoſitions perfectly identical, it would be impoſſible by their means to advance a ſingle ſtep beyond the ſimple ideas firſt perceived by the mind. And it would indeed be true, that if the predicate of the propoſition were nothing but a repetition of the ſubject under the ſame aſpect, and in the ſame or ſynonymous terms, no conceivable advantage could be made of it for the furtherance of knowledge. Of ſuch propoſitions as theſe, for inſtance, "ſeven are ſeven, eight are eight, the three angles of a triangle are the three angles of a triangle, two right angles are two right angles," it is manifeſt that we could never avail ourſelves for the improvement of ſcience: But when the thing, though in effect coinciding, is conſidered under a different aſpect; when that which is ſingle in the ſubject is divided in the predicate, and converſely; or when what is a whole in the one is regarded as a part of ſomething elſe in the other; ſuch propoſitions lead to the diſcovery

* *Campbell's Philoſophy of Rhetoric.*

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conceive that there can be any oppoſition between reaſon and common ſenſe. It is indeed the firſt-born of reaſon; and as they are commonly joined together in ſpeech and in writing, *they are inſeparable in their nature.* We aſcribe to reaſon two offices or two degrees: the firſt is to judge of things ſelf-evident; the ſecond to draw concluſions that are not ſelf-evident from thoſe that are. The firſt of theſe is the province, and the ſole province of common ſenſe; and therefore it *coincides with reaſon in its whole extent*, and is only *another name* for one branch or one degree of reaſon." Pere Buffier talks nearly the ſame language; but Dr Beattie expreſſes himſelf very differently. "That there is a real and eſſential difference between theſe two faculties; that common ſenſe cannot be accounted for by being called the *perfection of reaſon*, nor reaſon by being reſolved into *common ſenſe;* will appear (he thinks) from the following remarks: 1. We are conſcious, from internal feeling, that the energy of underſtanding, which perceives intuitive truth, is different from that other energy which unites a concluſion with a firſt principle by a gradual chain of intermediate relations. 2. We cannot diſcern any neceſſary connexion between reaſon and common ſenſe." Nay, he ſays, "That we often find men endued with the one who are deſtitute of the other:" and he inſtances dreams and certain kinds of madneſs where this is the caſe; adding, that a man who believes himſelf made of glaſs, ſhall yet reaſon very juſtly concerning the means of preſerving his ſuppoſed brittleneſs from flaws and fractures." Surely theſe are ſtrange remarks. Dreams and madneſs have hitherto been ſuppoſed to originate in the imagination, or, as it was denominated by the ancient philoſophers, the *phantaſia:* and when the ideas or forms which are there treaſured up are diſarranged or abſurdly compounded, a dreaming ſane man or a waking madman, if he reaſon at all, muſt reaſon from abſurd principles: not, however, through any defect of common ſenſe, but from a diſorder in that region of the brain, upon which the phantaſia more immediately depends. Of his firſt remark, we can only ſay, that to us it appears to be the reverſe of truth. In every propoſition which admits of demonſtration, *we* are conſcious that the concluſion is united with the firſt principle by a repetition of the very ſame energy of the underſtanding which perceives intuitive truth. That this is the caſe in every one of Euclid's demonſtrations, we appeal to every mathematical reader; and why it muſt be ſo, we ſhall by and by endeavour to evince.

Of Intuitive Evidence and Demonstration

discovery of innumerable and apparently remote relations. It is by the aid of such simple and elementary principles that the arithmetician and the algebraist proceed to the most astonishing discoveries. Nor are the operations of the geometrician essentially different: for to this class belong all propositions relating to number and quantity; that is, all which admit of mathematical demonstration. If the truth of a mathematical proposition be not self-evident; in other words, if the subject and predicate do not appear at first sight to be different names for the same thing, another term must be found that shall be synonymous to them both. Thus, to prove that the three internal angles of a right-lined triangle are equal to two right angles, I produce the base of the triangle; and by a very short process I discover that the exterior angle so formed is equal to the two interior and opposite angles. By a process equally plain and short, I perceive that the exterior angle and the interior adjacent angle are equal to two right angles: But I have already seen, that the exterior angle is neither more nor less than the two interior and opposite angles under a different aspect; whence it appears that the three internal angles of the triangle are nothing else than two right angles under a different aspect. In a word, all demonstration is founded on first principles or primary truths, which neither admit nor stand in need of proof, and to which the mind is compelled to give its assent by a bare intuition of the ideas or terms of which these primary truths are composed. Nothing is susceptible of demonstration, in the rigid sense of the word, but general, necessary, and eternal truths; and every demonstration is built upon intuition, and consists in a series of axioms or propositions of the very same kind with the first principle or truth from which the reasoning proceeds. That propositions formerly demonstrated are taken into the series, doth not in the least invalidate this account; inasmuch as these propositions are all resolvable into axioms, and are admitted as links in the chain; not because necessary, but merely to avoid the useless prolixity which frequent and tedious repetitions of proofs formerly given would occasion. But it is obvious that such truths only as result from the comparison of ideas and notions are necessary; and of course that such truths only are capable of strict demonstration. The truths which relate to real existences are all contingent, except that which affirms the existence of the Supreme Being, the Parent of all truth.

The mathematical sciences, categorical logic, and that part of metaphysics which demonstrates the being of God, are therefore the only branches of human knowledge which admit of strict demonstration. The longest demonstration in the mathematical sciences may be traced to this general and necessary truth, "Whatever is, is," or to some particular exemplification of it: the longest train of categorical syllogisms terminates in this general principle, "What is affirmed or denied of a whole *genus*, may be affirmed or denied of all the *species* and all the *individuals* belonging to that genus:" and the metaphysical demonstration of the being of God rests upon this foundation, "Whatever had a beginning, had a cause." That these are truths absolutely certain, which can neither be proved nor called in question, every man may be satisfied, merely by attending to the ideas or notions which the terms of each proposition express. The two first are merely identical propositions, of the truth of which no man has ever pretended to doubt; and though the last is not identical, it is a necessary and self-evident truth, as its contrary implies, that in the same thing there is power and no power, change and no change, action and inaction, at the same instant.

Of Experience and Analogy.

129 It is by intuition that we acquire all our notions of relation.

Before we dismiss the subject of intuition, it may not be improper to observe, that it is by this faculty or power of the mind contemplating its ideas, and comparing one idea with another, that we acquire all our notions of relation; such as *identity* and *diversity*, *resemblance*, *coexistence*, relations of *space* and *time*, relations of *quantity* and *number*, of a *cause* to its *effect*, and many more which it would be useless as well as tedious to enumerate.

Sect. III. *Of Experience and Analogy.*

130 Experience, the result of repeated observations.

It has been just observed, that intuition and demonstration are applicable only to general and necessary propositions, of which the contrary are not only false, but absurd and impossible. The great business of life, however, is with facts and contingent truths, which admit not of demonstration, but rest upon other evidence. The senses, external and internal, are the inlets to all our knowledge of facts; and the memory is the storehouse where that knowledge is preserved. Of what a man sees or feels, he can at the instant of seeing or feeling entertain no doubt; and whilst the ideas of what he has seen or felt, with all their associated circumstances, remained vivid and distinct in his memory, he is conscious that he possesses so much real knowledge. But all our knowledge, as it is derived from the senses, is of particular facts or particular truths; and the man who has in certain circumstances observed one particular phenomenon, for the existence of which he perceives no *necessity*, has not sufficient ground to conclude, that in similar circumstances similar phenomena will always occur. Milton, who surpassed the greater part of his cotemporaries in philosophical science almost as far as he has surpassed all succeeding poets in the sublimity of his genius, represents Adam, when first falling asleep, as under apprehensions that he was about to sink into his original state of insensibility:

> ———————— "Gentle sleep
> "First found me, and with soft oppression seiz'd
> "My drowsed sense, untroubled; though I thought
> "I then was passing to my former state
> "Insensible, and forthwith to dissolve."

Apprehensions similar to these would take place in his mind when he first perceived that darkness had overspread the earth. In his circumstances, he could have no ground to expect that the sun when once set would rise again to relume the world, as he had not then experienced the alternate succession of light and darkness, and probably knew not whence light proceeds. After some time, however, having observed day and night regularly to succeed each other, these two appearances, or the ideas of them, would be so associated in his mind, that each setting sun would suggest the idea of next sunrising, and lead him to expect that glorious

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glorious event with the utmoſt confidence. He would then conſider the alternate ſucceſſion of day and night as a law of nature, which might be affirmed in a propoſition expreſſive of a certain truth.

131 Is the only evidence that we have for all the general truths in phyſics, even thoſe which we think intuitively certain.

This continued obſervation of the ſame event happening in the ſame or ſimilar circumſtances, is what we call *experience;* and it is the only evidence which we have for all the general truths in phyſics, even for thoſe which we are apt to think intuitively certain *. Thus, that *milk* is white, and that *gold* is yellow, are ſuppoſed to be univerſal and neceſſary truths: but for any thing that we know, they may be particular truths; and they are certainly contingent, as the contrary to either of them may be ſuppoſed without abſurdity. We have indeed always obſerved the milk of animals of every ſpecies *white;* and therefore the idea of *white* becomes a neceſſary part of our *idea* of the ſubſtance milk, of which we call whiteneſs an eſſential property. This, however, reſpects only the milk of thoſe animals with which we are acquainted. But ſince the milk of all the animals with which we are acquainted, or of which we have heard, is white, we can have no reaſon to ſuſpect that the milk of any new and ſtrange animal is of any other colour. Alſo, ſince, wherever there has been the ſpecific gravity, ductility, and other properties of *gold*, the colour has always been *yellow;* we conclude that theſe circumſtances are neceſſarily united, though by ſome unknown bond of union, and that they will always go together.

* *Campbell's Philoſophy of Rhetoric;* and *Prieſtley's Remarks on the Drs Reid*, &c.

132 Difference between experience and analogy.

The proper proof, therefore, of ſuch univerſal propoſitions as "that milk is white," "that gold is yellow," or, "that a certain degree of cold will freeze water," conſiſts in what is called an induction of *particular facts* of preciſely the ſame nature. Having found, by much and various experience, that the ſame events never fail to take place in the ſame circumſtances, the *expectation* of the ſame conſequences from the ſame previous circumſtances is neceſſarily generated in our minds; and we can have no more ſuſpicion of a different event than we can ſeparate the *idea* of *whiteneſs* from that of the other properties of *milk.* When the previous circumſtances are preciſely the ſame, we call the proceſs of proof by the name of *induction*, and expect the event from *experience:* but if they be not preciſely the ſame, but only bear a conſiderable reſemblance to the circumſtances from which any particular appearance has been found to reſult, we call the argument *analogy;* and it is ſtronger in proportion to the degree of reſemblance in the previous circumſtances. Thus the milk of all the cows that we have ſeen, or upon which we have made the experiment, having been found nouriſhing, we confidently expect that the milk of all other cows will prove nouriſhing likewiſe; and this confidence of expectation is the reſult of uniform experience. But if, from having found the milk of all the animals with which we are acquainted to be nouriſhing, however different the nature of theſe animals; we infer that the milk of any ſtrange animal will likewiſe be nouriſhing; the inference is drawn by analogy, and by no means carries with it the conviction of experience. A proof from *real* experience can leave no doubt in the mind (Z); an argument from analogy always muſt. In the one caſe, we only infer that two events of preciſely the ſame nature, and in preciſely the ſame circumſtances, have been produced by the ſame kind of cauſe; in the other, we infer that two events ſimilar in moſt reſpects, though for any thing that we know diſſimilar in others, have been produced by the ſame kind of cauſe; and it is obvious that between theſe caſes the difference is great.

133 The evidence of analogy inferior to that of experience.

Thus, after having obſerved that all the projectiles to which we have paid any attention—a ſtone thrown from the hand, a ball from a gun, and an arrow from a bow—deſcribe a certain curve, and are impelled in that curve by two powers acting in different lines of direction which form with each other a certain angle, we infer that all projectiles which on the ſurface of the earth deſcribe the ſame curve are impelled by the ſame or ſimilar powers acting in the ſame or ſimilar lines of direction. This inference is the reſult of experience, and carries with it the fulleſt conviction to the mind. But when, from having obſerved that the curves deſcribed by the planets are of the ſame kind with thoſe deſcribed by projectiles on the earth, Sir Iſaac Newton inferred that theſe vaſt bodies are impelled in their orbits by forces of the very ſame kind, and acting in the ſame manner with the forces which impel a ball from a cannon or an arrow from a bow, his argument was founded only on analogy; and even that

(Z) We ſay from *real* experience; becauſe what is often taken for *experience*, and to human eyes has that appearance, is in fact nothing more than *analogy.* Thus a phyſician may have preſcribed to ninety-nine patients labouring under the ſame diſeaſe the ſame remedy, and always with the ſame ſucceſs. If ſo, he will think that he has experience of its utility, and will preſcribe it again with the fulleſt confidence. Yet in this caſe he may be diſappointed; for though the medicine be the ſame and the diſeaſe the ſame, there may be ſomething in the conſtitution of the hundredth patient ſo different from that of the ninety-nine, that what was ſalutary to them may be pernicious to him. This does not detract from the evidence of experience; it only ſhows, that the circumſtances of the caſe in which the medicine failed were different from thoſe in which it ſucceeded. In ſuch concluſions as are founded on a complete induction and uniform experience, every man expects the event with the laſt degree of aſſurance, and regards his paſt experience as a full *proof* of the future exiſtence of that event: In other caſes, where experience has been variable—or apparently variable—he knows that the induction has been incomplete, and therefore proceeds with caution. He weighs the oppoſite experiments; takes as complete a view as he can of the circumſtances in which they were made; conſiders which ſide is ſupported by the greater number of experiments, and inclines to that ſide with doubt and heſitation. And when at laſt he fixes his judgement, the evidence exceeds not what is called *probability.* All probability, then, ſuppoſes an oppoſition of experiments and obſervations, where the one ſide is found to overbalance the other, and to produce a degree of evidence proportioned to the ſuperiority.

Of Testimony.

that analogy is very remote. We know by experience that all projectiles which fall under our immediate cognizance are of the very ſame kind and in the very ſame circumſtances; that every one of them has a tendency, from whatever cauſe, to the centre of the earth, and is preſerved from falling by the force of projection; we know likewiſe that they are all moved through the medium of the atmoſphere, which at the ſurface of the earth is conſiderably denſe, and that a denſe medium muſt occaſion much reſiſtance: But we do not *know* that the planets have a tendency to the centre of the ſun, that they are preſerved from falling into that luminary by a projectile force, or whether they move through a *medium* or *in vacuo;* ſo that we are not *certain* that the motion of the planets is perfectly ſimilar to that of terreſtrial projectiles in any other circumſtance than the form of the curve which they all deſcribe; and from this ſingle caſe of coincidence no inference can be drawn which carries to the mind abſolute conviction.

When a man reaſons from *experience*, he infers, that what has uniformly happened hitherto, will happen always in the very ſame circumſtances; or that what is known to be the cauſe of *various phenomena of the ſame kind* is the cauſe of every other phenomenon in *all reſpects* ſimilar to theſe. Such an inference is founded on the united and complete evidence of ſenſe, memory, and reaſon. When a man reaſons from *analogy* he infers, that what has *generally* happened hitherto, will happen again in circumſtances *nearly ſimilar;* or that what is known to be the cauſe of various phenomena of the ſame kind, is the cauſe of other phenomena in *ſome reſpects* ſimilar to theſe. This inference is likewiſe founded on the united evidence of ſenſe, memory, and reaſon: but here the evidence of ſenſe is not complete, and it can be ſtrengthened only by finding more facts of the ſame or of a ſimilar nature.

Sect. IV. *Of Teſtimony.*

134 Mankind ready to believe the teſtimony of each other.

The laſt ſource of evidence which we propoſed to conſider is *teſtimony*, or the report of men concerning events which have fallen under the obſervation of their ſenſes. That we are all ready to believe the information which we receive from the teſtimony of our fellow creatures is undeniable; and indeed without ſuch belief every man's knowledge of facts and events would be confined to thoſe only of which he himſelf had been a perſonal witneſs. In that caſe, no man who had not travelled would believe that there are ſuch cities as Rome and Conſtantinople; and no man whatever could now believe that ſuch heroes as Hannibal and Cæſar had ever exiſted.

Between words and things there is no natural connexion; and though we are all accuſtomed to give to things the names by which they are known in the language that we ſpeak, and to expreſs their mutual relations by the words appropriated for that purpoſe; yet it is obviouſly impoſſible to denote one thing by the name of another, and to expreſs by words relations that have no exiſtence. This being the caſe, it may be aſked upon what principle we give credit to human teſtimony? To this queſtion various anſwers have been given, which have produced much controverſy on one of the moſt important ſubjects which can employ the mind of man.

135 The reaſon aſſigned by Hume for this propenſity.

"We may obſerve (ſays Mr Hume *), that there is no ſpecies of reaſoning more common, more uſeful, and even neceſſary to human life, than that which is derived from the teſtimony of men and the reports of eye-witneſſes and ſpectators. This ſpecies of reaſoning perhaps one may deny to be founded on the relation of cauſe and effect. I ſhall not diſpute about a word. It will be ſufficient to obſerve, that our aſſurance in any argument of this kind is derived from no other principle than our obſervation of the veracity of human teſtimony, and of the uſual conformity of facts to the reports of witneſſes. It being a general maxim that no (A) objects have any diſcoverable connexion together, and that all the inferences which we can draw from one to another are founded merely on our experience of their conſtant and regular conjunction; it is evident that we ought not to make an exception to this maxim in favour of human teſtimony, whoſe connexion with any event ſeems in itſelf as little neceſſary as any other. Were not the memory tenacious to a certain degree; had not men commonly an inclination to truth, and a principle of probity; were they not ſenſible to ſhame when detected in falſehood: Were not theſe, I ſay, diſcovered by *experience* to be qualities inherent in human nature, we ſhould never repoſe the leaſt confidence in human teſtimony. And as the evidence derived from witneſſes and human teſtimony is founded on paſt experience, ſo it varies with the experience, and is regarded either as *a proof* or *probability*, according as the conjunction between any particular kind of report and any kind of object has been found to be conſtant or variable. There are a number of circumſtances to be taken into conſideration in all judgements of this kind; and the ultimate ſtandard by which we determine all diſputes that may ariſe concerning them, is always derived from experience and obſervation. The reaſon why we place any credit in witneſſes and hiſtorians, is not derived from any *connexion* which we perceive *à priori* between teſtimony and reality, but becauſe we are accuſtomed to find a conformity between them. But when the fact atteſted is ſuch a one as has ſeldom fallen under our obſervation, here is a conteſt of two oppoſite experiences; of which the one deſtroys the other as far as it goes, and the ſuperior can only operate on the mind by the force which remains. The very ſame principle of experience which gives us a certain degree of aſſurance in the teſtimony of witneſſes, gives us alſo, in this caſe, another degree of aſſurance againſt the fact which they endeavour to eſtabliſh; from which contradiction there neceſſarily ariſes a counterpoiſe, and mutual deſtruction of belief and authority."

* *Eſſay on Miracles.*

136 confuted, and

This account of the origin of faith in teſtimony has been

(A) Is there then no diſcoverable connexion between a tree and the field in which it grows; between a man and his clothes; between an author and his work; between a ſceptic and paradoxes? Surely all theſe are correlates, and neceſſarily ſuggeſt the ideas of each other.

Of Testimony.

been controverted with much success by the Doctors Campbell and Reid. "That the evidence of testimony is derived solely from experience (says the former of these writers *), is at least not so incontestable a truth as Mr Hume supposes it; that, on the contrary, testimony hath a natural and original influence on belief antecedent to experience, will, I imagine, easily be conceived. For this purpose, let it be remarked, that the earliest assent which is given to testimony by children, and which is previous to all experience, is, in fact, the most unlimited; that by a gradual experience of mankind, it is gradually contracted, and reduced to narrower bounds. To say, therefore, that our diffidence in testimony is the result of experience, is more philosophical, because more consonant to truth, than to say that our faith in testimony has this foundation. Accordingly, youth, which is unexperienced, is credulous; age, on the contrary, is distrustful. Exactly the reverse would be the case were this author's doctrine just." This is a complete confutation of the reasoning of Mr Hume: but in order to prevent all cavilling, it is to be wished that the very acute author had explained more fully what he means by saying, that testimony hath a *natural* and *original* influence on belief; for these words may be taken in different senses, in one of which what he affirms is true, and in another false.

* *Dissertation on Miracles*, and *The Philosophy of Rhetoric.*

Dr Campbell's omission is amply supplied by Dr Reid, who gives † the following account of testimony, and of the credit which it obtains. "The wise and beneficent Author of nature, who intended that we should be social creatures, and that we should receive the greatest and most important part of our knowledge by the information of others, hath, for these purposes, implanted in our nature two principles that tally with each other. The first of these principles is a propensity to speak truth, and to use the signs of language so as to convey our real sentiments. This principle has a powerful operation even in the greatest liars; for where they lie once, they speak truth a hundred times. Truth is always uppermost, and is the natural issue of the mind. It requires no art or training, no inducement or temptation, but only that we yield to a natural impulse. Lying, on the contrary, is doing violence to our nature, and is never practised even by the worst men without some temptation. Speaking truth is like using our natural food, which we would do from appetite, although it answered no end; but lying is like taking physic, which is nauseous to the taste, and which no man takes but for some end which he cannot otherwise attain.—When we are influenced by any motive, we must be conscious of that influence, and capable of perceiving it upon reflection. Now, when I reflect upon my actions most attentively, I am not conscious that in speaking truth I am influenced on ordinary occasions by any motive moral or political. I find that truth is always at the door of my lips, and goes forth spontaneously if not held back. It requires neither good nor bad intention to bring it forth, but only that I be artless and undesigning. There may indeed be temptations to falsehood, which would be too strong for the natural principle of veracity, unaided by principles of honour or virtue; but where there is no such temptation, we speak truth by *instinct*. By this instinct, a real connexion is formed between our words and our thoughts; and thereby the former become fit to be signs of the latter, which they could not otherwise be."

† *Inquiry into the Human Mind*, &c.

Such is the account which Dr Reid gives of the truth of human testimony: and he adds, that there is another original principle implanted in us by the Supreme Being, to tally with it, viz. a disposition to confide in the veracity of others, and to believe what they tell us. "This (he says) is the counterpart to the former; and as that may be called the *principle of veracity*, we shall, for the want of a more proper name, call this the *principle of credulity*. It is unlimited in children, until they meet with instances of deceit and falsehood; and retains a very considerable degree of strength through life."

It is ever with extreme reluctance that we controvert the opinions of this able writer; and that reluctance cannot be lessened in the present instance, when we are conscious that great part of what he says is unanswerable. That truth is always at the door of the lips; that it requires no effort to bring it forth; that in ordinary cases men speak truth uninfluenced by any motive moral or political; that the greatest liars speak truth a hundred times where they lie once; and that lying is never practised by the worst men without some temptation, are positions which daily experience renders it impossible to question: But notwithstanding this, we do not think that truth is spoken by an *instinctive* principle; because it is inconceivable that instinct should teach the use of arbitrary and artificial signs, such as the words of every language undoubtedly are; or that between such signs and ideas any *instinctive* connexion should ever be formed. "Truth (as we have defined it) is the conformity of those words or signs by which things are expressed to the things themselves;" and things themselves are what they are, independent of us, our instincts, and perceptions. When we have precise and adequate ideas of objects, and when those ideas are related to one another as the objects themselves are related, we are in possession of mental truth; and in this case there is a *real* and *natural* connexion between the signs and the things signified: for we cannot frame original and simple ideas which have no archetype in nature; nor can *one* object, distinctly perceived, generate in our minds the ideas that are generated by *other* objects. Here external things are the objects, and ideas are the signs, which, when they are in conformity to the things signified by them, constitute truth.

137 The true reason assigned.

But in human testimony, the ideas in the mind of the speaker are the things signified, and the words of language are signs by which they are expressed; and when these things and signs are in conformity to each other, the words uttered express so much truth.—Now, though in this case there is no *natural* connexion between the sign and the thing signified, yet it is obvious, that without a violent effort of the speaker to the contrary they must always be in conformity with each other; because, in every language, there are words appropriated for the purpose of denoting every idea and relation which can be expressed; and in the mind of every man these ideas, relations, and *words*, have been constantly associated from the time that he learned to speak. So intimate is this association, and so impossible to be broken, that whoever will pay sufficient attention to

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to the operations of his own mind, will find that he *thinks* as well as *ſpeaks* in ſome language; and that in cogitation he ſuppoſes and runs over, ſilently and habitually, thoſe ſounds which in ſpeaking he actually utters (B). If this be ſo, it is impoſſible that a man without ſome effort ſhould ever ſpeak any thing but truth: for the *ideas* of what he has ſeen or heard, &c. are not of his manufacture; they are generated by external objects; and till they be effaced from the memory, they muſt always, by the law of aſſociation, make their appearance there with all their mutual relations, and in their proper dreſs. In the very act of learning to ſpeak, we neceſſarily learn to ſpeak the *truth:* for were we not to employ words exactly as they are employed by thoſe with whom we converſe, our language (if language it might be called) would be unintelligible; and we could neither declare our wants nor aſk relief with any hopes of ſucceſs. *Children* beginning to ſpeak, may indeed utter untruths without any motive, and merely from miſtake; becauſe the ideas and words of children have neither been long nor cloſely aſſociated: but it is impoſſible that a *man*, however wicked, ſhould habitually and without motives lie on ordinary occaſions, unleſs the fundamental principles of his nature have been totally altered; unleſs his brain has been diſordered by diſeaſe; unleſs his ideas have been diſarranged, and all his original aſſociations broken.

We know indeed by woful experience, that immoral men occaſionally utter falſehoods with a view to deceive. But on theſe occaſions they are influenced by ſome motive either of hope or terror: the falſehood is always uttered with an effort: and ſo ſtrong is the aſſociation between words and ideas, that the truth will at times break out in ſpite of all their endeavours to ſuppreſs it; ſo that the end or middle of a falſe narrative, if it be of any length, is commonly inconſiſtent with the beginning. We entertain a ſuſpicion concerning any matter of fact, when thoſe who relate it contradict each other—when they are but few in number, or of doubtful character—when they have an intereſt in what they affirm—when they deliver their teſtimony with heſitation—or, on the contrary, with too violent aſſeverations; becauſe theſe are circumſtances which we have generally experienced to accompany falſe witneſs. It is likewiſe with reluctance that we admit a narrative of events entirely different from every thing which hitherto we have ſeen or heard; becauſe we may not be certain that the narrator is not under ſome influence to deceive us in matters concerning which we have nothing but his teſtimony on which to ground our judgement. But in every caſe where the fact recorded is in itſelf poſſible, and attributed to an adequate cauſe; where a competent (C) number of witneſſes had ſufficient means of information, and are certainly under no inducement to deceive; teſtimony is complete evidence, however extraordinary the fact may be; becauſe no fact which is known to have an adequate cauſe can be ſo incredible, as that a number of men of ſound underſtandings ſhould act contrary to the fundamental principles of human nature, or be able, if ſo diſpoſed, to diſſolve aſſociations which had been formed in the mind of each from his infancy, and form new ones, all agreeing exactly with one another, but all contrary to truth.

PART II. OF BODY WITH ITS ADJUNCTS.

CHAP. I. *Of the* COMPOSITION *of* BODIES; *or, of* MATTER *and* FORM.

HITHERTO we have contemplated only the powers of our minds by which we acquire a ſtock of ideas, and the various operations of the intellect upon thoſe ideas, as treaſured up in the memory or imagination. In the courſe of the inquiry we have found, that every idea and notion which we have was ſuggeſted by ſomething independent of us; and in order to diſcover what thoſe things are, we have inveſtigated the nature of each ſenſe, as it is by the ſenſes only that we have any communication with the external world. By touch we perceive heat and cold, hardneſs and ſoftneſs, figure, ſolidity, motion, and extenſion; by the organ of ſmell, we perceive odours; by the tongue and palate, taſtes; by the ear, ſounds; and by the ſight, colours. We have likewiſe ſeen, that heat and cold, odours, taſtes, ſounds, and colours, are mere ſenſations which have no exiſtence but while they are perceived. On the other hand, hardneſs and ſoftneſs, figure and ſolidity, motion and extenſion, are neither ſenſations, nor like ſenſations; but are conceived to be ſomething ex-

ternal

(B) This ſeems to have been *Plato's* opinion; for he calls *thinking* λογον ον αυτη προς αυτην ἡ ψυχη δι εξερχεται περι ων αν σκοπη, "the language by which the ſoul explains itſelf to itſelf when it conſiders any thing." And *Plotinus* ſays, Ὁ εν φωνη λογος μιμημα του εν ψυχη, "the vocal words are an imitation of thoſe of the ſoul." To ſay that vocal words are an imitation of thoſe of the ſoul, is to ſpeak inaccurately, and to reverſe the proceſs of aſſociation; but it affords ſufficient evidence, that in the opinion of Plotinus men think as well as ſpeak in words.

(C) Should it be aſked what number we call competent, we beg leave to ſay, that it will be greater or leſs according to circumſtances. In caſes where they are not liable to the deceptions of ſenſe, two men of integrity and intelligence deſerve equal credit with two thouſand; but where there is particular occaſion for good organs, whether of ſight, hearing, or touch, the greater the number the greater is our ſecurity. To this muſt be added, that as one man is influenced by that which to another would be no motive, a great number of witneſſes concurring in the ſame teſtimony is always an additional ſecurity that they are not under the influence of any latent bias.

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ternal and independent of our faculties, which may operate in a deſert wilderneſs as well as in a populous city, though, for want of ſentient beings to operate upon, it cannot in the wilderneſs produce the ſame effects as in the city.

138 Of things perceived by the ſenſes the greater part always united.

Of things perceived by the ſenſes we find the greater part always united; for when a man perceives a piece of ſealing wax, if he makes uſe of all his ſenſes, he perceives at once cold, taſte, colour, hardneſs, roughneſs or ſmoothneſs, figure, ſolidity, motion or reſt, and extenſion. That the powers or qualities, which in this inſtance produce the ſenſations of heat or cold, taſte, odour, and colour, are ſo united to the hardneſs, figure, ſolidity, and extenſion of the wax, as that they cannot exiſt alone, is evident; becauſe it is impoſſible to remove any one of theſe things, or to conceive it removed, without removing with it all the reſt. What then is the bond of this union? Do theſe things neceſſarily accompany one another, ſo as that one of them cannot exiſt without bringing all the reſt along with it? No; there is no neceſſary connexion among them; for by the operation of fire the wax may be rendered liquid, when the *hardneſs* and *cold* are gone, though every thing elſe remains the ſame, or nearly the ſame, as it was before. By a ſtill further operation of fire the appearance may be entirely changed; and that which was formerly a piece of hard red wax, may be reduced to ſmoke and aſhes, in which there is neither hardneſs, colour, odour, nor figure; at leaſt there is not in the ſmoke and aſhes *ſuch* hardneſs, colour, odour, or figure, as was in the wax. The ſolidity and extenſion, however, remain; for we perceive aſhes and ſmoke to be extended and ſolid as much as wax or an adamant; nor is it poſſible to do any thing with the wax, or with any other ſenſible object, which ſhall deprive it of extenſion or ſolidity.

139 Some of theſe things termed *accidents*, and why.

Thus, then, extenſion and ſolidity may exiſt and be perceived when ſeparated from hardneſs, colour, and odour; but none of theſe can exiſt, or be conceived to exiſt, independent of extenſion and ſolidity. Hardneſs, colour, odour, taſte, and figure, or the things which ſuggeſt theſe notions to us, have with great propriety been termed accidents or qualities; becauſe they cannot exiſt or be conceived to exiſt by themſelves, but require for their ſupport one common ſubject. Extenſion and ſolidity can exiſt independent of them, but they cannot exiſt independent of ſolidity and extenſion.

140 Things perceived by the ſenſes, qualities, which inhere in a ſubject called *matter*.

Is then ſolidity the baſis of theſe qualities, ſo that they neceſſarily reſult from it? No; there are many things ſolid and extended which are neither hard, nor coloured, nor odorous, nor ſapid; which could not be if theſe qualities were the neceſſary effect of ſolidity. Beſides, all mankind conceive of ſolidity and extenſion as qualities of ſomething elſe; for we never ſay that ſolidity is extended or coloured, or hard or odorous, but that ſomething ſolid has theſe qualities: whence it is evident that we conſider ſolidity as a quality itſelf. In what then does ſolidity and all the other ſenſible qualities inhere, ſince they cannot exiſt ſeparately, and do not ſupport each other? This is a queſtion which modern philoſophers pretend not to anſwer: but ſome of the ancients were not ſo modeſt. Ariſtotle and his followers reſolved every bodily ſubſtance into *matter* and *form*, making matter the baſis or *ſubſtratum*, and under form comprehending all ſenſible qualities.

As attempts have been lately made to revive this philoſophy, it may not be improper to give a ſhort view of the doctrine of *matter* and *form*, if it were only to diſcover whether the ſpeculations of Ariſtotle and his adherents on this ſubject deſerve to be preferred to thoſe of Newton and Locke.

The moſt perſpicuous, and by far the moſt elegant writer among the moderns who has adopted the ancient philoſophy, is Mr Harris; and leſt we ſhould be accuſed by others of doing injuſtice to a ſubject above the reach of ordinary comprehenſion, we ſhall tranſcribe ſo much of what he has ſaid of *matter* and *form* in his Philoſophical Arrangements as ſeems neceſſary to make our readers underſtand his meaning as far as it is intelligible.

141 The Peripatetic doctrine concerning matter;

"Matter (ſays this writer) is that elementary conſtituent in compoſite ſubſtances which appertains in *common* to them all, without diſtinguiſhing them from one another. Every thing generated or made, whether by nature or art, is generated or made out of ſomething elſe; and this ſomething elſe is called its ſubject or matter. Such is iron to the ſaw; ſuch is timber to the boat. Now this *ſubject* or *matter* of a thing being *neceſſarily previous* to that thing's exiſtence, is *neceſſarily different* from it, and *not the ſame*. Thus iron, as iron, is not a ſaw; and timber, as timber, is not a boat. Hence, then, one character of every *ſubject* or *matter*, that is, the character of *negation* or *privation*. [He means *negation* or privation of what is to be made out of it.]

142 which is deſcribed as deſtitute of every attribute or quality,

"Again, Though the *ſubject* or *matter* of a thing be not that thing, *yet*, were it incapable of becoming ſo, it could not be called its ſubject or matter. Thus iron is the *ſubject* or *matter* of a ſaw; becauſe, though *not* a ſaw, it may ſtill *become* a ſaw. On the contrary, timber is *not* the ſubject or matter of a ſaw; becauſe it not only (as timber) is no ſaw, but can never be made one from its very nature and properties. Hence, then, beſides *privation*, another character of every *ſubject* or *matter*, and that is the character of *aptitude* or *capacity*. [He means aptitude or capacity to be that which is made out of it.]

"Again, When one thing is the *ſubject* or *matter* of *many* things, it implies a *privation* of them *all*, and a *capacity* to them *all*. Thus iron being the ſubject or matter of the ſaw, the axe, and the chiſſel, implies *privation* and *capacity* with reſpect to *all three*. Again, We can change a ſaw into a chiſſel, but not into a boat; we can change a boat into a box, but not into a ſaw. The reaſon is, there can be no change or mutation of one thing into another where the two changing beings do not participate the ſame matter (D). But even here, were the boat to moulder and turn to earth,

(D) In a note he ſays: This reaſoning has reference to what the ancients called υλη πϱοσεχης, *the immediate matter*, in oppoſition to υλη πϱωτη, *the remote* or *primary matter*.

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earth, and that earth by natural proceſs to metallize and become iron; through ſuch progreſſion as this we might ſuppoſe even the boat to become a ſaw. Hence therefore it is, that *all change* is by immediate or mediate participation of the *ſame matter.* Having advanced thus far, we muſt be careful to remember, firſt, that every *ſubject* or *matter* implies, as ſuch, *privation* and *capacity;* and next, that *all change* or *mutation* of beings into one another is *by means of their participating the ſame common matter.* This we have choſen to illuſtrate from works of art, as falling more eaſily under human cognizance and obſervation. It is, however, no leſs certain as to the productions of nature, though the ſuperior ſubtlety in theſe renders examples more difficult. The queſtion then is, whether in the world which we inhabit, it be not admitted from experience, as well as from the confeſſion of all philoſophers, that ſubſtances of every kind (E), whether natural or artificial, either immediately or mediately, paſs into one another: and whether, in that caſe, there muſt not be ſome one *primary matter* common to *all things.* I ſay ſome *one primary matter*, and that common to *all things*, ſince without ſome *ſuch* matter, *ſuch mutation* would be wholly impoſſible. But if there be ſome *one primary matter*, and that *common to all things*, this *matter* muſt imply, not (as particular and ſubordinate matters do) a *particular* privation and a *particular* capacity, but, on the contrary, *univerſal* privation and *univerſal* capacity. If the notion of ſuch a being appear ſtrange and incomprehenſible, we may farther prove the *neceſſity* of its exiſtence from the following conſiderations: Either there is no ſuch general change as here ſpoken of; which is contrary to fact, and would deſtroy the ſympathy and congeniality of things: Or, if there be, there muſt be a matter of the character *here* eſtabliſhed; becauſe without it (as we have ſaid) ſuch change would be *impoſſible.* Add to this, however hard *univerſal* privation may appear, yet had the *primary matter*, in its proper nature, any one particular attribute, ſo as to prevent its *privation* from being unlimited and univerſal, ſuch *attribute would run through all things*, and be conſpicuous in all. If it were white, all things would be white; if circular, they would be circular; and ſo as to other attributes; which is contrary to fact. Add to this, that the *oppoſite* to ſuch attribute could *never* have exiſtence, unleſs it were poſſible for the ſame thing to be at *once* and in the ſame inſtance both white and black, circular and rectilineal, &c. ſince this inſeparable attribute would neceſſarily be *every where;* becauſe the *matter*, which implies it, is itſelf *every where*, at leaſt may be found in all things that are generated and periſhable.

143 and to be apprehended only by abſtraction and analogy.

"Here then we have an idea (ſuch as it is) of that ſingular being υλη πρωτη, the *primary matter;* a being which thoſe philoſophers who are immerged in ſenſible objects know not well how to admit, though they cannot well do without it; a being which flies the perception of every *ſenſe*, and which is at beſt, even to the *intellect*, but a negative object, no otherwiſe *comprehenſible* than either by *analogy* or *abſtraction.* We gain a glimpſe of it by *abſtraction*, when we ſay that the *firſt manner* is *not* the lineaments and complexion which make the beautiful face; *nor yet* the *fleſh* and *blood* which make thoſe lineaments and that complexion; *nor yet* the liquid and ſolid aliments which make that fleſh and blood; *nor yet* the ſimple bodies of earth and water which make thoſe various aliments; but *ſomething*, which being *below* all theſe, and ſupporting them all, is yet *different* from them all, and eſſential to their exiſtence. We obtain a ſight of it by *analogy*, when we ſay, that as is the braſs to the ſtatue, the marble to the pillar, the timber to the ſhip, or any one *ſecondary matter* to any one *peculiar form;* ſo is the *firſt* and *original matter* to all *forms in general.*"

Such is the doctrine of the Peripatetics concerning the *primary matter* or the baſis of bodily ſubſtances. We forbear to make any remarks upon it till we have ſeen what they ſay of *form*, the other eſſential part of every body; for what is meant by *matter* and *form* will be moſt completely ſeen when they are viewed together.

144 The Peripatetic doctrine concerning form.

"FORM (ſays the ſame elegant writer) *is that elementary conſtituent in every compoſite ſubſtance, by which it is* DISTINGUISHED, CHARACTERIZED, *and known, from every other.* But to be more explicit: The *firſt* and moſt ſimple of all *extenſions* is a *line:* this, when it exiſts, united with a *ſecond* extenſion, makes a *ſuperficies;* and theſe two exiſting together with a *third*, make a *ſolid.* Now this *laſt* and *complete* EXTENSION we call the *firſt* and *ſimpleſt* FORM; and when this *firſt* and *ſimpleſt form* accedes to the *firſt* and *ſimpleſt matter*, the union of the two produces *body;* which is for that reaſon defined to be *matter triply extended.* And thus we behold the riſe of *pure* and original *body* (F) It muſt be remembered, however, that *body*, under this character, is ſomething *indefinite and vague*, and ſcarcely to be made an *object* of *ſcientific contemplation.* It is neceſſary to this end that its extenſion ſhould be *bounded;* for as yet we have treated it without ſuch regard. Now, the *bound* or *limit* of *ſimple body* is *figure;* and thus it is that *figure*, with regard to *body*, becomes the next *form* after *extenſion.*

145 The three original forms which, added to matter, conſtitute body phyſical.

"But though the *boundary* of body by *figure* is one ſtep towards rendering it *definite* and *knowable*, yet is not this ſufficient for the purpoſes of nature. It is neceſſary *here*, that not only its *external* ſhould be duly bounded, but that a ſuitable regard ſhould likewiſe be had to its *internal.* This *internal adjuſtment*, diſpoſition, or *arrangement* (denominate it as you pleaſe), is called ORGANIZATION, and may be conſidered as the *third* form which appertains to body. By its acceſſion we behold the riſe of BODY PHYSICAL or NATURAL; for every ſuch body is ſome way or other *organized.* And thus may we affirm, that theſe *three*, that is to ſay, *extenſion*,

(E) He muſt mean only bodily ſubſtances; for it is not admitted by ſuch philoſophers as make a diſtinction between mind and body, that the one ever paſſes into the other.

(F) "Original body (he ſays), when we look *downward*, has reference to the *primary matter*, its ſubſtratum: when we look *upwards*, it becomes itſelf a *matter* to *other things;* to the *elements*, as commonly called, air, earth, water, &c. and in conſequence to all the variety of *natural productions.*"

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extenſion, *figure*, and *organization*, are the *three original forms* to *body physical* or *natural*; *figure* having reſpect to its *external*, *organization* to its *internal*, and *extenſion* being common both to one and to the other. It is more than probable, that from the variation in theſe *univerſal* and (as I may ſay) *primary forms*, ariſe moſt of thoſe *ſecondary* forms uſually called *quantities ſenſible*, becauſe they are the proper objects of our ſeveral ſenſations. Such are roughneſs and ſmoothneſs, hardneſs and ſoftneſs; the tribes of colours, ſavours, odours; not to mention thoſe powers of character more *ſubtle*, the powers electric, magnetic (G), medicinal, &c.

"Here therefore we may anſwer the queſtion, how *natural* bodies are *diſtinguiſhed*. Not a ſingle one among them conſiſts of *materials in chaos*, but of materials wrought up after the moſt exquiſite manner, and that conſpicuous in their *organization*, or in their *figure*, or in *both*.—As therefore every *natural body* is diſtinguiſhed by the *differences* juſt deſcribed, and as theſe *differences* have nothing to do with the *original matter*, which being everywhere ſimilar can afford no diſtinction at all; may we not here infer the expediency of ESSENTIAL FORMS, that every *natural ſubſtance* may be eſſentially *characterized?* Theſe *forms*, though they differ from matter, can yet *never ſubſiſt without it*; but *united* with it, they help to produce every *compoſite* being, that is to ſay, in other words, every *natural ſubſtance*, in the viſible world. It muſt be remembered, however, that it is the FORM in this union which is the *ſource of all diſtinction*. It is by *this* that the *ox* is diſtinguiſhed from the *horſe*, not by that graſs on which they ſubſiſt, the *common matter* to both. To which alſo may be added, that as figures and ſenſible qualities are *the only objects of our ſenſations*, and theſe are all *parts* of *natural form*; ſo therefore (contrary to the ſentiment of the vulgar, who dream of nothing but of matter) *it is form, which is in truth the whole that we either hear, ſee, or feel*; nor is *mere matter* any thing better than an *obſcure imperfect being*, knowable only to the *reaſoning faculty* by the two methods already explained, I mean that of *analogy* and that of *abſtraction*. Here therefore we conclude with reſpect to *ſenſible forms*, that is to ſay, *forms immerged in matter* and *ever inſeparable* from it. In *theſe* and *matter* we place the ELEMENTS OF NATURAL SUBSTANCE."

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If this extract appear long, let it be remembered that it contains the fulleſt and moſt perſpicuous detail which is to be found in the Engliſh language, of a doctrine of which the author of *Ancient Metaphyſics* ſuppoſes Locke to have been ignorant; and for which ignorance he affects to treat the Engliſh philoſopher with ſupercilious contempt. Had Locke really been ignorant of the ancient doctrine of *matter* and *form*, it is probable that moſt people will be of opinion, that the *contempt* expreſſed by his cenſurer might have been ſpared; but if it ſhould appear, that, as far as this theory is intelligible, it differs not, except in words, from the doctrine laid down in the *Eſſay concerning Human Underſtanding*, what ſhall we think of that zeal for ancient phraſes, which had influence ſufficient to make one reſpectable philoſopher pour contempt upon another who was an ornament to his country?

146 Matter cannot be deſtitute of ſolidity.

What Mr Harris has ſaid of *matter* and *form* reſpecting works of art, is ſufficiently intelligible, and extremely juſt. Nor ſhould we object to the account which he gives of the origin of natural body, if he had not diveſted his firſt matter of every power and every quality, ſolidity and extenſion not excepted. But though we can ſuppoſe body diveſted of any one particular figure and of every ſenſible quality, ſuch as colour, odour, taſtes, &c. and the *ſubſtratum* or *baſis* or *matter* of it ſtill to remain, yet it ſeems impoſſible to conceive it diveſted of *ſolidity* without ſuppoſing it totally annihilated. Nay, if we have any juſt notion at all of ſolidity, it is evidently inſeparable from the ſubſtratum of body, whatever that ſubſtratum be; and indeed though Mr Harris diveſts his firſt matter of every attribute, the argument by which he proves the neceſſary exiſtence of ſuch a being does not require its privation to be ſo univerſal. "Had the *primary matter* (ſays he), in its proper nature, any one particular attribute, ſo as to prevent its privation from being unlimited and univerſal, *ſuch attribute would run through all things* and be conſpicuous in all." This indeed is obvious and undeniable: but *ſolidity* and *extenſion* do in *fact* run through *all things* into which the *ſubſtratum* or *matter* of body is ever formed or ever can be conceived to be formed; and therefore there is no neceſſity for ſuppoſing the firſt matter diveſted of theſe attributes (H).

Mr Harris ſays, that both Timæus and Plato drop expreſſions

(G) That it is from the *extenſion*, *figure*, and *organization* of bodies, that their *medicinal* powers ariſe, ſeems to be undeniable; for medicines operate by contact: but it is not ſo clear that the ſame *forms*, to uſe the author's language, are the ſource of *magnetical* powers. If the magnet be ſurrounded with an atmoſphere extending to a certain diſtance, ſuch may be the caſe; but if not, the author's conjecture muſt be ill founded. See MAGNETISM.

(H) Nor does it appear that it was diveſted of them by all the ancient philoſophers. We learn from Cudworth, that "the atomical phyſiology, the moſt ancient perhaps of any, teaches that body is nothing elſe but διαςατὸν ἀντίτυπον, *extended bulk*; and that nothing is to be attributed to it but what is included in the nature and idea of it, viz. greater or leſs magnitude, with diviſibility into parts, figure, and poſition, together with motion or reſt, but ſo as that no part of body can ever move itſelf. And conſequently, this philoſophy ſuppoſes, that there is no need of any thing elſe beſides the ſimple elements of magnitude, figure, ſite, and motion, (which are all clearly intelligible, or different modes of extended ſubſtance), to ſolve the corporeal phenomena by; and therefore not of any ſubſtantial *forms* diſtinct from the matter; nor of any other qualities really exiſting in the bodies without, beſides the reſults or aggregates of thoſe ſimple elements, and the diſpoſition of the inſenſible parts of bodies in reſpect of figure, ſite, and motion; nor of any intentional *ſpecies* or *ſhows* propagated from the objects to our ſenſes: nor, laſtly, of any other kind of motion or action really diſtinct from

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expreſſions as if they conſidered *matter* to be *place*; but place, as will be ſeen afterwards, can be the baſis of nothing. He likewiſe quotes a paſſage from Ammonius on the predicaments, in which it is ſaid "that there never was in *actuality* either matter without body, or body without quality; and we appeal to our readers if it be not abſolutely impoſſible to contemplate ſuch a being even in *idea*. To the queſtion, Whether the firſt matter has a ſeparate exiſtence by itſelf, diſtinct from all the qualities of body, the author of *Ancient Metaphyſics* anſwers thus:—"We have no idea of it exiſting ſeparately, becauſe we find no ſuch thing in nature, from which we draw all our ideas; but whether there may not be ſuch a thing exiſting in the regions of infinite ſpace, as *matter* without *form* and *dimenſions*; is what I think no man can take upon him to decide." But with all ſubmiſſion, if a man cannot decide this queſtion with the utmoſt certainty, his three ponderous volumes are nothing better than uſeleſs paper: for the ſubject of them is things *exiſting*; and concerning exiſtence we know nothing with greater certainty, than that a being of which nothing poſitive can be affirmed, cannot poſſibly have any exiſtence.

147 Some firſt matter common to all bodies;

That, in the world which we inhabit, bodily ſubſtances of every kind, whether natural or artificial, either immediately or mediately paſs into one another, is a truth which cannot be denied: and therefore it follows, that there muſt be ſome one primary matter common to all things. In modern philoſophy this primary matter is conſidered as ſolid, and as the *ſubſtratum* of all bodies; and all thoſe things which, in the language of Mr Harris, are comprehended under the appellation of *form*, are called *qualities*: ſo that on this ſubject the ancient and modern philoſophy differ in nothing but in the latter uſing the word *qualities* inſtead of the word *form*; and defining the firſt matter to be, a *ſolid* ſubſtance every where the ſame," whilſt the ancient philoſophy conſiders it as void of ſolidity.

148 of the nature of which, all men are equally ignorant.

Of the nature of this firſt matter all philoſophers are equally ignorant: for, as Mr Harris ſays, it is in truth *form*; or, as modern philoſophers would ſay, they are in truth *qualities*, which are the whole that we either hear, or ſee or feel, or of which we have either idea or conception. Mr Locke ſays expreſsly, "that if any one will examine himſelf concerning his notion of pure ſubſtance in general, he will find that he has no other idea of it at all, but only a ſuppoſition of he knows not what ſupport of ſuch qualities as are capable of producing ſimple ideas in us."

149 How we know that the things immediately perceived are qualities.

But how, it has been aſked, do we know that the things which we perceive are qualities, and cannot exiſt without a ſubject? We anſwer, Becauſe every one of them, except ſolidity, may be changed or deſtroyed, and the ſubject in which they inhere ſtill remain. Thus, though wax may be melted or burnt, and be no longer a hard red ſubſtance of ſuch a figure and ſuch a ſmell, the matter which ſupported the hardneſs, figure, colour, and ſmell, ſtill remains; for melted wax or aſhes is as much a ſolid ſubſtance as is that which may be uſed for the ſealing of letters, &c.

It has been ſaid that ſolidity (1) is the *ſubſtratum* of body;

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from local motion (ſuch as generation and alteration), they being neither intelligible as modes of extended ſubſtance, nor any way neceſſary: Foraſmuch as the forms and qualities of bodies may well be conceived to be nothing but the reſult of thoſe ſimple elements of magnitude, figure, ſite, and motion, variouſly compounded together; in the ſame manner as ſyllables and words in great variety reſult from the different combinations and conjunctions of a few letters, or the ſimple elements of ſpeech; and the corporeal parts of ſenſation, and particularly that of viſion, may be ſolved only by local motion of bodies, that is, either by corporeal effluvia (called *ſimulacra*, *membranæ*, and *exuviæ*), ſtreaming continually from the ſurface of the objects, or rather, as the later and more refined atomiſts conceived, by preſſure made from the object to the eye, by means of light in the medium. So that ως δια βακτηριας του ταθεντος αερος το βλεπομενον αναγγελλεται, the ſenſe taking cognizance of the object by the ſubtle interpoſed medium, that is tenſe and ſtretched (thruſting every way from it upon the optic nerves), doth by that, as it were by a ſtaff, touch it. Again, Generation and corruption may be ſufficiently explained by concretion and ſecretion, or local motion, without ſubſtantial forms and qualities. And laſtly, Thoſe ſenſible ideas of light and colours, heat and cold, ſweet and bitter, as they are diſtinct things from the figure, ſite, and motion of the inſenſible parts of bodies, ſeem plainly to be nothing elſe but our own fancies, paſſions, and ſenſations, however they be vulgarly miſtaken for qualities in the bodies without us. *Cudworth's Intellectual Syſtem*, Book i. chap. 1.

This, as will be ſeen by and by, is the philoſophy of Newton, Locke, and all their followers: and that it is the genuine philoſophy of the ancient atomiſts, we may ſafely take the word of the author whom we have quoted; for no modern has been more converſant with their writings, more completely maſter of their language, or has given their ſenſe with greater accuracy. Thoſe authors, therefore, who in their zeal for ancient metaphyſics would explode the phyſiology of Newton and Locke, and ſubſtitute in its place the Ariſtotelian doctrine of *matter* and *form*, belie their own pretences; for the theory which they would baniſh is more ancient than that which they introduce; and we appeal to our readers if it be not more intelligible.

(1) The philoſophers of moſt eminence who have maintained this opinion are, *Dr Watts*; the author of the *Procedure, Extent, and Limits, of the Human Underſtanding*; and *Dr Law*, late biſhop of Carliſle, who in a note upon *King's Origin of Evil* gives the opinion of the triumvirate in the following words:—"We find by experience, that a thing will always exhibit the ſame appearances in ſome reſpects, though it admit of changes in others: or, in Mr Locke's language, that certain numbers of ſimple ideas go conſtantly together, whereas ſome others do not. The former of theſe we call the *ſubſtance*, thing, or being, itſelf; the latter are termed its modes or *accidents*. Thus the ſubſtance of *body*, as far as we know of it, conſiſts in ſolidity and extenſion; which being neceſſarily finite, it alſo becomes capable of diviſion, figure, and motion. Theſe are its original inſeparable qualities,

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body; and men have been probably led into this notion from a conviction that ſuch *ſubſtratum*, whatever it be, is and muſt be ſolid; but that ſolidity is only a quality inſeparable from the firſt matter, and not that matter itſelf, muſt be evident from this conſideration, that ſolidity is the ſame in all bodies, and incapable of producing by itſelf any other effect than that of excluding from the place occupied by it every other ſolid ſubſtance. It could not of itſelf be the *ſubſtratum* of colour, taſte, or ſmell, otherwiſe all bodies would be coloured, ſapid, and odorous; and as, according to all our notions of it, it is incapable of any change, it could not by itſelf be ſo modified as to excite in us theſe ſenſations.

150 Our notion of matter relative and obſcure.

The things then immediately perceived by us, or of which we have any adequate idea or conception, are only qualities which muſt belong to a ſubject; and all that we know about this ſubject is, that it is that to which ſuch qualities belong. From this it is evident, that our notion of matter, as diſtinguiſhed from its qualities, is a relative * and obſcure notion, and muſt remain obſcure till men have other faculties. In this the philoſopher ſeems to have no advantage above the vulgar: for as they perceive colour, and figure, and motion, by their ſenſes, as well as he does; and as both are equally certain that there is a ſubject of thoſe qualities; ſo the notions which both have of this ſubject are equally obſcure; or, to ſpeak more properly, they have no *poſitive* notion of it at all. When a philoſopher calls it the *firſt matter*, a *ſubſtratum* or a *ſubject* of *inheſion*, thoſe learned words convey no meaning but what every man underſtands and expreſſes, by ſaying in common language, that it is a thing extended, ſolid, and moveable.

* *Reid's Eſſays on the Intellectual Powers of Man.*

They are therefore *qualities*, or in the language of ancient philoſophy, *forms* alone, about which, in corporeal ſubſtance, we can reaſon with preciſion and certainty; and it is ſufficient for all the purpoſes of life that we have of them an adequate knowledge. For as the *firſt matter* or original *ſubſtratum* of all bodies ſeems to be the ſame, though we know not what it is; and as one body is diſtinguiſhed from another only by its *qualities* or *powers*; a knowledge of the nature of theſe is all that can be neceſſary to direct our conduct with reſpect to the various objects with which we are ſurrounded.

151 Qualities, primary and

Qualities thus conſidered in bodies, are, firſt, ſuch as are utterly inſeparable from the body, in what ſtate ſoever it is; ſuch as in all the changes and alterations which it ſuffers, and under all the force which can be employed upon it, it conſtantly keeps. Thus, in the inſtance already given, a ſtick of ſealing wax may, by the operation of fire, be rendered liquid or reduced to ſmoke and aſhes; and when it has undergone theſe changes, it has loſt many of the ſenſible qualities which it had when a long round ſubſtance fit for the purpoſe of ſealing letters; but other qualities which were then perceivable in it ſtill remain: for not only liquid wax, but every particle of ſmoke and aſhes, is ſolid and extended, as well as the hardeſt or largeſt body; and every ſuch particle has likewiſe ſome figure, and is capable of motion or reſt. Again, If a grain of wheat or any other corporeal ſubſtance, be divided into two parts, and each part be again divided without end, ſtill the ſmalleſt particle of it will be ſolid, extended, of ſome figure, and capable of further diviſion. *Solidity, extenſion, diviſibility*, and *motion* or *reſt*, are therefore qualities inſeparable from *body*, and have on that account been with great propriety called its *original* or *primary qualities*.

152 ſecondary.

There are other qualities, which in truth are nothing in the bodies themſelves, but powers ariſing from the magnitude, figure, texture, and motion, of their inſenſible parts to produce in us various ſenſations; ſuch are *colours, ſounds, taſtes*, and *odours*. Theſe have been denominated *ſecondary qualities*; and to them may be added

lities, which conſtitute the thing, and ſeem not to depend on any thing elſe as a *ſubject*. But a particular figure, motion, &c. are only accidents or modes of its exiſtence; which do not neceſſarily attend it, though they themſelves cannot be ſuppoſed to exiſt without it. The ſubſtance of *ſpirit* conſiſts in the powers of thinking and acting, which likewiſe admit of various modifications. This ſeems to be all that we can learn concerning the nature of things from obſervation and experience. To inquire into the *manner* how theſe, which we call *properties*, exiſt together, or to attempt to explain the *cauſe*, ground, or reaſon, of their union, is in vain. To aſſign the word *ſubſtance* for a repreſentation of it, is ſaying nothing: it is ſetting a mere word for what we have neither any idea of nor occaſion for. Indeed if we conſider theſe primary qualities as needing ſomething to inhere in, we are obliged to ſeek for ſomething to ſupport them: and by the ſame way of reaſoning, we may ſeek for ſomething elſe to ſupport that other ſomething, and ſo on; and at laſt ſhall find no other ſupport for the whole but the cauſe which produced it." "Dr Watts (continues the Biſhop) is of opinion, that it is introducing a needleſs *ſcholaſtic* notion into the real nature of things, and then fancying it to have a real exiſtence:" (*Logic*, p. 14.) The author of the *Procedure, Extent*, &c. affirms. "That as far we directly know the eſſential properties of any ſubſtance, ſo far we have a *direct* knowledge of the ſubſtance *itſelf*: and if we had a direct knowledge of *all* the eſſential properties of any ſubſtance, we ſhould have an *adequate* knowledge of that ſubſtance; for ſurely, if there be any meaning in words, the knowing any thing of the eſſential properties of a thing is knowing *ſo much* of its very ſubſtance."

That the ſubſtance of body conſiſts in *ſolidity* and *extenſion*, and nothing more; and that theſe depend not upon any thing elſe as a *ſubject*; cannot be true: for *ſolidity*, in our conception, is nothing but *impenetrability*; but whoever uſes the word *impenetrability*, certainly means that there is *ſomething* impenetrable. That there is ſome real thing or being different from ſolidity and extenſion, which impreſſes us with the notion that it is ſolid and extended, is ſelf-evident to all mankind: if it be not matter, theſe conceptions muſt be communicated to us by the immediate agency of the Deity, which ſeems to have been the real opinion of the Biſhop of Carliſle. But this differs not from the theory of Berkeley, which we ſhall conſider by and by.

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added a third sort, which are universally allowed to be barely *powers*, though they are in fact as much real qualities in the subject as those we have just mentioned. Thus the power in fire to produce by its primary qualities a new colour or consistency in wax or clay, is as much a quality in the fire as the power which it has to produce in us a new sensation of warmth or burning. That *colours*, *tastes*, *sounds*, and *odours*, as they are perceived by us, are mere sensations, has been already proved: and that the powers in the bodies which produce these sensations are not, like *solidity* and *extension*, inseparable from the body to which they may belong, is evident; because a piece of *red* wax may be reduced to *black* ashes; and because by pounding an almond we may change its clear white colour into a dirty hue, and its pleasant taste into one that is oily and rancid; and a single rent through the body of a bell destroys its sound.

The primary qualities of body have a real existence independent of us and of every other creature. Thus the particular *bulk*, *number*, *figure*, and *motion*, of the *parts* of *fire* or *snow* are *really in the fire or snow*, whether any man's senses perceive them or not; and therefore these may be called *real qualities*, because they really exist in the bodies: But *light*, *heat*, *whiteness*, or *cold* (as they are perceived by us), are no more *really in fire or snow*, than sickness is in *tartar* or pain in a *sword*. Take away the sensations of them: let not the eyes see light or colours, nor the ears hear sounds; let not the palate taste nor the nose smell; and all colours, tastes, odours, and sounds, as they are such particular sensations, vanish and cease, and are reduced to their causes, *i. e.* to the bulk, figure, and motion of the parts of the body.

153 Bodily qualities are of three sorts.

The qualities then that are in bodies, rightly considered, are of three sorts. 1. The *bulk*, *figure*, *number*, *situation*, and *motion* or *rest*, of their *solid* parts. Of these, as they are in themselves, we have clear and distinct notions. We know that they are in the body whether we perceive them or not, and we call them *primary* or *essential qualities*. 2. The power that is in any body, by reason of its internal texture and insensible primary qualities, to operate upon our senses in a peculiar manner, producing in us the different sensations of *colours*, *sounds*, *tastes*, or *smells*, &c. These we have called *secondary qualities*, but they are often termed *sensible qualities*. 3. The *power* that is in any body, by reason of the particular constitution of its primary qualities, to make such a *change* in the *bulk*, *figure*, *texture*, and *motion* of *another body*, as to make it operate on our senses differently from what it did before. Thus, the sun has a power to make wax white, and fire to make lead fluid. These are universally called *powers*; but we have no such notions of them as we have of the *primary qualities* of bodies. We know that they exist, but we know not what they are. It has indeed been discovered, that the sensation of smell is occasioned by the effluvia of bodies*; that of sound by their vibration. The disposition of bodies to reflect a particular kind of light occasions the sensation of colour; and the operation of the minute parts of bodies upon the nerves of the tongue and palate is the cause of tastes. Very curious discoveries have been made of the nature of heat and its manner of operating, and an ample field still remains. We are likewise intuitively certain, that body can operate upon body only by impulse; but how certain impulses upon certain organs should produce sensations in us to which there is nothing similar in the impelling body, is equally unknown to the clown and the philosopher.

* *Reid's Essays on the Intellectual Powers of Man*, and *Locke's Essay*, &c.

154 The doctrine of the ancient atomists respecting qualities.

Such is the distinction which in modern philosophy is made between primary and secondary qualities; but it is a distinction which was likewise well known to that sect of ancient philosophers who were denominated *atomists*. At the head of these were Thales and Pythagoras (K); and we may infer from Aristotle, that the sect comprehended almost all the physiologists who taught before himself and Plato: for he says†, Δημοκριτος και οἱ πλειστοι των φυσιολογων ατοπωτατον τι ποιουσι, παντα γαρ τα αισθητα απτα ποιουσι, και εις σχηματα αναγουσι τους χυμους: "Democritus, and *most* of the *physiologists*, fall into a great absurdity; for they make all sense to be touch, and resolve sensible qualities into the figures of insensible atoms." And he adds, that "the former physiologists (without exception) said not well, that there is no black and white without the sight, nor bitter and sweet without the taste." He elsewhere ‡ tells us, that those philosophers explained generation and alteration without forms and qualities, by figures and local motion." Δημοκριτος και Λευκιππος ποιησαντες τα σχηματα την αλλοιωσιν και την γενεσιν εκ τουτων ποιουσι, διακρισει μεν και συγκρισει γενεσιν και φθοραν ταξει δε και θεσει αλλοιωσιν. "Democritus and Leucippus having made figures (or variously figured atoms) the first principles, make generation and alteration out of these; namely, generation

† *Lib. de Sensu et Sensibili*, cap. 4.

‡ *De Generatione et Corruptione*, lib. i. cap. 2.

(K) This is denied by Bishop Warburton, who thinks nothing better settled than that Democritus and Leucippus were the authors of the atomic physiology. We highly respect the learning and ingenuity displayed in the Divine Legation of Moses; but on this point we are convinced that its author is mistaken. Strabo expressly affirms, that Moschus the Phœnician was the author of the atomic physiology; and Cudworth has proved, by arguments which to us are perfectly satisfactory, that Thales and Pythagoras were both atomists, and that they derived the doctrine from Phœnicia or Egypt. They did not, indeed, speculate in physics, but delivered their doctrines as they had received them from tradition, and they referred all motion to mind as its cause. Leucippus and Democritus, we believe, were the first speculative atomists: but though they refined upon, and perhaps improved, the mere mechanical part of the physiology of their masters, they unhappily dropt the better part of it; and, banishing mind from their system of the universe, they became materialists and atheists. With the sober and pious part of philosophers this brought the atomic theory into disrepute; and Plato and Aristotle, who were theists, when they opposed that theory, always pointed their arguments against Leucippus and Democritus, which is probably what led the learned Bishop to consider these atheists as the authors of the atomic physiology.

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tion together with corruption from the concretion and ſecretion of them, but alteration from the change of their order and poſition." By the atomic phyſiologiſts the name of *quality* was generally applied only to thoſe things which we have called *ſecondary qualities*. The *primary* being conſidered as *eſſential* to *matter*, were ſeldom, if ever, called *qualities*. That the atoms, which they held to be the firſt principles of bodies, were figured, ſolid, extended, and moveable, is apparent, not only from the ſhort view of their ſyſtem which we have given from Cudworth, but likewiſe from the paſſages which we have juſt quoted from Ariſtotle: but the queſtion debated between them and their antagoniſts was, whether thoſe atoms had *ſmell*, *taſte*, and *colour*; or, as it was commonly expreſſed, whether they had *qualities*? Democritus, Leucippus, and the other atomiſts, we ſee, maintained that they had not; and the following account of the doctrine of Protagoras, another philoſopher of that ſchool, ſhows, that on this ſubject at leaſt the ancient advocates for the atomic ſyſtem reaſoned as juſtly as any of the moderns, and much more juſtly than the Peripatetics and Platoniſts by whom they were oppoſed. Plato having in his Theætetus firſt ſaid in general that the philoſophy of Protagoras made all things to conſiſt of a commixture of atoms and local motion, repreſents his doctrine concerning colours in particular, after this manner: "Firſt, As to that which belongs to the ſight, you muſt conceive what is called a white or black colour, not to be any thing abſolutely exiſting either without your eyes or within your eyes; but black and white, and every other colour, is cauſed by different motions made upon the eye, from objects differently modified; ſo that it is nothing either in the agent or patient abſolutely, but ſomething which ariſes from between them both (L)." From this paſſage it is plain, that Protagoras thought of colours exactly as Mr Locke thought, that they are not *real qualities* exiſting in bodies, but merely ſenſations excited in our minds; and indeed he is preſently after repreſented as having called them τινα εν ημιν φασματα, *certain fancies* or *appearances in us*. But there is in the Theætetus another paſſage, in which a fuller account is given of the atomic philoſophy, to this purpoſe: "The principle upon which all theſe things depend is this, That the whole univerſe (M) is motion of atoms and nothing elſe: which motion is conſidered two ways, and is accordingly called by two names, *action* and *paſſion*. From the mutual congreſs, and, as it were, attrition of theſe together, are begotten innumerable offsprings, which, though infinite in number, yet may be reduced to two general heads, *ſenſibles* and *ſenſations*, which are both generated at the ſame time. The *ſenſations* are *ſeeing*, *hearing*, and the like; and the correſponding *ſenſibles* are *colours*, *ſounds*, &c. Wherefore, when the eye and its proper object meet together, both the αισθητον and the αισθησις, the *ſenſible idea* of white and black, and the *ſenſation* of ſeeing, are generated together, neither of which would have been produced if thoſe two had not met. The like is to be conceived of all other *ſenſibles*, as hot and cold, &c. None of theſe are abſolute things in themſelves, or real qualities in external objects; but they are begotten from the mutual congreſs of agent and patient, and that by motion. So that neither the agent has any ſuch thing in it before its congreſs with the patient, nor the patient before its congreſs with the agent. But the agent and patient meeting together, and begetting *ſenſation* and *ſenſibles*, both the object and the ſentient are forthwith made to be ſo and ſo qualified; as when honey is taſted, the ſenſation of taſting, and the quality of ſweetneſs, are begotten together, though the ſenſation be vulgarly attributed to the taſter, and the quality of ſweetneſs to the honey." The concluſion of all which is ſummed up thus, ουδ εν ειναι αυτο καθ' αυτο, αλλα τινι αει γιγνεσθαι: "Not one of theſe ſenſible things is any thing abſolutely in the object without, but they are all generated or made relative to the ſentient (N)."

The language of ancient philoſophy was defective in preciſion; terms were uſed vaguely and improperly, ſo that the meaning of the author is often to be collected only from the context. When Protagoras is here made to ſay, that when the agent and patient meet together, both the object and the ſentient are forthwith made to be ſo and ſo *qualified*; as when honey is taſted, the ſenſation of taſting and the *quality* of ſweetneſs are begotten together; it could not be his meaning, that any real change is made upon the external object merely by our taſting it, but only that the actual ſenſation and the ſenſible *idea* of ſweetneſs are produced at once; juſt as he had ſaid before, that the ſenſible idea of white or black, and the ſenſation of ſeeing, are generated together. If his words be thus interpreted they expreſs a noble truth; and the whole paſſage ſhows, that the ancient atomic theory differed not from the theory of Des Cartes, Newton, and Locke, being the moſt rational, as well as the earlieſt ſyſtem of phyſics with which we have any acquaintance. By diveſting body of *eſſential forms* diſtinct from matter and motion, and by giving to the firſt matter extenſion and ſolidity, it renders the corporeal world intelligible; and accounts for thoſe appearances

(L) Υπολαβε τοινυν ουτωσι κατα τα ομματα πρωτον, ὁ δε καλεις χρωμα λευκον μη ειναι αυτο ἑτερον τι εξω των σων ομματων, μηδ' εν τοις ομμασι, αλλα μελαν τε και λευκον και ὁτιουν αλλο χρωμα εκ της προσβολης των ομματων προς την προσηκουσαν φοραν φανειται γεγενημενον και ὁ δε εκαστον ειναι φαμεν χρωμα, ουτε το προσβαλλον ουτε το προσβαλλομενον αλλα μεταξυ τι εκαστω ιδιον γεγονος.

(M) Protagoras was a follower of Leucippus and Democritus in every thing, and of courſe an atheiſt.—This, however, does not hinder him from having been a correct phyſiologiſt with reſpect to the compoſition of body; and as ſuch only is he quoted by us. It is, indeed, melancholy to think, that there was hardly a ſect of ancient philoſophers in which there were not many atheiſts.

(N) Αρχη δε εξ, ἡς α νυν δη ελεγομεν παντα ηρτηται ἡ δε αυτων, ὡς το παν κινησις ην και αλλο παρα τουτο ουδεν, της δε κινησεως δυο ειδη, πληθει μεν απειρον, ἑκατερον, δυναμιν δε το μεν ποιειν εχον, το δε πασχειν, &c.—See the *Theætetus*; ſee alſo *Cudworth's Intellectual Syſtem*, Book i. chap. 1.

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pearances which are called ſecondary qualities, in a manner perfectly ſatisfactory. Ariſtotle indeed oppoſed the atomic philoſophy, and had influence enough to bring it into diſrepute for many ages; but when he inſiſted that the two conſtituent principles of body are *matter* and *form*, both independent of all ſentient beings, and which may be conceived as exiſting diſtinct from each other, he ſubſtituted for a ſimple and ſublime theory an abſurd and incomprehenſible fiction.

Chap. II. *Of the* Essences *of* Bodies.

155 The eſſences of bodies reſult,

Having treated of the ſubſtance, qualities, and powers of body, we may ſeem to have exhauſted this part of our ſubject; but there is ſtill more to be done. Metaphyſicians, ancient and modern, have introduced another term into the ſcience, to denote that which diſtinguiſhes one ſpecies or ſort of bodies from all other ſpecies or ſorts; and this term we ſhall briefly explain. Gold is apparently different from lead, and from every other ſpecies of metal; a horſe is apparently different from an ox, and from every other ſpecies of animals; and all animals apparently differ from all vegetables, as vegetables differ from metals.

156 according to the Peripatetics and Platoniſts, from eſſential forms;

It is only with the *bodies*, not the minds of animals, that we are at preſent concerned: and we have ſeen that all bodies are compoſed of the ſame matter.—What then is it that makes different bodies exhibit to us ſuch different appearances; or, in other words, how come they to be poſſeſſed of ſuch different qualities and powers? It is (ſay the followers of Plato and Ariſtotle) from their having different *eſſential forms*, by which every natural ſubſtance is eſſentially characterized; for of every animal, vegetable, or metal, &c. there is a *form* conceived, as exiſting before the individuals in which it is incorporated, from which reſult all the properties of that animal, vegetable, or metal, ſuch as *figure*, *ſize*, *colour*, and the other qualities perceptible by our ſenſes: but this *internal and eſſential form* itſelf, from which all other forms reſult, is not perceptible by our ſenſes, nor even by our underſtanding directly and immediately, nor otherwiſe than by the analogy formerly mentioned. Theſe eſſential forms, we are told, mean ſomething, which, though different from matter, can yet never ſubſiſt without it; ſomething which, united with it, helps to produce every *compoſite* being, that is to ſay, in other words, every natural ſubſtance in the viſible world.

157 But theſe forms have no exiſtence.

This aſſertion Mr Harris ſubmits with deference to his contemporaries; becauſe (ſays he) "I ſpeak perhaps of ſpectres as ſhocking to ſome philoſophers as thoſe were to Æneas which he met in his way to hell—*Terribiles viſu formæ*." The elegant author's unwillingneſs to frighten his contemporaries, was a proof of his amiable and benevolent diſpoſition; but he needed not to have ſuffered from any ſuch apprehenſion. Thoſe ſpectres, apparently ſo dreadful, had long before been laid to reſt by the incomparable Cudworth, who has demonſtrated, that *eſſential forms* different from matter and motion, as they have no real exiſtence, had no place in the moſt ancient philoſophy; and that the different appearances or ſenſible qualities which different bodies exhibit, are the reſult of the different contexture of their inſenſible parts. Thus, gold and lead are compoſed of the ſame primary matter, but the atoms or minute parts of that matter are in the one ſubſtance differently combined from what they are in the other; and this different combination is the ſole cauſe that gold is ſpecifically heavier than lead, more ductile, and of a different colour, &c. For the very ſame reaſon, iron is harder than either gold or lead, ſpecifically lighter, and poſſeſſed of many other ſenſible qualities which are not found in either of theſe ſubſtances. One vegetable differs from another externally in ſize, colour, taſte, ſmell, rapidity of growth, and proportion of parts, &c.: but all vegetables are compoſed of the ſame matter; and the external difference which prevails among them is the reſult of a different ſtructure and motion of their inſenſible parts. The ſame is to be ſaid of the differences which prevail among the bodies of animals; they all reſult from internal organization and motion, and from nothing elſe, whatever be the immediate cauſe of that motion.

158 The real eſſences of bodies unknown to us.

This particular internal texture and motion of inſenſible parts, is that which makes one ſort of bodies differ externally from every other ſort of bodies; and it is by modern metaphyſicians called the *real eſſence* of bodies. Thus, that internal texture of minute parts, which makes gold of a bright yellow, extremely ductile, ſpecifically heavier than all other metals, and ſoluble in *aqua regia*, is the real eſſence of gold; but what that eſſence is in itſelf no man can tell, as we perceive only the qualities which reſult from it. We are, however, certain, that it is different from the real eſſences of lead and iron, becauſe it produces different effects from thoſe which are produced by theſe eſſences; and different effects are never produced in the ſame circumſtances by the ſame cauſe.

159 Nominal eſſences, what they are.

We have called the internal texture and motion of the inſenſible parts of bodies their *real eſſences*, to diſtinguiſh them from other *eſſences* which are only *nominal*, and with which we are perfectly acquainted, becauſe they are the fabrication of our own minds.—Thus, a beautiful bright yellow, a certain ſpecific gravity, extreme ductility, and ſolubility in *aqua regia*, are the qualities by which we diſtinguiſh gold from all other metals. Of theſe qualities we frame a ſort of general conception, which we call the *eſſence* of gold; and every ſubſtance in which we find this eſſence, we claſs under the ſpecific name gold. For though it is obvious that our conceptions cannot be the *real eſſences* of things external, yet are they ſufficient guides to theſe eſſences, as we know that bodies which, being all formed of the ſame matter, have the very ſame ſenſible qualities, muſt likewiſe have the ſame internal organization or texture of parts, becauſe it is only in that organization or texture that one body can differ from another.—And ſo much for bodily ſubſtance, qualities, and eſſences.

Chap. III. *Of the* Existence *of* Matter.

160 Berkeley attempts to demonſtrate that matter has no exiſtence.

We have endeavoured to prove, that all corporeal ſubſtances conſiſt of minute atoms, ſolid and extended; and that the ſenſible qualities of every body reſult from the combination and motion of the atoms of which that body is compoſed. The celebrated Berkeley, biſhop of Cloyne,

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Cloyne, however, attempted to demonstrate that these atoms have no real existence; and that the very supposition of a solid, extended, and inert substance, being the archetype of our ideas, involves in it an absurdity and contradiction.

It is universally allowed, that all our knowledge of matter is derived through the senses, either immediately in the very act of sensation, or mediately by an association which is resolvable into a process of reasoning. According to the principles which we have stated, and laboured to establish, matter itself is no immediate object of the senses; and as these are the principles upon which the bishop erected his demonstration, it will be incumbent upon us to consider his theory, because it has been represented as in the highest degree pernicious, and as leading to universal scepticism.

161 The view of his theory given by his antagonists.

The author of the *Essay on the Nature and Immutability of Truth*, represents Berkeley as teaching us, "that external objects (that is, the things which we take for external objects) are nothing but ideas in *our* minds; in other words, that they are in *every respect* different from what they appear to be; that matter exists not but in *our* minds; and that independent on *us* and *our* faculties, the earth, the sun, and the starry heavens, have no existence at all; that a lighted candle hath not *one* of *those qualities* which it *appears to have*; that it is not white nor luminous, nor round, nor divisible, nor extended; but that, for any thing we know, or can ever know to the contrary, it may be an Egyptian pyramid, the king of Prussia, a mad dog, the island of Madagascar, Saturn's ring, one of the Pleiades, or nothing at all." With respect to the consequences of this theory, he affirms, that "it is subversive of man's most important interests, as a moral, intelligent, and percipient being; and not only so, but also, that if it were universally and seriously adopted, the dissolution of society, and the destruction of mankind, would necessarily ensue within the compass of a month."

The dissolution of society and the destruction of mankind are indeed dismal consequences—enough to make a man shudder in his closet. But do they really flow from Berkeley's system? They certainly do, if it be the aim of that system to prove that a candle has not any one quality which it appears to have, and that it may be a *mad dog*; for should all philosophers, by some means or other, become converts to the theory of Berkeley, as we know that the bishops Sherlock, Smalridge, and others, actually did, the dissolution of society and the destruction of mankind would indeed be inevitable. The scribbling race, by using mad dogs for candles, would all become infected with the hydrophobia; and having their natural irritability augmented by the canine rabies, they would bite and tear till not a human being were left alive.

162 A view of his theory given by himself.

But to drop this ludicrous style, so unsuitable to philosophical investigation and calm inquiry, we beg leave to affirm, that the theory of Berkeley is here totally and grossly misrepresented, and that not one of those dangerous consequences which flow from that misrepresentation can be fairly deduced from any thing taught in *The Principles of Human Knowledge* and the *Dialogues on the Existence of Matter*. So far is Berkeley from teaching that external things are nothing but ideas in *our* minds, and that they are in every respect different from what they appear to be, that he teaches the very reverse of this in the plainest language possible. "I am of a vulgar cast (says he), simple enough to believe my senses, and leave things as I find them. It is my opinion, that the real things are those very things I see and feel and perceive by my senses. That a thing should really be perceived by my senses, and at the same time not really exist, is to me a plain contradiction. When I deny sensible things an existence out of the mind, I do not mean *my* mind in particular, but *all* minds. Now it is plain they have an existence exterior to my mind, since I find them by experience to be independent of it. There is therefore some other mind wherein they exist during the intervals between the times of my perceiving them; as likewise they did before my birth, and would do after my annihilation. And as the same is true with regard to all other finite created spirits, it necessarily follows there is an *omnipotent eternal mind*, which knows and comprehends all things, and exhibits them to our view in such a manner, and according to such rules, as he himself hath ordained, and are by us termed the laws of nature."

So far is Berkeley from teaching that, independent on *us* and *our* faculties, the earth, the sun, and the starry heavens, have no existence at all, and that a lighted candle has not one of those qualities which it appears to have, that he over and over affirms the direct contrary; that the universe has a real existence in the mind of that infinite God, in whom, according to the scriptures, we all live, and move, and have our being; that a lighted candle has not only all those qualities which it appears to have, but that, with respect to us, it has nothing else; that so far from being continually deceived by our senses, we are never deceived by them; and that all our mistakes concerning matter are the result of false inferences from true sensations.

The bishop makes the same distinction that we have made between ideas and notions; restraining the use of the former term to denote the relicts of sensation, and employing the latter to denote our knowledge or conception of spirits and all such objects as are not perceived by sense. He likewise affirms, that we can have no *idea* of an external inert substance; because an idea can be like nothing but another idea, or the sensation of which it is a relict: and as all mankind admit that ideas and sensations can have no existence but in the mind of a percipient being, he therefore infers that we can have no *idea* of any thing existing unperceived, and by consequence can have no idea of matter in the philosophical sense of that word. Solidity, extension, divisibility, motion, figure, colour, taste, and all those things which are usually called qualities primary and secondary, being according to him mere ideas, can have no existence but in a mind perceiving them; but so far is he from supposing their existence to depend upon the perception of our minds, that he says expressly, "When in broad day-light I open my eyes, it is not in my power to choose whether I shall see or no, or to determine what particular objects shall present themselves to my view; and so likewise as to the hearing and other senses, the ideas imprinted on them are not creatures of my will. There is therefore some other will or spirit that produces them.

them. The queſtion between the materialiſts and me is not, Whether things have a real exiſtence out of the mind of *this* or *that* perſon? but, Whether they have an abſolute exiſtence, diſtinct from being perceived by *God*, and exterior to *all minds?* I aſſert, as well as they, that ſince we are affected from without, we muſt allow powers to be without in a being diſtinct from ourſelves. So far we are agreed. But then we differ as to the kind of this powerful being. I will have it to be ſpirit; they matter, or I know not what third nature. Thus I prove it to be ſpirit: From the effects I ſee produced, I conclude there are actions; and becauſe actions, volitions (for I have no notion of any action diſtinct from volition); and becauſe there are volitions, there muſt be a will. Again, The things I perceive muſt have an exiſtence, they or their archetypes, out of my mind: but being ideas, neither they nor their archetypes can exiſt otherwiſe than in an underſtanding: there is therefore an underſtanding. But will and underſtanding conſtitute in the ſtricteſt ſenſe a mind or ſpirit. The powerful cauſe, therefore, of my ideas is, in ſtrict propriety of ſpeech, a ſpirit."

163 That theory, however improbable, certainly poſſible, and

This is a faithful abſtract of Berkeley's theory given in his own words. Matter, according to him, cannot be the *pattern* or *archetype* of ideas, becauſe an idea can reſemble nothing but another idea, or the ſenſation of which it is a relict. Matter, he thinks, cannot be the *cauſe* of ideas; for every cauſe muſt be active, and matter is defined to be inert and incapable of action. He therefore infers, that all our ſenſations of what we call the qualities of body are the effect of the immediate agency of the Deity upon our minds; and that corporeal ſubſtance has no exiſtence, or at leaſt that we have no evidence of its exiſtence. That ſuch may *poſſibly* be the origin of our ſenſations, no man will deny who reflects upon the infinite power and wiſdom of the Agent from whom they are ſaid to proceed. Dr Reid himſelf, the ableſt of all Dr Berkeley's opponents, frankly acknowledges that no man "can ſhow, by any good argument, that all our ſenſations might not have been as they are, though no body or quality of body had ever exiſted."

164 in its conſequences harmleſs.

In its conſequences we do not perceive that this theory can be hurtful either to religion, to virtue, or to the buſineſs of common life; for it only explodes the notion of a ſubſtratum, which, though it may have a real exiſtence, was never thought of by the generality of mankind in any nation under heaven. Dr Beattie indeed affirms, that in "leſs than a month after the non-exiſtence of matter ſhould be univerſally admitted, he is certain there could not, without a miracle, be one human creature alive on the face of the earth. But this aſſertion muſt be the conſequence of his miſtaking Berkeley's non-exiſtence of matter for the non exiſtence of ſenſible objects, the reality and exiſtence of which the biſhop never denied. On the contrary, he expreſsly ſays, "We are ſure that we really ſee, hear, feel; in a word, that we are affected with ſenſible impreſſions; and how are we concerned any farther? I *ſee* this cherry, I *feel* it, I *taſte* it; and I am ſure *nothing* cannot be ſeen, or felt, or taſted: it is therefore *real*. Take away the ſenſations of ſoftneſs, moiſture, redneſs, tartneſs, and you take away the cherry." All this is equally true and equally conceivable, whether the combined ſenſations which indicate to us the exiſtence of the cherry be the effect of the immediate agency of God or of the impulſe of matter upon our minds; and to the lives of men there is no greater danger in adopting the former than the latter opinion.

165 A conſequence of Berkeley's theory; which

But it has been ſaid, that Berkeley's doctrine neceſſarily leads to ſcepticiſm in religion, as the ſame kind of reaſoning which he employs to prove the non-exiſtence of matter, operates equally againſt the exiſtence of mind, and conſequently againſt the poſſibility of a future ſtate of rewards and puniſhments. "The rational iſſue of this ſyſtem (we are told) is ſcepticiſm with regard to every thing excepting the exiſtence of our ideas and their neceſſary relations. For ideas being the only objects of thought, and having no exiſtence but when we are conſcious of them, it neceſſarily follows, that there is no object of our thought which can have a continued and permanent exiſtence. Body and ſpirit, cauſe and effect, time and ſpace, to which we were wont to aſcribe an exiſtence independent of our thought, all are turned out of exiſtence by this ſhort dilemma: Either thoſe things are ideas of ſenſation or reflection, or they are not: If they are ideas of ſenſation or reflection, they can have no exiſtence, but when we are conſcious of them: If they are not ideas of ſenſation or reflection, they are words without any meaning."

This ſophiſm was advanced as a conſequence from Berkeley's principles by Mr Hume; and upon theſe principles it has been deemed unanſwerable by ſubſequent philoſophers of great merit. But is it really a part of Berkeley's ſyſtem, or can it be fairly inferred from the principles on which that ſyſtem is built? Theſe queſtions it is fit that Berkeley ſhould anſwer for himſelf: and we ſhall venture to aſſert, that his anſwer will be perfectly ſatisfactory to every reader who attends to the diſtinction, which, after the biſhop, we have ſtated between ideas and notions.

166 that author foreſaw and

Though we believe this dangerous inference from Berkeley's principles is commonly attributed to Hume as its author, it did not eſcape the ſagacity of the biſhop himſelf. In the third dialogue, *Hylas*, who pleads for the exiſtence of matter, thus objects to the reaſoning of his antagoniſt. "Notwithſtanding all you have ſaid, to me it ſeems, that according to your own way of thinking, and in conſequence of your own principles, it ſhould follow, that you are only a ſyſtem of floating ideas, without any ſubſtance to ſupport them. Words are not to be uſed without a meaning. And as there is no more meaning in ſpiritual ſubſtance than in material ſubſtance, the one is to be exploded as well as the other.

167 obviated, but

To this *Philonus* anſwers: "How often muſt I repeat, that I know or am *conſcious* of my own being; and that I myſelf am not my ideas, but ſomewhat elſe; a thinking active principle, that perceives, knows, wills, and operates about ideas: I know that I, one and the ſame ſelf, perceive both colours and ſounds; that a colour cannot perceive a ſound, nor a ſound a colour; that I am therefore one independent principle, diſtinct from colour and ſound; and, for the ſame reaſon, from all other ſenſible things and inert ideas. But I am not in like manner *conſcious* either of the exiſtence or eſſence of matter. Farther, I know what

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what I mean, when I affirm that there is a ſpiritual ſubſtance or ſupport of ideas; i. e. that a ſpirit knows and perceives ideas. But I do not know what is meant, when it is ſaid that an unperceiving ſubſtance hath inherent in it, and ſupports, either ideas or the archetypes of ideas. In the very notion or definition of material ſubſtance there is included a manifeſt repugnance and inconſiſtency. But this cannot be ſaid of the notion of ſpirit. That ideas ſhould exiſt in what doth not perceive, or be produced by what doth not act, is repugnant. But it is no repugnancy to ſay, that a perceiving thing ſhould be the ſubject of ideas, or an active being the cauſe of them. That I, who am a ſpirit or thinking ſubſtance, exiſt, I know as certainly as I know that my ideas exiſt. I know likewiſe what I mean by the terms *I* and *myſelf*; and I know this immediately or intuitively; though I do not perceive it as I perceive a triangle, a colour, or a ſound. Ideas are things inactive and perceived; and ſpirits a ſort of beings altogether different from them, by which they are perceived. I do not, therefore, ſay, that my ſoul is an idea, or like an idea. However, taking the word *idea* in a large ſenſe, my ſoul may be ſaid to furniſh me with an idea, that is, an image or likeneſs of God, though indeed extremely inadequate. For all the notion I have of God is obtained on reflecting on my own ſoul, heightening its powers, and removing its imperfections. I have, therefore, though not an inactive idea, yet in myſelf ſome ſort of an active thinking image of the Deity. And though I perceive him not by ſenſe, yet I have a notion of him, or know him, by reflection and reaſoning. My own mind and my own ideas I have an immediate knowledge of; and by the help of theſe do immediately apprehend the *poſſibility* of the exiſtence of other ſpirits and ideas. Farther, from my being, and from the dependency I find in myſelf and my ideas, I do by an act of reaſon *neceſſarily* infer the exiſtence of a God, and of all created things in the mind of God. It is granted that we have neither an immediate evidence, nor a demonſtrative knowledge, of the exiſtence of *other finite ſpirits*; but it will not therefore follow, that ſuch ſpirits are on a footing with material ſubſtances: if, to ſuppoſe the one be inconſiſtent, and if it be not inconſiſtent to ſuppoſe the other; if the one can be inferred by no argument, and there is a probability of the other; if we ſee ſigns and effects indicating diſtinct finite agents like ourſelves, and ſee no ſign or ſymptom whatever that leads to a rational belief of matter. I ſay, laſtly, That I have a *notion* of ſpirit, though I have not, ſtrictly ſpeaking, an *idea* of it. I do not perceive it as an idea, or by means of an idea; but know it by reflection. Whereas, I neither perceive matter objectively as I do an idea, nor know it as I do myſelf by a reflex act; neither do I mediately apprehend it by ſimilitude of the one or the other, nor yet collect it by reaſoning from that which I know immediately. All which makes the caſe of matter widely different from that of the Deity and all ſpirits."

Thus far we think Berkeley's theory tenible, and its conſequences harmleſs. That by the immediate agency of the Deity all our ſenſations *might* be what they are, though matter had no exiſtence, we think he has proved by arguments unanſwerable; and we are likewiſe of opinion, that by admitting the evidence of ſenſe, conſciouſneſs, and reaſon, in their fulleſt extent, and by diſtinguiſhing properly between thoſe things of which we have *ideas*, and thoſe of which we have *notions*, he has ſufficiently ſecured the exiſtence of ſpirits or percipient beings, and obviated the irreligious ſophiſtry of Hume before it was conceived by that author. But the good biſhop ſtops not here. Not ſatisfied with proving that all our ſenſations lead us immediately to the Deity, and that, for aught we know, matter, as defined by philoſophers, may have no ſeparate exiſtence, he proceeds farther, and endeavours to prove that matter cannot poſſibly exiſt. This appears even in the extracts which we have quoted from his book, in which he talks of the repugnance and inconſiſtency of the notion. In this part of his ſyſtem, we think he errs greatly, and advances an opinion altogether inconſiſtent with his own juſt principles.

168 Not ſatiſfied with this, he endeavours to prove the exiſtence of matter impoſſible.

169 His reaſoning

The repugnance of which he ſpeaks, ariſes ſolely from conſidering ſolidity and extenſion as relicts of ſenſation, or ideas of the ſame kind with thoſe of heat and cold, taſtes and ſounds. "Light and colours, heat and cold, extenſion and figures; in a word, the things we ſee and feel; what are they (ſays his lordſhip), but ſo many ſenſations, notions, ideas, or impreſſions, on ſenſe? and is it poſſible to ſeparate even in thought any of theſe from perception? Some there are who make a diſtinction betwixt *primary* and *ſecondary* qualities: by the former, they mean extenſion, figure, motion, reſt, ſolidity or impenetrability, and number: by the latter, they denote all other ſenſible qualities, as colours, ſounds, taſtes, and ſo forth.—The ideas we have of theſe they acknowledge not to be the reſemblances of any thing exiſting without the mind, or unperceived; but they will have our ideas of the primary qualities to be patterns or images of things which exiſt without the mind, in an unthinking ſubſtance which they call *matter*. But it is evident that extenſion, figure, and motion, are only ideas exiſting in the mind; that without extenſion ſolidity cannot be conceived; that an idea can be like nothing but another idea; and that conſequently neither they nor their archetypes can exiſt in an unperceiving ſubſtance. Hence it is plain, that the very notion of what is called *matter*, or *corporeal ſubſtance*, involves a contradiction in it."

170 fallacious.

This account of extenſion and ſolidity affords a ſtriking inſtance how much the moſt vigorous and upright mind is liable to be warped by prejudice in behalf of a darling theory, and how apt the cleareſt underſtanding is to be blinded by the equivocal uſe of terms. That Biſhop Berkeley poſſeſſed a vigorous and perſpicacious mind, his moſt vehement antagoniſts are eager to admit; and that his intentions were good, is known to all Europe. Yet by the equivocal uſe of the word *idea*, which the writings of Locke had then introduced into the language of philoſophy, he has here ſuffered himſelf to loſe ſight of a very proper and accurate diſtinction, which, ſo far as we know, was among the moderns firſt made by himſelf between *ideas* and *notions*. According to the biſhop, "we have a *notion* of power and a *notion* of ſpirits, but we can have no *idea* either of the one or the other; for all ideas being paſſive

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passive and inert, they cannot represent unto us by way of image or likeness that which acts. Such is the nature of *spirit* or that which acts, that it cannot be of itself perceived, but only by the effects which it produceth. It must be owned, however, that we have some *notion* of soul, spirit, and the operations of the mind, such as willing, loving, hating, inasmuch as we know or understand the meaning of these words."

Now we beg leave to affirm, that what is here said of spirits, and of which we readily admit the truth, is equally true of material or solid substances. We have no *ideas* of solidity and extension, because these things are not originally impressed upon the senses; but we have very distinct though relative *notions* of them, for they are clearly perceived by the effects which they produce. That this is at least possible, we have the acknowledgement of Bishop Berkeley himself: for he "freely owns, that from a cause, effect, operation, sign, or other circumstance, there may reasonably be inferred the existence of a thing not immediately perceived; and that it were absurd for any man to argue against the existence of that thing, from his having no direct and positive notion of it." This is exactly the case with respect to solid substances. These substances we do not immediately perceive; but we infer their existence from effects, signs, and other circumstances, and we have of them very clear though relative notions. Thus a man can open and shut his empty hand; but when he grasps an ivory ball of three or four inches diameter, he feels, that though the same power be exerted, his hand cannot then be shut. He is conscious that there is no change in himself; and being intuitively certain that every effect must have a cause, he infers with the utmost confidence, that the cause which prevents his hand from shutting is in the ball; or, in other words, that the thing which communicates to his eye the sensation of colour, and impresses upon his hand a sensation of touch, must be solid or impenetrable. Solidity, however, is not the sensation itself; it is only the cause of the sensation; and therefore it is so far from being an idea in our minds, that we are conscious our notion of it is of a thing totally different from all our ideas, of a thing external, at least to our minds. Indeed the notion itself is not positive; it is only relative, and inferred from the effects which are produced on our senses. That it is the *same* thing which communicates to our eye the sensation of colour, and has the power of resisting the compression of our hand, is evident: because, when the ball is thrown away, the resistance as well as the actual sensation vanish at once.

171
The idea of colour and the notion of solidity not naturally inseparable.

From this fact, which a less acute man would think a proof that the resistance was not occasioned by the immediate agency of the Supreme Being, but by the impenetrability of a solid substance of small dimensions, the bishop argues thus against the *possibility* of such a substance: "They who assert that figure, motion, and the rest of the primary or original qualities, do exist without the mind in unthinking substances, do at the same time acknowledge, that colours, sounds, heat, cold, and such like secondary qualities, do not; which they tell us are sensations existing in the mind alone, that depend on and are occasioned by the different size, texture, and motion, of the minute particles of matter. This they take for an undoubted truth, which they can demonstrate beyond all exception. Now if it be certain, that those original qualities are inseparably united with the other sensible qualities, and not even in thought capable of being abstracted from them, it plainly follows, that they exist only in the mind. But I desire any one to reflect and try whether he can by any abstraction of thought conceive the extension and motion of a body, without all other sensible qualities. For my own part, I see evidently that it is not in my power to frame an idea of a body extended and moved, but I must withal give it some colour or other sensible quality, which is acknowledged to exist only in the mind. In short, extension, figure, and motion, abstracted from all qualities, are inconceivable. Where, therefore, the other sensible qualities are, there must be these also, to wit, in the mind, and no where else."

In this reasoning, though plausible, there is an unintended fallacy. It is indeed true, that we cannot contemplate in imagination a solid substance without conceiving it to have some colour; but there is sufficient reason to believe, that this union of colour and solidity in our minds is not the effect of nature as it operates at first upon our senses, but merely the consequence of early and deep-rooted association. Bishop Berkeley himself has taught us, that the objects of sight are not at a distance; and that if a man born blind were suddenly made to see, he would conceive the objects of his sight as existing either in his eye or in his mind. This is a truth which no man will controvert who has dipt into the science of optics, or who has even paid the slightest attention to the perceptions of infants; and if so, it follows, that to a man born blind and suddenly made to see, colour and solidity would not appear united. Were such a person to lay hold of an ivory ball and raise it to the elevation of his eye, he would perceive whiteness as a new sensation existing in his eye or his mind, but he would feel resistance at the extremity of his arm. He would not have the least reason to conclude, that this whiteness was inseparably united to the cause of this resistance; and he would, in fact, draw no such conclusion, till experience had taught him, that by removing the ball or cause of resistance from his hand, he at the same time removed the sensation from his eye. After repeated experiments, he would indeed discover, that the cause of colour to the eye, was likewise by some means or other the cause of resistance to the hand; and he would so associate these in his mind, that the one would never afterwards make its appearance as an idea or a notion without bringing the other along with it. The whole difficulty, therefore, in this case, is to break an early and deep-rooted association; for it is plain that the associated ideas were not originally united, and that solidity and colour were at first conceived as separate.

If the reader perceive not the force of this reasoning, we beg leave to recommend to him the following experiment, which, if we mistake not, will carry conviction to his judgement, that in the last-quoted passage Bishop Berkeley has argued fallaciously, and that extension and colour are not *inseparably* united as ideas in the mind. Let him go into a dark room, containing a number of spherical bodies of various colours; let him take one of them into his hand;

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and he will inftantly *feel* refiftance, and have a *notion* of extenfion and folidity; but will he likewife have the *idea* of colour infeparably united with this notion? The bifhop fays he will: and if fo, it muft be the idea of fome *particular* colour; for his lordfhip has taught us, that the *abftract* and *general* idea of colour, which is neither *red*, nor *green*, nor *blue*, &c. cannot poffibly be formed. The man, then, we fhall fuppofe, whilft he feels refiftance, conceives the refifting body to be *green;* and holding it ftill in his hand, walks into the light of day. The *refiftance*, and confequently the *caufe* of refiftance, remains unchanged; but what becomes of the infeparable union of thofe with colour, when the body, upon being actually feen, proves to be *black*, i. e. to have no colour at all?—It appears, therefore, undeniable, that folidity and colour are not united in nature; that the one is an effential quality of fomething external to us, of which we have no *idea*, but a very diftinct though relative *notion;* and that the other is an actual fenfation in our minds, caufed by the impreffion of fomething external on the organ of fenfe, which leaves behind it in the memory or imagination a positive and direct *idea* that exifts no where elfe.

172 Matter exifts, but

Solid fubftance, therefore *may* exift, for though it is not immediately perceived by the fenfes, and is a thing of which we can have no *idea*, we acquire a clear and diftinct *notion* of it, by the very fame means which Bifhop Berkeley thinks fufficient to give us diftinct notions of power and of fpirits; and, therefore, that notion can involve in it no contradiction. Still, however, we would not fay with Dr Beattie, "that we could as eafily believe, that two and two are equal to ten; or, that whatever is, is not; as that matter has no feparate exiftence:" for it is certainly *poffible*, that the Supreme Being, without the inftrumentality of matter, could communicate to our minds all the fenfations and notions from which we infer the reality of folid fubftance. All that we contend for, as having the evidence of demonftration, is the *poffibility* of folid and extended fubftance; and if the thing be *poffible*, the general voice of mankind proclaims its *probability*.—We are *confcious* of our actual fenfations, and we know by *experience* that they are caufed by fomething diftinct from ourfelves. When a man grafps an ivory ball, he *feels* that he cannot fhut his hand, and he knows that the refiftance which prevents him proceeds *not* from *himfelf*. Thus far all mankind are agreed. But Bifhop Berkeley fays, that the refiftance proceeds immediately from the Supreme Being or fome other fpirit; whilft we, without pretending that his fcheme is impoffible, think it more natural to fuppofe that the man's hand is kept from fhutting by the refiftance of a folid fubftance of four inches diameter; of which fubftance, though we have no *idea* of it, we have as diftinct a *notion* as Berkeley had of fpirits. From one or other of thefe caufes this effect muft proceed; and it is of little importance to life or happinefs which of them be the true caufe, fince it is with the effect only that we are immediately concerned. Still, however, a philofopher would choofe to adopt the eafieft and moft natural fide of every alternative; which, if our notion of folidity be juft, is certainly, in the prefent cafe, the exiftence of matter.

After treating fo largely of the compofition of bodies, and fhowing the general agreement of metaphyficians, ancient and modern, with refpect to the notion of their folidity, it will appear ftrange to the lefs philofophical part of our readers, that we fhould now exprefs a doubt of that notion's being well-founded.—

173 is by fome philofophers denied to be folid.

We have ourfelves no doubt, but on the contrary are fully convinced, that folidity is effential to matter. This, however, has of late been denied by philofophers of great merit. Dr Prieftley, after Mr Mitchell and Father Bofcovich, affirms that matter is *not folid* or impenetrable to other matter; and that it has, in fact, no properties but thofe of *attraction* and *repulfion* *. The proofs of this pofition, which appears fo paradoxical, he draws from optical experiments, from electricity, and from the effects of heat and cold upon fubftances ufually conceived to be folid.

* *Difquifitions on Matter and Spirit*, and *Correfpondence with Dr Price.*

174 The arguments ufed in fupport of this hypothefis

The appearances from which the folidity of matter is inferred, are nothing more, he fays, than fuperficial appearances, and therefore have led to fuperficial and falfe judgments, which the *real appearances* will not authorize. "*Refiftance*, on which alone our opinion concerning the folidity or impenetrability of matter, is founded, is never occafioned by *folid matter*, but by fomething of a very different nature, viz. a *power of repulfion*, always acting at a real, and in general an affignable diftance, from what we call the body itfelf. When I prefs my hand againft the table, I naturally imagine that the obftacle to its going through the table, is the *folid matter* of which it confifts; but a variety of philofophical confiderations demonftrate that it generally requires a much greater power of preffure than I can exert to bring my fingers into actual contact with the table. Electrical appearances fhow that a confiderable weight is requifite to bring into feeming contact even the links of a chain hanging freely in the air, they being kept afunder by a repulfive power belonging to a very fmall furface, fo that they do not actually touch, though they are fupported by each other. It has been fhown, from optical confiderations, that a drop of water rolls upon a cabbage leaf without ever coming into actual contact with it; and indeed all the phenomena of *light* are moft remarkably unfavourable to the hypothefis of the folidity or impenetrability of matter. When light is reflected back from a body on which it feems to ftrike, it was natural to fuppofe that this was occafioned by its impinging againft the *folid parts* of the body; but it has been demonftrated by Sir Ifaac Newton, that the rays of light are always reflected by a *power of repulfion* acting at fome diftance from the body. Again, When part of a beam of light has overcome this power of repulfion, and has entered any tranfparent fubftance, it goes on in a right line, provided the medium be of a uniform denfity, without the leaft interruption, and without a fingle particle being reflected, till it comes to the oppofite fide, having met with no folid particles in its way, not even in the denfeft tranfparent fubftances, as glafs, cryftal, or diamond; and when it is arrived at the oppofite fide, it is folely affected by the laws of attraction and repulfion.

"Nay, that the component particles of the hardeft bodies themfelves do not actually touch one another, is demonftrable from their being brought nearer together by cold, and by their being removed farther from each other by heat. The power fufficient to overcome thefe

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these internal forces of repulsion, by which the ultimate particles of bodies are prevented from coming into actual contact, is what no person can pretend to compute. The power requisite to break their cohesion, or to remove them from the sphere of each other's attraction, may in some measure be estimated; but this affords no *data* for ascertaining the force that would be necessary to bring them into actual contact, which may exceed the other almost infinitely."

From these facts, Dr Priestley infers, that the mutual resistance of bodies proceeds in all cases from powers of repulsion acting at a distance from each body: that the supposition of the *solidity* or *impenetrability* of matter is destitute of all support whatever; and that matter itself is nothing but powers of attraction and repulsion, and several spheres of them, one within another. As other philosophers have said, "Take away solidity, and matter vanishes;" so he says expressly, "Take away attraction and repulsion, and matter vanishes."

To illustrate this strange notion, "Suppose (says he) that the Divine Being, when he created *matter*, only fixed certain *centres of various attractions and repulsions*, extending indefinitely in all directions, the whole effect of them to be upon each other: these centres approaching to, or receding from each other, and consequently carrying their peculiar spheres of attraction and repulsion along with them, according to certain definite circumstances. It cannot be denied that these spheres may be diversified infinitely, so as to correspond to all the kinds of bodies that we are acquainted with, or that are possible. For all effects in which bodies are concerned, and of which we can be sensible by our eyes, touch, &c. may be resolved into attraction or repulsion. A compages of these centres, placed within the spheres of each other's attraction, will constitute a body that we term *compact*; and two of these bodies will, on their approach, meet with a repulsion or resistance sufficient to prevent one of them from occupying the place of the other, without a much greater force than we are capable of employing; so that to us they will appear perfectly hard.

"As in the constitution of all actual bodies that we are acquainted with, these centres are placed so near to each other, that in every division that we can make we still leave parts which contain many of these centres; we, reasoning by analogy, suppose that every particle of matter is infinitely divisible; and the *space* it occupies is certainly so. But, strictly speaking, as those centres which constitute any body are not absolutely infinite, it must be naturally possible to come by division to one single centre, which could not be said to be divisible, or even to occupy any portion of space, though its sphere of action should extend ever so far; and had only *one* such centre of attraction, &c. existed, its existence could not have been known, because there would have been nothing on which its action could have been exerted; and there being no *effect*, there could not have been any ground for supposing a *cause*."

In answer to this reasoning against the solidity of matter, Dr Priestley was frequently asked by his candid and masterly antagonist *, "What it is that attracts and repels, and that is attracted and repelled?" But to the question he was never able to give a satisfactory answer. Indeed, how could he have been able? for, as Dr Price argues, "Exclusive of attraction and repulsion, he affirms matter to be absolutely nothing; and therefore, though we were to allow it the power of attracting and repelling, yet as it is nothing but this power, it must be the power of nothing, and the very idea of it be a contradiction."

* *Free Discussion between Dr Price and Dr Priestley.*

If there be any class of truths intuitively certain, that class comprehends the two following propositions: POWER CANNOT BE WITHOUT A SUBJECT; and NOTHING CAN ACT WHERE IT IS NOT. If, therefore, there be powers of attraction and repulsion, (which shall be considered afterwards in the Chapter of MOTION), there must be a subject of those powers; and if matter, whether solid or unsolid, be the subject, it cannot possibly attract or repel at a *distance*. Sir Isaac Newton, in his letters to Dr Bentley, calls the notion that matter possesses an innate power of attraction, or that it can act upon matter at a distance, and attract and repel by its own agency, "an absurdity into which, he thought, no one could possibly fall." Hence it follows, that the appearances from which Dr Priestley infers the penetrability of matter must be fallacious appearances, since they contradict an intuitive and necessary truth. The facts which he instances are, indeed, such as would make most other men suspicious of fallacy, and in his reasonings from them he sometimes takes for granted the truth to be proved. The links of a chain used for electrical purposes, supposing them to be in contact with each other, can touch only with very small surfaces. The electrical fluid is of considerable density, and incapable of being absorbed within a very narrow compass. This is evident, because it passes not through paper and other porous bodies without making a passage for itself, and leaving a visible aperture behind it; and though it assimilates with metals, and passes through them more easily than through other bodies, yet is it plain that it requires a certain quantity of metal to conduct it; for when the conductor falls short of the necessary quantity, it is melted or dissipated by the force of the fluid. This being the case, it follows that the links of a chain *may be* in actual contact (we do not positively affirm that they *are*), and yet the fluid become visible in passing from link to link; for if the point of contact be too small to absorb the *whole* fluid, *part* of it must pass without any metallic conductor through the atmosphere, and thus become apparent to the eye of the spectator.

175 founded on fallacious appearances and contrary to an intuitive and necessary truth.

With respect to light, it is obvious that there cannot possibly be any *demonstration*, in the logical sense of the word, that it is reflected by a power of repulsion acting at some distance from the body; for, in the opinion of all mankind, the primary and solid atoms of matter are too minute to fall under the cognizance of our senses, however assisted by art; and therefore, if light *appears* to be reflected at a distance from the surface of the body, we must conclude, either that between the point of reflection and the apparent surface of the body, there are solid atoms unperceived by us, or that light is reflected by the agency of some other substance than matter. One of these conclusions, we say *must* be drawn, because they are both *possible*, and there is no other alternative but to admit one of them, or to suppose that a thing may act where it is not;

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not; which is as clearly absurd and *impossible* as that *whatever is, is not*. Again, When part of a beam of light has entered any transparent substance, how does Dr Priestley know that it goes on in a right line, without the least interruption, till it comes to the opposite side? This he can know only by his senses; but the beam may meet with ten thousand interruptions from objects which the senses cannot perceive, and may describe a zig-zag line, of which the deflections are so small as to elude the keenest eye aided by the most powerful glass.

That the component particles of the hardest bodies do not *all* actually touch one another, is indeed evident from the effects of cold and heat upon those bodies: but it does not therefore follow that those bodies have no component particles; but only, that they are fewer in number than we are apt to imagine; that all the solid matter in the universe might possibly be compressed within a very narrow sphere; and that it is held together in different bodies and different systems by a power foreign from itself. These are truths which all philosophers have admitted who have thought sufficiently on the subject; but who will admit Dr Priestley's proposition, when it is translated into common English: "That the component *nothings* of the hardest bodies do not actually touch one another, is demonstrable from their being brought nearer together by cold, and by their being removed farther from each other by heat?"

176 Our most adequate notion of matter.

Dr Priestley owns, that if matter be solid it could act upon other matter by impulse. We are certain, that, whatever it be, it can act upon nothing in the manner which he describes; and therefore, to use the words of Dr Price, "matter, if it be any thing at all, must consist of solid particles or atoms occupying a certain portion of space, and therefore *extended*, but at the same time *simple* and *uncompounded*, and incapable of being resolved into any other smaller particles. It must likewise be the different form of these *primary* particles, and their different combinations and arrangement, that constitute the different bodies aad kinds of matter in the universe." This is exactly agreeable to the doctrines of Newton; who, after considering the question in every point of view, concludes, that "in the beginning God formed matter in solid, massy, hard, impenetrable, moveable particles, of such sizes and figures, and with such other properties, as most conduced to the end for which he formed them; and that those primary particles being solid, are incomparably harder than any porous bodies compounded of them; even so very hard as never to wear or break in pieces: no ordinary power being able to divide what God himself made one in the creation." To talk, as Dr Priestley does, of matter's being certain *centres of various attractions and repulsions* extending indefinitely in all directions, and to describe these centres as *not* being *physical points* or *solid atoms*, is either to say, that *nothing* attracts and repels; or it is to introduce the divine agency as the immediate cause of all our sensations. The former of these alternatives Dr Priestley disclaims; the latter he seems willing to admit. But if it be his meaning that all our sensations are caused by the immediate agency of God or created spirits, his scheme differs not from that of Berkeley, except in being less elegantly expressed and less ingeniously supported. Berkeley's scheme is evidently *possible*. The commonly received scheme is likewise possible. It remains therefore with the reader, whether he will adopt the system of the Bishop of Cloyne; or admit, with all other philosophers, that matter exists; that it consists of parts actually distinct and separable; and that each of these parts is a *monad* or solid atom, which requires no foreign agency to keep it united.

Chap. IV. *Of* Space *and its* Modes.

Of Space and its Modes.

177 The necessary adjuncts of body, what.

Having considered bodies in their substance, essences and qualities, and proved that they have a real existence independent of us and our conceptions, we proceed now to inquire into the nature of *space*, *motion*, *number*, and *duration*. These are commonly called the *adjuncts* of body, and are supposed to be absolutely inseparable from its existence. It does not indeed appear that *actual motion* is a necessary adjunct of body, considered as a mere solid, extended, and figured substance; but it is certainly necessary to the existence of organized and animated bodies, and the capability of being moved enters into our conceptions of all bodies whatever. Of these adjuncts, that which first demands our attention is *space*: for without a knowledge of its nature we could not have an adequate idea of motion, and without motion we could have no idea of time.

178 Our notion of space, how acquired.

Every body is extended; and between two bodies not in actual contact, we perceive that a third body may be easily introduced. That which admits of the introduction of the third body is what we call *space*: and if it be totally void of matter, it is called *pure space*. Whether there be any space absolutely pure, has been disputed; but that such space is possible, admits of no dispute. Were any one body (a cannon ball for instance) to be annihilated, and the circumambient air, with every other material substance, kept from rushing into the space which the ball had occupied, that portion of space, with respect to matter, would be empty or pure space: whether it would necessarily be filled with mind shall be considered afterwards. Pure space, therefore, is conceivable; and it is conceived as having three dimensions, length, breadth, and depth, which are generally called the three simple modes of space. In this respect it agrees with body: but the agreement proceeds no farther; for space is conceived as destitute of solidity, without which the existence of body is inconceivable. It has been formerly observed, that whatever may be distinctly conceived may possibly exist; but with respect to the existence of pure space, whatever is possible is real: for it shall be shown in the next section, that were there no space absolutely pure or void of matter, there could be no motion. Our business at present is to inquire what the nature of space is, and what notion we ought to have of its existence.

179 Space supposed to be something different from body and mind, and to be eternal and infinite, &c.

Many modern philosophers consider space as something entirely distinct both from body and mind: some of them ascribe to it no less than four of the attributes of the Deity—*eternity*, *immobility*, *infinity*, and *necessary existence*; and a few of them have gone so far as to call *infinite space* the *sensorium* of the Deity. "The supposal of the existence of *any thing whatever* (says Dr Clarke

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Clarke *) necessarily includes a *presupposition* of the existence of *space*. Nothing can possibly be conceived to exist without thereby presupposing space; which, therefore, I apprehend to be a *property* or *mode* of the self-existent Substance; and that, by being evidently necessary itself, it proves, that the substance of which it is a property must be also necessary." Elsewhere he says, that "space is a property or mode of the self-existent Substance, but not of any other substances. All other substances are *in* space, and are *penetrated* by it; but the self-existent Substance is not in space, nor penetrated by it, but is itself (if I may so speak) the *substratum* of space, the *ground* of the existence of *space* itself." He acknowledges, however, that such expressions as "the self-existent Substance is the *substratum* of space, or space is a property of the self-existent Substance, are *not*, perhaps, very proper: but what I mean (says he), is this: The idea of *space* (as also of *time* or *duration*) is an abstract or partial idea; an idea of a certain *quality* or *relation*, which we evidently see to be necessarily existing; and yet (which not being itself a *substance*) at the same time necessarily *presupposes* a substance, without which it could not exist."

* *Demonstration of the Being and Attributes of God*, and *Correspondence with a Gentleman in Gloucestershire*, passim.

These opinions respecting space have been adopted by succeeding philosophers of great merit, and particularly by Dr Price; who says, that "it is a maxim which connot be disputed, that *time* and *place* are necessary to the existence of all things. Dr Clarke (continues he) has made use of this maxim, to prove that infinite space and duration are the essential properties of the Deity; and I think he was right."

Had authority any weight in philosophy, we know not what modern writers we could oppose to the celebrated names of Clarke and Price, unless it were Bishop Berkeley, Dr Law late bishop of Carlisle, and the author of Ancient Metaphysics. But the question is not to be decided by authority. Learned and acute as Dr Clarke was, his assertions respecting space are contradictory and inconsistent. If nothing can possibly be conceived to exist without thereby presupposing the existence of *space*, how can space be a property or mode of the self-existent Substance? Are properties prior in the order of nature, or even in our conceptions, to the substances in which they inhere? Can we frame an abstract idea of figure, or extension, or solidity, before we conceive the existence of any one figured, extended, or solid substance? These are questions which every man is as capable of answering as the Doctors Clarke and Price, provided he can look attentively into his own mind, and trace his ideas to their source in sensation: and if he be not biassed by the weight of great names, we are persuaded he will find, that if it be indeed true, that the supposal of the existence of any thing whatever necessarily includes a *presupposition* of the existence of space, *space* cannot possibly be a *property* or *mode* of the self-existent Substance, but must of necessity be a *substance* itself.

180. This supposition controverted.

181. Space necessary to the existence of every thing.

It is, however, *not* true, that the supposal of the existence of any thing whatever necessarily includes a presupposition of the existence of space. The idea of space is indeed so closely associated with every visible and tangible object, that we cannot see the one nor feel the other without conceiving them to occupy so much of space. But had we never possessed the senses of sight and touch, we could not have supposed the existence of space necessary to the existence of any thing whatever. The senses of smelling, tasting, and hearing, together with our internal powers of consciousness and intellect, would certainly have compelled us to believe in our own existence, and to suppose the existence of other things; but no object either of consciousness, smelling, tasting, or hearing, can be conceived as occupying space. Space and every thing which fills it are conceived as of three dimensions; but who ever supposed or can suppose an *odour*, *taste*, or *sound*, to have *length*, *breadth*, and *depth*; or an object of consciousness to be an ell or an inch long?

Let us suppose that body and all the visible world had a beginning, and that once nothing existed but that Being which is alone of necessary as well as eternal existence; *space*, say the followers of Dr Clarke, would then exist likewise without bounds or limits. But we desire to know of these gentlemen what sort of a being this space is. It certainly is not *substance*; neither is it a property; for we have seen that the very notions of it, which lead men to suppose its existence *necessary*, render it impossible to be a property of the self-existent Being. Is it then nothing? It "is in one sense *: it is nothing *actually* existing; but it is something *potentially*; for it has the *capacity* of receiving body whenever it shall exist. It is not, and cannot, become any thing itself, nor hath it any actual existence; but it is that without which nothing corporeal could exist." For this reason it was that Democritus and Epicurus made space one of the principles of nature; and for the same reason Aristotle has made *privation* one of his three principles of natural things, *matter* and *form* being the other two. But though the privation of *one* form be doubtless necessary before matter can receive another (for a piece of wax or clay cannot receive the form of a *globe* before it lose the form of a square), yet Aristotle never dreamed that the privation of the square was any property of the globe, or that *privation* itself was to be reckoned a real being. On the contrary, he expressly calls it *το μη ον*, or *the no being*. In this way, if we please, we may consider space, and call it the *privation of fullness* or of body. We have indeed a positive idea of it, as well as of silence, darkness, and other privations: but to argue from such an idea of space, that space itself is something real, seems altogether as good sense as to say, that because we have a different idea of *darkness* from that of *light*, of *silence* from that of *sound*, of the *absence* of any thing from that of its *presence*; therefore *darkness*, *silence*, *absence*, must be real things, and have as positive an existence as *light*, *sound*, and *body*: and to deny that we have any positive idea, or, which is the very same thing, any idea at all, of the privations above mentioned, will be to deny what is capable of the most complete proof (see N° 19.), and to contradict common sense and daily experience. There are therefore ideas, and simple ones too, which have nothing *ad extra* correspondent to them; no proper *idiatum*, archetype, or objective reality: and we do not see why the idea of space may not be reckoned of that number. To say that *space* must have existence, because it has some properties (for instance, *penetrability*, or the *capacity* of receiving body), seems † to be the same thing as to urge that *darkness* must be *something* because it has the capacity of *receiving light*; *silence* the property of admitting

* *Ancient Metaphysics*.

† See *Notes on King's Origin of Evil*, and *Law's Enquiry into the Ideas of Space*, &c.

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admitting *ſound;* and *abſence* the property of being ſupplied by *preſence*. To reaſon in this manner is to aſſign abſolute negations; and ſuch as, in the ſame way, may be applied to *nothing*, and then call them *poſitive properties;* and ſo infer that the chimera, thus clothed with them, muſt needs be *ſomething*.

182 Space nothing but the poſſible exiſtence of body.

But it is ſaid, that as we cannot conceive ſpace to be annihilated, it muſt be ſome real thing of eternal and neceſſary exiſtence. If this argument had not been uſed by writers of great merit, and with the beſt intention, we ſhould not have ſcrupled to call it the moſt contemptible ſophiſm that ever diſgraced the page of philoſophy. Whatever now has an *actual* exiſtence, muſt from eternity have had a *poſſible* exiſtence in the ideas of the Divine mind. Body, as an extended ſubſtance, has now an *actual* exiſtence; and therefore it muſt from eternity have had a *poſſible* exiſtence in the ideas of the Divine mind: but the *poſſible exiſtence of body* is all that we can conceive by *ſpace;* and therefore this argument, upon which ſo much ſtreſs has been laid, amounts to nothing more, than that what has from eternity been poſſible, can at no period have been impoſſible. It is evident that the *capacity* or *potentiality* of every thing exiſting muſt have been from eternity; but is capacity or potentiality a real being? All the men and women who ſhall ſucceed the preſent generation to the end of time, have at this moment a poſſibility of exiſtence, nor can that poſſibility be conceived as an impoſſibility; but is it therefore any thing actually exiſting either as a ſubſtance or a quality?

It has been urged, that ſpace muſt be ſomething more than the mere abſence of matter; becauſe if nothing be between bodies, ſuch as the walls of a room, they muſt neceſſarily touch. But ſurely it is not *ſelf-evident* that bodies muſt neceſſarily touch if nothing be between them; nor of the truth of this propoſition can any thing like a proof be brought. It is indeed intuitively certain, that "things, when they are in contact, have nothing between them:" and hence it has raſhly been inferred, that things, when they have nothing between them, are in contact; but this is an illegitimate converſion of the propoſition. Every logician knows, that to convert a propoſition, is to infer from it another whoſe *ſubject* is the *predicate*, and whoſe *predicate* is the *ſubject*, of the propoſition to be converted: but we are taught by Ariſtotle and by common ſenſe, that an *univerſal* affirmative can be converted only into a *particular* affirmative. "Things, when they are in contact, have nothing between them," is an *univerſal* affirmative propoſition; and therefore it can be converted only into the following *particular* affirmative: "Some things, when they have nothing between them, are in contact;" a propoſition which by no means includes in it the contact of the walls of an empty room. The reaſon why the walls of an empty room do not touch, is that they are *diſtant;* but is *diſtance*, in the abſtract, any thing really exiſting? Two individuals differ, or there is a difference between them; but is *difference* itſelf any real external thing? Bodies are long, broad, thick, heavy; but are *length*, *breadth*, *denſity*, *weight*, properly any thing? Have they any real ſeparate archetypes or external idiata? Or can they exiſt but in ſome ſubſtance?

183 The fallacy which led to the ſuppoſition that ſpace is a real thing.

The reaſon why ſo many philoſophers have conſidered ſpace as a real external thing, ſeems to be this: Every bodily ſubſtance is extended; but ſpace is conceived to be that which contains body, and therefore to ſpace we likewiſe attribute extenſion. Extenſion is a quality which can have no exiſtence but as united with other qualities in ſome ſubſtance; and it is that of which, abſtracted from all ſubſtances, we can, properly ſpeaking, form no *idea*. We underſtand the meaning of the word, however, and can reaſon about that which it denotes, without regarding the particular ſubſtance in which extenſion may inhere; juſt as we can reaſon about whiteneſs without regarding any one white object, though it is ſelf-evident that whiteneſs, abſtracted from all objects, cannot figure in the mind as an idea. Qualities conſidered in this manner are general and relative notions, the objects of pure intellect, which make no appearance in the imagination, and are far leſs, if poſſible, to be perceived by ſenſe: but it is extremely painful to the mind to dwell upon ſuch notions; and therefore the ever-active fancy is always ready to furniſh them with imaginary *ſubſtrata*, and to make that which was a *general* and *inviſible notion* be conceived as a *particular ideal object*. In the caſe of extenſion this is the more eaſily done, that the notion which we have of a *real ſubſtratum* or ſubſtance, the ſupport of real qualities, is obſcure and relative, being the notion of *ſomething* we know not what. Now, by leaving, if we can, ſolidity and figure out of our conception, and joining the notion of *ſomething* with the notion of *extenſion*, we have at once the *imaginary ſubſtratum* of an *imaginary* quality, or the general notion of extenſion particularized in an imaginary ſubject; and this ſubject we call *ſpace*, vainly fancying that it has a real external and independent exiſtence. Whether this be not all that can be ſaid of ſpace, and whether it be not abſurd to talk of its having any real properties, every man will judge for himſelf, by reflecting upon his own ideas and the manner in which they are acquired. We ourſelves have no doubt about the matter. We conſider pure ſpace as a mere notion relative to the exiſtence of corporeal ſubſtance, as nothing more than the abſence of body, where body is poſſible; and we think the uſual diſtinction between *abſolute* and *relative* ſpace, if taken as real, the groſſeſt abſurdity. We do not however, pretend to dictate to others; but recommend it to every man to throw away all reſpect for great names, to look attentively into his own thoughts, and on this as on all metaphyſical ſubjects to judge for himſelf.

184 Place, what it is.

Having ſaid ſo much of ſpace in general, we need not waſte much time upon its modes. Indeed the only mode of ſpace, after conſidering it with reſpect to the three dimenſions of body, which now demands our attention, is that which we call *place*. As in the ſimpleſt mode of ſpace we conſider the relation of diſtance between any two bodies or points; ſo, in our idea of *place*, we conſider the relation of diſtance betwixt any thing, and any two or more points, which, being conſidered as at reſt, keep the ſame diſtance one from another. Thus, when we find any thing at the ſame diſtance now at which it was yeſterday from two or more points with which it was then compared, and which have not ſince the compariſon was made changed their

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their diſtance or poſition with reſpect to each other, we ſay that the thing hath kept its *place*, or is in the *ſame place*; but if it hath ſenſibly altered its diſtance from either of theſe points, we then ſay that it hath changed its *place*.

From this view of the nature of place, we need not obſerve that it is a mere relation; but it may be worth while to advert to this circumſtance, that a thing may without falſehood be ſaid to have continued in the ſame place, and at the ſame time to have changed its place, according to the different objects with which it is compared. Thus, if two perſons find a company of cheſs-men ſtanding each upon the ſame ſquare of the cheſs-board where they left them, the one may with truth affirm that they are all in the *ſame place*, or unmoved; and the other may with equal truth affirm that they have all changed *place*. The former conſiders the men only with reſpect to their diſtances from the ſeveral parts of the cheſs-board, which have kept the ſame diſtance and poſition with reſpect to one another. The latter muſt conſider the men with reſpect to their diſtance from ſomething elſe: and finding that the cheſs-board, with every thing upon it, has been removed, we ſhall ſuppoſe from one room to another, he cannot but ſay that the cheſs-men have changed their place with reſpect to the ſeveral parts of the room in which he formerly ſaw them.

This modification of diſtance, however, which we call *place*, being made by men for their common uſe, that by it they may deſign the particular poſition of objects where they have occaſion for ſuch deſignation, they determine this *place* by reference to ſuch adjacent things as beſt ſerve their preſent purpoſe, without regarding other things which, for a different purpoſe, would better determine the place of the ſame object. Thus in the cheſs-board, the uſe of the *deſignation of the place* of each cheſs-man being determined only within that chequered piece of wood, it would croſs that purpoſe to meaſure it by any thing elſe: but when theſe very cheſs-men are put up in a box, if any one ſhould aſk where the black king is, it would be proper to *determine the place* by reference to ſomething elſe than the cheſs-board; ſuch as the parts of the room or cloſet which contain the box.

185 The univerſe has no place.

That our idea of *place* is nothing but ſuch a relative poſition of things as we have mentioned, will be readily admitted, when it is conſidered that we can have no idea of the place of the *univerſe*. Every *part* of the univerſe has place; becauſe it may be compared with reſpect to its diſtance from other parts ſuppoſed to be fixed. Thus the earth and every planet of our ſyſtem has a place which may be determined by aſcertaining its diſtance from the ſun and from the orbits of the other planets; and the place of the ſyſtem itſelf may be aſcertained by comparing it with two or more fixed ſtars: but all the ſyſtems taken as *one whole* can have no *place*; becauſe there is nothing elſe to which the diſtance and poſition of that whole can be referred. It is indeed true, that the word *place* is ſometimes uſed, we think improperly, to denote that *ſpace* or portion of *ſpace* which any particular body occupies; and in this ſenſe, no doubt, the univerſe has place, as well as the earth or ſolar ſyſtem: but to talk of the place of the univerſe in the other and proper ſenſe of the word, is the groſſeſt nonſenſe.

Of Motion.

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186 Mobility eſſential to every corporeal ſubſtance, but not natural motion.

MOBILITY, or a capacity of being moved, is eſſential to every corporeal ſubſtance; and by actual motion are all the operations of nature performed. Motion, therefore, if it may be called an *adjunct* of body, is certainly the moſt important of all its adjuncts; and to aſcertain its nature and origin demands the cloſeſt attention of the metaphyſician, as well as of the mechanic and aſtronomer. With the *laws* of motion, as diſcovered by experience, we have at preſent no concern: they are explained and fully eſtabliſhed in other articles of this work (See MECHANICS, MOTION, &c.) The principal queſtions which we have to conſider are: "What is motion? and, By what power is it carried on?"

For an anſwer to the firſt of theſe queſtions, the modern metaphyſician refers every man to his own ſenſes; becauſe, in his apprehenſion, the word motion denotes a ſimple idea which cannot be defined. Among the ancients, the Peripatetics were of a different opinion; and Ariſtotle, whoſe love of dialectic made him define every thing, has attempted to give two definitions of *motion*. As ſome learned men are at preſent labouring to revive this ſyſtem, we ſhall, out of reſpect to them, mention thoſe definitions, and make upon them ſuch remarks as to us appear proper.

187 The Peripatetic definitions of motion

The author of *Ancient Metaphyſics* having obſerved, that both nature and art propoſe ſome end in all their operations; that when the end is obtained, the thing operated upon is in a ſtate of perfection or completion; and that in the operations of both nature and art there is a progreſs, and by conſequence a *change*, from one thing to another; adds, that this change is *motion*. Motion, therefore, according to him, is a change or progreſs to the end propoſed, or to that ſtate of perfection or completion which Ariſtotle calls εντελεχεια. It is not enough, however, that we know *to what* the change or progreſs is made: to have an adequate idea of motion, we muſt likewiſe know *from what* it proceeds. Now it is evident that every thing exiſting, whether by nature or art, was, before it exiſted, poſſible to exiſt; and therefore, adds the ſame author, things do in ſome ſort exiſt even before they exiſt. This former kind of exiſtence is ſaid by Ariſtotle to be εν δυναμει, that is, in *power* or *capacity*. In this way, plants exiſt in their ſeeds; animals in the embryo; works of art in the idea of the artiſts and the materials of which they are made; and, in general, every thing in the cauſes which produce it. From this power or capacity there is a progreſs to *energy* or actual exiſtence; ſo that we are now able to anſwer the queſtion, "*from what*, and *to what*, motion is a change?" for it is univerſally true of all *motion*, that it is a change from *capacity* to *energy*.

"Having thus diſcovered that *motion* lies betwixt *capacity* and *energy*, it is evident (he ſays) that it muſt have a connexion with each of them: and from this double connexion Ariſtotle has given us two definitions of it; one of them taken from the *energy*, or end to which it tends; the other from the *capacity* from which it begins. The firſt is expreſſed in two words, viz. ενεργεια ατελης, or *imperfect energy*; the other is εντελεχεια

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του εν δυναμει ἡ εν δυναμει; which may be translated thus, *The perfection of what is in capacity, considered merely as in capacity*. The meaning of the last words is, that nothing is considered in the thing that is moved but merely its *capacity*; so that motion is the perfection of that capacity, but not of the thing itself. It is something more (adds the learned author) than mere *capacity*; for it is capacity exerted, which when it has attained its end, so that the thing has arrived at that state to which it is destined by nature or art, ceases, and the thing begins to exist ενεργεια, or *actually*.

188 unintelligible.

By all the admirers of Aristotle, this latter definition has been preferred to the former; for what reason, it is difficult to say. They both involve in the thickest obscurity that which, viewed through the senses, is very easily understood; and on this, as on many other occasions, Aristotle was certainly guilty of darkening counsel by words without knowledge. The author, whose comment on this wonderful definition we have faithfully abridged, admits that it is not intelligible till we know what *change* and *progress* are; but is it possible to conceive any *change* to take place in bodily substances without *motion?* or, if we were called upon to explain what progress is, could we do it better than by saying that it is motion *from* something *to* something? It is likewise very obvious, that before we can have an adequate idea of *motion*, we must, according to this definition, know perfectly what the words *capacity*, *energy*, and *perfection* denote; and yet nothing can be more true than that *perfection* denotes a complex conception, which may be easily defined by resolving it into the simple ideas and notions of which it is compounded, whilst *motion* is susceptible of no such resolution. The perfection of a knife is compounded of the temper of the steel and the sharpness of the edge: the perfection of a system of philosophy consists of the importance of the subjects treated, the strength of the author's arguments, and the perspicuity of his style and manner; but of what is the *motion* of a ball, or an *atom*, or any thing else, compounded? We are aware that to this question the modern Peripatetics will reply, That it is not the motion of a *ball*, or an *atom*, or any *one thing*, that their master has so learnedly defined, but motion abstracted from *all individuals*, and made an object of pure intellect; and they will likewise affirm, that by the word *perfection* used in the definition, he does not mean *any one kind* of perfection as adapted to any particular *object* or *end*, but perfection abstracted from *all objects* and *all ends*. The perfection of *nothing* and the motion of *nothing*, for such surely are that motion and that perfection which are abstracted from *all objects* and *ends*, are strange expressions. To us they convey no meaning; and we have reason to think that they are equally unintelligible to men of greater acuteness (o). In a word, *motion* must be seen or felt; for it cannot be defined. To call it the *act of changing place*, or a *passage from one place to another*, gives no information; for *change* and *passage* cannot be conceived without previously conceiving *motion* (p).

189 The Peripatetic division of motion absurd.

The Peripatetics having idly attempted to *define* motion, proceed next to *divide* it into four kinds or classes. This division was by the father of the school pretended to be made from the effects which it produces, and was said by him to belong to three categories, viz. *quality*, *quantity*, and *where*, (see CATEGORY). The first kind is that well-known *motion* from *place* to *place*, which falls under the category last mentioned; the second is *alteration*, by which the quality of any thing is changed, the substance remaining the same. This belongs to the category of *quality*. The third is *increase*, and the fourth *diminution*, both belonging to the category of *quantity*. The ancient atomists, and all the modern metaphysicians of eminence, have with great propriety rejected this division, as being nothing but a collection of absurd distinctions where there is in nature no difference. It has been already shown, that body has no other real qualities than *solidity*, *extension*, and *figure*: but of these the first cannot be altered without destroying the substance; for every thing which is material is equally solid. The extension of a body may indeed be enlarged, and its figure may be altered, while the substance remains the same; but that alteration can be made only by moving from their *places* the solid atoms of which the body is composed. Aristotle's second kind of motion therefore differs not from the first; nor do the third and fourth differ from these two. For a body cannot be *increased* without acquiring new matter, nor diminished without losing some of the matter of which it was originally

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(o) "Nunc dicendum de natura motus. Atque is quidem, cum sensibus clare percipiatur, non tam natura sua, quam doctis philosophorum commentis obscuratus est. Motus nunquam in sensus nostros incurrit sine mole corporea, spatio et tempore. Sunt tamen qui motum, tanquam ideam quandam simplicem et abstractam, atque *ab omnibus aliis rebus sejunctam*, contemplari student. Verum idea illa tenuissima et subtilissima *intellectus aciem eludit*: id quod quilibet secum meditando experiri potest. Hinc nascuntur magnæ difficultates de natura motus, et definitiones, ipsa re quam illustrare debent longe obscuriores. Hujusmodi sunt definitiones illæ Aristotelis et scholasticorum, qui motum dicunt esse *actum mobilis quatenus est mobile*, vel, *actum entis in potentia quatenus in potentia*. Hujusmodi etiam est illud viri inter recentiores celebris, qui asserit *nihil in motu esse reale præter momentaneum illud quod in vi ad mutationem nitente constitui debet*. Porro constat, horum et similium definitionum auctores in animo habuisse abstractam motus naturam, seclusa omni temporis et spatii consideratione, explicare: sed qua ratione abstracta illa motus quintessentia (ut ita dicam) intelligi possit non video." *Berkeley de Motu.*

(p) "Multi etiam per *transitum* motum definiunt, obliti scilicet transitum ipsum sine motu intelligi non posse, et per motum definiri oportere: Verissimum adeo est definitiones, sicut nonnullis rebus lucem, ita vicissim aliis tenebras afferre. Et profecto, quascumque res sensu percipimus eas clariores aut notiores definiendo efficere vix quisquam potuerit. Cujus rei vana spe allecti res faciles difficillimas reddiderunt philosophi, mentesque suas difficultatibus, quas ut plurimum ipsi peperissent, implicavere." *Id. ibid.*

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originally compoſed: but matter can neither be added nor taken away without motion from place to place; for there is now no creation *de novo;* and we have no reaſon to imagine that, ſince the original creation, a ſingle atom has been ever annihilated. It is therefore paſt diſpute, that local motion is the only motion conceivable; and indeed, as far as we are capable of judging from what we know of body, it is the only motion poſſible.

190 Whether, if but one body exiſted, there could be motion?

This has given riſe to a queſtion which has been debated among modern philoſophers, though, as far as we know, it was never agitated among the ancients, viz. "Whether, if there were but one ſolid body exiſting, that body could poſſibly be moved." Biſhop Berkeley ſeems to be of opinion that it could not; becauſe no motion can be conceived but what has a direction towards ſome *place,* and the relation of place neceſſarily ſuppoſes the exiſtence of two or more bodies. Were all bodies, therefore, annihilated except one globe, it would be impoſſible (he thinks) to conceive that globe in motion (Q). With reſpect to the origin of our *ideas* of motion, his reaſoning appears unanſwerable; but we do not perceive how it concludes againſt the poſſibility of motion itſelf as exiſting in a ſingle body. It has been already ſhown in the chapter of *Simple Apprehenſion and Conception,* that though nothing can be conceived which may not poſſibly exiſt, yet many things may be poſſible which we have not faculties or means to conceive. In the preſent inſtance, were this ſolitary globe animated as our bodies are, were it endowed with all our ſenſes and mental powers, it certainly would not acquire any *idea* of motion though impelled by the greateſt force. The reaſon is obvious; it would have no objects with which to compare its place and ſituation at different periods of time; and the experience of a ſhip at ſea in calm weather, affords ſufficient proof that motion which is equable cannot be perceived by any other means than by ſuch a compariſon. When the waves ſwell and the ſhip pitches, it is indeed impoſſible that thoſe who are on board ſhould not perceive that they are actually in motion; but even this perception ariſes from comparing their poſition with that of the waves riſing and falling around them: whereas in the regions of empty ſpace the animated globe could compare its poſition with nothing; and therefore, whether impelled by equal or unequal forces, it could never acquire the *idea* of motion. It may perhaps be thought, that if this ſolitary globe were a *ſelf*-moving animal, it might acquire the *idea* of motion by inferring its exiſtence from the energy which produced it. But how, we would aſk, could an animal in ſuch circumſtances be *ſelf*-moving? Motion is the effect of ſome cauſe; and it has been already ſhown (ſee N° 117. of this article), that we have no reaſon to ſuppoſe that any being can be the *real* and *primary* cauſe of any effect which that being can neither conceive nor will: but as motion can be perceived only by the ſenſes, a ſolitary animal could have no idea of motion previous to its own exertions; and therefore could neither conceive, nor will, an exertion to produce it. Let us, however, ſuppoſe, that without any end in view it might ſpontaneouſly exert itſelf in ſuch a manner as would produce *ſenſible* motion, were it ſurrounded with other corporeal objects; ſtill we may venture to affirm, that ſo long as it ſhould remain in abſolute ſolitude, the being itſelf would acquire no *idea* of motion. It would indeed be *conſcious* of the *mental* energy, but it could not infer the exiſtence of motion as a conſequence of that energy; for the idea of motion can be acquired only by ſenſe, and by the ſuppoſition there are no objects from which the ſenſes of this ſpherical animal could receive thoſe impreſſions, without which there can be no perception, and of courſe no ideas.

191 Anſwered in the affirmative.

Let us now ſuppoſe, that, while this animated globe is under the influence either of external impulſe or its own ſpontaneous energy, other bodies are ſuddenly brought into exiſtence: would it then acquire the idea of motion? It certainly would, from perceiving its own change of place with reſpect to thoſe bodies; and though at firſt it would not perhaps be able to determine whether itſelf or the bodies around it were moving, yet a little experience would decide this queſtion likewiſe, and convince it that the motion was the effect either of its own *mental energy,* or that external *impulſe* which it had felt before the other bodies were preſented to its view. But it is obvious, that the creation of new bodies at a diſtance, can make no real alteration in the ſtate of a body which had exiſted before them: and therefore, as this animated globe would now *perceive* itſelf to be moving, we may infer with the utmoſt certainty that it *was moving*

(Q) Having proved that *place,* in the proper ſenſe of the word, is merely relative, and affirmed that all *motion* is relative likewiſe, the biſhop proceeds thus: "Veruntamen ut hoc clarius appareat, animadvertendum eſt, motum nullum intelligi poſſe ſine determinatione aliqua ſeu directione, quæ quidem intelligi nequit, niſi præter corpus motum, noſtrum etiam corpus, aut aliud aliquid, ſimul intelligatur exiſtere. Nam ſurſum, deorſum, ſiniſtrorſum, dextrorſum, omneſque plagæ et regiones in relatione aliqua ſundantur, et neceſſario corpus a moto diverſum connotant et ſupponunt. Adeo ut, ſi, reliquis corporibus in nihilum redactis, globus, exempli gratia, unicus exiſtere ſupponatur; in illo nullus motus concipi poſſit: uſque adeo neceſſe eſt, ut detur alıud corpus, cujus ſitu motus determinare intelligatur. Hujus ſententiæ veritas clariſſima elucebit, modo corporum omnium tam noſtri quam aliorum, præter globum iſtum unicum, annihilationem recte ſuppoſuerimus.

"Concipiantur porro duo globi, et præterea nihil corporeum, exiſtere. Concipiantur deinde vires, quomodocunque applicari: quicquid tandem per applicationem virium intelligamus, motus circularis duorum globorum circa commune centrum nequit per imaginationem concipi. Supponamus deinde cœlum fixarum creari: ſubito ex concepto appulſu globorum ad diverſas cœli iſtius partes motus concipietur. Scilicet cum motus natura ſua ſit relativus, concipi non potuit priuſquam darentur corpora correlata. Quemadmodum nec ulla relatio alia ſine correlatis concipi poteſt." *De Motu.*

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moving before; and that the motion of a ſingle body, though not *perceivable* by the ſenſes, might poſſibly be produced in empty ſpace.

192 Whether motion would be poſſible in ſpace abſolutely full?

Having thus ſeen that a ſingle body is capable of motion in empty ſpace, the next queſtion that occurs on this ſubject is, Whether it would be poſſible to move a body in ſpace that is abſolutely full? Such are the terms in which this queſtion is uſually put; and by being thus expreſſed, it has given riſe to the diſpute among natural philoſophers about the exiſtence of a *vacuum*. Perhaps the diſpute might have been avoided had the queſtion been more accurately ſtated. For inſtance, had it been aſked, whether motion would be poſſible, could matter be ſuppoſed abſolutely infinite without any the leaſt interſtice or vacuity among its ſolid parts? We apprehend that every reflecting man would have anſwered in the negative. At any rate, the queſtion ought to be thus ſtated in metaphyſics; becauſe we have ſeen that ſpace, though a poſitive term, denotes nothing really exiſting. Now it being of the very eſſence of every ſolid ſubſtance to exclude from the place which it occupies every other ſolid ſubſtance, it follows undeniably, that not one particle of an infinite ſolid could be moved from its place without the previous annihilation of another particle of equal extent; but that annihilation would deſtroy the infinity. Were matter extended to any degree *leſs* than infinity, the motion of its parts would undoubtedly be poſſible, becauſe a ſufficient force could ſeparate thoſe parts and introduce among them vacuities of any extent; but without vacuities capable of containing the body to be moved, it is obvious that no force whatever could produce motion. This being the caſe, it follows, that however far we ſuppoſe the material univerſe extended, there muſt be vacuities in it ſufficient to permit the motion of the planets and all the other heavenly bodies, which we plainly perceive to revolve round a centre; and if ſo, the next queſtion to be determined is, What can *in vacuo* operate upon ſuch immenſe bodies, ſo as to produce a regular and continued motion?

193 Bodies equally indifferent to motion and reſt.

That all bodies are equally capable of motion or reſt, has by natural philoſophers been as completely proved as any thing can be proved by obſervation and experience. It is indeed a fact obvious to the moſt ſuperficial obſerver; for if either of theſe ſtates were eſſential to matter, the other would be abſolutely impoſſible. If reſt were eſſential, nothing could be moved; if motion were eſſential, nothing could be at reſt, but every the minuteſt atom would have a motion of its own, which is contrary to univerſal experience. With reſpect to motion and reſt, matter is wholly paſſive. No man ever perceived a body inanimated begin to move, or when in motion ſtop without reſiſtance. A billiard ball laid at reſt on the ſmootheſt ſurface, would continue at reſt to the end of time, unleſs moved by ſome force extrinſic to itſelf. If ſuch a ball were ſtruck by another ball, it would indeed be moved with a velocity proportioned to the impetus with which it was ſtruck; but the impelling ball would loſe as much of its own motion as was communicated to that upon which the impulſe was made. It is evident, therefore, that in this inſtance there is no *beginning* of motion, but only the communication of motion from one body to another; and we may ſtill aſk, Where had the motion its origin? If the impelling ball was thrown from the hand of a man, or ſtruck with a racket, it is plain that by a volition of the man's mind the motion was firſt given to his own arm, whence it proceeded through the racket from one ball to another; ſo that the ball, racket, and arm, were mere inſtruments, and the mind of the man the only agent or firſt mover. That motion can be *begun* by any being which is not poſſeſſed of life, conſciouſneſs, and will, or what is analogous to theſe, is to us altogether inconceivable. Mere matter or inanimated body can operate upon body only by impulſe: but impulſe, though from the poverty of language we are ſometimes obliged to talk of its agency, is itſelf merely an effect; for it is nothing more than the contact of two bodies, of which one at leaſt is in motion. An infinite ſeries of effects without a cauſe is the groſſeſt abſurdity; aad therefore motion cannot have been communicated from eternity by the impulſe of body upon body, but muſt have been originally produced by a being who acts in a manner analogous to the energies of the human will.

194 Motion produced by impulſe can only be in a ſtraight line.

But though motion could not have been begun but by the energy of mind, it is generally believed that it might be continued by the mere paſſivity of body; and it is a law of the Newtonian philoſophy, that a body projected in empty ſpace would continue to move in a ſtraight line for ever. The only reaſon which can be aſſigned for this law is, that ſince body continues to move at all after the impetus of projection has ceaſed, it could not of itſelf ceaſe to move without becoming active; becauſe as much force is required to ſtop a body in motion as to communicate motion to the ſame body at reſt. Many objections have been made to this argument, and to the law of which it is the foundation; but as we do not perceive their ſtrength, we ſhall not fill our page with a formal examination of them (R). If a ſingle body could exiſt and have motion communicated to it *in vacuo* by the force

(R) By much the ſtrongeſt and beſt urged of theſe objections which we have ſeen, is made by Dr Horſley, a man equally learned in mathematics and in ancient and modern philoſophy. "I believe with the author of Ancient Metaphyſics (ſays he), that ſome active principle is neceſſary for the continuance as well as for the beginning of motion. I know that many Newtonians will not allow this: I believe they are miſled, as I myſelf have formerly been miſled, by the expreſſion *a ſtate of motion*. Motion is a change; a continuance of motion is a farther change; a farther change is a repeated effect; a repeated effect requires a repeating cauſe. State implies the contrary of change; and motion being change, a *ſtate of motion* is a contradiction in terms." See *Ancient Metaphyſics*, vol. ii.

If our readers think this reaſoning concluſive, they may be in the right; and in that caſe they will ſee the neceſſity of admitting, even for the continuance of rectilineal motion, the *plaſtic nature*, or ſomething equivalent to

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force of projection, we are persuaded, that from the very passivity of matter, that motion would never have an end; but it is obvious that it could be moved only in a straight line, for an impulse can be given in no other direction.

195 The Newtonian doctrine respecting the causes of the motion of the heavenly bodies.

The heavenly bodies, however, are not moved in straight lines, but in curves round a centre; and therefore their motion cannot have been originally communicated merely by an impressed force of projection. This is admitted by all philosophers; and therefore the Newtonians suppose that the planets are moved in elliptical orbits by the joint agency of two forces acting in different directions. One of these forces makes the planet tend directly to the centre about which it revolves: the other impels it to fly off in a tangent to the curve described. The former they call *gravitation*, which some of them have affirmed to be a property inherent in all matter; and the latter, which in a projectile force, they consider as impressed *ab extra*. By the joint agency of such forces, duly proportioned to each other, Sir Isaac Newton has demonstrated, that the planets must necessarily describe such orbits as by observation and experience they are found actually to describe. But the question with the metaphysician is, Whether such forces be real?

196 Mutual attraction among the heavenly bodies impossible.

With respect to projection, there is no difficulty; but that bodies should mutually act upon each other at a distance, and through an immense vacuum, seems at first sight altogether impossible. If the planets are moved by the forces of gravitation and projection, they must necessarily move *in vacuo*; for the continual resistance of even the rarest medium would in time overcome the force of the greatest impetus: but if they move *in vacuo*, how can they be attracted by the sun or by one another? It is a self-evident truth, that nothing can act but where it is present, either immediately or mediately; because every thing which operates upon another, must perform that operation either by its own immediate agency or by means of some instrument. The sun and planets are not in contact; nor, if the motion of these bodies be *in vacuo*, can any thing material pass as an instrument from the one to the other. We know indeed by experience, that every particle of unorganized matter within our reach has a tendency to move towards the centre of the earth; and we are intuitively certain, that such a tendency must have some cause; but when we infer that cause to be a power of attraction inherent in all matter, which mutually acts upon bodies at a distance, drawing them towards each other, we talk a language which is perfectly unintelligible (s). Nay more, we may venture to affirm that such an inference is contrary to fact. The particles of every elastic fluid fly *from* each other; the flame of a fire darts *upwards* with a velocity for which the weight of the circumambient air cannot account; and the motion of the particles of a plant when growing, is so far from tending toward the *centre* of the earth, that when a flowerpot is inverted, every vegetable in it, as soon as it is arrived at a sufficient length, bends itself over the side of the pot, and grows with its top in the natural position.

197 The heavenly bodies cannot be moved by two forces impressed *ab extra*;

Sensible of the force of these arguments against the possibility

to it, without which we have endeavoured to prove, that the heavenly bodies could not revolve round their respective centres in elliptical curves.

(s) A different opinion on this point is held by Professor Stewart in his *Elements of the Philosophy of the Human Mind*; a work of which the merit is such as to make it painful to us to differ in in any important opinion from the ingenious author. We shall, however, claim the same liberty of dissenting occasionally from him that he has claimed of dissenting from Newton, Locke, Clarke, and Cudworth, from whom he differs widely in thinking it as easy to conceive how bodies can act upon each other at a distance, as how one body can communicate motion to another by impulse. "I allow (says he, p. 79.) that it is impossible to conceive in what manner one body acts upon another at a distance through a vacuum; but I cannot admit that it removes the difficulty, to suppose that the two bodies are in actual contact. That one body may be the efficient cause of the motion of another body placed at a distance from it, I do by no means assert; but only that we have as good reason to believe that this may be possible, as to believe that any one natural event is the efficient cause of another."

If by *efficient* cause be here meant the *first* and *original* cause of motion, we have the honour to agree with the learned professor; for we are persuaded that body inanimated is not, in this sense of the word, the cause of motion either at hand or at a distance: but if he mean (and we think he must, because such was the meaning of Newton, from whom he professes to differ), that we can as easily conceive one body to be the instrumental cause of the motion of another from which it is distant, as we can conceive it to communicate motion by impulse, we cannot help thinking him greatly mistaken. We will not indeed affirm, with the writer whom he quotes, "that although the experiment had never been made, the communication of motion by impulse might have been predicted by reasoning *à priori*;" because we are not certain, that without some such experiment we should ever have acquired adequate notions of the solidity of matter: But if all corporeal substances be allowed to be solid and possessed of that negative power to which philosophers have given the name of *vis inertiæ*, we think it may be easily proved *à priori*, that a sufficient impulse of one hard body upon another *must* communicate *motion* to that other; for when the *vis inertiæ*, by which alone the one body is kept in its place, is less than the *vis impetus* with which the other rushes to take possession of that place, it is evident that the former body *must* give way to the latter, which it can do only by motion, otherwise the two bodies would occupy one and the same place, which is inconsistent with their solidity. But that a substance possessed of a *vis inertiæ* should make another substance possessed of the same negative power quit a place to which itself has no *tendency*, is to us not only *inconceivable*, but apparently impossible, as implying a direct contradiction.

possibility of an attractive power in matter which operates at a distance, other philosophers have supposed that the heavenly bodies are moved in elliptical orbits by means of two forces originally impressed upon each planet impelling it in different directions at the same time. But if the tendency of the planets towards the centre of the sun be of the same kind with that of heavy bodies towards the centre of the earth (and if there be such a tendency at all, we have no reason to suppose it different), it cannot possibly be the effect of impulse. A body impelled or projected *in vacuo* would continue to be moved with an equable velocity, neither accelerated nor retarded as it approached the object towards which it was directed; but the velocity of a body tending towards the centre of the earth is continually accelerated: and as we cannot doubt but that the same thing takes place in the motion of a body tending towards the centre of the sun, that motion cannot be the effect of impulse or projection.

198 nor by the agency of any material fluid.

Some of the Newtonians therefore have supposed, "That all kinds of attraction consist in fine imperceptible particles or invisible effluvia, which proceed from every point in the surface of the attracting body, in all right-lined directions every way; which in their progress lighting on other bodies, urge and solicit them towards the superior attracting body; and therefore (say they) the force or intensity of the attracting power in general must always decrease as the squares of the distances increase." The inference is fairly drawn from the fact, provided the fact itself were real or possible: but it is obvious, that if fine imperceptible particles or invisible effluvia were thus issued from every point in the surface of the sun, the earth and other planets could not move *in vacuo;* and therefore the projectile motion would in time be stopped by the resistance of this powerful medium. Besides, is it not altogether inconceivable, nay impossible, that particles issuing *from* the sun should draw the planets *towards* that centre? would they not rather of necessity drive them to a greater distance? To say, that after they have reached the planets, they change their motion and return to the place whence they set out, is to endue them with the powers of intelligence and will, and to transform them from passive matter to active mind.

These difficulties in the theories of attraction and impulse have set philosophers upon fabricating numberless hypotheses: and Sir Isaac Newton himself, who never considered gravitation as any thing more than an effect, conjectured that there might be a very subtile fluid or ether pervading all bodies, and producing not only the motion of the planets, and the fall of heavy bodies to the earth, but even the mechanical part of muscular motion and sensation. Others (T) again have supposed fire, or light, or the electric fluid, to be the universal agent; and some few (U) have acknowledged, that nothing is sufficient to produce the phenomena but the immediate agency of mind.

With respect to the interposition of any material fluid, whether ether, fire, light, or electricity, it is sufficient to say that it does not remove any one difficulty which encumbers the theory of innate attraction. All these fluids are elastic; and of course the particles of which they are composed are distant from each other. Whatever motion, therefore, we may suppose to be given to one particle or set of particles, the question still recurs, How is it communicated from them to others? If one body can act upon another at the distance of the ten-thousandth part of an inch, we can perceive nothing to hinder its action from extending to the distance of ten thousand millions of miles. In the one case as well as the other, the body is acting where it is not present; and if that be admitted to be possible, all our notions of action are subverted, and it is vain to reason about the cause of any phenomenon in nature.

199 The hypothesis of Plato, Aristotle, and Cudworth.

This theory of the intermediate agency of a subtile fluid differs not essentially from the vortices of Des Cartes; which appeared so very absurd to Cudworth, that with a boldness becoming a man of the first genius and learning, he rejected it, and adopted the plastic nature of Plato, Aristotle, and other Greek philosophers. That incomparable scholar observes, that matter being purely passive, the motion of the heavenly bodies, the growth of vegetables, and even the formation of animal bodies, must be the effect either of the immediate agency of God, or the agency of a *plastic nature* used as an instrument by Divine Wisdom. That they are not the effect of God's immediate agency, he thinks obvious from several circumstances. In the first place, They are performed slowly and by degrees, which is not suitable to our notions of the agency of almighty Power. Secondly, Many blunders are committed in the operations of nature, such as the formation of monsters, &c. which could never be were things formed by the immediate hand of God. He is therefore of opinion, that, after the creation of matter, God employed an inferior agent to give it motion and form, and to carry on all those operations which have been continued in it since the beginning of the world. This agent he calls *plastic nature;* and considers it as a being incorporeal, which penetrates the most solid substance, and, in a manner which he pretends not to explain otherwise than by analogy, actuates the universe. He does not look upon it as a being endued with perception, consciousness, or intelligence; but merely as an instrument which acts under Divine Wisdom according to certain laws. He compares it to art embodied; and quoting from Aristotle, says, Ει ενην εν τω ξυλω ἡ ναυπηγικη ὁμοιως αν τη φυσει εποιει. *If the art of the shipwright were in the timber itself, operatively and effectually, it would there act just as nature doth.* He calls it a certain lower life than the animal, which acts regularly and artificially for ends of which it knows nothing. It may be, he says, either a lower faculty of some conscious soul, or else an inferior kind of life or soul by itself, but depending in either case upon a higher intellect. He is aware with what difficulty such a principle will be admitted by those philosophers who have divided all being into such as is extended and such as is cogitative: but he thinks this division improper. He would divide

(T) The several followers of Mr Hutchinson.

(U) Cudworth, Berkeley, and the author of Ancient Metaphysics.

Of Motion.

divide beings into thofe which are folid and extended, and thofe which have life or internal energy. Thofe beings which have life or internal energy he would again divide into fuch as act with confcioufnefs, and fuch as act without it: the latter of which is this plaftic life of nature. To prove that fuch an inftrument is poffible, or that a being may be capable of operating for ends of which it knows nothing, he inftances *bees* and other animals, who are impelled by *inftinct* to do many things neceffary to their own prefervation, without having the leaft notion of the purpofe for which they work. (See INSTINCT.) He obferves, that there is an effential difference between reafon and inftinct, though they are both the attributes of mind or incorporeal fubftance: and that therefore, as we know of two kinds of mind differing fo widely, there is nothing to hinder us from inferring a third, with powers differing as much from inftinct as inftinct differs from reafon. Mankind are *confcious* of their own operations, *know* for what *purpofe* they generally act, and can by the power of *reflection* take a *retrofpective* view of their actions and thoughts, making as it were the mind its own object. Brutes are *confcious* of their own operations, but they are ignorant of the *purpofes* for which they operate, and altogether *incapable* of *reflecting* either upon their paft conduct or paft thoughts. Between their intellectual powers and thofe of man, there is a much greater difference than there is between them and a plaftic nature, which acts as an inftrument of Divine Wifdom without any confcioufnefs of its own operations. Ariftotle, from whom principally the learned author takes his notion of this plaftic nature, compares it, with refpect to the Divine Wifdom which directs and fuperintends its operations, to a mere builder or mechanic working under an architect, for the purpofe of which the mechanic himfelf knows nothing. The words of the Stagyrite are: Τους αρχιτεκτονας περι ἑκαστον τιμιωτερους και μαλλον ειδεναι νομιζομεν των χειροτεχνων, και σοφωτερους ὁτι τας αιτιας των ποιουμενων ισασιν οἱ δ᾽ ὡσπερ και των αψυχων ενια, ποιει μεν, ουκ ειδοτα δε ποιει, ὁιον καιει το πυρ· τα μεν ουν αψυχα φυσει τινι ποιειν τουτων ἑκαστον τους δε χειροτεχνας δι εθος *. "We account the architects in every thing more honourable than the mere workmen, becaufe they underftand the reafon of the things done; whereas the other, as fome inanimate things, only work, not knowing what they do, juft as the fire burns: the difference between them being only this, that inanimate things act by a certain nature in them, but the workman by habit."

* Metaphyf. lib. i. cap. 1.

200 Shown to be poffible.

Sill further to prove that a being may be endowed with fome vital energy of a fubordinate kind, and yet be deftitute of confcioufnefs and perception, the learned author obferves, that there is no reafon to think that the fouls of men in found fleep, lethargies, or apoplexies, are confcious of any thing; and ftill lefs, if poffible, to fuppofe that the fouls of embryos in the womb are from the very firft moment of their arrival there intelligent and confcious beings: neither can we fay, how we come to be fo differently affected in our fouls by the different motions made upon our bodies, nor are we confcious always of thofe energies by which we imprefs fantaftic ideas on the imagination. But if it be poffible for the fouls of men to be for one inftant void of confcioufnefs and intelligence, it follows, that confcioufnefs is not abfolutely neceffary to thofe energies and motions by which life is preferved. To this it may be added, upon the beft authority †, "that where animal or vegetable life is concerned, there is in every cafe a different relation between the caufe and effect, and feemingly depending upon the concurrence or influence of fome farther principle of change in the fubject, than what fubfifts in inanimate matter, or in the caufes and effects that are the objects of mechanical and chemical philofophy." Now to this principle of vegetable life, without which, in a feed or in a plant, vegetation will neither begin nor continue, though light, heat, air, earth, and water fhould concur in the utmoft perfection, Cudworth exprefsly compares his plaftic nature in the univerfe. It is fo far (fays he) from being the firft or higheft life, that it is indeed the laft and loweft of all lives, being really the fame thing with the vegetative.

† *Gregory's Philofophical and Literary Effays.*

201 Arguments for its truth: but

Thefe arguments, if the phenomena of elective attractions in chemiftry be added to them, demonftrate, we think, the *poffibility* of fuch a principle: and to thofe who are inclined to affirm that no fuch thing can exift, becaufe, according to the defcription of it given by Cudworth and the ancients, it is neither body nor fpirit, in the proper fenfe of the words; we beg leave to afk in the words of Locke, "who told them that there is and can be nothing but folid beings which cannot think, and thinking beings that are not extended? which is all that they mean by the terms body and fpirit." All the Greek philofophers who were not materialifts, and even the infpired writers of the Old and New Teftaments, conftantly diftinguifh between the *fpirit* and the *foul* of a man, calling the former fometimes νους and fometimes πνευμα, and the latter ψυχη; and St Paul, who before he was a Chriftian, was learned in philofophy, defcribes the conftituent parts of man as three, πνευμα, ψυχη, σωμα, *fpirit*, *foul*, and *body*. This diftinction, fetting afide the *authority* with which it comes to us, feems to be well founded; for there are many operations carried on in the human body without any confcious exertion of ours, and which yet cannot be accounted for by the laws of mechanifm. Of thefe, Cudworth inftances the motion of the diaphragm and other mufcles which caufe refpiration, and the fyftole and diaftole of the heart; neither of which, he thinks, can be the effect of mere mechanifm. But, as we are not confcious of any energy of foul from which they proceed, even while we are awake, and ftill lefs, if poffible, while we are afleep; he attributes them, not to the intellect or rational mind, but to this inferior vital principle called ψυχη (v); which, in his opinion, acts the

(v) The exiftence of this plaftic nature was warmly debated between Monfieur Le Clerc and Monfieur Bayle. Mofheim, who was inclined himfelf to admit fuch a principle, gives the following view of Le Clerc's fentiments from *Bibliotheque Choifie*, tom. ii. p. 113. "Refpiratio, inquit, et motus cordis, actiones funt, quorum nihil ad animam pertinet. Interim mechanice eas fieri, nullo modo probabile eft. In voluntariis the ſame part in the ſyſtem of the human body which the plaſtic nature acts in the ſyſtem of the world.—To make the reſemblance more ſtriking, he obſerves, that even the voluntary motion of our limbs, though it proceeds ultimately from an energy of will, ſeems to be the effect of that energy employing ſome *inſtrument* which pervades the ſinews, nerves, and muſcles of the body; and if the human ſpirit, or πνευμα employ the inſtrumentality of a plaſtic nature or ψυχη in moving the ſmall machine of the body, it ſeems to be far from incredible that the Divine Wiſdom ſhould employ the inſtrumentality of a plaſtic nature in moving the great machine of the univerſe.

202 whether it be true or not, the motions of the heavenly bodies are carried on by the conſtant agency of ſomething incorporeal.

But we need not inſiſt further on the *poſſibility* of ſuch an inſtrument. Whatever may be thought of the arguments of Cudworth, of which ſome are, to ſay the leaſt of them, plauſible, though others appear to us to have very little ſtrength, Dr Clarke has proved, with a force of reaſoning not inferior to mathematical demonſtration, that the motions of the heavenly bodies are carried on by the agency of ſomething very different from matter, under every poſſible form. "For, not to ſay that, ſeeing matter is utterly incapable of obeying any *laws* in the proper ſenſe of the word, the very original laws of motion themſelves cannot continue to take place, but by ſomething ſuperior to matter, *continually* exerting on it a certain force or power according to ſuch certain and determined laws: it is now evident beyond queſtion, that the bodies of all *plants* and *animals* could not poſſibly have been formed by mere matter according to any general laws of motion. And not only ſo, but that moſt univerſal principle of *gravitation* itſelf, the ſpring of almoſt all the great and regular inanimate motions in the world, anſwering not at all the *ſurfaces* of bodies, by which alone they can act upon one another, but entirely to their *ſolid contents*, cannot poſſibly be the reſult of any motion originally impreſſed upon matter." For though it is true, that the moſt ſolid bodies with which we are acquainted are all very porous; and that, therefore a ſubtile material fluid might penetrate the bodies of the planets, and operate upon them with a force exerted internally; ſtill it is ſelf-evident, that the *greateſt* quantities of ſuch a fluid could not enter into thoſe bodies which are *leaſt* porous, and where the greateſt force of *gravitation* reſides: "and, therefore, this motion muſt of neceſſity be cauſed by ſomething which penetrates the very *ſolid ſubſtance* of all bodies, and continually puts forth in them a force or power entirely different from that by which matter acts upon matter *." Which is, as the ſame able writer obſerves, an evident demonſtration, not only of the world's being originally made by a ſupreme intelligent Cauſe; but moreover, that it depends every moment upon ſome ſuperior Being, for the preſervation of its frame; and that all the great motions in it are cauſed by ſome immaterial power *perpetually* and *actually* exerting itſelf every moment in every part of the corporeal univerſe. This preſerving and governing power, whether it be the immediate power and action of the ſame Supreme Cauſe that created the world, or the action of ſome ſubordinate inſtruments appointed by him to direct and preſide reſpectively over certain parts thereof, gives us equally in either way a very noble idea of Providence. We know with certainty, that *real* and *original power* can belong only to a being endowed with intelligence and will; and, therefore, if the exiſtence of Cudworth's (w) plaſtic nature be admitted, (and we ſee not why it ſhould be called

* *Evidence of Nat. and Revealed Religion.*

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tariis commotionibus neſciunt animi noſtri, quid facto opus ſit, ut membra commoveantur: imperant illi tantum. Eſt vero aliud neſcio quid, quod fideliter, ſi modo organa recte ſint affecta, mandata ejus exſequitur. Quidni igitur ſuſpicemur, eſſe *naturam* in corpore noſtro *viventem*, præter animam noſtram, cujus ſit animæ præceptis et juſſis morem gerere? quamquam potentia ejus ita ſit definita, ut obedire nequeat animo, niſi recte ſeſe habeant organa. Eadem forte natura, corporis noſtri motibus impulſa, animam edocet, quid factum ſit, ut ille poſſit præcipere, quæ ad conſervationem corporis neceſſaria judicat. Anima, pergit, ſit hæc vera eſſe putes, ſimilis erit domino, ſibimet ipſi ſervire neſcio, nec ulla facultate alia, quam imperandi et jubendi inſtructo. Hæc vero natura fictrix non diſſimilis erit mancipii cui nihil eorum, quæ dominus meditatur, notum eſt, quodque nihil aliud facit, quam ut juſſis pareat, et dominum de illis rebus admoneat, quæ ad ſalutem ipſius pertinent." Moſheim proceeds,—Si quis huic loco ſic occurrat, Hæc ratione tria fingi in homine principia; reſpondet vir doctus: "Nullis conſtares argumentis, binis tantum hominem partibus conſtare. Eos, qui hominem ex binis tantum partibus component, nulla ratione explicare poſſe naturam conjunctionis animi et corporis, niſi ipſum Deum ſtatuant cunctis actionibus hominum intervenire: hoc vero Divina Majeſtate prorſus indignum eſſe. Definitionem accuratam mediæ hujus naturæ poſtulantibus ſeſe talem dare non poſſe definitionem reſpondet: Hoc unum ſeſe ſcire: eſſe eam naturam interiori agendi virtute inſtructam, quæ ex ſe et animam et corpus afficere queat; naturam, quæ doceat animam quid rerum geratur in corpore; naturam denique, quæ animi mandatis, quorum tamen cauſſas neſciat, fideliter obtemperet." Reliqua, quæ illuſtrandæ hujus rei cauſſa Clericus affert, prætereo. Satis copioſa eſt in illis, quæ produximus, meditandi materia. *Moſheim. ed. Syſt. Intellect.* p. 173.

Such a principle actuating the univerſe, if it be diveſted of intelligence, and conſidered as a ſecond or inferior cauſe, under the direction of the Supreme, is acknowledged by a very able judge to be a rational hypotheſis; and ſuch, if properly purſued, would certainly open a moſt entertaining ſcene of natural philoſophy.—See *Jones's Anſwer to an Eſſay on Spirit.*

(w) Beſides Cudworth, we have mentioned Berkeley and the author of *Ancient Metaphyſics*, as holding all motion to be an effect of the immediate agency of mind or incorporeal ſubſtance. The opinion of the laſt of theſe philoſophers is not eſſentially different from Cudworth's; and therefore it is needleſs to quote from him: Berkeley was better acquainted with the principles of the Newtonian philoſophy, as well as an abler mathematician

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called in (X) question), it can be considered only as an instrument employed by Divine Wisdom, as a chisel or a saw is employed by the wisdom of the mechanic.

203 This theory not inconsistent with the principles of Newton.

Nor let it be imagined, that this ancient theory of motion is in any degree inconsistent with the mathematical principles of Sir Isaac Newton's astronomy, or with the calculations raised from those principles. Having founded his astronomy on analogy between the phenomena of projectile and planetary motions, he assigned the same or similar *forces* existing in nature as the efficient causes of both. And indeed, both in the act of deriving his *principles* from the projectile phenomena, and afterwards for the purpose of applying them to the planetary, it was necessary to analyze the elliptical motion of the heavenly bodies into a compound of two simple motions in right lines, produced by the action of these different forces; and this might also be useful for the purposes of teaching and demonstration, just as we find it necessary, in all parts of science, to separate what in nature is inseparable, for the convenience and assistance of the understanding. The planetary motions, however, are very probably simple and uncompounded, for no experiments can be tried in those distant regions; and the astronomy of Newton, which is only the application of his mathematical principles to their mensuration from their *analogy* to projectile motions, does not at all require that the forces of gravitation and projection be assigned as their real existent causes (Y). It is sufficient for the analogy

matician, than either of these pupils of the ancients; and being likewise a man who on all subjects thought for himself, it may be worth while to lay before our readers a short abstract of his reasoning respecting the origin of motion. His words are: "Totum id quod novimus, cui nomen *corpus* indidimus, nihil in se continet quod motus principium seu causa efficiens esse possit. *Vis, gravitas, attractio*, et hujusmodi voces, utiles sunt ad ratiocinia et computationes de motu et corporibus motis; sed non ad intelligendam simplicem ipsius motus naturam, vel ad qualitates totidem distinctas designandas. Attractionem certe quod attinet, patet illam ab Newtono adhiberi, non tanquam qualitatem veram et physicam, sed solummodo ut hypothesin mathematicam. Quin et Leibnitius, nisum elementarem seu solicitationem ab impetu distinguens, fatetur illa entia non re ipsa inveniri in rerum natura, sed abstractione facienda esse. Similis ratio est compositionis et resolutionis virium quarumcunque directarum in quascunque obliquas, per diagonalem et latere parallelogrammi. Hæc mechanices et computationi inserviunt: sed aliud est computationi et demonstrationibus mathematicis inservire, aliud rerum naturam exhibere. Revera corpus æque perseverat in utrovis statu, vel motus vel quietis. Ista vero perseverantia non magis dicenda est actio corporis, quam existentia ejusdem actio diceretur. Cæterum resistentiam quam experimur in sistendo corpore moto, ejus actionem esse fingimus vana specie delusi. Revera enim ista resistentia quam sentimus, passio est in nobis, neque arguit corpus agere, sed nos pati: constat utique nos idem passuros fuisse, sive corpus illud a se moveatur, sive ab alio principio impellatur. Actio et reactio dicuntur esse in corporibus; nec incommode ad demonstrationes mechanicas. Sed cavendum, ne propterea supponamus virtutem aliquam realem, quæ motus causa sive principium sit, esse in iis. Etenim voces illæ eodem modo intelligendæ sunt ac vox *attractio*; et quemadmodum hac est hypothesis solummodo mathematica non autem qualitas physica; idem etiam de illis intelligi debet, et ob eandem rationem.

"Auferantur ex idea corporis extensio, soliditas, figura, remanebit nihil. Sed qualitates istæ sunt ad motum indifferentes, nec in se quidquam habent, quod motus principium dici possit. Hoc ex ipsis ideis nostris perspicuum est. Si igitur voce *corpus* significatur id quod concipimus, plane constat inde non peti posse principium motus: pars scilicet nulla aut attributum illis causa efficiens vera est, quæ motum producat. Vocem autem proferre, et nihili concipere, id demum indignum esset philosopho.

"Præter res corporeas, alterum est genus rerum cogitantium: in iis autem potentiam inesse corpora movendi, propria experientia didicimus, quando quidem anima nostra pro lubitu possit ciere et sistere membrorum motus, quacunque tandem ratione id fiat. Hoc certe constat, corpora moveri ad nutum animæ, eamque proinde haud inepte dici posse principium motus; particulare quidem et subordinatum, quodque ipsum dependeat, a primo et universali principio.

"Ex dictis manifestum est eos qui vim activam, actionem, motus principium, in corporibus revera inesse affirmant, sententiam nulla experientia fundatam amplecti, eamque terminis obscuris et generalibus adstruere nec quid sibi velint satis intelligere. E contrario, qui mentem esse principium motus volunt, sententiam propria experientia munitam preferunt, hominumque omni ævo doctissimorum suffragiis comprobatam.

"Primus Anaxagoras τον νουν introduxit, qui motum inerti materiæ imprimeret: quam quidem sententiam probat etiam Aristoteles, pluribusque confirmat, aperte pronuncians primum movens esse immobile, indivisibile, et nullum habens magnitudinem. Dicere autem, omne motivum esse mobile, recte animadvertit idem esse ac siquis diceret, omne ædificativum esse ædificabile. Plato insuper in Timæo tradit machinam hanc corpoream, seu mundum visibilem, agitari et animari a mente, quæ sensum omnem fugiat. Et Newtonus passim nec obscure inuit, non solummodo motum ab initio a Numine profectum esse, verum adhuc systema mundanum ab eodem actu moveri. Hoc sacris literis consonum est: hoc schalasticorum calcula comprobatur."

De Motu, passim.

(X) This we say upon the received opinion, that there are things wholly incorporeal. The truth of the opinion itself will be considered in a subsequent chapter.

(Y) Indeed Sir Isaac himself is very far from positively assigning them as the *real* causes of the phenomena. The purpose for which they were introduced into his philosophy he clearly explains in the following words: "Eadem ratione qua projectile vi gravitatis in orbem flecti posset et terram totam circumire, potest et luna, vel

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analogy, on which the whole philosophy is founded, that the phenomena of motion are known from experiments and observations to be the *same* in *both* instances; that the *principles* or *general laws* mathematically established from the *forces* of the *one* are transferred to the *phenomena* of the *other*; and that the proofs and operations deduced from these principles in the latter case, are confirmed by *facts* and *experience*, the first and final test of truth*.

*Tatham's Chart and Scale of Truth.

Chap. VI. *Of* Number.

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Unity, as an idea, cannot

"Amongst all the ideas that we have, as there is none (says Mr Locke †) suggested to the mind by more ways, so there is none more simple, than that of unity or *one*. It has no shadow of variety or composition in it. Every object our senses are employed about, every idea in our understandings, every thought of our minds, brings this idea along with it: and therefore it is the most intimate to our thoughts, as well as it is, in its agreement to all other things, the most universal idea we have; or number applies itself to men, angels, actions, thoughts, every thing that either doth exist or can be imagined." He seems likewise to be of opinion that we have the idea of *unity* before that of *many*; and that it is by repeating the simple idea of unity in our own minds that we come by the *complex ideas* of *two*, *three*, &c. In this opinion he is joined by Pere Buffier*; who observes that it is impossible to explain the nature of *unity*, because it is the most simple idea, and that which perhaps *first* occurred to the mind.

† *Essay*, book ii. chap. xvi.

*First Truths.

That *unity* is a simple idea, must be granted; but it certainly did not first occur to the mind, nor can it be abstracted from all individuals, and apprehended in Locke's sense of the word as a *general idea*. Let any man look into his own mind, and then say whether he has a general idea of *one* or *unity* as abstracted from every individual object mental and corporeal. In particular, when he thinks he has completely abstracted it from body and mind, sensations, ideas, actions, and passions, &c. let him be sure, before he pronounce it a general *abstract* idea, that he is not all the while contemplating the idea of its *name*, or of that numerical *figure*, by which it is marked in the operations of arithmetic. Both these ideas are in themselves particular; and become general in their import, only as representing every individual object to which unity is in any sense applicable. But in the chapter *of Abstraction*, we have said enough to convince every person capable of conviction that they are used as signs for whole classes of objects.

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be abstracted from every individual.

Instead of being an abstract general idea, *unity*, as the basis of number, is in fact nothing but a mere *relation*, which cannot be conceived without the related objects; and so far is it from being the *first* idea that occurred to the mind, that it is certainly the result of a comparison, made by the intellect, of two or more objects. The ideas which first occur to the mind are, beyond all doubt, those which are called *ideas of sensation*; and many such ideas every child receives before he is capable of comparing objects and forming to himself notions of number. *Unity*, or the idea of *one*, is indeed the element of the science of *arithmetic*, just as a mathematical *point* is the element of the science of *geometry*; but accurate notions of these elements are, in the progress of knowledge, subsequent to ideas of *many* and of *surfaces*. There is reason to believe that persons totally illiterate have no notion at all of *mathematical points*; and we think it possible to conceive an intelligent and conscious being in such a situation as that he could not acquire a notion of *unity* or *one*. Were a child never to see or feel two objects of the *same kind*, we doubt if he would think of numbering them, or of making such a comparison of the one with the other as would suggest to his mind the relations of *one* and *two*; for these relations imply both a sameness and a difference of the objects beyond the power of a child to ascertain. The difference indeed would be perceptible to the senses, but the senses would perceive no sameness or agreement. A guinea, a shilling, and a ball of lead, impress upon the mind different sensations; and therefore a child undoubtedly distinguishes these objects from one another: but what could make him derive from this his first idea of the relation of number? A guinea, a shilling, and a ball of lead, are not *one*, *two*, *three*, in any sense which a child can comprehend. To be convinced of this, let any man throw a guinea, a shilling, and a ball of lead upon a table, and ask a *clown* what is their number. From being accustomed to retail the *names* of number as signs, without affixing to them any idea of the things signified, he will probably answer with quickness *three*, or perhaps *one*, *two*, *three*: but if he be further asked in what *respect* they are *one*, *two*, *three*, we believe his answer will not be so ready: They are not *one*, *two*, *three guineas*, or *shillings*, or *balls of lead*. A philosopher knows them to be three pieces of the same first matter under different forms, and can therefore apply to them the relation of number with truth and propriety; but of the first matter a *clown* is entirely ignorant, and of course cannot call them *one*, *two*, *three*, in any sense which is at once true and to him intelligible.

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Unity, a particular relation.

To make it still more evident, that it is only by comparing together things of the *same kind* that our *first* ideas of unity and number are formed, let us suppose no created being to have hitherto existed except the animated and intelligent globe mentioned in the last chapter, and we think it will be granted that such a being in solitude could never acquire the idea of *unity*. Let

vel vi gravitatis, *si modo gravis sit*, vel alia quacunque vi qua in terram urgeatur, retrahi semper a cursu rectilineo terram versus et in orbem suum flecti: et absque tali vi luna in orbe suo retineri non potest. Hæc vis, si *justo minor* esset, non satis flecteret lunam a cursu rectilineo: si *justo major*, plus satis flecteret, ac de orbe terram versus deduceret. Requiritur quippe ut sit *justæ magnitudinis*: et mathematicorum est invenire vim, qua corpus in dato quovis orbe data cum velocitate accurate retineri possit; et vicissim invenire viam curvilineam, in quam corpus e dato quovis loco data cum velocitate egressum data vi flectatur."——*Principia Mathem.* Def. V.

Of Number.

Let us next suppose a *cubical* body to be created and exhibited to the senses of this spherical man; the consequence would be a *sensation* or feeling entirely new: but that feeling would not be of *unity*; for, as the author of *Ancient Metaphysics* has somewhere well observed, unity is no object of sensation. The sensation would be of colour, hardness, softness, roughness or smoothness, &c. for beyond these the empire of the senses does not reach. Again, Let another body be created of a colour and figure totally different from the colour and figure of the cube, and the spherical man would then experience new sensations having no agreement with those which he had formerly felt. These different kinds of sensations might be compared together; but the result of the comparison would not be the ideas which are denoted by the words *one* and *two*, but merely that which is expressed by *difference* or *dissimilarity*. Were another cube, however, of exactly the same size and colour with the former to be brought into existence, and both to be at once presented to the view of the spherical man, the rudiments of the idea of number would then be generated in his mind, because he could not but perceive the cubes to be in one respect different and in another the same; different as being distinct from each other, and agreeing in their effects upon the organs of sensation.

207 Men must have made some progress in classing things according to genera and species, before they acquired any notion of number.

It appears, therefore, that mankind must have made some progress in classing things according to their genera and species, before they acquired any correct ideas of the relation of number, or thought of using numerical names or figures as general and discriminating signs: for we say *one*, *two*, *three*, &c. only with respect to the species or genus of which each of the things denoted by these numbers is an individual; and if there be any thing which has no genus or species, neither number nor unity can, in the original sense of the words, be predicated of it (Z). We say indeed that there is *one* God; but perhaps we do not always attend to the meaning of the expression. Language was formed to answer the common purposes of life; and those purposes are best answered by denoting individuals by the name of the species or genus to which they belong: but *God* belongs to no species or genus, unless he be said improperly (A) to be of the universal genus of *Being*; and therefore the true meaning of the word *one*, when joined to the verb *is*, and transferred from the creature to the Creator, in such a sentence as—"there *is one* God"—seems to be nothing more than an affirmation that God exists, and that to him the relation of number cannot be applied. In a word, *unity* and *number* are merely relations between the individuals of the same species or genus of being; and men acquire ideas of these relations at the same time and by the same means that they are led to class things into species and genera. As to the processes of addition and subtraction, and the various purposes to which number is applied, these things belong to the science of arithmetic, and fall not under the province of the metaphysician, whose sole object is to ascertain the real nature and causes of things. It may, however, be worth while to observe, that Locke, whose notions of number seem to have been different from ours, owns, 'that a man can hardly have any ideas of numbers of which his language does not furnish him with names. But if units were either real things, or even positive ideas, we see not how *names* could be necessary to their existence; whereas, if they be nothing more than mere relations, it is obvious that they cannot be conceived but as relative either to beings actually existing, or to names which are the signs of actual beings.

Chap. VII. *Of* Time.

Of Time.

208 Time, a mode of duration in contradistinction to eternity.

When St Augustine was asked what time is? he replied, "*Si non roges, intelligo*." An answer from which it may be inferred, that he thought the nature of *time* could not be explained by a logical definition. *Time* and *eternity* are commonly considered as the two modes of *duration*; and if duration be taken in what Locke thinks its true and original sense, to denote permanence of existence, with a kind of resistance to any destructive force, the distinction seems to be sufficiently proper. It is indeed the best that we can make or comprehend; for *duration*, *time*, and *eternity*, are subjects which have perplexed philosophical minds in all ages, and of which, if we have adequate notions, it is very difficult to express these notions in language. Instead of attempting it by previous definitions, the method in which the ancients generally began their inquiries, we shall pursue the better course of induction recommended by Lord Bacon, and endeavour to show by what means we acquire the notion of that mode of duration which is called *time* in contradistinction to

(Z) We are happy to find our notions on this subject confirmed by an authority so respectable as that of Professor Stewart. "Without the power of attending separately to things which our senses present to us in a state of union, we never (says this able writer) could have had any idea of *number*: for before we can consider different objects as forming a multitude, it is necessary that we should be able to apply to all of them one common name; or, in other words, that we should reduce them all to the same genus. The various objects, for example, animate and inanimate, which are at this moment before me, I may class and number in a variety of different ways, according to the view of them that I choose to take. I may reckon successively the number of sheep, of cows, of horses, of elms, of oaks, of beeches; or I may first reckon the number of animals, and then the number of trees; or, I may at once reckon the number of all the organized substances which my senses present to me. But whatever be the principle on which my classification proceeds, it is evident that the objects numbered together must be considered in those respects only in which they agree with each other; and that if I had no power of separating the combinations of sense, I never could have conceived them as forming a plurality." *Elements of the Philosophy of the Human Mind*, chap. iv.

(A) We say *improperly*, because beings which were *created* can have nothing in *common* with that Being which is *self-existent*, and upon whose *will* and *power* all other things depend.

Of Time.

to *eternity*. We begin with time; becauſe we ourſelves exiſt in it, and it is in ſome ſenſe familiar to us. If we be able to trace our notions of this mode of duration to their ſource, we may then give a definition of it founded on fact and univerſal experience, and afterwards proceed to conſider the other mode in conjunction with infinity, to which it is nearly allied.

It has been already obſerved (ſee N° 92 of this article), that every man, while awake, has a train of ſenſations and ideas conſtantly paſſing through his mind in ſuch a manner as that the one ſucceeds the other in a regular order. It is not poſſible, either, by detaining in the mind one idea to the excluſion of all others, to ſtop the courſe of this ſucceſſion entirely; or, by hurrying ſome ideas off the ſtage, and calling others in their place, to quicken its progreſs beyond a certain degree. One man indeed has naturally a quicker ſucceſſion of ideas than another; and all men can, by great exertions, accelerate or retard in a ſmall degree the natural flow of their thoughts. A ſtudious man lays hold, as it were, of a particular idea, which he wiſhes to contemplate, and detains it

209 Whilſt the mind is occupied by one idea or notion, there is no perception of time; which

in the imagination, to the excluſion of all others; a man of wit calls remote ideas into view with a rapidity of which a cool and phlegmatic reaſoner can form no conception; and a forcible *ſenſation* takes full poſſeſſion of the mind, to the excluſion of all *ideas* whatever. Whilſt the attention is wholly occupied by one idea, or by one ſenſation, the mind has no notion whatever of time; and were it poſſible to detain ſuch idea or ſenſation alone in the mind till the hand of a clock ſhould move from the number of one hour to that of another, the hour, as marked on the dial-plate and meaſured by the motion of the hand, would appear but as one inſtant abſolutely void of duration. For the truth of this aſſertion we appeal to the experience of our readers. Such of them as have ever been engaged in deep ſtudy muſt often have had their attention ſo fixed upon one object, that large portions of time, as meaſured by the clock, have paſſed away wholly unheeded; and every man who has ſeen a very ſtriking and uncommon object, muſt remember, that when the ſenſation was firſt impreſſed upon his mind, all other objects, ideas, and notions, and among the reſt the notion of time, were for a while excluded.

210 ariſes from comparing the ſucceſſion of our ideas with the permanence of other objects.

No ſenſation, however, keeps poſſeſſion of the whole mind after it has ceaſed to be new; nor can the moſt vigorous exertions long preſerve any one idea from being driven off the ſtage by the ſucceeding train. Now this ſucceſſion of ideas appearing and diſappearing in their turns, is that which, when compared with the permanency of ourſelves and other things, gives us our firſt and juſteſt notion of time: for whilſt we are thinking, or whilſt a ſeries of ideas is ſucceſſively paſſing through our minds and vaniſhing, we know that we ourſelves and the things around us exiſt; and this exiſtence, or continuation of exiſtence, commenſurate with the train of our fleeting ideas, is what we call the *duration* of ourſelves and the things around us.

We are aware that our firſt notions of time have been often ſaid to be derived from *motion* as perceived by our ſenſes in the objects around us. It is obſerved by Euclid, that "if there were no *motion*, there could be no ſound, nor any ſenſe of hearing." "He might have added (ſays the author of Ancient Metaphyſics), nor any other perception of ſenſe. Further, Without motion there would have been no viſible world, nor generation or production of any kind here below; and, among other things, *time* could have had no exiſtence." All this is certainly true; but that corporeal motion, though the original ſource of all our ideas, is not that which *immediately* ſuggeſts to us the notion of time, will be readily granted by him who conſiders that motion itſelf is perceived by us only when it excites or accompanies a conſtant ſucceſſion of perceptions and ideas. Motion, when equable and very ſlow, ſuch as that of the hour hand of a common watch, is not perceived by us in its courſe; nor can we diſcover that the thing has moved at all, till after we have been ſenſible of the lapſe of a conſiderable portion of what is commonly called *time;* when we diſcover that the hand of the watch has changed its place with reſpect to other objects which we know to be fixed. The ſame is true of motion remarkably quick: "Let a cannon ball (ſays Locke) paſs through a room, and in its way take with it any limb or fleſhy parts of a man; it is as clear as any demonſtration can be, that it muſt ſtrike ſucceſſively the two ſides of the room; it is alſo evident that it muſt touch one part of the fleſh firſt, and another after, and ſo in ſucceſſion: and yet I believe nobody who ever felt the pain of ſuch a ſhot, or heard the blow againſt the two diſtant walls, could perceive any ſucceſſion either in the pain or ſound of ſo ſwift a ſtroke."

Of theſe two phenomena a ſatisfactory account may be eaſily given; from which we think it will at the ſame time be apparent, that the ſucceſſion of the train of ideas in the mind is the meaſure and ſtandard of all other ſucceſſions. We know that the energy of mind which reviews a train of ſenſible ideas is of the very ſame kind with that which attends to a ſeries of paſſing ſenſations (ſee N° 68.); and therefore it is natural to ſuppoſe that we can pay attention to ſenſations and ideas paſſing with nearly equal velocities. But it has been ſhown, that every ſenſation remains in the mind or ſenſorium for a very ſhort ſpace after the object which excited it is taken away: whence it follows, that a body communicating to the organs of ſenſe a ſeries of ſimilar impreſſions ſucceeding each other with remarkable rapidity, cannot excite a train of ſimilar and diſtinct ſenſations; becauſe the effects of the firſt and ſecond impreſſions not having vaniſhed when thoſe of the third and fourth arrive, the whole train of effects muſt neceſſarily coaleſce into one uniform ſenſation. This reaſoning is confirmed by experience. Similar ſounds ſucceeding each other at conſiderable intervals, are all diſtinctly perceived; and if the motion be accelerated gradually, it may be carried to a great degree of velocity before the ſounds be confounded and coaleſce into one. "Mr Herſchel having, by means of a clock, produced ſounds or clicking noiſes, which ſucceeded each other with ſuch rapidity that the intervals between them were, as far as could be judged, the ſmalleſt poſſible, found that he could evidently diſtinguiſh one hundred and ſixty of them in a ſecond of time; but beyond that he could by no effort of attention diſtinguiſh one ſound from another. The ſame philoſopher tried another experiment on viſible ſenſations. By means of the ſame handle and work of the clock, he cauſed a wheel in it to turn till

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till it acquired the velocity of once in a ſecond. He continued to increaſe the velocity, and obſerved it while revolving at the rate of twenty times round in thirteen ſeconds, and could ſtill diſtinguiſh the teeth and ſpaces from each other; whence it appears (by a computation given at length), that he had two hundred and forty-ſix diſtinct viſible ſenſations generated by equable motion in a ſecond of time. The teeth of the wheel, he owns, were not ſo far viſible as to ſhow their ſhape diſtinctly, much leſs could they have been counted: but he very plainly diſtinguiſhed the circumference to be divided into teeth and ſpaces; and he ſuppoſes that the ſame diviſion might ſtill have been ſeen though the motion had been a little faſter, as far perhaps as two turns in a ſecond, equal to three hundred and twenty ſenſations *." The reaſon that the diviſion could not be ſeen whilſt the wheel moved more rapidly than twice round in a ſecond of time, was doubtleſs the continuance of that agitation in the brain from which each ſenſation proceeded, until a new impreſſion cauſed a new agitation, which coaleſced with the former and removed all diſtinction. Hence it is plain, that no external ſucceſſion can be perceived which moves with a greater velocity than that of which the internal train of ſenſations and ideas is capable. On the other hand, an external ſucceſſion which moves with leſs rapidity than that to which the internal flow of ideas may be reduced, either has not ſufficient force to generate ſenſations at all, or the ſucceſſive impreſſions from which the ſenſations proceed follow one another at ſuch diſtances as to permit the natural train of ideas to intervene between them, and thus deſtroy the perception of the ſucceſſion entirely.

* *Watſon's Treatiſe on Time.*

To us, therefore, it ſeems evident, that the conſtant and regular ſucceſſion of ideas in the mind of a waking man, is the meaſure and ſtandard of all other ſucceſſions; of which, if any one either exceeds the pace of which our ideas are capable, or falls ſhort of it, the ſenſe of a conſtant and continued ſucceſſion is loſt, and we perceive it not but with certain intervals of reſt between. So that it is not motion, but the conſtant train of ideas in our minds, that ſuggeſts to us our firſt notion of time; of which motion no otherwiſe gives us any conception, than as it cauſes in our minds a conſtant ſucceſſion of ſenſations: and we have as clear a notion of time by attending to the train of ideas ſucceeding each other in our minds, as by a train of ſenſations excited by conſtant and perceptible motion.

That it is merely by comparing the permanent exiſtence of things with the fleeting ſucceſſion of ideas in our own minds that we acquire our notions of time, may perhaps be ſtill more evident from the following narrative quoted by Dr Beattie †, from *L'Hiſtoire de l'Academie Royale des Sciences pour l'année* 1719. "A nobleman of Lauſanne, as he was giving orders to a ſervant, ſuddenly loſt his ſpeech and all his ſenſes. Different remedies were tried without effect. At laſt, after ſome chirurgical operations, at the end of ſix months, during all which time he had appeared to be in a deep ſleep or deliquium, his ſpeech and ſenſes were ſuddenly reſtored. When he recovered, the ſervant to whom he had been giving orders when he was firſt ſeized with the diſtemper, happening to be in the room, he aſked whether he had executed his commiſſion, not being ſenſible, it ſeems, that any interval of time, except perhaps a very ſhort one, had elapſed during his illneſs." If this ſtory be true, here was a man, who, by the train of ideas vaniſhing at once from his mind, loſt the perception of what was to others ſix months of time; and had all mankind been in his ſtate, the ſame portion of time would have been irrecoverably loſt even to the annals of chronology.

† *Eſſay on Truth.*

We are aware of an objection to any inference which may be drawn reſpecting the preſent queſtion from the caſe of this nobleman. It may be ſaid, that he had loſt, together with the perception of time, the perception of every thing beſides; and that, therefore, motion may ſtill be the cauſe from which a waking man derives his notions of time. But in reply to this objection, we beg leave to aſk, Whether if a ball had been put in motion on a table, and the nobleman had been told, that a body moved with the velocity of that ball would have been carried over ſo many thouſand miles of diſtance during the time that he lay in a ſtate of inſenſibility, he could from ſuch information alone have formed any tolerable notion of the length of time in which he was inſenſible? He certainly could not, for want of a ſtandard by which to meaſure the rapidity of the motion. He would, indeed, have known inſtantly that he had been inſenſible for a conſiderable length of time, becauſe he had the evidence of former experience that a body carried by perceptible motion over a great extent of diſtance would have generated in his mind a vaſt train of ſucceſſive ſenſations; but till he had attended this ball during part of its courſe, and compared with the permanency of other objects the ſeries of ſenſations which it generated in his mind, he would not have been able to gueſs with any thing near to accuracy the length of time it would take to paſs over a thouſand miles.—The ſame inſenſibility of duration happens to every man in ſound ſleep. From having notions of time, ſuch as they are, formed in our minds, we never indeed ſuppoſe, however ſoundly we have ſlept, that the moment at which we awake in the morning is contiguous to that in which we fell aſleep at night The reaſon is obvious; every man has been awake whilſt others were ſleeping, and has known by experience, that if they had been awake likewiſe a train of ideas would have paſſed through their minds which muſt have ſuggeſted to them the notions of time. Moſt men, too, have been frequently awake whole nights, and have thus acquired a notion of time as going on inceſſantly, whether perceived by them or not; and this notion being cloſely aſſociated with our ideas of night and morning, we inevitably ſuppoſe a portion of time to have elapſed between them, though unperceived by us in our ſleep. But were a man to ſleep without dreaming from Sunday night till Tueſday morning, and then to awake at his uſual hour as marked on the clock, there are numberleſs inſtances on record to convince us, that he would not of himſelf ſuppoſe, nor perhaps be very eaſily perſuaded, that more than one night had elapſed between his falling aſleep and the moment at which he awoke.

It being thus evident, that our notion of time is ſuggeſted by that compariſon which we inevitably make of the exiſtence of things permanent with the train

train of ideas inceſſantly paſſing through our minds; we may now perhaps be able to anſwer the queſtion, "What is time?" It muſt of neceſſity be one of three things, viz. either the ideal ſucceſſion itſelf; a certain quality inherent in all objects; or merely the relation of coexiſtence between things that are permanent and the trains of fleeting ideas which ſucceed each other on the theatre of the imagination. It is not the firſt of theſe; for in every train of thought, the appearance of any one idea in the mind occupies no more of the extenſion of time, than a mathematical point occupies of the extenſion of diſtance. Ten thouſand mathematical points added together would make no part of a line; and ten thouſand ideas made to coaleſce, if that were poſſible, would occupy no part of that mode of duration which is called *time*. A point is the boundary of a line, but no part of it: the appearance of an idea in the mind is inſtantaneous; and an inſtant is the boundary, but no part of time. Hence it follows, that were every thing inſtantaneous like ideas in a train, there could be no ſuch thing as time, ſince nothing could be ſaid to have in that ſenſe of the word any duration. That time is not a quality inherent in all objects, is likewiſe plain; for we have ſeen, that were *ideas* as permanent as objects, the notion of time could never have been acquired. Succeſſion, though it does not itſelf conſtitute time, is eſſential to its exiſtence; and were all motion to ceaſe, and the attention of men to be immoveably fixed upon one invariable object or cluſter of objects, *time* would ceaſe likewiſe. It remains, therefore, that time can be nothing elſe than the relation of coexiſtence apprehended between things that are permanent and thoſe trains of fleeting ideas which inceſſantly ſucceed each other on the theatre of the imagination. Thus whilſt a man is ſteadily looking at one object, which, from its being common, does not occupy his whole mind, he may be conſcious of a thouſand ideas ſtarting up in his imagination, and each in its turn vaniſhing the inſtant in which it appeared. Every one of theſe ideas had an exiſtence as well as the object at which he is looking; but the exiſtence of each of them was inſtantaneous and in ſucceſſion, whilſt the exiſtence of the external object is permanent. The object, therefore, as contraſted with the train of ideas, is ſaid to endure or to exiſt in time, whilſt each idea is deſtitute of duration, and exiſts in no time.

212 Time a mere relation of coexiſtence.

213 Objections anſwered.

To this theory ſome objections occur, which it will be incumbent upon us to obviate. It may be ſaid, that though each idea conſidered by itſelf is inſtantaneous, and occupies no time; yet the whole train when taken together, without being compared with any thing external, is perceived to occupy a conſiderable portion of that mode of duration; and that, therefore, time itſelf muſt be ſomething more than a mere relation between a fleeting ſucceſſion of ideas and objects of more permanent exiſtence. But how, we beg leave to aſk, is the whole train perceived to occupy any portion of time? Is it not by being compared with our own exiſtence? A man, whilſt a train of ideas is paſſing through his mind, may be ſuddenly deprived of all his external ſenſes, and then indeed it will be impoſſible for him to compare the fleeting exiſtence of this internal ſucceſſion with the more permanent exiſtence of external things; but, whilſt he thinks at all, he muſt be conſcious of his *own* exiſtence, and cannot avoid perceiving, that whilſt his ideas paſs in conſtant ſucceſſion, each making an inſtantaneous appearance in his mind, he himſelf remains unchanged. Now, what is it that this perception ſuggeſts to the mind? Evidently nothing more than the relation of coexiſtence between a fleeting ſucceſſion and a permanent object; for were it poſſible that the man could be deprived of memory as well as of his ſenſes, and ſtill have ideas ſucceeding each other in his mind, he would then think all objects equally fleeting; he would indeed be himſelf a mere ſucceſſion of inſtantaneous diſtinct perſons, and could have no notion whatever of time. His exiſtence, though it ſhould ſeem to endure half a century as eſtimated by others, muſt to himſelf appear to paſs away like a flaſh of lightning.

It may be ſtill further objected to our theory, that time is meaſured by motion; and that it ſeems very abſurd to talk of meaſuring a relation, eſpecially a mere *ideal* relation, by a real external thing. In anſwer to this objection, which at firſt ſight appears formidable, we beg leave to obſerve, that all relations are equally ideal; and that yet many of them may be ſaid to be meaſured by real external things, with as much propriety as time can be ſaid to be meaſured by motion. When a man wiſhes to aſcertain the relation of quantity which one body bears to another, though he knows that ſuch a relation has no other than an ideal exiſtence, and cannot be conceived but in conjunction with the related bodies, he applies to them ſucceſſively ſome common ſtandard; and having diſcovered the relation which each bears to that, he compares the one relation with the other, and thus aſcertains the relation ſought. Juſt ſo it is with reſpect to motion meaſuring time. That which to each individual conſtitutes real time, is the relation of coexiſtence between the fleeting ſucceſſion of his own ideas and other things of a more permanent nature. But a man has often occaſion to aſcertain the time of things external which fall not under the inſpection of his ſenſes; and in ſociety all men have tranſactions with one another to be performed in ſome determinate portion of time, though there are not, perhaps, two men exiſting whoſe ordinary trains of thought flow with preciſely the ſame rapidity. To remedy theſe inconveniences, it was neceſſary to invent ſome common ſtandard, by means of which men might aſcertain the duration of actions performed at a diſtance, and be able to keep appointments made with each other. The only ſtandard proper for theſe purpoſes is ſuch a conſtant and equable motion as has ſuggeſted a flux of perceptions common to all men in all ages and countries; and hence the motions of the heavenly bodies have been univerſally made uſe of for the common regulators of time. Theſe motions, however, do not conſtitute real and natural time, any more than a foot or a yard applied to two diſtant bodies conſtitutes the relation of quantity which theſe bodies bear to each other. They are merely ſtated meaſures, to be differently applied according to the different purpoſes which we have in view.

Thus, if a man in Europe wiſhes to know what would to him have been the *real* and *natural* time of an action performed in the Eaſt Indies, he has only to be told, that it was co-exiſtent, we ſhall ſuppoſe, with

Of Time.

with a diurnal revolution of the earth; and by comparing this common meaſure with his uſual flow of thought, he can form ſome notion of the extent of that train of ideas, which, had he been preſent, would to him have been ſucceſſively co-exiſtent with the action in queſtion. But when perſons have an appointment to keep, this common meaſure of motion muſt be differently, or rather partially, applied. In ſuch caſes, it is no part of their intention to compare their own exiſtence with that of the whole train of ideas which may paſs in the mind of each; for the reſult of ſuch a compariſon, which alone conſtitutes true and natural time, would not be the ſame in perhaps any two men: but their purpoſe is, to compare their own permanent exiſtence only with that train of ſenſations which ſhall be excited in the mind by the perceptible motion of the ſun, or any other body fixed upon which moves equably; and ſuch a train muſt conſiſt of an equal number of inſtants in all men. Neither the ſun, nor the hour hand of a common watch, moves with ſuch apparent rapidity as to keep pace with the internal flow of thought of which the moſt phlegmatic man is conſcious. That theſe bodies move at all, is known only by their viſible change of place during the lapſe of a conſiderable portion of real time; and as there is in their courſe a certain number of places diſtinctly marked, to which alone it is agreed that the attention is to be turned, it is impoſſible that of time ſo computed two men can have different notions. Such time, however, is but partial; and the method of aſcertaining it, when compared with that by which we aſcertain real time, has a ſtriking reſemblance to that by which we aſcertain the relation of partial quantity between two diſtant bodies. When it is our purpoſe to aſcertain the relation of real quantity which one body bears to another, we apply the common ſtandard to each in every dimenſion of length, breadth, and depth; but when we have no other view than to aſcertain the relation of length which the one bears to the other, we apply the common ſtandard to each in that dimenſion only. Juſt ſo it is with regard to real and partial time. When an individual wiſhes to aſcertain what would to him have been the duration of any action which he did not ſee performed, he applies the common ſtandard to the exiſtence of that action, and to the uſual flow of his own thoughts: but when two men talk of the duration of any action, or agree to meet on ſuch a day, they compare the exiſtence of the action, or the diſtance intervening between the preſent moment and the day of meeting, only with that partial train of ſenſations which by the common ſtandard is generated in an equal number, and in the ſame order, in the minds of both.

214 Time muſt have had a beginning.

It will be ſaid, that if time be nothing more than a mere relation ſubſiſting between trains of ideas or other fleeting objects, and things of a more permanent exiſtence; and if the univerſe had a beginning; either time muſt have had a beginning likewiſe, or the Deity cannot be immutable. We allow the force of the argument; but inſtead of an objection, we conſider it as a confirmation of the truth of our theory. The Deity, who is immutable, exiſts not in time, but in eternity; and that theſe, though from the poverty of language they are both called modes of duration, are yet very different from each other, we ſhall endeavour to prove in the next chapter.

Of Infinity and Eternity.

Chap. VIII. *Of* Infinity *and* Eternity.

215 Why we treat of infinity and eternity among the adjuncts of body.

As corporeal ſubſtance is certainly not infinite, and as the preſent material ſyſtem has in itſelf every evidence of its not being eternal, it may ſeem ſtrange, perhaps, to the reader, that we ſhould treat of infinity and eternity among the adjuncts of body. But in modern metaphyſics theſe words are uſed in a vague ſenſe to denote the extent of ſpace and time; and in this chapter it is our intention to do little more than aſcertain their meaning, and to ſhow, in oppoſition to ſome celebrated names, of what ſubjects they may not be predicated. There is a mathematical and a metaphyſical infinity, which, though often confounded, ought to be kept diſtinct. In mathematics, extenſion is ſaid to be diviſible *ad infinitum*, and number is ſometimes conſidered as infinite: but in metaphyſics theſe modes of expreſſion are extremely improper. A poſitive and metaphyſical infinite is that which has no limits, and to which no addition can be made; but it is obvious that there is no number which may not be enlarged, nor any poſitive idea of extenſion which has not limits, and which may not be either increaſed or diminiſhed. The infinity of the mathematician is termed *infinity of power*, and that of the metaphyſician *abſolute infinity*. The firſt conſiſts in this, that a being, however great or ſmall it be ſuppoſed, may ſtill be conceived to poſſeſs more greatneſs or minuteneſs than we can form an idea of, even after the utmoſt ſtretch of human thought. Thus when it is ſaid, that all extenſion as ſuch is infinitely diviſible, it is not meant that every extended ſubſtance contains an infinite number or *real parts*; for then the parts of an inch would be equal to thoſe of a league: but the meaning is, that in ideal extenſion we can never reach the end of ideal diviſion and ſubdiviſion. In like manner, when it is ſaid that number is infinite, the meaning is not that any poſitive number is without limits, or the poſſibility of increaſe, but that we might go on for ever, adding unit to unit, without approaching nearer to the end of the proceſs. If, therefore, the mathematician would ſpeak properly, and without the affectation of paradox, he ought to ſay that all extenſion as ſuch is *indefinitely* diviſible, and that unit might be added to unit without end; but theſe phraſes ſuggeſt notions very different from that of a metaphyſical infinite, which is ſomething poſitive to which nothing can be added (B).

216 Space and time ſuppoſed to be, the one infinite, and the other eternal:

That there is ſomething poſitively infinite, has been very ſeldom queſtioned; but it has been warmly diſputed among metaphyſicians what ſubjects are infinite. Dr

(B) Ὀυ γαρ ὀυ μηδεν εξω αλλ ὀυ αει το εξω εϛι, τουτο απειρον εϛι. *Ariſt. Phyſ. Auſcult.* lib. ix. cap. 9. page 492. tom. i. *Oper.*

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Dr Clarke and his adherents have contended that ſpace and time are real things; that they are both of neceſſary exiſtence; that the former impreſſes us with the idea of its infinity, and that the latter is poſitively eternal. "Time and ſpace (ſays the doctor *) are the *ſine qua non* of all other *things*, and of all other *ideas*. To ſuppoſe either of them *finite*, is an expreſs *contradiction* in the idea itſelf. No man *does* or *can* poſſibly *imagine* either of them to be finite; but only either by *non-attention* or by *choice* he attends perhaps to *part* of his *idea*, and *forbears attending to* the remainder. They who ſuppoſe *ſpace* to be nothing but a *relation between two bodies* are guilty of the abſurdity of ſuppoſing that which is *nothing* to have *real qualities*: *For the ſpace which is between two bodies* is always unalterably juſt what it was, and has the very ſame dimenſions, quantity, and figure, whether *theſe* or any *other bodies* be there or any where elſe, or not at *all*. Juſt as *time* or *duration* is the ſame, whether you turn your *hour-glaſs* or no, or whether the ſun moves or ſtands ſtill, or whether there *was* or *was not any ſun*, or any *material world* at all. To ſet *bounds* to ſpace is to ſuppoſe it *bounded* by ſomething which itſelf *takes up ſpace*, and that is a *contradiction*; or elſe that it is *bounded by nothing*, which is another contradiction. To ſuppoſe ſpace *removed*, *deſtroyed*, or *taken away*, amounts to the abſurd ſuppoſition of removing a thing away *from itſelf*; that is, if in your *imagination* you *annihilate* the *whole* of *infinite ſpace*, the whole of *infinite ſpace* will ſtill remain; and if you annihilate any *part* of it, *that part* will ſtill *neceſſarily* remain, as appears by the unmoved ſituation of the *reſt*; and to ſuppoſe it *divided* or *diviſible* amounts to the ſame contradiction."

* *Demonſtration of the Being and Attributes of God*, and *Correſpondence with a Gentleman of Glouceſterſhire.*

The abſurdity of conſidering ſpace as a real external thing has been already evinced in Chap. IV. p. 624, where it was ſhown how we acquire the notion, and what kind of notion it is. Space, as was there obſerved, may be conceived either as the mere abſence and poſſibility of body; or as ideal extenſion, united to, and inhering in, an ideal ſubſtratum. Taken in the former ſenſe, it is an object of pure intellect; in the latter, it is an *idea* or *form* in the imagination. That the abſence of body or matter is the *ſine qua non* of all other things, and all other ideas, Dr Clarke was not diſ-

217 poſed to affirm, when he made the divine ſubſtance, to

but improperly.

pervade every material atom in the univerſe: and to talk of the abſence of body being infinite is a palpable contradiction, unleſs Berkeley's doctrine be true, that the material world has no exiſtence. To ſay that the *poſſibility* of matter is infinite, is to uſe language which has no other meaning than that, however far the material world be on all ſides extended, its extenſion may ſtill be conceived greater and greater *ad infinitum*. This is a poſition which no philoſopher ancient or modern has ever denied; but it is ſo far from implying that we have a poſitive idea of the infinity of the material world, or of any adjunct of the material world, that it is abſolutely inconſiſtent with ſuch infinity. Whatever is capable of perpetual increaſe muſt certainly have limits, and every new addition is the limit of that to which the addition was made.

218 Taken in the ſecond acceptation as an ideal extenſion

Neither ſpace nor

united with an ideal *ſubſtratum*, ſpace is ſo far from being infinite in any ſenſe of the word, that we will venture to aſſert no man ever contemplated ſuch a *form* in his own imagination, without conceiving it to be bounded. Of this, at leaſt we are certain, that when we have attempted to frame a poſitive idea of pure ſpace, it has not been in our power to diveſt that idea of limits. Thoſe who can frame in their minds real and poſitive ideas wholly abſtracted from every individual object, may indeed perform in this way many feats above our abilities; but as we poſſeſs no ſuch powers of abſtraction, every thing which we can call an idea is limited in the ſame manner that the object itſelf is limited from which the idea was derived.—Thus, the largeſt expanſion that ever we beheld is the concave hemiſphere; and when we try to form the largeſt poſitive idea of pure ſpace, all that we can do is to figure to ourſelves that concave empty of body. We may, indeed, ſuppoſe its diameter to be either a million or ten thouſand millions of miles; and we may go on enlarging it *ad infinitum*: but when we return from this proceſs of intellect to the contemplation of the ideal forms of the imagination, none of theſe forms appear to us larger or more extended than the hemiſphere, which is the object of ſenſe, and they all appear to be bounded, and bounded in the very ſame way.

With reſpect to the eternity of time, we think Dr Clarke equally miſtaken as with reſpect to the infinity of ſpace. Of time, indeed, we cannot, properly ſpeak- 219

ing, have any *idea* or mental *form*. Time, as we have ſeen, is a mere relation, and is in itſelf the creature of the mind which has no external *idiatum*. It is ſuggeſted, however, by the fleeting ſucceſſion of our ideas, compared with the more permanent exiſtence of other objects: and therefore ſucceſſion is eſſential to it. But nothing which has parts, whether coexiſtent or in ſucceſſion, can be poſitively infinite. For, "in an infinite ſeries of ſucceſſive generations of men, for inſtance, there will be ſeveral infinites that are parts of one another; and by conſequence one greater than another: which (as has been well argued *) is an expreſs contradiction, ſince the greater muſt neceſſarily bound the leſs, and exceed its limits by ſo much as it is greater than it; that is, muſt make it not infinite. Infinite generations contain an infinitely greater infinity of particular men. An infinite number of men muſt have twice as many hands, and ten times as many fingers, and ſo on. Infinite time has an infinity of ages; theſe a much greater infinity of years, days, hours, &c. Space likewiſe (according to Dr Clarke) has three dimenſions, all infinite. It muſt therefore, contain an infinity of ſurfaces, an infinitely greater infinity of lines, and a ſtill infinitely greater infinity of phyſical points. The caſe is the ſame in number itſelf, which, if we ſuppoſe it to contain an abſolute infinity of thouſands (and we may as well do that as imagine it to comprehend an infinity of units), it will contain ten times as many hundreds, fifty times as many ſcores, and ſo on. All this is only the *indefiniteneſs* of number, which we in vain attempt to turn into a poſitive infinite with which it is totally incompatible. For let us add *one* to any of theſe infinite ſeries of generations, ages, lines, or numbers, which we know to be always in our power, and if it was abſolutely infinite before, here is one more than infinite. If it only becomes infinite now, then one finite added to another finite makes infinity. If it be no larger af-

time can be poſitively infinite; and why.

* Dr Law's *Inquiry into the ideas of Space, Time, Immenſity, and Eternity.* See alſo the ſame acute writer's tranſlation of *King's Origin of Evil.*

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ter the addition than it was before, then one part added to another adds nothing; all which are abſurdities. The ſame will appear, if we ſubtract a part from this ſuppoſed abſolute infinite, which may be done in any of the forementioned ſubjects, as well as in every thing which admits of parts, or may be taken in pieces by the mind."

220 The uſual reply to the foregoing reaſoning ſhown

To this kind of reaſoning Dr Clarke replies as follows: "To endeavour to prove that there cannot poſſibly be any ſuch thing as *infinite time* or *ſpace*, from the impoſſibility of an addition of finite parts ever compoſing or exhauſting an infinite; or from the imaginary inequality of the number of years, days, and hours, that would be contained in the one; or of the miles, yards, and feet, that would be contained in the other, is ſuppoſing infinites to be made up of numbers of finites; that is, it is ſuppoſing finite quantities to be *aliquot* or *conſtituent parts* of infinite, when indeed they are not ſo, but do all *equally*, whether *great* or *ſmall*, whether *many* or *few*, bear the very ſame proportion to an infinite, as mathematical points do to a line, or lines to a ſuperficies, or as moments do to time, that is, none at all. No given number or quantity can be any *aliquot* or *conſtituent* part of infinite, or be compared at all with it, or bear any kind of proportion to it, or be the foundation of any argument in any queſtion concerning it."

If it be indeed true, and it is that for which we contend, that no given number or quantity can be any aliquot or conſtituent part of infinite, or be compared at all with it; then it undeniably follows, not that miles, yards and feet, are no conſtituent parts of ſpace; or years, days, and hours conſtituent parts of time; but that ſpace and time cannot poſſibly be poſitive infinites. This, we ſay, follows undeniably: for nothing is more evident, than that all quantities of the ſame kind, from the largeſt to the leaſt, bear a certain proportion to each other; and upon the ſuppoſition that ſpace is a real extending thing, miles, yards, and feet are included in it, and bear to it the relation of parts to a whole. The ſame is true of time, days, and hours. To affirm (for no proof is offered), that all finite quantities, whether great or ſmall, whether many or few, do equally bear the very ſame proportion to an infinite, as mathematical points do to a line, or as moments do to time, is plainly to beg the queſtion—

221 to be a *petitio principii.*

"that *ſpace* conſidered as a real extended thing is *infinite*;" and to beg it, too, in oppoſition to the common ſenſe and reaſon of mankind. Mathematical points we all know to be nothing real, but merely negations of extenſion; but ſuppoſing ſpace to be ſomething real and extended, can any man perſuade himſelf that a mile or a million of miles of this ſpace is likewiſe a mere negation of extenſion? With him who can bring himſelf to this perſuaſion, we pretend not to argue. He is poſſeſſed of faculties, whether true or falſe, of which we are deſtitute.

That finite quantities, whether great or ſmall, do all equally bear the ſame proportion to an *infinite in power*, is indeed true; but it is no great diſcovery: for ſuch an infinite, as we have ſeen, is nothing but the continued poſſibility of repeating the ſame mental proceſs of addition or multiplication; and he who can go on for ever adding, in his own imagination, foot to foot, or hour to hour, will find it equally eaſy to add, in the ſame manner, league to league, or age to age. If he can perform the one operation, he muſt likewiſe have power to perform the other; and he cannot but perceive that it is as impoſſible to come to an end, of adding league to league, or age to age, as of adding foot to foot, or hour to hour; but then he muſt know that theſe leagues, feet, ages, and hours, are not real external things, but mere ideas and notions in his mind. If ſuch powers of ideal multiplication and addition be what Dr Clarke means by the ideas of ſpace and time, it is indeed a contradiction to ſuppoſe either of them limited; for that is to ſuppoſe our powers different from what we know them to be by conſciouſneſs and experience. But to confound *powers* with the *objects* of thoſe powers, is certainly very inaccurate; and to ſuppoſe, becauſe we can go on for ever adding one portion of ideal ſpace or time to another, that therefore our ideas of ſpace and time are in themſelves poſitively infinite, is a contradiction: for to an idea poſitively infinite, it is obvious that nothing can be added. Either, therefore, ſpace and time do not impreſs us with the ideas of their poſitive infinity; or we cannot have the power of adding league to league, and age to age, without end.

"But (ſays the doctor), to ſuppoſe ſpace removed, deſtroyed, or taken wholly away, amounts to the abſurd ſuppoſition of removing a thing from itſelf; that is, if in your imagination you remove the whole of ſpace, the whole of ſpace will ſtill remain." True, every man has ideas of ſpace treaſured up in his imagination, which the ſound of the very word ſpace will at all times bring into his immediate view; and whilſt he has ſuch ideas, it is impoſſible that he ſhould not have them; which is all the myſtery of the matter, and amounts to nothing more than that a thing cannot be and not be at the ſame inſtant. When the doctor affirms, that if "you annihilate any part of ſpace, that part will neceſſarily remain, as appears by the unmoved ſituation of the reſt," we are not certain that we perfectly underſtand him. A man may ſurely think of a cubical inch without thinking of a foot or a yard; and he may ſuppoſe the inch taken away from the foot or the yard, and theſe ideal quantities ſo much leſſened by the ſubtraction. But if the doctor be here again confounding the powers of the mind with the poſitive ideas of ſpace, the ſentence when explained will be ſeen to contain nothing to his purpoſe. Every man has the power of contemplating in idea millions of miles, and millions of ages, and of adding mile to mile, and age to age, without end; and if he try to deprive himſelf of any part of this power, or to fix a limit to the mental proceſs of addition, he will find that in ſpite of himſelf his imagination will ramble beyond the limit aſſigned, and that he has attempted an impoſſibility. This, however, is ſo far from being a proof that his ideas of ſpace and time are poſitively infinite, that, as we have already obſerved, it is a proof of the contrary.

222 Space and time are ſaid to be the *ſine qua non* of all other things; but

But (ſays this great man and his followers) "ſpace and time are the *ſine qua non* of all other things and all other ideas. The ſuppoſal of the exiſtence of *any thing whatever* includes neceſſarily a *preſuppoſition* of the exiſtence of *ſpace* and *time*;" and therefore, if there be any thing infinite and eternal, ſpace and time muſt likewiſe be ſo.

To

Of Infinity and Eternity.

To every corporeal ſubſtance, and every idea of ſuch ſubſtance, ſpace and time are indeed neceſſary: for every body has extenſion and duration; and every idea of a particular body, being nothing but a ſecondary perception in the imagination or memory, muſt have the ſame relation to imaginary extenſion, that the object from which it was derived has to extenſion which is real. Every idea, too, which remains in the imagination whilſt a train of other ideas paſſes ſucceſſively in view, or whilſt external things are perceived to change, has real time. But will any man ſay that *conſciouſneſs*, our notion of *power*, our acts of *willing*, or even *taſtes*, *ſounds*, and *ſmells*, are extended, or that the ſuppoſal of their exiſtence neceſſarily implies a preſuppoſition of the exiſtence of ſpace? We acquire our ideas of extenſion and ſpace by means of our ſenſes of touch and ſight; and we learn from experience, that things external and extended are the cauſes of our ſenſations of taſte, ſound, and ſmell. The effects are in our minds cloſely aſſociated with the ideas of their cauſes; and it is not perhaps eaſy to think of a particular ſound, taſte, or ſmell, without at the ſame time thinking of the object by which it was at firſt excited in the mind; but had we been originally formed with the powers of conſciouſneſs, thinking, and willing, and with no other ſenſes than thoſe of taſting, ſmelling, and hearing, it is obvious that we never could have had the idea of *ſpace;* and therefore, that idea cannot poſſibly be neceſſary to the preſuppoſition of every thing elſe. To conſciouſneſs, thinking, and willing, ſpace is ſo far from being neceſſary, that we cannot perceive any the moſt diſtant relation between them. It is not more difficult to conceive a part greater than the whole, than it is to conceive an ell of *conſciouſneſs*, of *thought*, or of *will;* nor is it in the power of any man to make *ſpace* and *ſweetneſs* coaleſce in his mind ſo as to form of the two ſimple ideas one complex conception. The very reverſe is the caſe with reſpect to the objects of ſight and touch. The idea of every thing which we ſee and handle neceſſarily coaleſces in the mind with the idea of ſpace, nor can we poſſibly ſeparate the one from the other; but the things which we ſee and handle are neither infinite nor capable of infinity.

223 there are things which have no relation whatever to ſpace, or

224 to time.

With reſpect to time, the ſame obſervations will be found to be juſt as with reſpect to ſpace. Whatever is liable to change, exiſts in time and cannot be eternal; but if there be any being immutable, and who views at once all things which to us are paſt, preſent, and to come, the exiſtence of that being is not commenſurable with time. That ſuch a being is poſſible no man can doubt, who reflects, that if we had one permanent idea invariably in the mind, we ſhould never have acquired the *notion* of ſucceſſion or of time; and that if there were *actually* no *change* in nature there could not poſſibly in nature be any ſuch *thing as time.* Every man, therefore, who can conceive exiſtence without change, muſt be convinced, that "the ſuppoſal of the exiſtence of any thing whatever does *not* neceſſarily include the preſuppoſition of the exiſtence of time; and that there may be an eternity diſtinct from time, as well as an infinity diſtinct from ſpace; nay, that nothing which is properly infinite and eternal can poſſibly occupy either ſpace or time.

225 Infinity and eternity, what they are.

If it be aſked, What kind of infinity and eternity they are which have no relation to ſpace and time? Cudworth, treading in the footſteps of the ancients, has long ago anſwered, That they are "abſolute perfection, and neceſſary exiſtence. For (ſays he), *infinite underſtanding* and *knowledge* is nothing elſe but *perfect* knowledge, which hath in it no defect or mixture of ignorance, but knows whatſoever is knowable. In like manner, *infinite power* is nothing elſe but *perfect* power, which hath in it no defect or mixture of impotency—a power which can do every thing which is poſſible or conceivable. Laſtly, *Infinity of duration*, or *eternity*, is really nothing elſe but *perfection*, as including in it *neceſſary exiſtence* and *immutability;* ſo that it is a contradiction to ſuppoſe ſuch a being to have had a beginning, to ceaſe to be, or to ſuffer or be affected by any change whatever. And becauſe infinity is perfection, therefore nothing which includes in its idea or eſſence any thing of *imperfection*, as every poſitive idea of number, corporeal magnitude, and ſucceſſive duration, evidently does, can be truly and properly infinite *."

* *Intellectual Syſtem.*

It muſt indeed by confeſſed, that the idea of ſucceſſion ſo inſinuates itſelf into our uſual ideas of exiſtence, and is ſo cloſely connected with the exiſtence of all finite beings, that we find it extremely difficult to imagine the eternal exiſtence of God, any otherwiſe than as an eternally continued ſeries or ſucceſſion. Our conſtant converſation with material objects, and the aſſociations thence ariſing, make it almoſt impoſſible for us to conſider things abſtracted from time and ſpace; yet we have the evidence of experience and conſciouſneſs, that an idea may be conceived without relation to ſpace and time, and that ſpace and time cannot be made to coaleſce with ſome of our notions. The ſame muſt be true with reſpect to infinity and eternity; for we have ſeen that neither ſpace, time, nor any thing elſe which conſiſts of parts, whether continuous or ſucceſſive, can be ſuppoſed to be poſitively infinite, as the ſuppoſition implies the moſt palpable contradiction. But that there may be perfect power, perfect knowledge, and permanent invariable exiſtence, is ſo far from implying any contradiction, that even we, whoſe faculties are ſo very narrow, can yet make ſome advances towards the conception of ſuch perfections. Thus, every man of common underſtanding knows that ſome things are in themſelves poſſible, and others impoſſible, to be performed by any power. Of theſe poſſibilities and impoſſibilities a philoſopher knows more than an illiterate man; and one philoſopher knows more than another. An intellect more perfect knows more of them than any man; and that intellect which knows them all muſt be abſolutely perfect, and incapable of improvement, becauſe it knows every thing which is to be known. The ſame is true of perfect power:—but we ſhall treat of real infinity and eternity more at large when we come to demonſtrate the being and attributes of God. At preſent it is ſufficient to have ſhown that nothing can be poſitively infinite but a being abſolutely perfect; which never was not, which can produce all things poſſible and conceivable, and upon which all other things muſt depend.

PART III. OF MINDS AND THEIR POWERS.

Chap. I. *Of* Mind *in* General.

THE ſcience of metaphyſics comprehends every thing, into the exiſtence, nature, or cauſes of which any inquiry may be made. But all things of which we have any notion or idea may be divided into mind and body, with their various powers, qualities,
226 Mind diſtinguiſhed from body. and adjuncts. By body is meant that which is ſolid, extended, inert, and diviſible; and its ſeveral adjuncts are ſpace, motion, number, and time. The only mind with which we are *intimately* acquainted is our own; and we know that it is poſſeſſed of the powers of ſenſation, perception, retention, conſciouſneſs, reflection, reaſon, and will. Theſe are totally different from extenſion, ſolidity, diviſibility, and motion; and therefore it is proper to diſtinguiſh the being of which they are powers by another name than that of body.

227 Probably minds of different orders. Of bodies there are various kinds poſſeſſing various ſenſible qualities; and from analogy it is reaſonable to conclude, that there may be various claſſes of minds endowed with different kinds or degrees of power. For this indeed we have ſtronger evidence than that of analogy. Brute animals evidently poſſeſs the powers of perception and ſpontaneity with ſome degree of conſciouſneſs; but as they appear not to reflect upon their own conduct, or to have their actions influenced by motives, their minds are inferior to ours, though ſtill perfectly diſtinct from mere extended, inert, and diviſible ſubſtances. Mind, therefore, conſidered with reſpect to its powers, is evidently different from body conſidered with reſpect to its qualities. This is indeed a truth which has ſeldom if ever been controverted; but it has been long and warmly diſputed, Whether mind and body be not both compoſed of the ſame firſt matter?

228 The abſurd hypotheſis of Hobbes reſpecting mind. Hobbes ſuppoſed, that every material atom is endowed with the faculty of ſenſation (c); but that for want of memory each ſenſation is momentaneous, being inſtantly and wholly effaced as ſoon as its cauſe is removed. Though this hypotheſis is too abſurd to require a formal and laboured confutation, it may not be improper to obſerve, that, if it were true, the hairs of a man's head would feel extreme pain when pinched by the hot iron of the hair-dreſſer; and that the nails of his fingers would be ſeverely tortured when under the operation of the knife or the raſp.

229 Other hypotheſes. Others have ſuppoſed that each atom of matter has a *tendency towards* ſenſation and perception; and that when a ſufficient number of theſe atoms are brought together in a certain order, the *united tendencies* produce the *actual* powers which diſtinguiſh mind from groſs body. This ſuppoſition is if poſſible more abſurd than that of Hobbes. Senſation and perception are of ſuch a nature, that a mere *tendency towards* them is inconceivable. A thing muſt either be ſenſible and percipient, or inſenſible and inert: there is evidently no medium. Or if we could ſuppoſe each individual atom to have a *tendency* towards ſenſation, it would by no means follow that a number of ſuch atoms brought together in any poſſible order would become one ſentient, thinking, and active being. A number of bodies laid upon an inclined plane have each a *tendency* to roll downwards; but if the declivity of the plane be not ſuch as that their ſeparate tendencies may overcome the reſiſtance oppoſed to each individual body by friction, the *united tendencies* of all the bodies when brought together will not be able to overpower the reſiſtance of their united frictions. Juſt ſo is it with reſpect to ſenſation and perception: If the tendency of one atom cannot overcome one degree of inertneſs, the tendency of a thouſand atoms will not overcome a thouſand degrees of the ſame inertneſs.

We have juſt mentioned theſe abſurd ſuppoſitions 231 Only two opinions at preſent on the ſubject.
that our article might be complete: but it is proper to inform the reader, that, ſo far as we know, neither of them has for theſe many years been maintained by any philoſopher of eminence either at home or abroad. The opinions on this ſubject, which at preſent divide the republic of letters, are two; and theſe alone are worthy of examination. One party maintains, That perception, memory, reaſon, and will, &c. are the powers of a being which muſt be immaterial and indiviſible: The other alleges, That as we know nothing of theſe powers but from our own conſciouſneſs, and as we can trace them in ourſelves to the brain and no farther, we have no reaſon to ſuppoſe that they are the powers of any ſubſtance diſtinct from matter. Both parties, however, diſtinguiſh that which in man is the ſubject of thought from his external organs of ſenſe, and agree to call it by the name of *mind;* though the one conſiders it as compoſed of the ſame firſt matter with the duſt of the ground; whilſt the other believes it to have no property whatever in common with that matter.

Were we to adopt ſome of the ancient methods of philoſophizing, this important queſtion might be ſoon decided. A moſt reſpectable writer, who has laboured to reſtore the metaphyſics of Plato and Ariſtotle, hopes to confute the materialiſts, by laying down what they muſt think arbitrary definitions of mind and matter, and then ſhowing that the one is not the other. "In

(c) Scio fuiſſe philoſophos quoſdam, eoſdemque *viros doctos*, qui corpora omnia ſenſu prædita eſſe ſuſtinuerunt: *Nec video*, ſi natura ſenſionis in reactione ſola collocaretur, QUOMODO *refutari poſſint*. Sed etſi ex reactione etiam corporum aliorum, phantaſma aliquod naſceretur; illud tamen, remoto objecto, ſtatim ceſſaret. Nam niſi ad retinendum motum impreſſum, etiam remoto objecto, apta habeant organa, ut habent animalia; ita tantum ſentient, ut nunquam ſenſiſſe ſe recordentur. Senſioni ergo, quæ vulgo ita appellatur, neceſſario adhæret memoria aliqua. *Hobbes's Phyſic*, cap. xxv. ſect. 5.

"In all the parts of the material world (ſays he) there is a perpetual *motion:* For the celeſtial bodies move conſtantly in one reſpect or another; and all here below is in a continual viciſſitude of generation and corruption, which cannot be without *motion.* Now, where there is *motion*, there muſt be ſomething that *moves:* What is *moved* I call *body;* what moves I call *mind.*" From this definition he undertakes to prove, that mind muſt be immaterial. "That there is a relation between *moving* and *being moved* (ſays he), nobody can deny; and the relation is no other than that of *action* and *paſſion.* But the nature of relation is ſuch, that it muſt neceſſarily be between two things at leaſt; and it is further neceſſary, that the two things related ſhould exiſt together. Hence, if there be that which *moves*, there muſt be a different thing that *is moved;* and wherever the one is, the other muſt neceſſarily be; ſo that nothing can move itſelf. This being eſtabliſhed, I ſay that what *moves* muſt be either material or immaterial: for the one of theſe being the negation of the other, there can be no middle betwixt them; becauſe a thing muſt neceſſarily *be*, or not *be*. If then it be immaterial, there is an end of the queſtion: but if it be ſaid to be material, then I ſay that it muſt be *moved* itſelf before it can move any thing elſe; for it is only in that way that body can move body. If then it muſt be firſt moved itſelf, but cannot itſelf move itſelf, what is it that moves itſelf? If it be anſwered, That it is another material mover, then I repeat the ſame queſtion, to which the ſame anſwer muſt be given: and ſo we have an infinite ſeries of *material movers*, without any beginning or *principle* of *motion.* Now this is abſurd, and contradictory to this firſt principle of natural philoſophy, admitted by all philoſophers ancient and modern, That *nothing can be produced without a cauſe* *.

For the immateriality of the human mind, and of every being endowed with the powers of perception and thought, the learned writer has better arguments; but it is upon this chiefly that he reſts his perſuaſion, that mind is the only *mover* in the univerſe. It is needleſs to obſerve, that in the very definitions and axioms upon which this reaſoning is built, the thing to be proved is taken for granted: for if it be ſelf-evident, that what *moves* is, in the author's ſenſe of the word, *mind*, that what is *moved* is *body*, and that *nothing can move itſelf*, all reaſoning on the ſubject is ſuperfluous. This, however, is ſo far from being ſelf-evident, that a materialiſt may reply, "every animal moves itſelf, and yet every animal is nothing more than a ſyſtem of matter." This poſition, whether true or falſe, can neither be proved nor confuted by arguments *à priori* founded on general definitions. That animals move themſelves, and that to the ſenſes they appear to be nothing elſe than ſyſtems of matter, are facts which cannot be controverted. If we would know whether they have in them a principle of motion which is not material, we muſt ſubmit to the laws of induction (ſee LOGIC); and by inveſtigating the eſſential qualities of matter, endeavour to aſcertain whether a material ſyſtem can be rendered active. That we ourſelves have active powers, we know by the moſt complete of all evidence, viz. conſciouſneſs of their energies; and it has been already ſhown, that ſuch powers as we experience in ourſelves cannot exiſt but in a ſubject poſſeſſed of will and underſtanding. The queſtion therefore to be firſt decided between the materialiſts and immaterialiſts is, Whether the powers of conſciouſneſs, underſtanding, and will, can reſult from the particular organization of a ſyſtem of matter? If they can, we have no reaſon to attribute them in man to any other ſource: If theſe powers appear neceſſarily to require an immaterial principle for their ſupport, it will probably be granted, that an immaterial principle is the ſource of every power and every motion in the univerſe; and the doctrine of *mind*, in the ſtricteſt ſenſe of the word, will be ſufficiently eſtabliſhed.

231 The proper method of inveſtigating the nature of mind.

* Ancient Metaphyſics.

CHAP. II. *Of the* SUBSTANCE *of the* HUMAN MIND.

232 Arguments for the immateriality of the human mind.

THE moſt celebrated materialiſt of this or perhaps of any other age is Dr Prieſtley; who having in his own imagination diveſted matter of ſolidity, and reduced it to mere centres of attraction and repulſion, obſerves, that "if one *kind of ſubſtance* be capable of ſupporting all the known *properties* of man; that is, if thoſe properties have nothing in them that is abſolutely incompatible with one another; we ſhall be obliged to conclude (unleſs we openly violate the rules of philoſophizing, which will not authorize us to *multiply cauſes* or kinds of ſubſtance *without neceſſity*), that no other kind of ſubſtance enters into his compoſition; the ſuppoſition being manifeſtly *unneceſſary*, in order to account for any appearance whatever.—All the properties that have hitherto been attributed to matter, may be compriſed under thoſe of attraction and repulſion. Beſides theſe, man is poſſeſſed of the powers of *ſenſation* or *perception*, and *thought.* But if, without giving the reins to our imaginations, we ſuffer ourſelves to be guided in our inquiries by the ſimple rules of philoſophizing above mentioned, we muſt neceſſarily conclude, that theſe powers alſo may belong to the ſame ſubſtance that has alſo the properties of attraction, repulſion, and *extenſion* (D), which I as well as others call by the name of *matter.* The reaſon of the concluſion is ſimply this, that the powers of ſenſation or perception and thought, as belonging to man, have never been found but in conjunction with a certain *organized ſyſtem of matter;* and therefore that thoſe powers neceſſarily exiſt in and depend upon ſuch a ſyſtem. This at leaſt muſt be our concluſion, till it can be ſhown that theſe powers are incompatible with the

(D) When Dr Prieſtley mentions the *extenſion* of corporeal ſubſtance, it muſt be remembered that he does not mean the extenſion of any real thing poſſeſſed of an independent exiſtence. The extenſion belongs wholly to the *ſphere* or the *combination* of ſpheres of *attraction* and *repulſion.* The centre itſelf, which attracts and repels, he repeatedly affirms not to have the dimenſions even of a phyſical point; and he ſometimes ſeems to entertain a doubt whether it be any thing more than a mere relative notion.

Of the Subſtance of the Human Mind.

the other known properties of the ſame ſubſtance; and for this I ſee no ſort of pretence."

This is what Dr Prieſtley calls the proper and direct proof that the ſentient principle in man is the material ſubſtance of the brain; and he enforces it by the following obſervations: "Had we formed a judgement concerning the neceſſary ſeat of thought by the circumſtances that *univerſally accompany it*, which is our rule in all other caſes, we could not but have concluded that in man it is a property of the *nervous ſyſtem*, or rather of the brain; becauſe, as far as we can judge, the faculty of thinking, and a certain ſtate of the brain, always accompany and correſpond to one another; which is the very reaſon why we believe that any property is inherent in any ſubſtance whatever. There is no inſtance of any man retaining the faculty of thinking when his brain was deſtroyed; and whenever that faculty is impeded or injured, there is ſufficient reaſon to believe that the brain is diſordered in proportion; and therefore we are neceſſarily led to conſider the latter as the ſeat of the former. Moreover, as the faculty of thinking in general ripens and comes to maturity with the body, it is alſo obſerved to decay with it; and if, in ſome caſes, the mental faculties continue vigorous when the body in general is enfeebled, it is evidently becauſe in thoſe particular caſes the *brain* is not much affected by the general cauſe of weakneſs. But, on the other hand, if the brain alone be affected, as by a blow on the head, by actual preſſure within the ſkull, by ſleep, or by inflammation, the mental faculties are univerſally affected in proportion. Likewiſe, As the mind is affected in conſequence of the affections of the body and brain, ſo the body is liable to be reciprocally affected by the affections of the mind, as is evident in the viſible effects of all ſtrong paſſions, hope or fear, love or anger, joy or ſorrow, exultation or deſpair. Theſe are certainly irrefragable arguments, that it is properly no other *than one and the ſame thing* that is ſubject to theſe affections, and that they are neceſſarily dependent upon one another. In fact, there is juſt the ſame reaſon to conclude, that the powers of ſenſation and thought are the neceſſary reſult of a particular organization, as that ſound is the neceſſary reſult of a particular concuſſion of the air. For in both caſes equally the one conſtantly accompanies the other; and there is not in nature a ſtronger argument for a neceſſary connexion of any cauſe and any effect. To adopt an opinion different from this, is to form an hypotheſis without a ſingle fact to ſupport it *."

* *Diſquiſitions on Matter and Spirit.*

Though the ingenious author thinks, that if there be any foundation for the eſtabliſhed rules of philoſophizing, this reaſoning ought to be concluſive, he yet ſubjoins, for the greater ſatisfaction of his readers, ſome additional arguments, or rather, as he ſays, diſtinct illuſtrations of the great argument. They are as follow:

1. "That the faculty of thinking neceſſarily depends, for its *exerciſe* at leaſt, upon a ſtock of ideas, about which it is always converſant, will hardly be queſtioned by any perſon. But there is not a ſingle idea of which the mind is poſſeſſed but what may be proved to have come to it from the bodily ſenſes, or to have been conſequent upon the perceptions of ſenſe. The notion, therefore, of the *poſſibility* of thinking in man, without an organized body, is not only deſtitute of all evidence from actual appearances, but is directly contrary to them; and yet theſe appearances ought alone to guide the judgement of philoſophers.

2. "The only reaſon why it has been ſo earneſtly contended for, that there is ſome principle in man that is not material, is, that it might ſubſiſt, and be capable of ſenſation and action, when the body is dead. But if the mind was naturally ſo independent of the body, as to be capable of ſubſiſting by itſelf, and even of appearing to more advantage, after the death of the body; it might be expected to diſcover ſome ſigns of its independence before death, and eſpecially when the organs of the body were obſtructed, ſo as to leave the ſoul more at liberty to exert itſelf; as in a ſtate of *ſleep* or *ſwooning*, which muſt reſemble the ſtate of death; in which it is pretended that the ſoul is moſt of all alive, moſt active, and vigorous. But judging by appearances, the reverſe of all this is the caſe.

3. "If the mental principle was, in its own nature immaterial and immortal, all its particular faculties would be ſo too; whereas we ſee that every faculty of the mind without exception is liable to be impaired, and even to become wholly extinct, before death. Since, therefore, all the faculties of the mind, ſeparately taken, appear to be mortal, the ſubſtance or principle in which they exiſt muſt be pronounced to be mortal too.

4. "If the ſentient principle in man be immaterial, it can have no *extenſion*; it can neither have length, breadth, nor thickneſs; and conſequently every thing within it, or properly belonging to it, muſt be *ſimple* and *indiviſible*. Let us now conſider how this notion agrees with the phenomena of ſenſation and ideas. It will not be denied, but that ſenſations or ideas properly exiſt *in the ſoul*, becauſe it could not otherwiſe retain them, ſo as to continue to perceive and think after its ſeparation from the body. Now, whatever ideas are in themſelves, they are evidently produced by external objects, and muſt therefore correſpond to them; and ſince many of the objects or archetypes of ideas are diviſible, it neceſſarily follows, that the ideas themſelves are diviſible alſo. But, how is it poſſible that a thing (be the nature of it what it may) that is *diviſible*, ſhould be contained in a ſubſtance, be the nature of *it* likewiſe what it may, that is *indiviſible?* If the archetypes of ideas have extenſion, the ideas which are expreſſive of them, and are actually produced by them according to certain mechanical laws, muſt have extenſion likewiſe; and therefore the mind in which they exiſt, whether it be material or immaterial, muſt have extenſion alſo. But how any thing can have extenſion and yet be immaterial, without coinciding with our idea of mere empty *ſpace*, I know not."

To the argument, which is here chiefly inſiſted on as being agreeable to the eſtabliſhed rules of philoſophizing, a very able reply has been made, which we ſhall give in the words of its elegant and ſpirited author. But before we attempt to dig up the foundation of the doctor's ſyſtem, it may not be improper to demoliſh, if poſſible, the additional buttreſſes by which it is ſtrengthened. An experienced general, before he ſtorm a citadel which he knows to be ſtrongly ly fortified and ſkilfully defended, will take care to raze every leſs important redoubt from which the enemy might annoy him in his rear.

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Becauſe the faculty of thinking in general ripens, comes to maturity, and decays with the body, and the body on the other hand is affected by the affections of the mind, the doctor affirms that we have the ſame reaſon to conclude, that the powers of ſenſation and thought are the neceſſary reſult of a particular organization, as that ſound is the neceſſary reſult of a particular concuſſion of the air. This argument is concluſive only upon the ſuppoſition that there is no *poſitive* evidence whatever for the immateriality of the being which is the ſubject of thought. If the other reaſonings for the materiality and immateriality of the mind be of equal weight, this argument ought doubtleſs to turn the balance; but if there be the ſmalleſt preponderancy in behalf of the immaterialiſts, it is a mere begging of the queſtion to attempt to counteract it by any inference which can be drawn from the mutual affections of the body and mind. If two ſuch heterogeneous beings as an immaterial mind and an organized body can be ſuppoſed united in one perſon, they muſt neceſſarily affect each other; and to affirm, on account of this reciprocal affection, that they are *one and the ſame*, is equally abſurd as to ſay that an electrician and his apparatus are *one and the ſame*. Dr Prieſtley himſelf did not at firſt perform his electrical experiments with ſo much eaſe as after he had acquired facility by long practice, nor could he even yet perform them ſo neatly with a bad as with a good apparatus.

That which the doctor calls the firſt illuſtration of his argument might be admitted, and the force of the argument itſelf be conſiſtently denied. Some kind of organized body may be neceſſary to the mind as an inſtrument without which it could not exert its faculties; but it would certainly be raſh to infer that the mind muſt *therefore* be a ſyſtem of matter. An anvil and a hammer are neceſſary to the exerciſe of the blackſmith's art; but what would be thought of him who ſhould from this fact conclude, that the blackſmith himſelf muſt be a ſyſtem of iron! This, therefore, inſtead of illuſtrating the great argument, ſeems to be wholly foreign from the queſtion in debate; and it has in fact been admitted by Dr Price *, and thouſands of others who reject the doctrine of materialiſm, as an impious abſurdity. The ſecond illuſtration, however, is more to the purpoſe; and as it is not new, we ſhall give it an old anſwer.

* *Correſpondence with Dr Prieſtley.*

Why do not we perceive external objects in our *ſleep* or in a *ſwoon*? "Becauſe (ſays Mr Wollaſton †), the *paſſages* are become impracticable, the *windows* ſhut, and the *nerves* being obſtructed, or ſomehow rendered for the time uſeleſs, can tranſmit no information to it. Why, however, does it not reaſon and think about *ſomething or other*? Becauſe, all the *marks* by which things are remembered, being for the preſent choked up or diſordered, the remembrance of thoſe *objects* about which it is wont to employ itſelf, and even of the words (or other ſigns) in which it uſes to reaſon, and to preſerve the deductions and concluſions it makes, is all ſuſpended at leaſt for the time: and ſo its tables being covered, its books cloſed, and its tools locked up, the requiſites for reaſoning are wanting, and no ſubject offers itſelf to exerciſe its thoughts, it having yet had little or no opportunity to take in *higher objects* and more *refined matter* for contemplation. And, to conclude, if it be demanded, Why any one ſhould imagine that the *ſoul* may think, perceive, act, *after death*, when it doth not do this in ſleep, &c.? the anſwer is, Becauſe thoſe *encloſures* and *impediments* which occaſioned the forementioned intermiſſions, and thoſe great limitations under which it labours at all times, will be removed with its enlargement out of the body. When it ſhall in its *proper vehicle* be let go, and take its flight into the open fields of heaven, it will then be bare to the immediate impreſſions of objects: And why ſhould not thoſe impreſſions which affected the *nerves*, that moved and affected the vehicle and ſoul in it, *affect the vehicle immediately* when they are immediately made upon it, without the interpoſition of the nerves? The hand which feels an object at the end of a *ſtaff*, may certainly be allowed to feel the ſame much better by *immediate contact* without the ſtaff."

† *Religion of Nature Delineated.*

The opinion, that the ſoul is united to ſome fine vehicle, which dwells with it in the brain, and goes off with it at death, was not peculiar to Mr Wollaſton. It was thought extremely probable by Dr Hartley, and ſhall be ſhown afterwards to have been a very ancient opinion; but we do not quote it at preſent as either well or ill founded, but only as ſufficient, in conjunction with the reaſoning of its author, to obviate the force of Dr Prieſtley's ſecond illuſtration of his argument for the materiality of mind, provided the argument itſelf be not more powerful than any which the immaterialiſts can bring againſt it.

The doctor's third illuſtration we have already obviated, when we accounted for the mind and the body mutually affecting each other; and we might refer to Dr Price's anſwer (E) to the fourth, as being, in our opinion, a full confutation of it. But as that author's notions of *mind* and *ideas* differ in ſome reſpects from our own, we ſhall examine this objection to the doctrine of the immaterialiſts upon principles which we believe Dr Prieſtley more inclined to admit.

That the ſentient principle in man, if it be immaterial,

(E) In *Diſquiſitions*, p. 37 and 102, it is aſſerted, that ideas are certainly diviſible. "This ſeems to me very abſurd. It would be as proper to aſſert ideas to be hard or round. The idea of an object is the apprehenſion, view, or notion of it; and how can this be diviſible? Perception is a ſingle and indiviſible act. The object perceived may be diviſible; but the *perception* of it by the mind cannot be ſo. It is ſaid in page 95, *that if ideas are not things diſtinct from the mind, a mind with ideas and a mind without ideas would be the ſame.*—I maintain, that ideas are not diſtinct from the mind, but its conceptions; or not *things* themſelves, but *notions* of things. How does it follow from hence, that a mind with or without ideas is the ſame? It would ſeem that this follows much more from the contrary aſſertion." *Correſpondence between Dr Price and Dr Prieſtley.*

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terial, can have no extenſion, is a truth which we think cannot be controverted; and if ſo, every thing in that principle muſt be *ſimple* and *indiviſible*. Thus far we agree with Dr Prieſtley; but with reſpect to what follows we differ from him entirely. The agitation in the brain, which is the immediate cauſe of ſenſation, muſt indeed correſpond to the impreſſion *ab extra* by which it is produced, and therefore muſt have the property of extenſion; but that agitation, whatever it be, is not itſelf ſenſation any more than a bludgeon is a blow, or a ſword is a wound. Dr Prieſtley, indeed, in anſwer to Dr Price, affirms, that, according to Hartley's theory, ideas are only *vibrations in the brain*; but whoever ſhall take the trouble to examine that theory himſelf, will not find that its author ever advances ſuch an opinion, or conſiders vibrations as any thing more than the inſtruments by which ſenſations and ideas are excited in the ſentient principle. A real and proper idea, as we have often repeated, is nothing elſe than a fainter ſenſation: but no ſenſation, from whatever cauſe it may proceed, is itſelf extended; nor could we, without memory, the reaſoning faculty, and the power of local motion, have acquired from mere ſenſe any notion of extenſion at all: (ſee ſect. 3. Chap. I. Part I.) Senſations and ideas are thoſe *appearances* (if we may ſo ſay), which vibrations or ſome other motion in the brain excite in the mind; but a *half* appearance is an abſurdity. A man may view *half a tree* with his eyes, and he may contemplate the idea of *half a tree* in his mind; but he cannot have *half a view* or *half an idea* of any thing. Senſations and ideas reſult from the mutual agency of the brain and ſentient principle upon each other; and if the agency of the brain be vibration, more of it may vibrate at one time than at another: but ſurely the mere relation between its agency at any time and the agency of the mind, can neither have extenſion nor be diviſible; for who ever thought of extending or dividing relations? On this ſubject it is extremely difficult to write with perſpicuity and preciſion; and what we have ſaid may very poſſibly be miſunderſtood. Our notion is to ourſelves clear and determinate; but language, which was not invented by metaphyſicians, wants words in which it may be properly expreſſed. Perhaps the reader may underſtand what we mean, when we ſay that a ſenſation or an idea is the inſtantaneous effect of the mutual agency of the brain and ſentient principle. Of this we think every man, by a little attention, may be perfectly convinced, though it may be impoſſible ever to diſcover the preciſe nature of this agency; and if ſo, it is plain that ſenſations and ideas cannot be divided, for no inſtantaneous effect of any kind is diviſible. A ſenſation, and of courſe a ſimple and original idea, neither has extenſion itſelf, nor ſuggeſts the notion of extenſion *ab extra*. By running the hand or any other member along a ſolid body, we feel continued reſiſtance: this feeling, or the idea of this feeling, becomes in time ſo cloſely aſſociated with all our ſenſations of touch and ſight, that the one cannot be ſeparated from the other; and theſe aſſociations are what Dr Prieſtley calls *extended ideas*. Upon the whole then, we think it apparent, that our ſenſations, and the relicts of our ſenſations, are unextended and indiviſible (F); and that though they ſuggeſt

(F) We affirm this only of *human* ſenſations and ideas, becauſe theſe are the only ſenſations and ideas of which we are conſcious, and about which we can reaſon. Other animals are ſentient as well as man, and appear to have their ſenſations excited by impreſſions *ab extra*; but whether in every ſpecies of animals a ſingle impreſſion excites but one ſenſation common to the whole animal, or different ſenſations which are felt each by a different faculty or ſentient principle, is a queſtion which we are not able to anſwer. We make this remark, becauſe from the phenomena of ſenſation in the earthworm and other reptiles, ſome philoſophers of eminence having ſuppoſed, that in theſe creatures the ſentient faculty belongs to the material ſyſtem, and is diviſible with it; have thence concluded, we think raſhly, that all arguments for the immateriality of the human mind are founded merely on our ignorance. We call this concluſion raſh; becauſe, though we know perfectly what a human ſenſation is, we have ſo little knowledge of the nature of ſenſation in worms, that what may be true of the one *principle* of ſenſation may be falſe of the other. Indeed, if we are to judge from the phenomena, this is actually the caſe. It appears from experiments made by Abbe Spallanzani and others, that if a certain number of rings be cut off either from the anterior or poſterior part of a worm, or even from both, the remainder will not only continue to live and be ſentient, but will alſo regenerate a new head and a new tail, and become again a complete worm. Nothing like this takes place in man or in the higher orders of animals; and therefore, were it certain that the ſentient principle in the worm is diffuſed through the whole ſyſtem, and diviſible with it, we could not infer that the principle of ſuch ſenſations as we are conſcious of, is likewiſe extended and diviſible. It is, however, ſo far from being certain that the ſentient principle is diffuſed through the whole worm, that nothing neceſſarily follows from this fact, but that its ſeat is at ſome diſtance from either extremity. Nay, were it true, as perhaps it is, that a worm may be ſo divided, as that each of the two ſections ſhall retain life, ſenſation, and this reproductive power, we would not therefore be authorized to conclude that the ſentient principle is *one* coextended and diviſible with the material ſyſtem. The earthworm, like many other reptiles, being an hermaphrodite, which unites in itſelf both ſexes, may poſſibly conſiſt of two animated ſyſtems; which, though united by ſome bond of connexion, by which ſenſation is communicated from the one to the other, are yet in themſelves perfectly diſtinct. Should this, upon proper inveſtigation, be found to be the caſe; and ſhould it likewiſe be found, that when a worm is divided into three or more parts, only one or two of theſe parts continue to live, there would be no room whatever for ſuppoſing that even in theſe creatures the principle of ſenſation is extended and diviſible. In the mere power of reproducing amputated parts, when that power is conſidered by itſelf, there is nothing more wonderful than in the growing of the nails of our fingers, or the hairs

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gest to us the existence of extended things *ab extra*, the sentient being *may* be unextended and indivisible.

Having thus examined Dr Priestley's auxiliary arguments for the materiality of mind, we now proceeed to consider his main and direct proof. To this, as we have observed, so able a reply has been made, that it would be injustice to our readers not to lay it before them, in the words of its author. "I readily acknowledge (says this spirited essayist *), that the power of sensation or perception never having been found but in conjunction with a certain organized system of matter, we ought, as philosophers, to conclude that this power necessarily exists in, and results from, that organized system, unless it can be shown to be incompatible with other known properties of the same substance. On the other hand, it must be admitted, that constant conjunction implies *necessary* connexions only when reasons cannot be discovered to prove the conjunction to be accidental and arbitrary. In the present instance, it is alleged, that discerptibility is a property of matter absolutely incompatible with the property of sensation or perception; or in other words, that sensation is a power or property incapable of division. But as the power of the entire system is clearly nothing more than the sum or aggregate of the powers of all the parts, it necessarily follows, that the primary particles of which the system is composed must, upon the material hypothesis, possess distinct powers of sensation; and that those powers combined constitute the indivisible power of sensation belonging to the system; or, in other words, that the *indivisible* power of sensation is a *divisible* power, nay, an infinitely divisible power, if matter be, as philosophers in general allow, an infinitely divisible substance—a conclusion obviously and grossly ridiculous. We are then compelled to acknowledge, that sensation or perception is not the property of a material substance; i. e. if the common mode of expression be retained, it is the property of an immaterial substance; or, to avoid verbal contention, it is a property not resulting from, or necessarily connected with, the organical system, but a property wholly foreign, superinduced, and adventitious (G).

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* *Essays, Philosophical, Historical, and Literary*, vol. ii.

hairs of our heads. The only thing which seems to militate against the simplicity of the principle of sensation in worms, is the continuance of life, &c. with both parts of a worm when cut into two by a knife or pair of scissars; but if a worm be found to have two seats of sensation analogous to the brain in higher animals, and if it be likewise found that life continues only in such sections as retain at least one seat of sensation, the sentient principle in the worm may be as simple and indivisible as in any animal whatever. We neither wish nor expect much stress to be laid upon these hints and conjectures. Should they induce any of our physiological readers, who have leisure, and are at the same time skilled in philosophy, properly so called, to institute a set of experiments upon worms and such reptiles, and to trace apparent effects to their higher causes, they might eventually lead to important discoveries. In the mean time, it is sufficient for our purpose to observe, that whatever be the sentient principle or principles in the earthworm, it is obvious that the whole animal cannot in any case be conscious, as man undoubtedly is, of *one individual sensation*; and that therefore no arguments built upon the phenomena accompanying sensation in worms, can be of any importance in the controversy about the materiality or immateriality of the human mind.

(G) This argument is not new. It was long ago urged by Dr Clarke against Mr Dodwell; and some of our readers may not be ill pleased to see it stated by so masterly a reasoner: "That the soul cannot possibly be *material*, is demonstrable from the single consideration of bare sense or consciousness. For matter being a divisible substance, consisting always of separable, nay of actually separate and distinct parts, it is plain that unless it were essentially conscious, in which case every particle of matter must consist of innumerable separate and distinct consciousnesses, no system of it, in any possible composition or division, can be an individual conscious being. For suppose three or three hundred particles of matter, at a mile or any given distance one from another, is it possible that all these separate parts should in that state be one individual conscious being? Suppose then all these particles brought together into one system, so as to touch one another, will they thereby, or by any motion or composition whatsoever, become one whit less truly distinct beings than they were when at the greatest distance? How then can their being disposed in any possible system make them one individual conscious being? If you will suppose God by his infinite power superadding consciousness to the united particles, yet still these particles being really and necessarily as distinct beings as ever, cannot be *themselves* the *subject* in which that individual consciousness inheres; but the consciousness can only be superadded by the addition of something, which in all the particles must still itself be but one individual being. The soul, therefore, whose power of thinking is undeniably one individual consciousness, cannot possibly be a material substance." *Clarke's Letter to Mr Dodwell*, 2d edition.

That the same mode of reasoning was known to the ancients, Cudworth has shown by numerous quotations; and as an argument certainly loses nothing by antiquity, or by having occurred to thinking men in distant ages, we shall lay before our readers two passages from Plotinus, of which the extract from Clarke's letter (though we are persuaded it was not borrowed by the author) must be considered as little more than a paraphrastical translation.——τι τοινυν φησουσιν, ὁι την ψυχην σωμα ειναι λεγοντες, πρωτον μεν περι ἑκαστου μερους της ψυχης της εν τω αυτω σωματι, ποτερον ἑκαστον ψυχην, ὁια εστι και ἡ ὁλη; και παλιν του μερους το μερος; ουδεν αρα το μεγεθος συνεβαλλετο τη ουσια αυτης· καιτοι εδει γε ποσου τινος οντος· αλλα και ὁλον πολλαχη, οπερ σωματι παρειναι αδυνατον. εν πλειοσι το αυτο ὁλον ειναι, και το μερος ὁ περ το ὁλον, ὑπαρχειν· ει δε ἑκαστον των μερων, ου ψυχην φησουσιν, εξ αψυχων ψυχη αυτοις υπαρξει, *En.* IV. *Lib.* vii. *Cap.* 5.

The same argument is elsewhere stated thus: ει δε ἑκαστον ζωην εχοι, και εν αρκει· ἑι δε μηδενος αυτων ζωην εχοντος ἡ συνοδος πεποιηκε ζωην, ατοπον· μαλλον δε αδυνατον συμφορησιν σωματων ζωην εργαζεσθαι, και νουν γενναν τα ανοητα. *En.* IV. *Lib.* vii. *Cap.* 2.

"In opposition to this reasoning, the materialists affirm, that entire systems may possess, and they think themselves warranted to pronounce that organized systems of matter actually do possess, powers essentially different from those which inhere in the several parts. Amongst various familiar though striking illustrations of this truth, it has been said, that a rose possesses the property of sweetness or fragrance, a globe the property of sphericity, a harpsichord the property or power of producing harmony, *aqua regia* the property of dissolving gold, &c. though the component particles of these different organized systems are themselves totally destitute of the powers and properties here enumerated.

"The immaterialists, in reply, assert, that it is not only false in fact, but a direct contradiction, and an absolute impossibility in the nature of things, that a system should possess any property which does not inhere in its component parts. To assert that the power of the whole is the sum or aggregate of the powers of all the parts, is an identical and self-evident proposition, the whole and all the parts being terms precisely synonymous. Whoever, therefore, calls in question the truth of this axiom, must maintain that the power of the whole is something different from the power of all the parts, i. e. that the power of the whole is *not* the power of the whole.

"It will be easy to demonstrate the correspondence of facts with this plain and simple theory. For this purpose, it is necessary to observe, that the properties of matter, or what are generally denominated such, may be divided into real and nominal, which Locke and others have called primary and secondary qualities. Figure, magnitude, and motion, are qualities really inherent in matter; but figure, magnitude, and motion, eternally varied, can produce only different combinations of figure, magnitude, and motion. There are also powers, or qualities, vulgarly considered as inherent properties of matter organically disposed, which are really and truly qualities or affections of the mental or percipient principle, and have no existence when not perceived. Thus the sweetness or fragrance of the rose, considered as mere sweetness and fragrance, can be nothing but an affection of the mind; considered as a quality of the rose, they can mean nothing more than a certain arrangement, configuration, and motion of parts, which in some inexplicable manner produces the sensation of sweetness. In this instance, therefore, the power of the whole is plainly the aggregate of the powers residing in the parts, by the motion and organization of which a certain effect is produced upon a foreign and percipient substance.

"But a globe, we are told, possesses the property of sphericity, though not a single particle amongst that infinite number of which the globe is constituted is itself of a spherical form. The fallacy of this illustration is, however, as easily demonstrable as that of the former. The sphericity of a globe is evidently the sum or aggregate of the curvilinear or convex parts which compose its surface; and the property of the whole is neither more nor less than the combined properties of all its parts. No one doubts, that by new compositions or arrangement of material particles possessing magnitude, figure, and motion, an endless diversity of phenomena may be produced, to which it may be necessary to apply new names. New names, however, do not constitute new properties; and though we give to a globe the appellation of an entire system, and ascribe to it the property of sphericity, we know at the same time that it is really nothing more than a collection of thousands of millions of particles, actually separate and distinct, arranged in that particular form which we denominate spherical. But this can never be regarded as in the remotest manner analogous to the *creation* of the power of perception, in consequence of a certain organical arrangement or disposition of impercipient particles. Though sphericity is, indeed, the property of the entire sphere, yet every part of the sphere, if divided, possesses its share of sphericity. But if the percipient principle be divided, what would become of the power of perception? A sphere equally divided becomes two hemispheres; Does a perception, when divided in like manner, become two demi-perceptions?

"The same reasonings may easily be transferred, and applied to the harpsichord. Can any one be absurd enough to affirm that the power of harmony resides in the harpsichord, as the power of perception does in the mind? After the utmost skill of the artificer has been exerted, we discover nothing more in the harpsichord than new modifications of the old properties of figure, magnitude, and motion, by means of which certain vibrations are communicated to the air, which, conveyed by the medium of the auditory nerves to the sensorium, produce the sensation of harmonic sounds. These new modifications are therefore attended, indeed, with new and very wonderful effects; but then those effects are produced upon, and are themselves modifications of, the sentient or percipient faculty. And though it is wholly incomprehensible to us in what manner these effects, that is, these *sensations*, are produced, we well know, and perfectly comprehend, that they are not new powers belonging to any organized system of matter; that they have no existence but in a mind perceiving them; and that they are far from militating against that grand and universal axiom, that the power of the whole is nothing more than the united powers of all the parts.

"As to the last instance adduced, of the power of *aqua regia* to dissolve gold, though neither the spirit of salt, nor the spirit of nitre of which it is compounded, separately possesses that power, it is plain, that from the union of these two substances, certain new modes of configuration and motion result; and the solution of gold is the consequence of this new arrangement and motion of the parts. But the particles of which the menstruum is composed were always possessed of the properties of figure and motion; and what is styled a new property, is clearly nothing more than a new effect of the old properties differently modified. In a word, the advocates for materialism may safely be challenged to produce, in the whole compass of nature, a case which bears the least analogy to that which these instances are most unphilosophically adduced to prove and to illustrate. It is an absurdity which transubstantiation itself does not exceed, to maintain that a whole is in reality any thing different from its component parts: and all nature rises up in confutation of an assertion so monstrous and extravagant. To affirm that perception can arise from any combination of impercipient particles, is as truly ridiculous, as to affirm that

that a combination of the ſeven primary colours with the four cardinal virtues may conſtitute a planet. It is equivalent to an aſſertion, that an epic poem might be compoſed of parallelograms, cones, and triangles. In a word, it is an abſurdity not leſs real, and little leſs obvious, than that of the blind man who thought that the idea of a ſcarlet colour reſembled the ſound of a trumpet."

If a matter be taken in the common aceptation, to be a ſolid, extended, and inert ſubſtance, this reaſoning for the immateriality of the ſentient principle in man appears to us to have the force of demonſtration, which no difficulties or partial objections, ariſing from

235 Reply by the materialiſts ſhown

our inability to conceive the band of union between two ſuch heterogeneous ſubſtances as mind and body, can ever weaken, and far leſs overturn. But the modern materialiſts deny that matter is either ſolid or inert. "All thoſe facts (ſay they) which led philoſophers to ſuppoſe that matter is impenetrable to other matter, later and more accurate obſervations have ſhown to be owing to *ſomething elſe* than ſolidity and impenetrability, viz. a *power of repulſion*, which for that reaſon they would ſubſtitute in its place. The property of *attraction* or repulſion (ſays Dr Prieſtley) appears to me not to be properly what is *imparted* to matter, but what really *makes it to be what it is*; inſomuch, that without it, it would be nothing at all; and as other philoſophers have ſaid,—'Take away ſolidity, and matter vaniſhes,' ſo I ſay, 'Take away attraction and repulſion, and matter vaniſhes." If this be admitted, the ingenious author hopes that we ſhall not conſider matter with that contempt and diſguſt with which it has generally been treated, there being no thing in its real nature that can juſtify ſuch ſentiments reſpecting it.

We know not why, upon any hypotheſis, mat-

236 to be abſurd.

ter ſhould be viewed with contempt and diſguſt.— Whether penetrable or impenetrable, every conſiſtent theiſt conſiders it as one of the creatures of God, perfectly fitted to anſwer all the purpoſes for which it was intended: but were it really deſtitute of ſolidity, and endowed with the powers of attraction and repulſion, we ſhould ſtill be obliged to conſider it as incapable of the powers of ſenſation and thought. If we have any notion at all of what is meant by centres of attraction and repulſion (of which indeed we are far from being confident), it appears to us to be intuitively certain, that nothing can be the reſult of any poſſible combination of ſuch centres, but new and more enlarged ſpheres of attraction and repulſion. But ſurely conſciouſneſs, ſenſation, and will, are as different from attraction and repulſion, as a cube is from the ſound of a trumpet, or as the ſenſations of a felon in the agonies of death are from the attraction of the rope by which he is hanged. If this be admitted, and we are perſuaded it will be denied by no man whoſe underſtanding is not clouded by an undue attachment to paradoxes, the ſentient principle cannot poſſibly be matter: for if, when the powers of attraction and repulſion are taken away, matter vaniſhes; and if conſciouſneſs and ſenſation are not attraction and repulſion; it is not more evident that three and two are not nine, than that the ſubſtance which attracts and repels cannot be that which is conſcious and percipient.

Locke, who was certainly no materialiſt, as he repeatedly affirmed, and indeed demonſtrated, that thought could never be the reſult of any combinations of figure, magnitude, and motion, was yet of opinion, that God by his almighty power might endow ſome

237 Locke's opinion haſty and ill-founded,

ſyſtems of matter with the faculties of thinking and willing. It is always with reluctance than we controvert the opinions of ſo great a man; and it is with ſome degree of horror that we venture in any caſe to call in queſtion the power of Omnipotence.— But Omnipotence itſelf cannot work contradictions; and it appears to us nothing ſhort of a contradiction, to ſuppoſe the individual power of perception inhering in a ſyſtem which is itſelf extended and made up of a number of ſeparate and diſtinct ſubſtances. For let us ſuppoſe ſuch a ſyſtem to be ſix feet long, three feet broad, and two feet deep (and we may as well ſuppoſe a ſyſtem of theſe dimenſions to be percipient, as one that is ſmaller), then it is plain, that every idea muſt be extended, and that part of it muſt be in one place, and part in another. If ſo, the idea of a ſquare inch will be ſix feet long, three feet broad, and two feet deep; and what is ſtill harder to be digeſted, the ſeveral parts of this idea will be at a great diſtance from each other, without any bond of union among them. The being which apprehends one extremity of the idea, is, by the ſuppoſition, ſix feet diſtant from the being which apprehends the other extremity; and though theſe two diſtinct beings belong to one ſyſtem, they are not only ſeparable, but actually ſeparated from each other as all the particles of matter are. What is it then that apprehends as *one* the whole of this extended idea? Part of it may be apprehended by one particle of matter, and part of it by another; but there is nothing which apprehends, or can apprehend, the whole. Perhaps it will be ſaid, the power of apprehenſion is not divided into parts, but is the power of the one ſyſtem, and therefore apprehends at once the whole idea. But a power or faculty cannot be ſeparated from its ſubject, power which inheres in nothing being confeſſedly impoſſible; and a material ſyſtem is not *one ſubject* in which any individual power or faculty can inhere. There muſt, therefore, be united to the ſyſtem ſome *one* being, which is the ſubject of thought, and which is unextended as well as indiviſible. This, we ſay, follows undeniably. For, let us ſuppoſe, that an extended being without ſeparable parts is poſſible, and that ſuch a being is percipient; it is obvious, that the whole of any one of its perceptions could not be in one place. Now, though we ſhould grant to Dr Prieſtley and other materialiſts, that every idea of an extended ſubſtance has itſelf three dimenſions, and is incorporated and commenſurate with the whole percipient ſyſtem; what, upon this ſuppoſition, ſhall we think of conſciouſneſs and of the perception of truth? Is conſciouſneſs or truth extended? If ſo, one ſide or ſuperfices of conſciouſneſs, or of a truth, may be greater or leſs than another, above or below, to the right or to the left; and it will be very proper and philoſophical to ſpeak of the length, breadth, and depth, of conſciouſneſs or of truth. But ſurely to talk of the place, or the extenſion of theſe things, is as abſurd as to talk of the colour of ſound, or the ſound of a triangle; and we might as well ſay, that conſciouſneſs is green or red, as that it is an ell or an inch long;

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long; and that truth is blue, as that it has three dimensions.

This reasoning is somewhat differently stated by Cudworth; who observes, that if the soul be an extended substance, "it must of necessity be either a physical point (i. e. the least extension possible, if there be any such least extension), or else it must consist of more such physical points joined together. As for the former of these, it is impossible that *one single atom*, or *smallest point* of extension, should be able to perceive distinctly all the *variety* of things, i. e. take notice of all the *distinct* and *different* parts of an *extended object*, and have a *description* or *delineation* of the whole of them upon itself (for that would be to make it the least, and not the least, possible extension at the same time: Besides, to suppose every soul to be but one *physical point*, or the smallest *possible extension*, is to suppose such an essential difference in matter or extension, as that some of the *points* thereof should be *naturally* devoid of all *life*, *sense*, and *understanding*; and others again, naturally *sensitive* and *rational*. And even should this absurdity be admitted, it would yet be utterly inconceivable how there should be *one*, and *but* one, *sensitive* and *rational* atom in every man; how this atom of so *small* dimensions should actuate the whole system; and how it should constantly remain the same from infancy to old age, whilst all the other parts of the system transpire perpetually, and are succeeded by new matter (H).

238 because the sentient being cannot be extended.

"But if, according to the second hypothesis, souls be extended substances consisting of many points one without another, and all concurring in every sensation; then must every one of these points perceive either a *point* only of the object, or else the *whole*. Now, if every *point* of the *extended soul* perceives only a *point* of the *object*, then is there no *one thing* in us that perceives the whole, or that can compare one part of the object with another. On the other hand, if every *point* of the *extended soul* perceive the *whole object* at once, then would there be *innumerable perceptions* of the same object in every sensation; as many, indeed, as there are points in the extended soul.—And from both these suppositions it would alike follow, that no man is *one single percipient* or person, but that in every man there are innumerable distinct *percipients* or *persons*; a conclusion directly contrary to the infallible evidence of consciousness (I)."

Cogent as these arguments for the immateriality of

(H) Should it be said, that this essential difference between the atoms of matter is not fortuitous; that some of them are created intelligent for the express purpose of animating systems of others which are unintelligent; and that these intelligent atoms do not operate upon the systems with which they are united, by the *vis inertiæ*, *solidity*, or *extension*, of matter, but by the energies of understanding and will: Should this (we say) be alleged, surely it may be asked, for what purpose they are conceived to have the quality of extension? It is evidently of no use; and it has been already shown, and shall be more fully shown afterwards, that by our notions of consciousness and understanding, we are so far from being led to suppose the subject of these powers extended, that we cannot suppose any relation whatever between them and extension. But if these intelligent atoms be divested of their quality of extension, they will be transformed from matter to mind, and become the very things for the existence of which we plead.

(I) As the materialists endeavour to prejudice the public against the motion of an unextended soul, by representing it as a fiction of *Des Cartes*, altogether unknown to the ancients, it may not be improper to give our readers an opportunity of judging for themselves how far this representation is just.—*Plotinus*, reasoning about the nature of the soul from its energies of sensation, expresses himself in these words:—ειτι μελλει αισθανεσθαι τινος, ἑν αυῖο δει ειναι, και τω αυῖω πανῖος αν̔ιλαμϐανεσθαι και ει δια πολλων αισθηῖηριον πλειω τα εισιονῖα, ἡ πολλαι περι ἑν ποιοτητης και δι ἑνος ποικιλον, ὁιον προσωπον· ου γαρ αλλο μεν ρινος αλλο δε οφθαλμων, αλλα ταυῖον ὁμου πανῖων· και ει το μεν δι ομματων το δε δι ακοης, εν τι δει ειναι εις ὁ αμφω· ἡ πως αν ειποι ὁῖι ἑῖερα ταυῖα, μη εις το αυῖο ὁμου των αισθησεων ελθον των. "That which perceives in us, must of necessity be one thing, and by one and the same indivisible perceive all; and that whether they be more things entering through several organs of sense, as the many qualities of one substance, or one various and multiform thing, entering through the same organ, as the countenance and picture of a man. For it is not one thing in us that perceives the nose, and another thing the eyes; but it is one and the self-same thing that perceiveth all. And when one thing enters through the eyes, another through the ears, both these also must of necessity come at last to one indivisible; otherwise they could not be compared together, nor one of them be affirmed to be different from the other, the several ideas of them meeting nowhere in one place." Pursuing the same argument, and having observed, that if what perceiveth in us be extended, then one of these three things must of necessity be affirmed, that either every part of this extended soul perceives a part only of the object, or every part of it the whole object; or else, that all comes to some one point, which alone perceives both the several parts of the object and the whole: he observes of the first of these suppositions,—μεγεθει ονῖι τουῖω, ξυμμεριζοιῖο αν· ωσῖε αλλο αλλου μερος, και μηδενα ἡμων ὁλου του αισθηῖου αν̔ιληψιν εχειν· ὡσπερ αν ει εγω μεν αλλου· συ δε αλλου αισθοιο: "If the soul be a magnitude, then must it be divided, together with the sensible object, so that one part of the soul must perceive one part of the object, and another another; and nothing in it, the whole sensible; just as I should have the sense of one thing, and you of another." Of the second supposition he writes in this manner: ει δε ὁτιουν πανῖος αισθησεῖαι· εις απειρα διαιρεισθαι του μεγεθους πεφυκοῖος απειρους και αισθησεις καθ᾽ εκασῖον αισθηῖον συμϐησεῖαι γιγνεσθαι ἑκασῖω ὁιον του αυῖου απειρους εν τω ἡγεμονουνῖι ἡμων εικονας: "But if every part of the extended soul perceive the whole sensible object, since magnitude is infinitely divisible, there must be in every man infinite sensations and images of one object."—And as for the third and last part of this disjunction, Plotinus by asserting the infinite divisibility of body, here shows that the supposition of any one physical point is in itself an absurdity. But if it were not, he agrees with Aristotle

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of the ſentient principle appear to be, they have been lately treated with the moſt ſovereign contempt by a writer who profeſſes to be a diſciple of Dr Prieſtley's, but who ſeems not to have learned the modeſty or the candour of his maſter. Dr Prieſtley labours to prove, that to account for the phenomena of perception and volition, &c. it is not neceſſary to ſuppoſe an immaterial principle in man. Mr Cooper with greater boldneſs affirms, and undertakes to demonſtrate with all the parade of mathematical preciſion *, that ſuch a principle is impoſſible. Though the authority of this philoſopher in ſuch inquiries as depend not immediately upon the retort and the furnace, is certainly not great, he yet utters his dogmas with ſuch confidence, that it may not be improper to examine the chief arguments upon which they reſt.

* *Tracts Ethical, Theological, and Political*, vol. i.

239 An attempt to prove the impoſſibility of immaterial ſubſtance

"Suppoſe (ſays he) the ſoul to have no common property with matter; then, no thing can act upon any other but by means of ſome common property. Of this we have not only all the proof that induction of known and acknowledged caſes can furniſh, but that additional proof alſo which ariſes from the impoſſibility of conceiving how the oppoſite propoſition *can* be true. But by the ſuppoſition, the ſoul has no property in common with matter; and therefore the ſoul cannot act upon matter. But by the ſuppoſition of every ſyſtem of immaterialiſm (except thoſe of Malebranche, Berkeley, and Leibnitz), it is deemed an eſſential property of the ſoul, that it acts upon the body, or upon matter; therefore the ſoul can and cannot act upon matter at the ſame time, and in the ſame reſpect. But this is a contradiction in terms; and as two contradictions cannot both be true at the ſame time, the ſuppoſition of the exiſtence of an immaterial ſoul cannot be true; that is, the ſoul does not exiſt."

240 ſhown to be futile.

This reaſoning, the reader will obſerve, is carried on with all the pomp of mode and figure. The propoſitions hang upon each other like the ſeveral ſteps of an algebraic proceſs: but as in ſuch proceſſes one error unwarily admitted produces a falſe reſult, ſo in demonſtrative reaſonings one unſound argument admitted into the premiſes is neceſſarily productive of error in the concluſion. When the author affirms, "that no thing can act upon any other but by means of ſome common property," he affirms without the ſhadow of proof what is certainly not ſelf-evident. He ſays, indeed, that of this we have all the proof that induction of known and acknowledged caſes can furniſh; but unleſs conſciouſneſs be calculated to deceive us, this is unqueſtionably a miſtake. Matter, he repeatedly affirms, has no other properties than thoſe of attraction and repulſion: but a man moves his arm by a mere energy of will; and therefore, according to this demonſtrator, an energy of will muſt be either material attraction or material repulſion. If ſo, it is reaſonable to conclude, that when a man draws his hand towards his head, the centre of his brain exerts its power of *attraction*; and that when he extends his arm at full length before him, the ſame centre exerts its power of *repulſion*. We beg pardon of our readers for detaining them one moment upon ſuch abſurdities as theſe: yet we cannot diſmiſs the argument without taking the liberty to aſk our all-knowing author, How it comes to paſs that the ſame centre ſometimes attracts and ſometimes repels the ſame ſubſtance at the ſame diſtance; nay, that it both attracts and repels ſubſtances of the ſame kind, at equal diſtances, and at the very ſame inſtant of time? This muſt be the caſe, when a man puts one hand to his head, and thruſts another from him; and therefore, if theſe operations be the effect of attraction and repulſion, it muſt be of attraction and repulſion to which induction of known and acknowledged caſes furniſhes nothing ſimilar or analogous, i. e. of ſuch attraction and repulſion as, according to Mr Cooper's mode of reaſoning, does not exiſt. The truth is, that we are not more certain that we ourſelves exiſt, than that an energy of will is neither attraction nor repulſion; and therefore, unleſs all matter be endued with will, it is undeniable, that, whatever be the ſubſtance of the ſoul, one thing acts upon another by a property not common to them both. In what *manner* it thus acts, we pretend not to know: but our ignorance of the *manner* of any operation is no argument againſt the *reality* of the *operation itſelf*, when we have for it the evidence of conſciouſneſs and daily experience; and when the author ſhall have explained to general ſatisfaction how material centres attract and repel each other at a diſtance, we ſhall undertake to explain how one thing acts upon another with which it has no common properties.

241 A ſecond attempt of the ſame kind

Suſpicious, as it ſhould ſeem, that this reaſoning has not the complete force of mathematical demonſtration, the author ſupports his opinion by other arguments. "Whatever we know (ſays he), we know by means of its properties, nor do we in any caſe whatever certainly know any thing but theſe; and we infer in all caſes the exiſtence of any thing which we ſuppoſe to exiſt from the exiſtence of its properties. In ſhort, our idea of any thing is made up of a combination of our ideas of its properties. Gold is heavy, ductile, tenacious, opaque, yellow, ſoluble in *aqua regia*, &c. Now, let any one ſuppoſe for an inſtant that gold is deprived of all theſe, and becomes neither heavy, ductile, tenacious, opaque, yellow, ſoluble, &c. what remains, will it be gold? Certainly not. If it have other properties, it is another ſubſtance. If it have no properties remaining, it is nothing. For nothing is that which hath no properties. Therefore, if any thing loſe all its properties, it becomes nothing; that is, it loſes its exiſtence. Now, the exiſtence of the ſoul is inferred, like the exiſtence of every thing elſe, from its ſuppoſed properties, which are the phenomena of thinking, ſuch as perception, recollection, judgement, and volition. But in all caſes of *perfect* ſleep, of the operation of a ſtrong narcotic, of apoplexy, of ſwooning, of drowning where the vital powers are not extinguiſhed, of the effects of a violent blow on the back

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Ariſtotle in aſking πως τω αμιρει το μεριστον·—thereby plainly indicating, that the ſentient principle is totally ſeparated from extenſion, and can neither be conſidered as extended like a ſuperficies or ſolid, nor unextended as a phyſical point.

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back part of the head, and all other leipothymic affections, there is neither perception, recollection, judgement, nor volition; that is, all the properties of the soul are gone, are extinguished. Therefore, the soul itself loses its existence for the time. If any man shall say, that these properties are only *suspended* for the time, I would desire him to examine what idea he annexes to this suspension; whether it be not neither more nor less than that *they are made not to exist for the time*. Either no more is meant, or it is contradictory to matter of fact; and moreover, if more *be* meant, it may easily be perceived to involve the archetypal existence of abstract ideas, and to contradict the axiom, *impossibile est idem esse et non esse*."

242 shown to be equally weak.

For the benefit of short-sighted inquirers, it is to be wished that the author had favoured the public with this *proof* which might have been so easily brought; for we can discern no connexion whatever between the suspension of the exercise of the powers of the mind, and the archetypal existence of abstract ideas, or the absurd proposition that it is *possible for the same thing to be and not to be*. We think, however, that we understand enough of this reasoning which he has given us to be able to pronounce with some confidence that it is nothing to the purpose. For, in the *first* place, We beg leave to observe, that between the properties of gold and the powers of thinking, &c. there is no similarity; and that what may be true when affirmed of the one, may be false when affirmed of the other. The powers of the mind are all more or less active; the enumerated properties of gold are all passive. We know by the most complete of all evidence, that the exercise of power *may be* suspended, and the power itself remain unimpaired; but to talk of the suspension of the energies of what was never energetic, if it be not to contradict the axiom *impossibile est idem esse et non esse*, is certainly to employ words which have no meaning. Yet even this argument from the properties of gold might have led the author to suspect that something else may be meant by the suspension of the exercise of powers, than that *those powers are made not to exist for the time*. In a room perfectly dark gold is not yellow; but does it lose any of its essential properties, and become a different substance, merely by being carried from light to darkness? Is a man while in a dark room deprived of the faculty of sight, and one of the powers of his mind made not to exist for the time? The author will not affirm that either of these events takes place. He will tell us that gold exhibits not its yellow appearance, merely because the proper medium of light passes not from it to the eye of the percipient, and that it is only for want of the same medium that nothing is seen by us in perfect darkness. Here, then, by his own confession, is a power of the mind, and a property of an external object, both suspended in their energies, without being annihilated; and no proof has yet been brought that all the powers of the mind may not in the same manner be suspended in their energies without being made not to exist. As light is necessary to vision, but is not itself either the thing which sees or the thing which is seen; so may the brain be necessary to the phenomena of thinking, without being either that which thinks, or that which is thought upon: and as actual vision ceases when light is withdrawn, though the eye and the object both continue to exist; so may the *energy* of thinking cease when the brain is rendered unfit for its usual office, though the being which thinks, and the power of thought, continue to exist, and to exist unimpaired. That this is actually the case every man must be convinced who believes that in thinking he exerts the same powers to-day that he exerted yesterday; and therefore our author's second demonstration of the nonexistence of mind is, like his first, founded upon assertions which cannot be granted.

243 A third attempt of the same kind

Another of these pretended demonstrations is as follows: "If the soul exist at all, it must exist somewhere; for it is impossible to frame to one's self an idea of any thing existing, which exists nowhere. But if the soul exist somewhere, by the terms it occupies space, and therefore is extended; but whatever has extension, has figure in consequence thereof. The soul then, if it exist, hath the properties of extension and figure in common with matter. Moreover, by the supposition of every immaterial hypothesis (except those of Malebranche, Berkeley, and Leibnitz), it acts upon body, i. e. upon matter; that is, it attracts and repels, and is attracted and repelled, for there is no conceivable affection of matter but what is founded on its properties of attraction and repulsion; and if it be attracted and repelled, its reaction must be attraction and repulsion. The soul then has the properties of extension, figure, attraction and repulsion, or solidity. But these comprise every property which matter, as such, has ever been supposed to possess. Therefore the soul is matter, or material. But by the supposition it is immaterial; therefore it does not exist. For nothing can exist whose existence implies a contradiction."

244 shown to confute itself.

Mr Cooper, we see, still proceeds in the direct road of mathematical demonstration; but in the present instance we beg leave to stop him in the very beginning of his course, and to ask *where* the universe exists? When he shall have given such an answer to this question as men of common sense may be able to comprehend, we may perhaps attempt to tell him where an unextended soul exists. If this demonstration be not a collection of words without meaning, the existence of space as a real thing is taken for granted. Space, therefore, has extension, and of course figure; but we believe Mr Cooper will find some difficulty in ascertaining the figure of infinite space. The mind certainly acts upon body. For this we have the evidence of consciousness and experience; but we have no evidence whatever that it must therefore attract and repel, and be attracted and repelled. It has been already observed, that the mind, whatever be its substance, acts upon the body by energies of will. What these are, every man knows with the utmost certainty and precision; whilst we may venture to assert, that no man knows precisely what corpuscular attraction and repulsion are, supposing the existence of such powers to be possible. When we speak of attraction and repulsion, we have some obscure notion of bodies acting upon each other at a distance; and this is all that we know of the matter. But when we think of an energy of the human will, the idea of distance neither enters nor can enter into our notion of such an energy. These are facts which we pretend not to prove by a mathematical or a chemical process. Every man must be convinced

convinced of their truth by evidence more complete than any proof, viz. immediate conſciouſneſs of his own thoughts and volitions. This being the caſe, we may turn Mr Cooper's artillery againſt himſelf, and, becauſe mind acts upon body by powers different from attraction and repulſion, argue that body neither attracts nor repels; and were it true, as it is certainly falſe, that nothing could act upon another but by means of ſome property common to both, we might infer that every atom of matter is endowed with the powers of volition and intelligence, and by conſequence that every man is not one but ten thouſand conſcious beings, a concluſion which our philoſopher ſeems not inclined to admit.

245 Objections to the doctrine of immaterialiſm ſtated and anſwered.

Having finiſhed his *demonſtrations*, the author ſtates other objections to the doctrine of immaterialiſm, which, as they are not his own nor new, have greater weight. "It appears no more than reaſonable (ſays he), that if the doctrine of materialiſm be rejected as inadequate to explain the phenomena, theſe latter ſhould at leaſt be explained in ſome manner or other better upon the *ſubſtituted* than the *rejected* hypotheſis; ſo that it is reaſonable to require of an immaterialiſt that his ſuppoſition of a diſtinct ſoul ſhould explain the *rationale* of the phenomena of thinking. But, ſtrange to ſay, ſo far from attempting to explain theſe phenomena on the immaterial hypotheſis, it is acknowledged on all hands that even on this hypotheſis the phenomena are inexplicable." This objection it would certainly be no difficult taſk to obviate; but from that trouble, ſmall as it is, we are happily exempted by the objector. "I would have it underſtood (ſays he), that no materialiſt ever undertook to ſay *how* perception reſults from our organization. What a materialiſt undertakes to aſſert is, that perception, *whatever* it be, or *however* it reſults from, does actually reſult from our organization." According to Mr Cooper, then, the *rationale* of thinking is equally inexplicable by materialiſts and immaterialiſts; and the truth is, that we know the *rationale* of hardly any one operation in nature. We ſee that the ſtroke of a racket produces motion in a billiard ball; but how it does ſo, we believe no man can ſay. Of the fact, however, we are certain; and know that the motion is produced by ſome power, about the effects of which we can reaſon with preciſion. In like manner we know with the utmoſt certainty, that we ourſelves have the powers of perception and volition; and that theſe powers cannot be conceived as either an ell or an inch long. How they reſult from the mutual agency of an immaterial and material ſubſtance upon each other, we are indeed profoundly ignorant; but that ſuch is the fact, and that they are not the reſult of mere organization, we muſt neceſſarily believe, ſo long as it is true that the power of the entire ſyſtem is nothing more than the ſum or aggregate of the powers of all its parts. The immaterial hypotheſis contains in it ſomething inexplicable by man: The material hypotheſis likewiſe contains, by the confeſſion of its advocates, ſomething that it equally inexplicable; and is over and above burdened with this contradiction, that the whole is ſomething different from all its parts. It is therefore *no* "ſingular phenomenon in literary hiſtory, that one hypotheſis ſhould be rejected as inadequate to account for appearances, and that the hypotheſis ſubſtituted ſhould, even by the acknowledgment of its abettors, be ſuch as not only not to explain the *rationale* of the appearances, but from the nature of it, to preclude all hopes of ſuch an explanation." This is exactly the caſe with reſpect to a *vacuum* in aſtronomy. That hypotheſis does not in the leaſt tend to explain the rationale of the motions of the planets; but yet it muſt be admitted in preference to a *plenum*, becauſe upon this laſt hypotheſis motion is impoſſible.

246 Whether as many things may be aſſerted of the ſoul as of the body.

"Suppoſing the exiſtence of the ſoul, it is an unfortunate circumſtance (ſays Mr Cooper), that we cannot properly aſſert poſitively any thing of it at all." Were this the caſe, it would indeed be a very unfortunate circumſtance; but can we not aſſert poſitively as many things of the ſoul as we can of the body? Can we not ſay with as much propriety and certainty, that the ſoul has the powers of perception and volition, &c. as that the body is ſolid and extended, or as that matter has the powers of attraction and repulſion? We know perfectly what perception and volition are, though we cannot have *ideas* or mental images of them; and if our author knows what attraction and repulſion are, we believe he will not pretend to have of them ideas entirely abſtracted from their objects. "But granting the ſoul's exiſtence, it may be aſked (ſays he), Of what uſe is an hypotheſis of which no more can be aſſerted than its exiſtence?" We have juſt obſerved, that much more can be aſſerted of the ſoul than its exiſtence, viz. that it is ſomething of which perception and will are properties; and he himſelf aſſerts nothing of matter but that it is ſomething of which attraction and repulſion are properties.

"This ſoul, of which theſe gentlemen (the immaterialiſts) are conſcious, is immaterial eſſentially. Now, I deny (ſays our author), that we can have any idea at all of a ſubſtance purely immaterial." He elſewhere ſays, that nothing can exiſt which is not extended, or that extenſion is inſeparable from our notions of exiſtence. Taking the word *idea* in its proper ſenſe, to denote that appearance which external objects make in the imagination, it is certainly true that we can have no *idea* of an immaterial ſubſtance; but neither have we, in that ſenſe, any idea of matter abſtracted from its qualities. Has Mr Cooper any *idea* of that which attracts and repels, or of attraction and repulſion, abſtracted from their objects? He may, perhaps, have, though we have not, very adequate ideas of bodies acting upon each other at a diſtance; but as he takes the liberty to ſubſtitute aſſertions for arguments, we beg leave in our turn to aſſert, that thoſe ideas neither are, nor can be, more clear and adequate than our notion of perception, conſciouſneſs, and will, united in one being.

247 Extenſion not inſeparable from all notions of exiſtence.

That extenſion is no otherwiſe inſeparable from our notions of exiſtence than by the power of an early and perpetual aſſociation, is evident from this circumſtance, that, had we never poſſeſſed the ſenſes of ſight and touch, we never could have acquired any idea at all of extenſion. No man, who has thought on the ſubject, will venture to affirm, that it is abſolutely impoſſible for an intelligent being to exiſt with no other ſenſes than thoſe of ſmell, taſte, and hearing. Now it is obvious that ſuch a being muſt acquire ſome notion of exiſtence

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istence from his own consciousness: but into that notion extension could not possibly enter; for neither sounds, tastes, smells, nor consciousness, are extended; and it is a fundamental article of the materialists creed, that all our ideas are relicts of sensation. Since then existence may be conceived without extension, it may be inferred that they are not inseparable from each other; and since cogitation cannot be conceived with extension, we may reasonably conclude, that the being which thinks is not extended.

Mr Cooper indeed, with his master, talks of extended ideas and extended thoughts: but we must assert, in the words of Cudworth, that "we cannot conceive a *thought* to be of such a certain *length*, *breadth*, and *thickness*, measurable by *inches*, *feet*, and *yards*; that we cannot conceive the *half*, or *third*, or *twentieth* part of a thought; and that we cannot conceive every thought to be of some determinate *figure*, such as *round* or *angular*, *spherical*, *cubical*, *cylindrical*, or the like. Whereas if extension were inseparable from existence, *thoughts* must either be mere *nonentities*, or extended into *length*, *breadth*, and *thickness*; and consequently all truths in us (being nothing but complex thoughts) must be long, broad, and thick, and of some determinate figure. The same must likewise be affirmed of volitions, appetites, and passions, and of all other things belonging to cogitative beings; such as knowledge and ignorance, wisdom and folly, virtue and vice, &c. that these are either all of them absolute *nonentities*, or else extended into three dimensions, and measurable not only by *inches* and *feet*, but also by solid measures, such as *pints* and *quarts*. But if this be absurd, and if these things belonging to soul and mind (though doubtless as great realities at least as the things which belong to body) be *unextended*, then must the substances of souls or minds be themselves unextended, according to that of Plotinus, νους ου διασ͂ας αφ ἑαυτου, and therefore the human soul cannot be material."

248 That the human mind cannot exert its faculties but in union with some corporeal system, an opinion probable and

Mr Cooper employs many other arguments to prove the materiality of the sentient principle in man; but the force of them extends no farther than to make it in the highest degree probable, that the mind cannot exert its faculties but in union with some organized corporeal system. This is an opinion which we feel not ourselves inclined to controvert; and therefore we shall not make any particular remarks upon that part of our author's reasonings. That an immaterial and indiscerptible being, such as the soul, is not liable to be *dissolved* with the body, is a fact which cannot be controverted: for what has no parts can perish only by *annihilation*; and of annihilation the annals of the world afford no instance. That an immaterial being, endowed with the powers of perception and volition, &c. *may be capable* of exerting these powers in a state of separation from all body, and that at least one immaterial Being does actually so exert them, or other powers analogous to them, are truths which no man whose arrogance does not surpass his judgement will venture to deny; but the question at present between the most rigid immaterialists and their opponents, is, whether there be ground to think that the human soul is such a being?

Now, when Mr Baxter and his followers confidently affirm, that human perception must *necessarily* subsist after the dissolution of the present mortal and perishable system; and that the soul, when disencumbered of *all body*, will have its faculties greatly *enlarged*; they affirm what to us appears incapable of proof. That a disembodied soul *may* perceive, and think, and act, and that its powers of intellection *may* have a wider range than when they were circumscribed by a corporeal system, which permitted their action upon external objects only through five organs of sense, is certainly *possible*; and the argument by which the materialists pretend to prove it *not* possible, is one of the most contemptible sophisms that ever disgraced the page of philosophy. To affirm, that because our intellectual powers, in their embodied state, seem to decay with the system to which they are united, the mind, when set free, must therefore have no such powers at all, is equally absurd as to say, that because a man shut up in a room which has but one window sees objects less and less distinctly as the glass becomes more and more dimmed, he must in the open air be deprived of the power of vision. But because the human soul *may*, for any thing that we see to the contrary, subsist, and think, and act, in a separate state, it does not therefore necessarily follow that it *will* do so; and every thing that we know of its nature and its energies leads us to think, that without some kind of body by which to act as by an instrument, all its powers would continue dormant. There is not the shadow of a reason to suppose that it existed and was conscious in a prior state; and as its memory at present unquestionably depends upon the state of the brain, there is all the evidence of which the case will admit, that if it should subsist in a future state divested of all body, though it might be endowed with new and enlarged powers of *perception*, it could have no *recollection* of what it did and suffered in *this world*, and therefore would not be a fit object either of reward or of punishment. This consideration has compelled many thinking men, both Pagans and Christians, to suppose that at death the soul carries with it a fine material vehicle, which is its immediate sensorium in this world, and continues to be the seat of its recollection in the next. Such, we have seen, was the opinion of Mr Wollaston and Dr Hartley; it was likewise the opinion of Cudworth and Locke, who held that the Supreme Being alone is the only mind wholly separated from matter; and it is an opinion which even Dr Clarke, one of the ablest advocates for immaterialism, would not venture positively to deny.

Nor is this opinion peculiar to a few moderns. Cudworth, after giving a vast number of quotations from Pythagoreans and Platonists, which prove to a demonstration that they held the Deity to be the only mind which perceives and acts without the instrumentality of matter, observes, "from what hath been said, it appeareth, that the most ancient assertors of the incorporeity and immortality of the human soul, yet supposed it to be always conjoined with some body." Thus *Hierocles* plainly: ἡ λογικη ουσια συμφυες εχουσα σωμα, ὁῦω παρα του δημιουργου εις το ειναι πχρηλθεν, ως μητε το σωμχ ειναι αῦην, μητε ανευ σωμᾶος· αλλ αῦην μεν ασωματον, αποπερα τουσθαι δε εις σωμα το ὁλον αῦης ειδος. *The rational nature having always a kindred body, so proceeded from the demiurgus, as that neither itself is body, nor yet can it be without body; but though itself be incorporeal, yet its whole form is terminated in a body.* 249 ancient.

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body. Agreeably to this the definition which he gives of a man is, ψυχη λογικη μεΐα συμφους αθανατου σωμαΐος, *a rational ſoul, together with a kindred immortal body;* and he affirms, that our preſent animated terreſtrial body, or mortal man, is nothing but ἔιδωλον ανθρωπου, *the image of the true man*, or an acceſſion from which it may be ſeparated. Neither does he affirm this only of human ſouls, but alſo of all other rational beings whatſoever below the Supreme Deity, that they always naturally actuate ſome body. Wherefore a demon or angel (which by *Hierocles* are uſed as ſynonymous words), is alſo defined by him after the ſame manner, ψυχη λογικη μεΐα φωΐεινου σωμαΐος, *a rational ſoul, together with a lucid body*. And accordingly *Proclus* upon *Plato's Timæus affirmeth*, παντα δαιμονα των ημεΐερων κρεΐονα ψυχων, και νοεραν εχειν, ψυχην, και οχημα αιθεριον: *That every demon, ſuperior to human ſouls, hath both an intellectual ſoul and an ethereal vehicle, the entireneſs thereof being made up or compounded of theſe two things.* So that there is hardly any other difference between demons or angels, and men, according to theſe philoſophers, but only this, that the former are lapſable into aërial bodies only, and no further; but the latter into terreſtrial alſo. Now, *Hierocles* poſitively affirms this to have been the true cabala, and genuine doctrine of the ancient Pythagoreans, entertained afterwards by Plato: και τουτο των Πυθαγορειων ἠν δογμα, ὁ δε Πλατων υσΐερον εξεφηνεν, απεικασας ξυμφυτω δυναμει υποπΐερου ξευγους τε και ἡνιοχου; πασαν θειαν τε και ανθρωπινην ψυχην. *And this was the doctrine of the Pythagoreans, which Plato afterwards declared; he reſembling every both human and divine ſoul* (i. e. in our modern language, every created rational being) *to a winged chariot, and a driver or charioteer both together*: meaning by the chariot, an animated body; and by the charioteer, the incorporeal ſoul actuating it.

That this Pythagorean opinion of the Deity's being the only mind which thinks and acts without material organs was very generally received by the ancient Chriſtians, might be proved by a thouſand quotations: We ſhall content ourſelves with producing two from the learned *Origen*. "Solius Dei (ſaith this philoſophic father of the church), id eſt, Patris, Filii, et Spiritus Sancti, naturæ id proprium eſt, ut ſine materiali ſubſtantia, et abſque ulla corporeæ adjectionis ſocietate, intelligatur ſubſiſtere *." "Materialem ſubſtantiam opinione quidem et intellectu ſolum ſeparari, a naturis rationalibus, et pro ipſis, vel poſt ipſas affectam videri; ſed nunquam ſine ipſa eas vel vixiſſe, vel vivere: Solius namque Trinitatis incorporea vita exiſtere putabitur †." Should Mr Cooper and his friends aſk, What is the uſe of a ſoul which cannot act without the inſtrumentality of matter? or why we ſhould ſuppoſe the exiſtence of ſuch a ſubſtance? we beg leave, in our turn, to aſk theſe gentlemen, What is the uſe of a brain which cannot ſee without eyes? and why they ſhould ſuppoſe all our ſenſations to terminate in ſuch an internal ſyſtem, ſince the vulgar certainly ſuppoſe their ſenſations to ſubſiſt in their reſpective organs? How this ancient notion, which makes body ſo eſſential a part of man, is conſiſtent with the immortality of the human ſoul, we ſhall inquire in a ſubſequent chapter; in which we ſhall endeavour to aſcertain what kind of immortality we have reaſon to expect, and upon what evidence our expectation muſt reſt. Previous to this inquiry, however, it is neceſſary to enter upon another, which is of the firſt importance, and which every materialiſt has endeavoured to perplex; we mean that which concerns *perſonal identity*: for if, as has been often ſaid, no man is the ſame perſon two-days ſucceſſively, it is of no importance to us whether the ſoul be mortal or immortal.

* *Peri Archon*, lib. 1. cap. 6.

† Lib. 2. cap. 2.

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250 Perſonal identity,

Whether we are to live in a future ſtate, as it is the moſt important queſtion which can poſſibly be aſked, ſo it is the moſt intelligible one which can be expreſſed in language. Yet ſtrange perplexities have been raiſed about the meaning of that identity or ſameneſs of perſon, which is implied in the notion of our living now and hereafter, or indeed in any two ſucceſſive moments; and the ſolution of theſe difficulties hath been ſtranger than the difficulties themſelves. To repeat all that has been ſaid on the ſubject would ſwell this chapter to a diſproportionate bulk. We ſhall therefore content ourſelves with laying before our readers the ſentiments of Biſhop Butler, and the fancies and demonſtrations of the philoſopher of Mancheſter. We are induced to adopt this courſe, becauſe we think the illuſtrious biſhop of Durham has exhauſted the ſubject, by ſtating fairly the opinions which he controverts, and by eſtabliſhing his own upon a foundation which cannot be ſhaken, and which are certainly not injured, by the objections of Mr Cooper.

251 though it cannot be defined, eaſily underſtood and aſcertained by conſciouſneſs and memory.

"When it is aſked (ſays this philoſophical prelate *) in what perſonal identity conſiſts? the anſwer ſhould be the ſame as if it were aſked in what conſiſts ſimilitude or equality?—that all attempts to define would but perplex it. Yet there is no difficulty at all in aſcertaining the idea or notion: For as, upon two triangles being compared or viewed together, there ariſes to the mind the notion of ſimilitude; or, upon twice two and four, the notion of equality: ſo likewiſe, upon comparing the conſciouſneſs of one's ſelf or one's own exiſtence in any two moments, there as immediately ariſes to the mind the notion of perſonal identity. And as the two former compariſons not only give us the notions of ſimilitude and equality, but alſo ſhow us that two triangles are ſimilar, and that twice two and four are equal; ſo the latter compariſon not only gives us the notion of perſonal identity, but alſo ſhows us the identity of ourſelves in theſe two moments—the preſent, ſuppoſe, and that immediately paſt, or the preſent and that a month, a year, or twenty years paſt. In other words, by reflecting upon that which is myſelf now, and that which was myſelf twenty years ago, I diſcern they are not two, but one and the ſame ſelf.

* *Diſſertation 1ſt, ſubjoined to the Analogy of Religion*, &c.

252 Theſe, however, do not make perſonal identity.

"But though conſciouſneſs of what is preſent and remembrance of what is paſt do thus aſcertain our perſonal identity to ourſelves; yet, to ſay that remembrance makes perſonal identity, or is neceſſary to our being the ſame perſons, is to ſay that a perſon has not exiſted a ſingle moment, nor done one action, but what he can remember; indeed none but what he reflects upon. And one ſhould really think it ſelf-evident, that conſciouſneſs of perſonal identity preſuppoſes and therefore

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fore cannot constitute personal identity; any more than knowledge, in any other case, can constitute truth, which it presupposes.

"The inquiry, what makes vegetables the same in the common acceptation of the word, does not appear to have any relation to this of personal identity; because the word *same*, when applied to them and to person, is not only applied to different subjects, but is also used in different senses. When a men swears to the same tree, as having stood fifty years in the same place, he means only the same as to all the purposes of property and uses of common life, and not that the tree has been all that time the same in the strict philosophical sense of the word: For he does not know whether any one particle of the present tree be the same with any one particle of the tree which stood in the same place fifty years ago. And if they have not one common particle of matter they cannot be the same tree in the proper and philosophic sense of the word *same*; it being evidently a contradiction in terms to say they are, when no part of their substance and no one of their properties is the same; no part of their substance, by the supposition; no one of their properties, because it is allowed that the same property cannot be transferred from one substance to another: And therefore, when we say that the identity or sameness of a plant consists in a continuation of the same life, communicated under the same organization to a number of particles of matter, whether the same or not; the word *same*, when applied to life and to organization, cannot possibly be understood to signify what it signifies in this very sentence, when applied to matter. In a loose and popular sense, then, the life, and the organization, and the plant, are justly said to be the same, notwithstanding the perpetual change of the parts. But, in a strict and philosophical manner of speech, no man, no being, no mode of being, no any thing, can be the same with that with which it has indeed nothing the same. Now sameness is used in this latter sense when applied to persons. The identity of these, therefore, cannot subsist with diversity of substance.

253 What it is.

"The thing here considered, and demonstratively, as I think, determined, is proposed by Mr Locke in these words: *Whether it* (i. e. the same self or person) *be the same identical substance?* And he has suggested what is a much better answer to the question than that which he gives it in form: For he defines person *a thinking intelligent being*, &c. and personal identity, *the sameness of a rational being*; and then the question is, Whether the same rational being is the same substance? which needs no answer; because being and substance are in this place synonymous terms. The ground of the doubt, whether the same person be the same substance, is said to be this, that the consciousness of our own existence, in youth and in old age, or in any two joint successive moments, is not *the same individual action*, i. e. not the same consciousness, but different successive consciousnesses. Now it is strange that this should have occasioned such perplexities: for it is surely conceivable that a person may have a capacity of knowing some object or other to be the same now which it was when he contemplated it formerly; yet in this case, where, by the supposition, the object is perceived to be the same, the perception of it in any two moments cannot be one and the same perception. And thus, though the successive consciousnesses which we have of our own existence are not the same, yet are they consciousnesses of one and the same thing or object; of the same person, self, or living agent. The person of whose existence the consciousness is felt now, and was felt an hour or a year ago, is discerned to be, not two persons, but one and the same person; and therefore is one and the same.

254 False notions of personal identity

"Mr Locke's observations upon this subject appear hasty; and he seems to profess himself dissatisfied with suppositions which he has made relating to it. But some of those hasty observations have been carried to a strange length by others; whose notion, when traced and examined to the bottom, amounts, I think, to this: 'That personality is not a permanent but a transient thing: That it lives and dies, begins and ends, continually: That no one can any more remain one and the same person two moments together, than two successive moments can be one and the same moment: That our substance is indeed continually changing: but whether this be so or not, is, it seems, nothing to the purpose; since it is not substance, but consciousness alone, which constitutes personality; which consciousness, being successive, cannot be the same in any two moments, nor consequently the personality constituted by it *.'" Hence it must follow, that it is a fallacy upon ourselves to charge our present selves with any thing we did, or to imagine our present selves interested in any thing which befel us yesterday; or that our present self will be interested in what will befal us to-morrow; since our present self is not in reality the same with the self of yesterday, but another self or person coming in its room, and mistaken for it; to which another self will succeed to-morrow. This, I say, must follow: for if the self or person of to-day and that of to-morrow are not the same, but only like persons; the person of to-day is really no more interested in what will befal the person of to-morrow, than in what will befal any other person. It may be thought, perhaps, that this is not a just representation of the opinion we are speaking of; because those who maintain it allow that a person is the same as far back as his remembrance reaches: And indeed they do use the words *identity* and *same* person; nor will language permit these words to be laid aside. But they cannot, consistently with themselves, mean that the person is really the same: For it is self-evident, that the personality cannot be really the same, if, as they expressly assert, that in which it consists is not the same. And as, consistently with themselves, they cannot, so I think it appears they do not, mean that the person is *really* the same, but only that he is so in a fictitious sense, in such a sense only as they assert: for this they do assert, that any number of persons whatever may be the same person. The bare unfolding this notion, and laying it thus naked and open, seems the best confutation of it. However, since great stress is said to be put upon it, I add the following things:

255 overthrown.

"*First*, This notion is absolutely contradictory to that certain conviction, which necessarily and every moment rises within us, when we turn our thoughts upon ourselves, when we reflect upon what is past, and look forward to what is to come. All imagination, of a daily change of that living agent which each man calls himself

* *Answer to Dr Clarke's third Defence of his Letter to Mr Dodwell*, second edit p. 44. 56, &c.

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ſelf for another, or of, any ſuch change throughout our whole preſent life, is entirely borne down by our natural ſenſe of things. Nor is it poſſible for a perſon in his wits to alter his conduct with regard to his health or affairs, from a ſuſpicion that though he ſhould live to-morrow he ſhould not however be the ſame perſon he is to day.

"*Secondly*, It is not an *idea* or abſtract *notion*, or quality, but a being only, which is capable of life and action, of happineſs and miſery. Now all beings confeſſedly continue the ſame during the whole time of their exiſtence. Conſider then a living being now exiſting, and which has exiſted for any time alive: this living being muſt have done, and ſuffered, and enjoyed, what it has done, and ſuffered, and enjoyed, formerly (this living being, I ſay, and not another), as really as it does, and ſuffers, and enjoys, what it does, and ſuffers, and enjoys, this inſtant. All theſe ſucceſſive actions, ſufferings, and enjoyments, are actions, enjoyments, and ſufferings, of the ſame living being; and they are ſo prior to all conſiderations of its remembering or forgetting, ſince remembering or forgetting can make no alteration in the truth of paſt matter of fact. And ſuppoſe this being endued with limited powers of knowledge and memory, there is no more difficulty in conceiving it to have a power of knowing itſelf to be the ſame being which it was ſome time ago, of remembering ſome of its actions, ſufferings, and enjoyments, and forgetting others, than in conceiving it to know, or remember, or forget, any thing elſe.

"*Thirdly*, Every perſon is conſcious that he is now the ſame perſon or ſelf he was as far back as his remembrance reaches: ſince when any one reflects upon a paſt action of his own, he is juſt as certain of the perſon who did that action, namely himſelf (the perſon who now reflects upon it), as he is certain that the action was at all done. Nay, very often a perſon's aſſurance of an action having been done, of which he is abſolutely aſſured, ariſes wholly from the conſciouſneſs that he himſelf did it: and this he, perſon, or ſelf, muſt either be a ſubſtance or the property of ſome ſubſtance. If *he*, if perſon, be a ſubſtance; then conſciouſneſs that he is the ſame perſon, is conſciouſneſs that he is the ſame ſubſtance. If the perſon, or *he*, be the property of a ſubſtance, ſtill conſciouſneſs that he is the ſame property is as certain a proof that his ſubſtance remains the ſame, as conſciouſneſs that he remains the ſame ſubſtance would be; ſince the ſame property cannot be transferred from one ſubſtance to another.

"But though we are thus certain than we are the ſame agents, living beings, or ſubſtances, now, which we were as far back as our remembrance reaches; yet it is aſked, Whether we may not poſſibly be deceived in it? And this queſtion may be aſked at the end of any demonſtration whatever; becauſe it is a queſtion concerning the truth of perception by memory: and he who can doubt whether perception by memory can in this caſe be depended upon, may doubt alſo whether perception by deduction and reaſoning, which alſo include memory, or indeed whether intuitive perception itſelf, can be depended upon. Here then we can go no farther: for it is ridiculous to attempt to prove the truth of our faculties, which can no otherwiſe be proved than by the uſe or means of thoſe ſuſpected faculties themſelves."

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256 Objection to the foregoing reaſoning.

This reaſoning, which we believe will to moſt men appear unanſwerable, Mr Cooper hopes to overturn by the following obſervations*: "If all imagination of a daily change in us be borne down by our natural ſenſe of things, then (ſays he) does our natural ſenſe of things poſitively contradict known fact; for a daily, a momentaneous, change in us, i. e. in our bodies, does actually take place." True, a daily change in our bodies does take place, and ſo likewiſe does a daily change in our clothes; but ſurely no man was ever led by his natural ſenſe of things to ſuppoſe, that his limbs or external organs were the ſeats of ſenſation and will, any more than that his coat or his ſhoes were any real parts of his trunk or of his feet. But it is only that which thinks and wills than any man conſiders in this caſe, as himſelf or his perſon; and if our natural ſenſe of things, or conſciouſneſs, tell us, that what thinks and wills has continued the ſame from a diſtance of time as far back as we can remember, it is certain, that, whether it be material or immaterial, it has continued from that period, otherwiſe we can be certain of nothing. "But (ſays our philoſopher) other known and aſcertained facts are frequently borne down by our natural ſenſe of things: for how many thouſand years before the days of *Copernicus* was the motion of the earth round the ſun entirely borne down by our natural ſenſe of things, which made us give full credit to the motion of the ſun round the earth? Do not the generality of mankind believe, upon the evidence of their natural ſenſe of things, that every part of their body remains exactly the ſame to-day as it was yeſterday?"

* *Tracts*, &c.

257 Anſwered.

To the former of theſe queſtions we anſwer poſitively, that before the days of *Copernicus* the motion of the earth round the ſun was *not* borne down by our *natural ſenſe* of things, but by ill-founded hypotheſes and inconcluſive reaſonings. By the natural ſenſe of things, nothing can be meant, in this place, but the evidence of conſciouſneſs or of external ſenſation; but the *actual motion* either of the ſun or of the earth is not perceived either by conſciouſneſs or by ſenſation. Of conſciouſneſs nothing is the object but the internal energies and feelings of our own minds; and with regard to the motion of the ſun or of the earth, nothing is perceived by the ſenſe of ſight but that, after conſiderable intervals of time, theſe two great bodies have repeatedly changed their places in the heavens with reſpect to each other. This is all that on this ſubject our *natural ſenſe of things* leads us to believe; and is not this infallibly true? Afterwards indeed, by taking for granted the truth of propoſitions, for which neither ſenſe nor conſciouſneſs affords the ſhadow of evidence; the vulgar now, and all mankiad formerly, reaſoned themſelves into the opinion, that the earth ſtands ſtill, and that the ſun moves round it. In vulgar philoſophy it is taken for granted, that in the univerſe there is not a *relative* but an *abſolute upwards* and an *abſolute dowawards*; that our heads are abſolutely upward, and our feet downward; and that were the earth to revolve round its axis, theſe poſitions would be reverſed, that our heads would be placed beneath our feet, and that we ourſelves would fall from the earth into

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into empty fpace. Upon thefe falfe hypothefes the vulgar reafon correctly. They know that bodies cannot change their place without motion; they know that in the time of their remembrance the fun and the earth have been perpetually varying their places with refpect to each other; they know that they themfelves have never fallen, nor had a tendency to fall, into empty fpace; and hence they infer that it is the fun and not the earth that moves (K). But will any man fay that the abfurd fuppofitions from which this conclufion is logically deduced, have the evidence either of fenfation or of confcioufnefs, as the permanency of that living agent which each man calls himfelf has?

To our author's fecond queftion we likewife reply with confidence, that the generality of mankind do *not* believe, upon their natural fenfe of things, that every part of their body remains exactly the fame to-day as it was yefterday. It would be ftrange indeed if they did, after having repeatedly experienced the wafte of increafed perfpiration or fweating; after having witneffed men emaciated by ficknefs, and again reftored to plumpnefs in health; and after having perhaps loft whole limbs, which certainly their natural fenfe of things teaches them to confider as parts of their body. In all thefe cafes, the generality of mankind are as fenfible of changes having taken place in their bodies as he who has attended ever fo clofely to phyfiological inquiries, though not one of them has the leaft imagination of a change having taken place in the living agent which each man calls himfelf.

Bifhop Butler obferves, that if the living agent be perpetually changing, it is a fallacy upon ourfelves to charge our prefent felves with any thing we did, to imagine our prefent felves interefted in any thing which befel us yefterday, or that our prefent felf will be interefted in what will befal us to morrow. To this judicious obfervation our daring philofopher replies, "that as the man of to-morrow, though not in all points the fame with, yet depends for his exiftence upon, the man of to-day, there is fufficient reafon to care about him." Could he have faid, that as the man of to-day depends for his exiftence on the man of to-morrow, there is fufficient reafon for the prefent man to care about the future man; or that as the man of to-morrow depends for his exiftence on the man of to day, there is to day fufficient reafon for the future man to care about the prefent man; we fhould in either cafe, if the anachronifm had been kept out of fight, have feen the force of his argument. Every man has fufficient reafon to care about the ox upon which he is to be fed; but we cannot fo clearly perceive what reafon the ox has to care about the man.

Not fatisfied, it would feem, with this reply, our author proceeds to affirm, "that the man of to-morrow, poffeffing a reminifcence of the actions of the man of to-day, and knowing that thefe actions will be referred to him both by himfelf and others (which is certainly knowing that both himfelf and others are moft iniquitous wretches), they cannot be indifferent to the man of to day, who looks forward to the properties of the man of to-morrow;" i. e. the reminifcence and knowledge of a future man conftitute all the relation that fubfifts between a prefent man and his actions; a difcovery worthy of an original genius. But as on the fubject of perfonal identity we pretend to no originality, we fhall leave this propofition to the meditation of our readers, and take the liberty to afk our author a queftion or two refpecting this fame reminifcence, which he is gracioufly pleafed to acknowledge for a property.

He defines identity, "the continued exiftence of any being unaltered in fubftance or in properties;" and he repeatedly acknowledges that no identical quality or property can be transferred from one fubject to another. Let us now fuppofe, that a man has a reminifcence of an individual action performed a month ago, and that this reminifcence is accompanied with a confcioufnefs that the action was performed by himfelf. This fuppofition, whether true or falfe, may certainly be made; for it implies nothing more than what every man firmly believes of himfelf in every act of remembrance. Let us again fuppofe, that, at the diftance of ten or twenty years, the man known by the fame name has a reminifcence of the fame action, with a confcioufnefs that he himfelf performed it. Is this reminifcence the fame with the former? or is it a different reminifcence? If it be the fame, either the perfon remembering at the diftance of ten or twenty years is the fame with him who remembered at the diftance of a month, or there is an identical quality transferred from one fubftance to another, which is admitted to be impoffible. If reminifcence be itfelf a real and immediate quality of any fubftance, and not the mere energy of a power, and if the one reminifcence be different from the other, the fubjects in which thefe two different qualities inhere muft likewife be different. Yet the man who has the reminifcence at the diftance of a month, has the evidence of confcioufnefs that the action was performed by him; and the man who has the reminifcence at the diftance of ten or twenty years, has likewife the evidence of confcioufnefs that the fame action was performed by him and not by another. By the confeffion of Hume and of all philofophers, confcioufnefs never deceives; but here is the evidence of one confcioufnefs in direct oppofition to another; and therefore, as two contradictory propofitions cannot both be true, either the one reminifcence is the fame with the other, or reminifcence is no real quality. That one act of reminifcence fhould be numerically the fame with another, which followed it at the diftanee of twenty years, is plainly impoffible; whence it fhould feem, that reminifcence itfelf is no real and immediate quality of any fubftance. But if this be fo, what is reminifcence? We anfwer, it is plainly neither more nor lefs than the *energy* of a power, which

(K) This inference too has been fo often drawn, that it comes in time to coalefce in the mind with the *fenfations*, from which the motion either of the fun or of the earth is deduced with infallible certainty; and hence it is confidered as part of that truth which fenfation immediately difcovers. *See our Chapter of Association.*

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which though dormant between its energies, remains unchanged from the one to the other, and which being itfelf the real and immediate quality of a fubject, that fubject muft likewife remain unchanged. That powers may remain dormant, and yet unchanged, every man muft be convinced; who having ftruck any thing with his hand, knows that he has power to repeat the ftroke, and yet does not actually repeat it. Two blows with the hand immediately following each other are numerically different, fo that the one cannot with truth be faid to be the other; but we have the evidence of external fenfe, that they are both ftruck by the fame member. In like manner, two energies of reminifcence directed to the fame object, and fucceeding each other at any interval of time, cannot poffibly be one and the fame energy; but as the latter energy may include in it the former as well as the object remembered by both, we have the evidence of confcioufnefs that both are energies of the fame power; and we have feen, that to fuppofe them any thing elfe, may be demonftrated to involve the groffeft abfurdities and contradictions.

Mr Cooper has other arguments to obviate the force of Bifhop Butler's demonftration of perfonal identity; fuch as, that a "high degree of *fimilarity* between the two fucceeding men is fufficient to make the one care about the other;" and, that "a good man, knowing that a future being will be punifhed or rewarded as the actions of the prefent man deferve, will have a fufficient motive to do right and to abftain from wrong." But if there be any one of our readers who can fuffer himfelf to be perfuaded by fuch affertions as thefe, that the living agent which he calls himfelf is perpetually changing, and at the fame time that fuch change is confiftent with the expectation of future rewards and punifhments, he would not be reclaimed from his error by any reafoning of ours. We fhall therefore truft fuch trifling with every man's judgement, and proceed to examine our author's *demonftration*, that perfonal identity has no exiftence. But here it is no part of our purpofe to accompany him through his long chemical ramble, or to controvert his arguments for the nonidentity of vegetable and animal bodies. The only thing to which, after Bifhop Butler, we have afcribed identity, is that which in man is fentient and confcious; and the nonidentity of this thing, whatever it be, Mr Cooper undertakes to demonftrate from the known properties of fenfations and ideas.

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A pretended demonftration that perfonal identity is impoffible.

This demonftration fets out with a very ominous circumftance. The author, after conducting impreffions *ab extra*, from the extremities of the nerves to the brain, affirms, that *fenfations* and *ideas* are nothing but "motions in the brain perceived;" i. e. when a man thinks he is looking at a mountain, not only at reft, but to appearance immoveable, he is grofsly deceived: for he perceives nothing all the while but *motion in his brain!* Were not the defire of advancing novelties and paradoxes invincible in fome minds, we fhould be aftonifhed at finding fuch an affertion as this fall from the pen of any man who had paid the flighteft attention to the different energies of his own intellect. Motions in the brain, as we have repeatedly obferved, are the immediate caufes of our fenfations; but is it conceiveable, is it poffible, that any thing fhould be the caufe of itfelf? The motion of a fword through the heart of a man, is the immediate caufe of that man's death; but is the fword or its motion *death* itfelf, or can they be conceived as being the *fenfations* of the *man* in the *agonies* of *dying?* But fenfations and ideas, whatever they be, exift in fucceffion; and therefore, argues our demonftrator, no two fenfations or ideas can be one and the fame fenfation or idea. The conclufion is logically inferred; but what purpofe can it poffibly ferve? What purpofe! why it feems "fenfations and ideas are the only *exiftences whofe exiftence* we certainly know (a charming phrafe, the *exiftence* of *exiftences*, and as original as the theory in which it makes its appearance); and, therefore, from the nature of fenfations and ideas there is no fuch thing as permanent identity." Indeed! what then, we may be permitted to afk, is the import of the word *we* in this fentence? Does it denote a feries of fenfations and ideas, and does each fenfation and each idea certainly know not only itfelf, but all its anceftors and all its defcendants? Unlefs this be admitted, we are afraid that fome other exiftence befides fenfations and ideas muft be allowed to be certainly known, and even to have fomething of a permanent identity. Nay, we think it has been already demonftrated (fee Chapter of Time), that were there not fomething permanent, there could be no time, and of courfe no notion of a firft and laft, or indeed of fucceffion, whether of fenfations or ideas. And therefore, if we have fuch a notion, which the author here takes for granted, and upon which indeed his demonftration refts, it follows undeniably that there is fomething permanent, and that we *know* there is fomething permanent, which obferves the fucceffion of fenfations and ideas.

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Shown to be abfurd and ridiculous.

"All this, indeed, Mr Cooper in effect grants; for he is not much ftartled at the appearance of contradictions in his theory. "I find (fays he), by perpetually repeated impreffions which I perceive, that my hands, body, limbs, &c. are connected, are parts of one whole. I find, by perpetually repeated perceptions alfo, that the fenfations excited by them are conftantly fimilar, and conftantly different from the fenfations excited by others." He has then repeated perceptions: but how can this be poffible, if *he* be not different from the perceptions, and if *he* do not *remain unchanged* while the perceptions fucceed each other at greater or lefs intervals of time? A ftriking object paffing with rapidity before the eyes of a number of men placed befide each other in a line of battle, would undoubtedly excite a fucceffion of fenfations; but furely that fucceffion would not take place in the mind of *any individual* in the line, nor could any *fingle man* in this cafe fay with truth that he had *repeated* perceptions of the object. In like manner, were that which is fentient perpetually changing, no man could poffibly fay or fuppofe that he had repeated perceptions of any thing; for upon this fuppofition, the man of to-day would have no more connexion with the man who bore his name yefterday, or twenty years ago, than the man in the line had with the firft.

Upon the whole, we cannot help thinking that Bifhop Butler's demonftration of perfonal identity remains unfhaken by the batteries of Mr Cooper.—It refts, indeed,

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deed, upon the solid basis of consciousness and memory; and if implicit credit be not given to the evidence of these faculties, we cannot proceed a single step in any inquiry whatever, nor be certain of the truth even of a mathematical demonstration.

260 A difficulty removed.

But as we have ourselves supposed, that to sensation, reminiscence, and every actual energy of the mind of man, the instrumentality of some material system is necessary, it may perhaps be thought incumbent on us to show how the perpetual flux of the particles of matter which compose the brain, as well as all the other parts of the body, can consist with the identity of the person who perceives, remembers, and is conscious. If this cannot be done, our hypothesis, ancient and plausible as it is, must be given up; for of personal identity it is impossible to doubt. In this case, however, we perceive no difficulty; for if there be united to the brain an immaterial being, which is the subject of sensation, consciousness, and will, &c. it is obvious, that all the *intellectual powers* which properly constitute the person, must be inherent in that being. The material system, therefore, can be necessary only as an instrument to excite the energies of those powers; and since the powers themselves remain unchanged, why should we suppose that their energies may not be continually exerted by successive instruments of the same kind, as well as by one permanent instrument? The powers of perception and volition are not in the material system, any more than the sensation of seeing is in the rays of light, or the energy of the blacksmith in the hammer with which he beats the anvil. Let us suppose a man to keep his eye for an hour steadily fixed upon one object. It will not surely be denied, that if this could be done, he would have one uninterrupted and unvaried perception of an hour's duration, as measured by the clock. Yet it is certain that the rays of light which alone could occasion that perception would be perpetually changing. In like manner, a blacksmith, whilst he continues to beat his anvil, continues to exert the same power whether he uses one hammer all the time, or a different hammer at each stroke. The reason is obvious; the eye, with all its connexions of brain and mind in the one case, and the person of the smith in the other, remain unchanged; and in them alone reside the faculty of sensation and the power of beating, though neither the faculty nor the power can be exerted without material instruments. But were it possible that millions of men could in the space of an hour take their turns in rotation with each new ray of light, it is self-evident, that in this case, there would be nothing permanent in sensation; and, therefore, there could not be one uninterrupted and unvaried perception, but millions of perceptions, during the hour, totally distinct from and unconnected with each other. Let us now suppose a man to fix his eye upon an object for the space of a minute, and at the distance of a day or a month to fix it upon the same object a second time. He would not indeed, in this case, have one uninterrupted and unvaried perception, but he would be conscious of the energy of the very same faculty the second time as at the first. Whereas, were one man to view an object to day, and another to view the same object to-morrow, it is obvious, that he who should be last in the succession could know nothing of the energy of that faculty by which the object was perceived the first day, because there would be nothing common to the two perceptions.

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Thus then we see, that *personal identity* may with truth be predicated of a compound being, though the material part be in a perpetual flux, provided the immaterial part remain unchanged; and that of such a being only is a resurrection from the dead possible.—For since the motions of the brain do nothing more than excite to energy the permanent powers of the mind, it is of no sort of consequence to that energy, whether these motions be continued by the same numerical atoms, or by a perpetual succession of atoms arranged and combined in the very same manner. We shall, therefore, be the same persons at the resurrection as at present, whether the mind be united to a particular system composed of any of the numberless atoms which have in succession made parts of our present bodies, or to a system composed of totally different atoms, provided that new system be organized in exactly the same manner with the brain or material vehicle, which is at present the immediate instrument of perception. This (we say) is self-evident; but were the immaterial part to change with the changing body, a resurrection of the same persons would be plainly impossible.

Chap. IV. *Of the* Immortality *of the* Soul.

261 The immortality of the soul the general belief in all nations.

Wherever men have been in any degree civilized, and in some nations where they have been in the most savage state, it has been the general persuasion, that the mind or soul subsists after the dissolution of the body. The origin of this persuasion, about which disputes have been raised, no Christian hesitates to attribute to revelation. The Egyptians, from whom the Greeks derived many of their theological and philosophical principles, appear to have taught the immortality of the soul, not as a truth discovered by the exertions of human reason, but as a dogma derived to them from the earliest ages by tradition. This indeed may be confidently inferred from the character and conduct of their first Greek disciples. Those early wise men who fetched their philosophy immediately from Egypt, brought it home as they found it, in detached and independent placits. Afterwards, when schools were formed, and when man began to philosophize by hypothesis and system, it was eagerly inquired upon what foundation in *nature* the belief of the soul's immortality could rest; and this inquiry gave rise to the various disquisitions concerning the *substance* of the soul, which have continued to exercise the ingenuity of the learned to the present day. It was clearly perceived, that if consciousness, thought, and volition, be the result of any particular modification of matter and motion, the living and thinking agent must perish with the dissolution of the system; and it was no less evident, that if the being which perceives, thinks, and wills, be not material, the mind of man *may* subsist after the resolution of the body into its component particles. The discovery of the immateriality of the mind was therefore one *step towards* the proof of its immortality; and in the opinion of many philosophers, whose hopes ought to rest on a surer basis, it was alone a complete proof.—"They who hold sensitive perception in brutes (says a pious writer)

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writer *) to be an argument for the immateriality of their ſouls, find themſelves under the neceſſity of allowing thoſe ſouls to be immortal."

* See *the Procedure, Extent, and Limits of the Underſtanding.*

The philoſophers of ancient Greece, however, felt not themſelves under any ſuch neceſſity. Whatever were their opinions reſpecting the ſouls of brutes, they clearly perceived that nothing which had a beginning of exiſtence could be naturally immortal, whether its ſubſtance were material or immaterial.—

262 The philoſophers of ancient Greece believed likewiſe in its pre-exiſtence

"There never was any of the ancients before Chriſtianity (ſays the accurate Cudworth), that held the ſoul's future permanency after death, who did not likewiſe aſſert its pre-exiſtence; they clearly perceiving, that if it were once granted that the ſoul was generated, it could never be proved but that it might be alſo corrupted. And, therefore, the aſſertors of the ſoul's immortality commonly began here, firſt to prove its pre-exiſtence, proceeding thence to eſtabliſh its permanency after death. This is the method of proof uſed in Plato: Ην που ἡμων ἡ ψυχη πριν εν τω δε τω ανθρωπινω ειδει γενεσθαι, ὡστε και ταυτη αθανατον τι εοικεν ἡ ψυχη ειναι. *Our ſoul was ſomewhere before it came to exiſt in this human form, and thence it appears to be immortal, and as ſuch will ſubſiſt after death.*

263 and abſolute eternity.

To give this argument for immortality any ſtrength, it muſt be taken for granted, not only that the ſoul exiſted in a *prior* ſtate, but that it exiſted from all *eternity*; for it is obvious, that if it had a beginning in any ſtate, it may have an end either in that ſtate or in another. Accordingly, Plato aſſerts in plain terms its eternity and ſelf-exiſtence, which, as we learn from Cicero, he infers from its being the principle of motion in man. Quin etiam cæteris, quæ moventur, hic fons, hoc principium eſt movendi. *Principii autem nulla eſt origo.* Nam ex principio oriuntur omnia: ipſum autem nulla ex re alia naſci poteſt: nec enim eſſet id principium, quod gigneretur aliunde †." This, it muſt be acknowledged, is very contemptible reaſoning; but the opinion which it was intended to prove was held by all the philoſophers. They were unanimous in maintaining the *ſubſtance* of the ſoul, though not its *perſonality*, to be eternal *à parte ante* as well as *ad partem poſt*; and Cicero, where he tells us that this opinion paſſed from *Pherecydes Syrus*, to Pythagoras, and from Pythagoras to *Plato*, expreſſes their notion of the ſoul's duration by the word *ſempiternus* ‡, which, in its original and proper ſenſe, is applicable only to that which has neither beginning nor end.

† *Tuſcul.* lib. i. cap. 23.

‡ *Tuſcul.* lib. i.

Indeed none of the philoſophers of ancient Greece appear to have believed a creation (ſee CREATION) poſſible: for it was a maxim univerſally received among them, *De nihilo nihil fit, in nihilum nil poſſe reverti*; that *nothing can come from nonentity, or go to nonentity.* This maxim, as held by the theiſtical philoſophers, the learned Cudworth labours to interpret in a ſenſe agreeable to our notions of the origin of the world; but the quotations urged by himſelf muſt convince every competent reader that on this occaſion he labours in vain. For inſtance, when Ariſtotle writes of Parmenides and Meliſſus, that ουδεν ουδε γινεσθαι φασιν ουδε φθειρεσθαι των οντων, *they ſay that no real entity is either made or deſtroyed*; what can be his meaning, but that thoſe philoſophers taught that nothing could be either created or annihilated? He teſtifies the ſame thing of *Xenophanes* and *Zeno*, when he ſays that it was a fundamental principle of their philoſophy—μη ενδεχεσθαι γινεσθαι μηδεν εκ μηδενος—*that it is impoſſible that any thing ſhould be made out of nothing.* And of Empedocles, when he relates απαντα ταυτα κακεινος ὁμολογει ὁτι εκ τε μη οντος αμηχανον εστι γινεσθαι το τε ον εξολλυσθαι ανηνυστον και αρρηκτον—*That he acknowledges the very ſame thing with other philoſophers*, viz. *that it is impoſſible that any thing ſhould be made out of nothing, or periſh into nothing.* But it is needleſs to multiply quotations reſpecting the opinions of ſingle philoſophers. Of all the phyſiologers before himſelf and Plato, Ariſtotle ſays, without exception, περι ταυτης ὁμογνωμονουσι της δοξης ὁι περι φυσεως, ὁτι το γιγνομενον εκ μη οντων γιγνεσθαι αδυνατον †—*That they agree in this opinion, that it is impoſſible that any thing ſhould be made out of nothing*: and he calls this the common principle of naturaliſts; plainly intimating, that they conſidered it as the greateſt abſurdity to ſuppoſe that any real entity in nature could either be brought from nothing or reduced to nothing.

† *Phyſic.* lib. i. cap. 5.

The author of the *Intellectual Syſtem*, in order, perhaps, to hide the impiety of this principle, endeavours to perſuade his readers, that it was urged only againſt the hypotheſis of forms and qualities of bodies conſidered as real entities, diſtinct from matter. But how it could be ſuppoſed to militate againſt that particular opinion, and not againſt the poſſibility of all creation, is to us perfectly inconceivable. The father of the ſchool which analyzed body into matter and form, together with by far the greater part of his followers, taught the eternity of both theſe principles (L); and therefore maintained, as ſtrenuouſly as any atomiſt, the univerſal maxim, *De nihilo nihil fit.* Even Plato himſelf, whoſe doctrine of *ideas* is ſuppoſed to wear a more favourable aſpect than Ariſtotle's *forms* to the truths of revealed religion, taught the *eternity* of *matter*; but whether as a ſelf-exiſting ſubſtance, or only as an emanation from the Deity, is a queſtion which has

(L) *Ariſtotelem*, et pleroſque Peripateticorum, in vulgus notum eſt, in hac fuiſſe ſententia—nec *natum* eſſe, nec *interiturum* unquam hunc mundum. Vid. PETRUS GASSENDUS *Phyſic.* ſect. i. lib. i. cap. 6. *JAC. THOMASIUS de Stoica mundi exuſtione*, Diſſ. 4. et alii. Plures ita haud dubie ſenſerunt philoſophorum veterum. Hinc video *MANILIUM* in *Aſtronomico*, lib. i. inter philoſophorum de mundo ſententias hanc, ac ſi præcipua eſſet, primo commemorare loco:

Quem ſive ex nullis repetentem ſemina rebus,
NATALI QUOQUE EGERE placet, ſemperque FUISSE,
ET FORE, PRINCIPIO pariter FATOque carentem.

Moſheim's edition of Cudworth's Intellectual Syſtem, lib. i. cap. 3. ſect. 33. note 60. On this ſubject ſee alſo *Ancient Metaphyſics.*

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has been diſputed. That he admitted no proper creation, may be confidently inferred from Plutarch; who, writing upon the generation of animals, according to the doctrine laid down in the *Timæus*, has the following paſſage: Βελτιον ουν, Πλατωνι πειθομενους τον μεν κοσμον ὑπο θεου γεγονεναι λεγειν και αδειν· ὁ μεν γαρ καλλισος των γεγονοτων ὁιδε αρισος των αιτιων την δε ΟΥΣΙΑΝ και ΥΛΗΝ εξ ης γεγονεν ου γενομενην, αλλα ὑποκειμενην αει τω δημιουργω εις διαθεσιν και ταξιν αυτης, και προς εξομοιωσιν, ὡς δυνατον ην παρασχειν· ου γαρ εκ του μη οντος ἡ γενεσις, αλλ' εκ του μη καλως, μηδ' ικανως εχοντος, ὡς οικιας και ἱματιον, και ανδριαντος *. *It is therefore better for us to follow Plato, and to ſay and ſing that the world was made by God. For as the world is the beſt of all works, ſo is God the beſt of all cauſes. Nevertheleſs, the* SUBSTANCE OR MATTER *out of which the world was made, was* NOT *itſelf made, but was always ready at hand, and ſubject to the artificer, to be ordered and diſpoſed by him. For the making of the world was not the production of it out of nothing, but out of an antecedent bad and diſorderly ſtate, like the making of a houſe, garment, or ſtatue.*

* *Plut. Op.* tom. ii. p. 1014.

If, then, this be a fair repreſentation of the ſentiments of Plato, and ſurely the author underſtood thoſe ſentiments better than the moſt accompliſhed modern ſcholar can pretend to do, nothing is more evident, than that the founder of the academy admitted of no proper creation, but only taught that the matter which had exiſted from eternity in a chaotic ſtate, was in *time* reduced to order by the *Demiurgus* or Supreme Being. And if ſuch were the ſentiments of the divine Plato, we cannot heſitate to adopt the opinion of the excellent Moſheim, which the reader will probably be pleaſed to have in his own words: "Si à Judæis diſcedas, neſcio an ullus antiquorum philoſophorum mundum negaverit æternum eſſe. Omnes mihi æternum profeſſi videntur eſſe mundum: hoc uno vero disjunguntur, quod nonnulli ut *Ariſtoteles*, *formam* et *materiam* ſimul hujus orbis, alii vero, quorum princeps facile Plato, *materiam* tantum *æternam*, formam vero, à Deo comparatam, dixerunt †."

† *Notes on Cudworth's Intellectual Syſtem.*

Now, it is a fact ſo generally known, as not to ſtand in need of being proved by quotations, that there was not among them a ſingle man who believed in the exiſtence of mind as a being more excellent than matter, and eſſentially different from it, who did not hold the ſuperior of at leaſt equal antiquity with the inferior ſubſtance. So true is this, that Syneſius, though a Chriſtian, yet having been educated in one of the ſchools of philoſophy, could not, by the hopes of a biſhopric, be induced to diſſemble this ſentiment: αμελει την ψυχην ουκ αξιωσω ποτε σωματος ὑστερογενη νομιζειν ‡. —*I ſhall never be perſuaded to think my ſoul younger than my body.* This man probably believed, upon the authority of the ſcriptures, that the matter of the viſible world was created in time; but he certainly held with his philoſophic maſters, that his own ſoul was as old as any atom of it, and that it had conſequently exiſted in a prior ſtate before it animated his preſent body.

‡ *Epiſt.* 105

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Thoſe who maintained that the world was uncreated, maintained upon the ſame principle that their ſouls were uncreated likewiſe; and as they conceived all bodies to be formed of one firſt matter, ſo they conceived all ſouls to be either emanations from the one firſt Mind, or diſcerpted parts of it. Ariſtotle, who diſtinguiſhes between the intellectual and ſenſitive ſouls, ſays expreſsly of the former, that it "enters from without, and is DIVINE;" adding this reaſon for his opinion, that "its energy is not blended with that of the body—λειπεται δε τον νουν μονον θυραθεν επεισιεναι, και θειον ειναι μονον· ουδε γαρ αυτου τη ενεργεια κοινωνει σωματικη ενεργεια*. As to the Stoics, *Cleanthes* held (as Stobæus informs us †), that "every thing was made out of one, and would be again reſolved into one." But let Seneca ſpeak for them all: "Quid eſt autem, cur non exiſtimes in eo *divini* aliquid exiſtere, qui DEI PARS eſt? Totum hoc, quo continemur, et unum eſt, et Deus: et ſocii ejus ſumus, et membra ‡—*Why ſhould you not believe ſomething to be divine in him, who is indeed* PART OF GOD? *That* WHOLE *in which we are contained is* ONE, *and that one is* GOD; *we being his companions and* MEMBERS. Epictetus ſays, *The ſouls of men have the neareſt relation to God, as being* PARTS OR FRAGMENTS *of him,* DISCERPTED *and* TORN *from his* SUBSTANCE; συναφεις τω θεω, ἁτε αυτου μορια ουσαι και αποσπασματα. Plato writes to the very ſame purpoſe, when, without any ſoftening, he frequently calls the ſoul *God*, and *part of God*. And Plutarch ſays, that "Pythagoras and Plato held the ſoul to be immortal; for that, launching out into the ſoul of the univerſe, it returns to its parent and original—Πυθαγορας, Πλατων, ἀφθαρτον ειναι την ψυχην· εξιουσαν γαρ εις την του παντος ψυχην, αναχωρειν προς το ομογενες ||." Plutarch declares his own opinion to be, that "the ſoul is not ſo much the work and production of God, as a PART of him; nor is it made BY him, but FROM him, and OUT of him: ἡ δε ψυχη ουκ εργον εστι μονον, αλλα και μερος· ουδ' ΥΠ' αυτου, αλλ' ΑΠ' αυτου, και ΕΞ αυτου γεγονεν §." But it is needleſs to multiply quotations. Cicero delivers the common ſentiments of his Greek maſters on this head, when he ſays ¶, "A natura deorum, ut doctiſſimis ſapientiſſimiſque placuit, HAUSTOS animos et LIBATOS habemus." And again: "Humanus autem animus DECERPTUS EX MENTE DIVINA: cum alio nullo, niſi cum ipſo Deo (ſi hoc fas eſt dictu), comparari poteſt."

* *De Generatione Animalium*, lib. ii. cap. 3.

† *Eclog. Phyſ.* c. 20.

‡ *Epiſt.* 92.

|| *De Placitis Philoſophorum*, lib. iv. cap. 7.

§ *Plato Quæſt.*

¶ *De Divinatione*, lib. i. cap. 49.

265 But differed in opinion as to the mode of their ſeparation.

Whilſt the philoſophers were thus unanimous in maintaining the ſoul to be a part of the ſelf-exiſtent Subſtance, they differed in opinion, or at leaſt expreſſed themſelves differently, as to the mode of its ſeparation from its divine parent. Cicero and the Stoics talk as if the Supreme Mind were extended, and as if the human ſoul were a part literally torn from that mind, as a limb can be torn from the body. The Pythagoreans and Platoniſts ſeem to have conſidered all ſouls as emanations from the divine Subſtance rather than as parts torn from it, much in the ſame way as rays of light are emanations from the ſun. Plato, in particular, believed in two ſelf-exiſtent principles, God and matter. The former he conſidered as the ſupreme Intelligence, incorporeal, without beginning, end, or change; and diſtinguiſhed it by the appellation of το αγαθον, *the Good.* Matter, as ſubſiſting from eternity, he conſidered as without any one *form* or *quality* whatever, and as having a natural tendency to diſorder. Of this chaotic maſs God formed a perfect world, after the eternal pattern in his own mind, and endowed it with a ſoul or emanation from himſelf. In the language of Plato, therefore, the univerſe being animated by a ſoul which proceeds from God, is called the *ſon of God*; and

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and several parts of nature, particularly the heavenly bodies, are *gods*. The human soul, according to him, is derived by emanation from God, through the intervention of this soul of the world; and receding farther from the first intelligence, it is inferior in perfection to the soul of the world, though even that soul is debased by some material admixture. To account more fully for the origin and present state of human souls, Plato supposes *, that "when God formed the universe, he separated from the soul of the world inferior souls, equal in number to the stars, and assigned to each its proper celestial abode; but that those souls, (by what means, or for what reason, does not appear), were sent down to the earth into human bodies, as into sepulchres or prisons." He ascribes to this cause the depravity and misery to which human nature is liable; and maintains, that it "is only by disengaging itself from all animal passions, and rising above sensible objects, to the contemplation of the world of intelligence, that the soul of man can be prepared to return to its original state." Not inconsistently with this doctrine, our philosopher frequently speaks of the soul of man as consisting of three parts: or rather he seems to have thought that man has three souls; the first the principle of intelligence, the second of passion, and the third of appetite (M); and to each he assigns its proper place in the human body. But it was only the intellectual soul that he considered as immortal.

* *Enfield's Abridgement of Brucker's History of Philosophy.*

Aristotle taught, in terms equally express, that the human soul is a part of God, and of course that its substance is of eternal and necessary existence. Some of his followers, indeed, although they acknowledged *two first principles*, the active and the passive, yet held, with the Stoics, but *one substance* in the universe; and to reconcile these two contradictory propositions, they were obliged to suppose matter to be both active and passive. Their doctrine on this subject is thus delivered by Cicero: "De natura ita dicebant, ut eam dividerent in res duas, ut altera esset efficiens, altera autem quasi huic se præbens, ea quæ efficeretur aliquid. In eo, quod efficeret, vim esse censebant; in eo autem quod efficeretur, materiam quandam; in UTROQUE TAMEN UTRUMQUE. Neque enim materiam ipsam cohærere potuisse, si nulla vi contineretur, neque VIM SINE ALIQUA MATERIA; nihil est enim, quod non alicubi esse cogatur †." *They divided nature into two things, as the first principles; one whereof is the efficient or artificer, the other that which offers itself to him for things to be made out of it. In the efficient principle, they acknowledged active force; in the passive, a certain matter; but so, that in* EACH BOTH OF THESE WERE TOGETHER: *forasmuch as neither the matter could cohere together unless it were contained by some active force, nor* THE ACTIVE FORCE SUBSIST OF ITSELF WITHOUT MATTER; *because that is nothing which may not be compelled to be somewhere.* Agreeably to this strange doctrine, Arrian, the interpreter of Epictetus, says of himself, ειμι ανθρωπος, μερος των παντων, ὡς ὡρα ἡμερας, "I am a man (a part of the το παν or *universe*), as an hour is part of the day."

† *Academicium*, lib. cap. 6.

Aristotle himself is generally supposed to have believed in the eternal existence of two substances, *mind* and *matter*; but treating of the generation of animals, he says, ενδε το παντι θερμοτης ψυχικη, ως τροπον τινα παντα ψυχης ειναι πληρη διο συνισταται ταχεως ὁποταν εμπεριληφθη ‡. *In the universe there is a certain animal heat, so as that after a manner all things are full of mind; wherefore they are quickly completed (or made complete animals) when they have received a portion of that heat.* This *heat*, from which, according to Cicero ‖, the Stagyrite derived all souls, has, it must be confessed, a very material appearance; insomuch that the learned Mosheim seems to have been doubtful whether he admitted of any immaterial principle in man; but for this doubt there appears to us to be no solid foundation. Aristotle expressly declares, that *this heat is not fire* nor any *such power, but a spirit which is in the seeds* or *elementary principles of bodies*; τουτο δε ου πυρ, ουδε τοιαυτη δυναμις εστιν, αλλα το εμπεριλαμβανομενον εν τω σπερματι και εν τω αφρωδει πνευμα §. And as the excellent person himself acknowledges (N), that Aristotle taught the existence of two principles, God and matter, not indeed subsisting

‡ *De Generatione Animalium*, lib. iii. cap. 11.

‖ *Tuscul.* lib. i. c. 3.

§ *De Generatione Animalium*, lib. ii. c. 3.

(M) "Plato triplicem finxit animam; cujus principatum, id est, rationem, in capite, sicut in arce, posuit: et duas partes separare voluit, iram et cupiditatem, quas locis disclusit; iram in pectore, cupiditatem subter præcordia locavit." *Ciceronis Tusc. Quest.* lib. i. cap. 10.

This hypothesis has been adopted by the learned author of Ancient Metaphysics: but it cannot be proved by argument, and is in direct opposition to consciousness. Were there three distinct minds in each man—the principles of intelligence, of passion, and of appetite, it is obvious that *each man* would be *three persons*, and that *none* of these persons could know any thing of the powers and properties of the *other two*. The intelligent person could not reason about *passion* or *appetite*; nor could the persons who know nothing but passion and appetite reason about *intelligence*, or indeed about any thing else. The very question at issue, therefore, furnishes the most complete proof possible, that the same individual which each man calls himself, is the principle of intelligence, of passion, and of appetite; for if the Platonic hypothesis were true, that question could never have been started, as no one individual of the human race could have understood all its terms. It may be just worth while to mention, that the author of Ancient Metaphysics, attributing all motion, and even the coherence of the minute particles of body, to the immediate agency of mind, of course furnishes every human body with at least *four minds*. This fourth mind differs not from the *plastic nature* of Cudworth, and is likewise a Platonic notion apparently better founded. That there are in our bodies motions perpetually carried on by the agency of something which is not the principle of either our intelligence, our passions, or our appetites, is a fact which cannot be denied; but if those motions proceed immediately from mind, it must either be from the *supreme* mind, or from some *subordinate* mind, acting under the supreme, but wholly *distinct from and independent* of that which each man calls himself.

(N) "Non cum illis componi prorsus potest ARISTOTELES, qui bina rerum separataque statuunt principia, Deum

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ing separately, but eternally linked together by the closest union; we think it follows undeniably, that this heat, from which he derived all souls, must be that mind which he called *God*, and which he considered as the actuating soul of the universe.

Upon these principles neither Aristotle nor the Stoics could believe with Plato, that in the order of nature there was first an emanation from the Supreme Mind to animate the universe, and then through this universal soul other emanations to animate mankind. The Stagyrite believed, that the Supreme Mind himself is the soul of the world, and that human souls are immediately derived from him. The genuine Stoics, acknowledging but one substance, of necessity considered both the souls and bodies of men as portions of that substance, which they called το εν; though still they affected to make some unintelligible distinction between body and mind. But however the various schools differed as to those points, they were unanimous as to the soul's being a part of the self-existing Substance; and Cicero gives their whole system from Pacuvianus in words which cannot be misunderstood:

> Quicquid est hoc, omnia animat, format, alit, auget, creat,
> Sepelit, recipitque in sese omnia, omniumque idem est Pater:
> Indidemque eadem, quæ oriuntur de integro, atque eodem occidunt.

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Upon these principles they maintained the necessary existence of the soul;

To these verses he immediately subjoins the following query: "Quid est igitur, cur, cum domus sit omnium una, eaque communis, cumque *animi hominum* SEMPER *FUERINT*, *FUTURIQUE SINT*, cur ii, quid ex quoque eveniat, et quid quamque rem significet, perspicere non possint *?" And upon the same principle he elsewhere argues, not merely for the immortality, but for the *eternity* and *necessary existence* of the soul: "Animorum nulla in terris origo inveniri potest: His enim in naturis nihil inest, quod vim memoriæ mentis, cogitationis habeat; quod et præterita teneat, et futura provideat, et complecti possit præsentia; quæ sola divina sunt. Nec invenietur unquam, unde ad hominem venire possint, nisi à Deo. Ita quicquid est illud, quod sentit, quod sapit, quod vult, quod viget, cæleste et divinum est; OB EAMQUE REM ÆTERNUM SIT NECESSE EST †." This was indeed securing the future permanency of the soul in the most effectual manner; for it is obvious, that what had not a beginning can never have an end, but must be of eternal and necessary existence.

* *De Divinatione*, lib. i. p. 57.

† *Frag. de Consolatione.*

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but not in its distinct and personal capacity.

But when the ancients attributed a proper eternity to the soul, we must not suppose that they understood it to be eternal in its *distinct* and *personal existence*. They believed that it proceeded or was *discerpted* in *time* from the substance of God, and would *in time* be again *resolved* into that substance. This they explained by a close vessel filled with sea water, which swimming a while upon the ocean, does, on the vessel's breaking, flow in again, and mingle with the common mass. They only differed about the time of this reunion; the greater part holding it to be at death; but the Pythagoreans not till after many transmigrations. The Platonists went between these two opinions; and rejoined pure and unpolluted souls immediately to the Universal Spirit; but those which had contracted much defilement, were sent into a succession of other bodies, to be purged and purified, before they returned to their parent substance *."

* *Warburton's Divine Legation.*

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A similar doctrine held by the Bramins.

A doctrine similar to this of Plato has been held from time immemorial by the Bramins in India, whose sacred books teach, "That intellect is a PORTION of the GREAT SOUL of the universe, breathed into all creatures, to animate them for a certain time; that after death it animates other bodies, or returns like a *drop* into that *unbounded ocean* from which it first arose; that the souls of men are distinguished from those of other animals, by being endowed with reason and with a consciousness of right and wrong; and that the soul of him who adheres to right as far as his powers extend, is at death ABSORBED INTO THAT DIVINE ESSENCE, never more to re-animate flesh. On the other hand, the souls of those who do evil, are not at death disengaged from all the elements; but are immediately clothed with a body of fire, air, and *akash* (a kind of celestial element, through which the planets move, and which makes no resistance) in which they are for a time punished in hell. After the season of their grief is over, they reanimate other bodies: and when they arrive through these transmigrations at a state of purity, they are absorbed into God, where all PASSIONS are UTTERLY UNKNOWN, and where CONSCIOUSNESS IS LOST IN BLISS †."

† See *Preliminary Dissertation to Dow's History of Indostan.*

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This doctrine incompatible with a future state of rewards and punishments, and

Whether the Greeks derived their notions of the divinity and transmigration of souls from the east, or whether both they and the Bramins brought the same doctrines at different periods from Egypt, it is foreign from the purpose of this article to inquire. Certain it is, that the philosophers of Greece and India argued in the very same manner, and upon the very same principles, for the *natural* immortality of the soul; and that the immortality which they taught was wholly incompatible with God's moral government of the world, and with a future state of rewards and punishments. That this is true of the doctrine of the Bramins, is evident from the last-quoted sentence: for if the soul, when absorbed into the Divine essence, loses all consciousness of what it did and suffered in the body, it cannot possibly be rewarded for its virtues practised upon earth. That the philosophers of Greece taught the same cessation of consciousness, might be inferred with the utmost certainty, even though we had not Aristotle's express declaration to that purpose: For as they all believed their souls to have existed before they were infused into their bodies, and as each must have been conscious that he remembered nothing of his former state (o), it was impossible to avoid concluding,

Deum et materiam. Arctissime enim utrumque hoc initium conjunxit Stagyrita, atque ipsa naturæ necessitate Deum cohærere cum mole hac corporea putavit." *Cudworth's Intellectual System*, Book i. Chap. iv. Sect. 6. note 3.

(o) This is expresly acknowledged by Cicero, though he held with his Greek masters the eternity of the soul. In

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cluding, that in the future ſtate of his ſoul as little would be remembered of the preſent. Accordingly Ariſtotle teaches, that "the agent intellect only is immortal and eternal, but the paſſive corruptible,"—*τουτο μονον αθανατον και αιδιον ὁ δε παθητικος νους φθαρτος* *. Cudworth thinks this a very doubtful and obſcure paſſage; but Warburton, whoſe natural acuteneſs often diſcovered the ſenſe of ancient authors when it had eſcaped the ſagacity of abler ſcholars, has completely proved, that by the *agent intellect* is meant the *ſubſtance* of the ſoul, and by the *paſſive* its *particular perceptions*. It appears therfore that the Stagyrite, from the common principle of the ſoul's being a part of the Divine ſubſtance, draws a concluſion againſt a future ſtate of rewards and puniſhments; which though all the philoſophers (except Socrates) embraced, yet all were not ſo forward to avow.

* *De Anima*, lib. iii. cap. 6.

270 Groſsly abſurd in itſelf;

That the hypotheſis of the ſoul's being a part of the Divine ſubſtance is a groſs abſurdity, we ſurely need not ſpend time in proving. The argument long ago urged againſt it by St Auſtin muſt ere now have occurred to every reader. In the days of that learned father of the church, it was not wholly given up by the philoſophers; and in his excellent work of the *City of God*, he thus expoſes its *extravagance* and impiety: "Quid infelicius credi poteſt, quam Dei partem vapulare, cum puer vapulat? Jam vero *partes Dei* fieri *laſcivas*, *iniquas*, *impias*, atque omnino *damnabiles*, quis ferre poteſt niſi qui prorſus inſanit?

271 yet the only principle from which the ſoul can be inferred to be eſſentially immortal.

But though this hypotheſis be in the higheſt degree abſurd and wholly untenible, we apprehend it to be the only principle from which the *natural* or *eſſential* immortality of the ſoul can poſſibly be inferred. If the ſoul had a *beginning* it *may* have an *end;* for nothing can be more evident than that the being which had not exiſtence of itſelf cannot of itſelf have perpetuity of exiſtence. Human works, indeed, continue in being after the power of the workman is withdrawn from them; but between human works and the Divine there is this immenſe difference, that the former receive from the artiſt nothing but their form; whereas the latter receive from the Creator both their form and their ſubſtance. Forms are nothing but modifications of ſubſtance; and as ſubſtances depend upon God and not upon man, human works are continued in being by that fiat of the Creator, which made the ſubſtances of which they are compoſed ſuſceptible of different forms, and of ſuch a nature as to retain for a time whatever form may be impreſſed upon them. Human works therefore are continued in being by a power different from that by which they are finiſhed; but the works of God depend wholly upon that power by which they were originally brought into exiſtence; and were the Creator to withdraw his ſupporting energy, the whole creation would ſink into nothing.

272 Baxter's argument for the natural or eſſential immortality of the ſoul.

Self-evident as this truth certainly is, ſome eminent philoſophers *ſeem* to have queſtioned it. "No ſubſtance or being (ſays Mr Baxter *) can have a natural tendency to annihilation, or to become nothing. That a being which once exiſts ſhould ceaſe to exiſt is a real effect, and muſt be produced by a real cauſe: But this cauſe could not be planted in the nature of any ſubſtance or *being* to become a tendency of its nature; *for it could not be a free cauſe*, otherwiſe it muſt be a *being* itſelf, the ſubject of the *attribute freedom*, and therefore not the property of another *being; nor a neceſſary cauſe*, for ſuch a cauſe is only the effect of ſomething impoſing that neceſſity, and ſo no cauſe at all."

* *Inquiry into the Nature of the human Soul*, vol. i. ſect. 3.

273 Inconcluſive,

That the author's meaning in this argument is good, cannot, we think, be controverted; but he has not expreſſed himſelf with his uſual accuracy. He ſeems to confound *cauſes* with the *abſence* of cauſes, and the *effects* of the *former* with the *conſequences* of the *latter*. The viſible world was brought into exiſtence by the actual energy of the power of God; and as the viſible world had nothing of itſelf, it can *remain* in exiſtence only by a *continuance* of the *ſame energy*. This energy therefore is at the preſent moment as *real a cauſe* as it was ſix thouſand years ago, or at any period when it may have been firſt exerted; and the viſible world is its *real and permanent effect*. But would the ceaſing of this energy be likewiſe a *cauſe?* It would certainly be followed with the annihilation of the viſible world, juſt as the withdrawing of the ſun-beams would be followed with darkneſs on the earth. Yet as no one has ever ſuppoſed that darkneſs, a nonentity, is a *poſitive effect* of the ſun or of his beams, but only a mere negative conſequence of their abſence; ſo, we think, no one who believes in creation can conſider that deſtruction which would inevitably follow the withdrawing of the energy by which all things are ſupplied, as the *poſitive effect* of a contrary energy, or as any thing more than a *negative conſequence* of the ceaſing of that volition or energy of power by which God at firſt brought things into exiſtence. For "where the *foundation* of exiſtence lies *wholly* in the power of an infinite Being *producing*, the *ground* of the *continuance* of that exiſtence muſt be wholly in the ſame power *conſerving;* which has, therefore, with as much truth as frequency, been ſtyled a continued creation (P)."

274 and in effect given up by himſelf.

The force of this reaſoning Mr Baxter certainly ſaw, when he ſaid, that "a tendency to perſevere in the ſame ſtate of nature, and a tendency to change it, are contradictories, and impoſſible to be planted in the ſame ſubject at once: or, not to urge the contradiction, if the laſt prevailed, the remaining in the ſame ſtate for any given time would be impoſſible. We forget the true cauſe of all theſe tendencies, *the will of God*, which it is abſurd to ſuppoſe contrary to itſelf. The tendency in matter to perſevere in the ſame ſtate of reſt or motion, is nothing but *the will of the Creator*, who preſerves all things in their exiſtence and manner of exiſtence; nor can we have recourſe to any other cauſe

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In anſwer to ſome very fooliſh aſſertions concerning the evil of death, he ſays, "Ita, qui nondum nati ſunt, miſeri jam ſunt, quia non ſunt: et nos ipſi, ſi poſt mortem miſeri futuri ſumus, miſeri fuimus antequam nati. Ego autem *non commemini, antequam ſum natus, me miſerum*. *Tuſcul.* lib. i. cap. 6.

(P) See Stillingfleet's *Origines Sacræ*, where this queſtion is treated in a very maſterly manner by one of the ableſt metaphyſicians of the 17th century. See alſo our article PROVIDENCE.

Of the Immortality of the Soul.

cauſe for the preſervation of immaterial ſubſtance in its exiſtence. Therefore theſe tendencies are to be aſcribed to the will of God, and it is abſurd to ſuppoſe them contrary."

275 Analogical evidence of the immortality of the ſoul, and a moral proof of a future ſtate of rewards and puniſhments.

All this is unqueſtionably true. The exiſtence or nonexiſtence of matter and of created ſpirits depends wholly upon the will of God; and we cannot ſuppoſe him to be willing to-day the reverſe of what he willed yeſterday, becauſe we know that all his volitions are directed by unerring wiſdom. We have likewiſe the evidence of experience, that nothing is ever ſuffered to periſh but particular ſyſtems, which periſh only *as ſyſtems* by a decompoſition of their parts. A being, which like the ſoul has no parts, can ſuffer no decompoſition; and therefore, if it periſh, it muſt periſh by annihilation. But of annihilation there has not hitherto been a ſingle inſtance; nor can we look for a ſingle inſtance without ſuppoſing the volitions of God to partake of that unſteadineſs which is characteriſtic of man. Corporeal ſyſtems, when they have ſerved their purpoſe, are indeed reſolved into their component parts; but the matter of which they were compoſed, ſo far from being *loſt*, becomes the matter of *other ſyſtems* in endleſs ſucceſſion. Analogy, therefore, leads us to conclude, that when the human body is diſſolved, the immaterial principle by which it was animated continues to think and act, either in a ſtate of ſeparation from all body, or in ſome material vehicle to which it is intimately united, and which goes off with it at death; or elſe that it is preſerved by the Father of ſpirits, for the purpoſe of animating a body in ſome future ſtate. When we conſider the different ſtates through which that living and thinking *individual*, which each man calls himſelf, goes, from the moment that it firſt animates an embryo in the womb, to the diſſolution of the man of fourſcore; and when we reflect likewiſe on the wiſdom and *immutability* of God, together with the various diſſolutions of corporeal ſyſtems, in which we know that a ſingle atom of matter has never been loſt; the preſumption is certainly ſtrong, that the ſoul ſhall ſubſiſt after the diſſolution of the body. But when we take into the conſideration the *moral* attributes of God—his juſtice and goodneſs, together with the unequal diſtribution of happineſs and miſery in the preſent world; this preſumption from analogy amounts to a *complete moral proof* that there ſhall be a future ſtate of rewards and puniſhments (Q) (ſee MORAL *Philoſophy* and RELIGION): and if we eſtimate the duration of the rewards by the benevolence of Him by whom they are to be conferred, we cannot imagine them ſhorter than eternity.

276 Freedom of agency implied in accountableneſs.

CHAP. V. *Of* NECESSITY *and* LIBERTY.

Of Neceſſity and Liberty.

IN the preceding chapter we have adverted to that great *moral proof* for a future ſtate, and the immortality of the ſoul, ariſing from the relation in which man, as a being accountable for his conduct, ſtands to a God of almighty power, infinite wiſdom, and perfect juſtice. But the circumſtance of accountableneſs implies freedom of agency; for it is contrary to all our notions of right and wrong (ſee MORAL *Philoſophy*), that a man ſhould be either rewarded or puniſhed for actions which he was neceſſitated or compelled to perform.

Human actions are of three kinds: one, where we act by inſtinct, without any view to conſequences; one, where we act by will, in order to obtain ſome end; and one, where we act againſt will. It is the ſecond kind of actions only which confers upon the agent merit or demerit. With reſpect to the firſt, he acts blindly (ſee INSTINCT), without deliberation or choice; and the external act follows from the inſtinctive impulſe, no leſs neceſſarily than a ſtone by its gravity falls to the ground. With reſpect to the laſt, he is rather an inſtrument than an agent; and it is univerſally allowed, that were a ſtrong man to put a ſword into the hand of one who is weaker, and then to force it through the body of a third perſon, he who held the ſword would be as guiltleſs of the murder as the ſword itſelf. To be entitled to rewards, or liable to puniſhment, a man muſt act voluntarily; or in other words, his actions muſt proceed from that energy of mind which is termed *volition*; and, we believe, it has never been denied, that all men have power to do whatſoever they *will*, both with reſpect to the operations of their minds and the motions of their bodies, uncontrouled by any foreign principle or cauſe. "Every man (ſays Prieſtley) is at liberty to turn his thoughts to whatever ſubject he pleaſes, to conſider the reaſons for or againſt any ſcheme or propoſition, and to reflect upon them as long as he ſhall think proper; as well as to walk wherever he pleaſes, and to do whatever his hands and other limbs are capable of doing." Without ſuch liberty as this, morality is inconceivable. 277 Every man has power to do what he wills:

But though philoſophers have in general agreed with reſpect to the power which a man has to perform ſuch actions as he wills, they have differed widely in opinion reſpecting the nature of his volitions. That theſe are the reſult of motives, has ſeldom if ever been queſtioned; but whether that reſult be neceſſary ſo as that the agent has no ſelf-determining power to decide between different motives, has been warmly diſputed by men equally candid, impartial, and intelligent. The principal writers on the ſide of neceſſity are, Hobbes, Collins, Hume, Leibnitz, Lord Kames, Hartley, Edwards, Prieſtley, and perhaps Locke. On the other ſide are Clarke, King, Law, Reid, Butler, Price, Bryant, Wollaſton, Horſley, Beattie, and Gregory, 278 But different opinions entertained of the freedom of volition.

(Q) It was by ſuch arguments that Socrates reaſoned himſelf into the belief of a future ſtate of rewards and puniſhments. He was ſingular, as we have already obſerved, in this belief; and he was as ſingular in confining himſelf to the ſtudy of morality. "What could be the cauſe of this belief, but this reſtraint, of which his belief was a natural conſequence? For having confined himſelf to morals, he had nothing to miſlead him; whereas the reſt of the philoſophers, applying themſelves with a kind of fanaticiſm to *phyſics* and *metaphyſics*, had drawn a number of abſurd, though ſubtle, concluſions, which directly oppoſed the conſequences of thoſe moral arguments."
Warburton's Div. Leg. vol. ii.

gory, &c. To give a ſhort view of this celebrated queſtion, is all that our limits will permit; and as we do not think ourſelves competent to ſettle the diſpute, it were perhaps a thing deſirable to give the oppoſite reaſonings in the words of thoſe eminent authors themſelves. It muſt, however, be obvious to the reader, that the ſtyle and manner of ſo many different writers are extremely various, and that to introduce them all into our abſtract, would make the whole a maſs of confuſion. We ſhall, therefore, ſelect one writer to plead the cauſe of neceſſity, ſupplying his defects from thoſe who, though inferior to him on the whole, may yet have argued more ably on ſome particular points which the queſtion involves: and to this combined reaſoning we ſhall ſubjoin ſuch anſwers as to us appear moſt concluſive. Hartley, Hume, and Prieſtley, are perhaps the moſt profound reaſoners on the ſide of neceſſity; but there is ſo much more perſpicuity in the arguments of Lord Kames, that we cannot help preferring them, as being on the whole better calculated to give the ordinary reader a fair view of the ſubject.

279 Scheme of neceſſity, according to Lord Kames.

"Into actions done with a view to an end (ſays his lordſhip *), deſire and will enter: deſire to accompliſh the end goes firſt; the will to act, in order to accompliſh the end, is next; and the external act follows of courſe. It is the will then, that governs every external act done as a mean to accompliſh an end; and it is deſire to accompliſh the end that puts the will in motion; deſire, in this view, being commonly termed the *motive* to act. But what is it that raiſes deſire? The anſwer is ready: It is the proſpect of attaining ſome agreeable end, or of evading one that is diſagreeable. And if it be inquired, what makes an object agreeable or diſagreeable? the anſwer is equally ready: It is our nature that makes it ſo. Certain viſible objects are agreeable, certain ſounds, and certain ſmells: other objects of theſe ſenſes are diſagreeable. But there we muſt ſtop; for we are far from being ſo intimately acquainted with our own nature as to aſſign the cauſes.

* *Sketches of the Hiſtory of Man*, Book iii. Sketch 2. part 1. ſect. 8.

"With reſpect to inſtinctive actions, no perſon, I preſume, thinks that there is any freedom. With reſpect to voluntary actions, done in order to produce ſome effect, the neceſſity is the ſame, though leſs apparent at firſt view. The external action is determined by the will: the will is determined by deſire; and deſire by what is agreeable or diſagreeable. Here is a chain of cauſes and effects, not one link of which is arbitrary, or under command of the agent: he cannot will but according to his deſire; he cannot deſire, but according to what is agreeable or diſagreeable in the objects perceived: nor do theſe qualities depend on his inclination or fancy; he has no power to make a beautiful woman ugly, nor to make a rotten carcaſs ſmell ſweetly.

"Many good men, apprehending danger to morality from holding our actions to be neceſſary, endeavour to break the chain of cauſes and effects above mentioned; maintaining, that whatever influence deſire or motives may have, it is the agent himſelf who is the cauſe of every action; that deſire may adviſe, but cannot command; and, therefore, that a man is ſtill free to act in contradiction to deſire and to the ſtrongeſt motives.

"That a being may exiſt which in every caſe acts blindly and arbitrarily, without having any end in view, I can make a ſhift to conceive: but it is difficult for me even to imagine a thinking and rational being, that has affections and paſſions, that has a deſirable end in view, that can eaſily accompliſh this end; and yet after all can fly off or remain at reſt, without any cauſe, reaſon, or motive, to ſway it. If ſuch a whimſical being can poſſibly exiſt, I am certain that man is not that being. There is not perhaps a perſon above the condition of a changeling, but can ſay *why* he did ſo and ſo, what moved him, what he intended. Nor is a ſingle fact ſtated to make us believe that ever a man acted againſt his own will or deſire, who was not compelled by external force.—On the contrary, conſtant and univerſal experience proves, that human actions are governed by certain inflexible laws; and that a man cannot exert his ſelf-motive power but in purſuance of ſome deſire or motive.

"Had a motive always the ſame influence, actions proceeding from it would appear no leſs neceſſary than the actions of matter. The various degrees of influence that motives have on different men at the ſame time, and on the ſame man at different times, occaſion a doubt, by ſuggeſting a notion of chance. Some motives, however, have ſuch influence as to leave no doubt: a timid female has a phyſical power to throw herſelf into the mouth of a lion roaring for food; but ſhe is withheld by terror no leſs effectually than by cords: if ſhe ſhould ruſh upon a lion, would not every one conclude that ſhe was frantic? A man, though in a deep ſleep, retains a phyſical power to act, but he cannot exert it. A man, though deſperately in love, retains a phyſical power to refuſe the hand of his miſtreſs; but he cannot exert that power in contradiction to his own ardent deſire, more than if he were faſt aſleep. Now, if a ſtrong motive have a neceſſary influence, there is no reaſon for doubting, but that a weak motive muſt alſo have its influence, the ſame in kind, though not in degree. Some actions indeed are ſtrangely irregular; but let the wildeſt actions be ſcrutinized, there will always be diſcovered ſome motive or deſire, which, however whimſical or capricious, was what influenced the perſon to act. Of two contending motives, is it not natural to expect that the ſtronger will prevail, however little its exceſs may be? If there be any doubt, it muſt ariſe from a ſuppoſition, that a weak motive may be reſiſted arbitrarily. Where then are we to fix the boundary between a weak and a ſtrong motive? If a weak motive can be reſiſted, why not one a little ſtronger, and why not the ſtrongeſt? Between two motives oppoſing each other, however nearly balanced, a man has not an arbitrary choice but muſt yield to the ſtronger. The mind, indeed, fluctuates for ſome time, and finds itſelf in a meaſure looſe: at laſt, however, it is determined by the more powerful motive, as a balance is by the greater weight after many vibrations.

"Such, then, are the laws that govern our voluntary actions. A man is abſolutely free to act according to his own will; greater freedom than which is not conceivable. At the ſame time, as man is made accountable for his conduct to his Maker, to his fellow creatures, and to himſelf, he is not left to act arbitrarily; for at that rate he would be altogether unaccountable: his will is regulated by deſire; and deſire by what pleaſes or diſpleaſes him.—Thus, with regard to human conduct, there is a chain of laws eſtabliſhed by nature; no one link of which is left arbitrary. By that wiſe ſyſtem, man is made accountable; by it he is made a fit ſubject for divine and human government: by it perſons of ſagacity foreſee the conduct of others; and by it the preſcience of the Deity with reſpect to human actions is clearly eſtabliſhed."

Of the doctrine of neceſſity, a more perſpicuous or plauſible view than this is not to be found in any work with which we are acquainted. It is indeed defective, perhaps, as his lordſhip only *hints* at the *nature* of that relation which ſubſiſts between motive and action; but from his comparing the fluctuations of the mind between two contending motives, to the vibrations of a balance with different weights in the oppoſite ſcales, there is no room to doubt but that he agreed exactly in opinion with Mr Hume and Dr Prieſtley. Now, both theſe writers hold, that the relation of motives to volition and action, is the very ſame with that which ſubſiſts between cauſe and effect in phyſics, as far as they are both known to us.

280 Mr Hume, and

"It is univerſally allowed (ſays Mr Hume *), that matter, in all its operations, is actuated by a neceſſary force; and that every natural effect is ſo preciſely determined by the energy of its cauſe, that no other effect, in ſuch particular circumſtances, could poſſibly have reſulted from it. The degree and direction of every motion is, by the laws of nature, preſcribed with ſuch exactneſs, that a living creature may as ſoon ariſe from the ſhock of two bodies, as motion in any other degree or direction than what is actually produced by it. Would we, therefore, form a juſt and preciſe idea of *neceſſity*, we muſt conſider whence that idea ariſes, when we apply it to the operation of bodies. But our idea of this kind of neceſſity and cauſation ariſes entirely from the uniformity obſervable in the operations of nature, where ſimilar objects are conſtantly conjoined together, and the mind is determined by cuſtom to infer the one from the appearance of the other. Theſe two circumſtances form the whole of that neceſſity which we aſcribe to matter. Beyond the *conſtant conjunction* of ſimilar objects, and the conſequent *inference* from one to the other, we have no notion of any neceſſity or connexion." He then gives a pretty long detail to prove a great uniformity among the actions of men in all nations and ages; and concludes that part of his argument with affirming, "not only that the conjunction between motives and voluntary actions is as regular and uniform as that between the cauſe and effect in any part of nature; but alſo, that this regular conjunction has been univerſally acknowledged among mankind, and has never been the ſubject of diſpute either in philoſophy or common life." He afterwards obſerves, "That men begin at the wrong end of this queſtion concerning liberty and neceſſity, when they enter upon it by examining the faculties of the ſoul, the influence of the underſtanding, and the operations of the will. Let them firſt diſcuſs a more ſimple queſtion, namely, the operations of body, and of brute unintelligent matter, and try whether they can there form any idea of cauſation and neceſſity, except that of a conſtant conjunction of objects, and ſubſequent inference of the mind from one to another. If theſe circumſtances form in reality the whole of that neceſſity which we conceive in matter, and if theſe circumſtances be alſo univerſally acknowledged to take place in the operations of the mind, the diſpute is at an end; at leaſt muſt be owned to be thenceforth merely verbal. When we conſider how aptly *natural* and *moral* evidence link together, and form only one chain of argument, we ſhall make no ſcruple to allow that they are of the ſame nature, and derived from the ſame principles.—Between a connected chain of natural cauſes and voluntary actions, the mind feels no difference in paſſing from one link to another; nor is leſs certain of a future event which depends upon motives and volitions, than if it were connected with the objects preſent to the memory and ſenſes by a train of cauſes, cemented together by what we are pleaſed to call a *phyſical* neceſſity. The ſame experienced union has the ſame effect on the mind, whether the united objects be motives, volition and action, or figure and motion. We may change the names of things, but their nature and their operation on the underſtanding never change."

* *Inquiry concerning Human Underſtanding*, ſect. 8.

281 Dr Prieſtley.

Dr Prieſtley, in words a little different, teaches the very ſame doctrine which was taught by Mr Hume.—"In every determination of the mind (ſays he *), or in caſes where volition and choice are concerned, all the previous circumſtances to be conſidered are the *ſtate of mind* (including *every thing belonging to the will itſelf*), and the *views of things* preſented to it; the latter of which is generally called the *motive*, though under this term ſome writers comprehend them both. To diſtinguiſh the *manner* in which events depending upon *will* and *choice* are produced, from thoſe in which no volition is concerned, the former are ſaid to be produced *voluntarily*, and the latter *mechanically*. But the ſame general maxims apply to them both. We may not be able to determine *à priori* how a man will act in any particular caſe; but it is becauſe we are not particularly acquainted with his *diſpoſition of mind*, *preciſe ſituation*, and *views of things*. But neither can we tell in which way the wind will blow to-morrow, though the *air* is certainly ſubject to no other than neceſſary laws of motion.

"It is univerſally acknowledged, that there can be no effect without an adequate cauſe. This is even the foundation on which the only proper argument for the being of a God reſts. And the neceſſarian aſſerts, that if, in any given ſtate of mind, with reſpect both to *diſpoſition* and *motives*, two different determinations or volitions be poſſible, it can be ſo on no other principle, than that one of them ſhall come under the deſcription of an *effect without a cauſe*; juſt as if the beam of a balance might incline either way, though loaded with equal weights. It is acknowledged, that the mechaniſm of the balance is of one kind, and that of the mind of another; and, therefore, it may be convenient to denominate them by different words; as, for inſtance, that of the balance may be termed a *phyſical*, and that of the mind a *moral* mechaniſm. But ſtill, if there be a *real mechaniſm* in both caſes, ſo that there can be only one reſult

* *The Doctrine of Philoſophical Neceſſity illuſtrated.*

reſult from the ſame previous circumſtances, there will be a *real neceſſity*, enforcing an abſolute certainty in the event. For it muſt be underſtood, that all that is ever meant by *neceſſity in a cauſe*, is that which produces *certainty in the effect*."

Such is the nature of human volitions, according to every neceſſarian of eminence who has written on the ſubject ſince the days of Hobbes: and if this theory be juſt, if there be a conſtant and inſeparable conjunction of motives and actions ſimilar to that of cauſe and effect in phyſics, it is obvious, that in volition the mind is as inert as body is in motion.

282 View of human liberty.

This conſequence is indeed avowed and inſiſted upon by Hume, Prieſtley, and their adherents; whilſt the advocates for human liberty, on the other hand, contend for an abſolute exemption of the will from all internal *neceſſity*, ariſing from its own frame and conſtitution, the impulſe of ſuperior beings, or the operations of objects, reaſons, or motives, &c. By this they do not mean, that between motives and volitions there is no relations whatever, or that a man can ever chooſe evil as evil, or refuſe good as good. Such an aſſertion would be contrary to conſciouſneſs and univerſal experience. But what they endeavour to prove is, that the conjunction of motive and volition is not inſeparable, like that of cauſe and effect in phyſics; that a man may in moſt caſes chooſe according to any one of two or more motives preſented to his view; that by chooſing any thing, he may make it in ſome meaſure agreeable by his own act, or, to ſpeak more properly, may bend his deſire to it; that in volition, the mind is not inert; and that, therefore, we are under no *neceſſity* to act in a particular manner in any given caſe whatever.

That the conjunction of motive and action is not conſtant like that of cauſe and effect in phyſics, and that by conſequence the mind in forming volitions is not inert, has been evinced by Dr Gregory with the force and preciſion of mathematical demonſtration.—Former writers on the ſide of liberty had often obſerved, that upon the ſuppoſition of the *inertia* of mind, a man, with equal and oppoſite motives preſented at once to his view, would, during their continuance, remain perfectly at reſt, like a balance equally loaded in both ſcales. The obſervation is admitted to be juſt by all the advocates for neceſſity; but they contrive to evade its conſequences, by denying that in any given caſe a man can be at once aſſailed by two equal and oppoſite motives. Thus, when it is ſaid that a porter, ſtanding with his face due north, muſt remain in that poſition at perfect reſt, as long as equal motives ſhall at once be offered to him for travelling eaſtward and weſtward, the neceſſarians admit the force of the argument; but when it is added that a guinea, offered for every mile that he ſhould travel in each of theſe oppoſite directions, ought therefore to fix him at reſt till one of the offers be withdrawn, they deny that the deſire of gaining the guineas is the *whole* of the motives which operate upon his mind. He may have, ſay they, ſome ſecret reaſon which we cannot diſcern for preferring the one direction to the other; and that reaſon, added to the guinea, will make him go eaſtward or weſtward, juſt as an ounce thrown into either ſcale of a balance poiſed by equal weights will make that ſcale preponderate. Though we think that this ſolution of the difficulty can ſatisfy no man who is not already biaſſed to the neceſſarian ſyſtem; and though, even were it to be admitted, it ſeems to militate againſt the conſtant conjunction of motives and actions, unleſs it can be proved that the porter muſt travel the road which he has been neceſſitated to chooſe with reluctance and a heavy heart; yet as it may admit of endleſs quibbling upon ambiguous words, the philoſophical world is much indebted to Dr Gregory †, for an argument which, in our opinion, can neither be overturned nor evaded, and which demonſtrates that the conjunction of motive and action cannot be conſtant and inſeparable, like that of cauſe and effect in phyſics.

† *Eſſay on the Relation between Motive and Action.*

283 Demonſtration that the conjunction of motive and action is conſtant.

His reaſoning is to this purpoſe: Suppoſe a porter to be offered a guinea for every mile that he ſhall travel directly eaſtward. If there be no phyſical cauſe or moral motive to keep him at reſt, or to induce him to move in another direction, there cannot be a doubt, upon either hypotheſis, but he will gladly embrace the propoſal, and travel in the direction pointed out to him, till he ſhall have gained as much money as to ſatisfy his moſt avaricious deſires. The ſame thing would have happened, if a guinea had been offered for every mile that he ſhould travel due ſouth. In theſe two caſes taken ſeparately, the relation between the man's motions and his actions would be ſtrikingly analogous to that between a ſingle impulſe and motion in phyſics. Let us now ſuppoſe the two offers to be made at the ſame inſtant, and the man to be aſſured that if he travel eaſtward he can have no part of the reward promiſed for his travelling to the ſouth, and that if he travel ſouthward he can have no part of the reward promiſed for his travelling to the eaſt. What is he to do in this caſe? If his mind be inert in volition, and if the two motives operate upon him with the ſame neceſſity that cauſes operate in phyſics, it is obvious that the man could travel neither towards the eaſt nor towards the ſouth, but in a diagonal direction from north-weſt to ſouth-eaſt; and this he muſt do *willingly*, although perfectly ſatisfied that he could gain nothing by his journey. As this inference is contrary to fact and univerſal experience, the doctor very juſtly concludes that the premiſes, from which it is deduced by mathematical reaſoning, muſt be falſe and abſurd; or, in other words, that the relation between motive and action cannot be that of conſtant conjunction, like the relation between cauſe and effect in phyſics.

He uſes many arguments of the ſame kind, and equally convincing, to prove the abſurdity of ſuppoſing the inertneſs of mind, and only an occaſional conjunction of motives and actions; but we forbear to quote them, both becauſe we wiſh his book to be read, and becauſe we think the ſingle argument which we have borrowed from him ſufficient to demoliſh the theory of Prieſtley and Hume, which reſts wholly upon the hypotheſis of the *conſtant* conjunction of motive and action.

But is it then not really true, that the external action is determined by the will, the will by deſire, and deſire by what is agreeable or diſagreeable? That the external action is univerſally determined by the will, is certainly true; but that the will is neceſſitated and univerſally determined by the deſire is as certainly falſe. If Potiphar's

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Potiphar's wife was handſome, and made her propoſal to Joſeph with any degree of female addreſs; and if his conſtitution was like that of other young men; there cannot be a doubt but that he felt a *deſire* to do what ſhe requeſted of him: yet we know that he *willed* to do otherwiſe, and in direct oppoſition to his *deſire* fled from the room. Perhaps it may be ſaid, that his volition to flee was the effect of a contrary and ſtronger *deſire* not to ſin againſt God; but this is confounding the reader, by calling two energies of mind, between which there is little or no ſimilarity, by the ſame name. He perceived, or knew, that to comply with his miſtreſs's requeſt would be to ſin againſt God; he knew that he ought not to ſin againſt God, and therefore he choſe or determined himſelf not to do it. We can eaſily conceive how the preſence, attitudes, and addreſs, of the lady might be agreeable to him, and excite deſire. There may very poſſibly be more than one of our readers, who, during the courſe of their lives, have experienced ſomething of the ſame kind: but could abſtract truth be in the ſame way agreeable, ſo as to excite in his mind a *deſire* of virtue ſufficient to annihilate or baniſh the *deſire* of the woman? As well may it be ſaid that one ſenſation can annihilate another, that the beautiful colours of the rainbow can remove the ſenſation of ſtench from the mind of him who is plunged into the midſt of a dunghill, or that the ſmell of a roſe can make a man inſenſible to the pain of a ſtroke inflicted by a bludgeon. Senſitive deſire, and the perception of duty, are things ſo totally different, that to conſider them as operating againſt each other, like different weights in the oppoſite ſcales of a balance, is as abſurd as to ſuppoſe that ſound can operate againſt colour, or colour againſt ſmell. A man may prefer ſound to colour, or colour to ſmell, and act accordingly; but the determination muſt be wholly his own, unleſs theſe two ſenſations be themſelves either agents or phyſical cauſes of the *ſame kind*, like the weights in the oppoſite ſcales of the balance.

284 Men do not always determine themſelves by the ſtrongeſt motive.

The advocates for liberty do not pretend, that in matters of importance a man ever acts without ſome motive or reaſon for his conduct. All that they inſiſt upon is, that between two or more motives of different kinds he has a liberty of choice, and that he does not always determine himſelf by that which he knows to be the greateſt. Without ſuch freedom, they think men might be often brought into ſituations where they could not act at all, and where inaction would at the ſame time be in the higheſt degree abſurd. Thus, were two bags of gold containing each a thouſand or ten thouſand guineas, to be placed on the ſame table, before a man whoſe family is periſhing for want, and were the man to be told that he might take either of them, but not both, is it conceivable that he would be held in perpetual ſuſpence between the two? No; he would inſtantly and with alacrity take up one of them, without feeling the leaſt regret for the want of the other. This action would, indeed, be the conſequence of a very powerful motive, the deſire to obtain honeſtly that wealth of which he and his family ſtood ſo much in need. That motive, however, being general, would draw him equally to both bags; and it remains with the neceſſarians to ſay by what elſe than a ſelf-determining power he could take either the one or the other. When it is affirmed, that ſuch ſelf-determination would be an effect without a cauſe, the advocates for liberty cannot help thinking that their antagoniſts are guilty of advancing as an argument a *petitio principii;* for the affirmation is true, only if the mind in volition be inert, and the *inertia* of the mind is the ſole queſtion at iſſue. If the mind be not inert, it is plain, that in conſequence of a man's ſelf-determination, no effect would be produced without a ſufficient cauſe. At any rate, motives cannot be cauſes. In the proper ſenſe of the word, a cauſe is that which produces an effect; but the production of an effect requires active power; and power being a quality, muſt be the quality of ſome being by whom it may be exerted. Power may be dormant, and therefore power without will produces no effect. Are motives, then, real beings endowed with power and will? No; they are only views of things or mental conceptions, which in the ſtricteſt ſenſe of the word are paſſive; and between two motives the mind determines itſelf, without receiving an impulſe from either.

Nor is it only between motives of equal force that men have the power of determining themſelves. Whoever believes in a future ſtate of rewards and puniſhments, and yet acts in a manner which he knows to be offenſive to Him who is to be the future and final judge, unqueſtionably prefers to the ſtrongeſt of all motives, another which even to himſelf appears to have comparatively but very little ſtrength. Whether there be men who occaſionally act in this manner, is a queſtion which can be decided only by an appeal to every one's conſciouſneſs. That there are, we can have no doubt; for we never met with a ſingle individual, not biaſſed by ſyſtem, who was not ready to acknowledge, that during the courſe of his life he had done many things, which at the time of action he clearly perceived to be contrary to his true intereſt. Without a ſelf determining power in the mind, this could never be the caſe. Did motives operate with the neceſſity of phyſical cauſes, it is obvious that in every poſſible ſituation the ſtrongeſt muſt conſtantly prevail; and that he who in certain circumſtances had in time paſt done any particular thing, would on a return of the ſame circumſtances do the very ſame thing in every time future. Dr Prieſtley, indeed, wiſhes to perſuade his readers that this is actually the caſe. "In every determination of the mind (ſays he), or in caſes where volition and choice are concerned, all the previous circumſtances to be conſidered are the *ſtate of mind* (including) *every thing belonging to the will itſelf*), and the various views of things preſented to it;" and he affirms, that "whenever the ſame preciſe circumſtances occur twice, the very ſame determination or choice will certainly be made the ſecond time that was made the firſt." This is an aſſertion of which no man can controvert the truth; for it is an identical propoſition. If in the circumſtances previous to the determination of the mind, *every thing* belonging to the *will itſelf* muſt be included, it is ſelf-evident that he who in any given circumſtances has acted a particular part, will on a return of theſe circumſtances act the ſame part a ſecond time; for this is only ſaying, that he who on two different occaſions ſhall exert volitions of the ſame tendency, will not on theſe occaſions exert volitions of which the tendencies are different. But the queſtion to

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to be decided is, Whether a man, in the ſame general ſtate of mind, poſſeſſed of the ſame degree of health, and conſcious of the ſame appetites, muſt, in external circumſtances perfectly alike, neceſſarily exert at all times the ſame volitions. That the human mind is under no ſuch neceſſity, we think every man's conſciouſneſs and experience may abundantly ſatisfy him; for there are, perhaps, but very few who have not at one time reſiſted temptations, to which at another they have choſen to yield.

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If they did, folly as well as merit and demerit would be baniſhed from the world.

That there is a relation between motives and actions, muſt be confeſſed; but that relation is neither *neceſſity*, nor conſtant conjunction. If it were, all actions would be perfectly rational; and folly, as well as merit and demerit, would be baniſhed from the conduct of men. What is the particular nature of that relation which ſubſiſts between the voluntary actions of men, and the motives from which they proceed, can be known to every individual only by an attentive and unbiaſſed reflection on the operations of his own mind. Without this reflection, no man can be made to underſtand it by the reaſonings of philoſophers, and with it no man can need the aid of thoſe reaſonings. That a ſelf-determining power, ſuch as that for which we plead, contributes to the ſum of human happineſs, has been ſhown by Archbiſhop King and his ingenious tranſlator; who have proved, with the force of demonſtration, that the mind can take pleaſure in the object of its choice, though that object be in itſelf neither agreeable nor diſagreeable to our natural appetites; and that if it could not, it would be in vain in ſuch a world as ours to hope for any portion of felicity. Into that detail our limits will not permit us to enter: but to the reader who wiſhes for further information, we beg leave to recommend the laſt edition of King's Origin of Evil, by Dr Law late biſhop of Carliſle; without, however, vouching for the truth of all the opinions advanced by either of thoſe learned writers.

Before we conclude this chapter, it may be proper to obſerve, that it is only in volition that we are conſcious of any original active power in ourſelves, and that without ſuch conſciouſneſs we could never have acquired the *notion* of active power. In our deſires and appetites, we neither are active nor ſuppoſe ourſelves active. Lord Kames, and moſt neceſſarians, confound deſire with volition; but that they are perfectly diſtinct is plain from this circumſtance, that we daily *deſire* many things which we know to be wholly *out* of our own power*, whereas no man ever *willed* what he did not believe to be *in* his own power. We all *deſire* or wiſh that our children may be virtuous, wiſe, and happy; and though we are conſcious that it is not in our power to make them ſo, we cannot baniſh the deſire from our breaſts. But madmen only have ever *willed* virtue, wiſdom, and happineſs, to any perſon; and if there was ever a man ſo extravagantly mad as to exert ſuch a volition as this, he has at the time fancied himſelf a divinity, and therefore believed that the object of his volition depended upon himſelf. When the aſtronomer, whoſe character is ſo admirably drawn by our great maſter of moral wiſdom †, fancied himſelf the regulator of the weather and the diſtributor of the ſeaſons, he might *will* either *rain* or *ſunſhine* as he thought proper, becauſe he conſidered the object of his volition as depending upon a power imparted to him from heaven; but though he might *deſire* he could not *will*, the riſing or the falling of *winds*, for theſe he confeſſed were not ſubjected to his authority. In a word, without freedom in volition, power is inconceivable; and therefore it is as certain that we are free agents, as that we have any notion of active powers.

* Reid's Eſſays on the Active Powers of Man.

† Raſſelas Prince of Abyſſinia.

Of the Being and Attributes of God.

Chap. VI. *Of the* Being *and* Attributes *of* God.

It has been already obſerved, that as of bodies there are various kinds, endowed with various properties; ſo the probability is, that of minds endowed with different powers, or different degrees of power, the variety may be as great, or perhaps greater. The exiſtence and powers of our own minds are made known to us by conſciouſneſs and reflection; and from our dependent ſtate, and the mutability of the objects around us, we are neceſſarily led to infer the exiſtence of another mind, which is independent, unchangeable, eternal, and the cauſe of all things which have a beginning of exiſtence. Between that mind and our own, we can hardly avoid believing that there are many orders of "thrones, dominations, princedoms, virtues, powers;" but as we have no intuitive knowledge of ſuch intermediate beings, and cannot from any thing which we perceive diſcern the *neceſſity* of their exiſtence, they are not properly the object of ſcience. The exiſtence however, and many of the attributes, of One Firſt Cauſe, are capable of the ſtricteſt demonſtration; "for the inviſible things of Him from the creation of the world are clearly ſeen, being underſtood by the things which are made."

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The exiſtence of God capable of demonſtration.

Of this great truth, the moſt important by far which can occupy the mind of man, many demonſtrations have been given both by divines and by philoſophers. We ſhall lay before our readers ſuch a one as to us appears perfectly concluſive, being founded on the intuitive knowledge which we have of our own exiſtence, and therefore independent of all theories about the nature and reality of the material world.

Every man, whether he adopt the common theory or that of Berkeley reſpecting matter, is conſcious that he *himſelf* exiſts, and muſt therefore grant that *ſomething now* exiſts. But, if any thing exiſts *now* *, then muſt ſomething have *always* exiſted; otherwiſe that thing which *now* exiſts, muſt either have been created by *nothing*, i. e. have been *cauſed by no cauſe*, or elſe it muſt have *created itſelf*, acting before it exiſted. Both theſe ſuppoſitions are ſo palpably abſurd, that no atheiſt has avowed them, either among the ancients or the moderns. We muſt therefore admit, either that there is ſome one *independent* being, which now exiſts, and always has exiſted; or that the things which we know to exiſt at preſent (every man's *ſelf* for inſtance), were produced by *ſomething* which had its *exiſtence* from *ſomething elſe*, which alſo depended upon *ſome other cauſe*, and ſo on in an *infinite ſeries of cauſed* or *ſucceſſive beings*. But this laſt ſuppoſition, though it has been often made, is as groſsly abſurd as either of the two former. For of this infinite ſeries, either *ſome one* part has *not* been ſucceſſive to any other, or

* See *Notes to King's Origin of Evil.*

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Some one independent Being has exiſted from eternity.

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or else *all* the several parts of it have been successive. If some one part of it was *not successive*, then it had a *first part*; which destroys the supposition of its infinity (R). If *all* the several parts of it have been successive, then have they all once been *future*; but if they have *all* been future, a time may be conceived when none of them had existence: and if so, then it follows, either that all the *parts*, and consequently the *whole* of this infinite series, must have arisen from *nothing*, which is absurd; or else that there must be something in the *whole* besides what is contained in *all the parts*, which is also absurd.

As the possibility or impossibility of an infinite series of dependent beings is the main question at issue between the atheists and us, we shall state the preceding reasoning in a manner somewhat different. For this purpose, let us suppose some one to affirm, that the course of generation has had no beginning, and consequently that the number of successive births has been infinite. We would ask such a person, Whether before the birth of Abraham, for example *, there had past an infinite series of generations or not? If not, the course of generation must have had a beginning, which is the conclusion for which we contend. But if the series past was infinite, then at the birth of Joseph the great-grandson of Abraham, it is evident, that more generations were past, and that the number then was greater than that which was supposed to be infinite; so that upon this supposition we have a number that is both infinite and not infinite, which is a manifest contradiction. Should it be said that the number of generations was infinite, as well at the birth of Abraham as at the birth of Joseph; it will then follow, that one infinite may be greater than another of the very same kind; and consequently that an infinite may be bounded, *i. e.* be finite. But should it be alleged, that the number of births at Abraham's was finite, and became infinite when it reached to Joseph's, it will then follow, that one finite number added to another may make an infinite number, which is directly contrary to every possible notion of infinity. We might argue in the same manner against an infinite series of every kind, the very supposition of which involves the most palpable contradictions. See Chap. *Of* INFINITY *and* ETERNITY.

* See an *Essay towards an Eviction of the Being and Attributes of God, by Seth Ward* —Printed at Oxford, 1655.

288 whose duration is not commensurate with succession, and

From the impossibility of an infinite series it necessarily follows, that there exists, and must have existed from eternity, some one independent being, whose duration cannot be commensurate with succession, and to whom the relation of time is not applicable. Here will some atheists presently imagine, that by the same mode of reasoning they may disprove the existence of God: for do not they who thus destroy the eternity of the world, destroy at the same time the eternity of the Creator? If time itself be not eternal, how can the Deity or any thing else be so?

In urging these questions, it must be taken for granted that time is essential to all existence, and that God cannot be eternal otherwise than by a successive flux of infinite time. But it has been already shown (N° 224.), that successive duration is not essential to existence; that we can even *conceive* existence without succession; and it may here be added, that if we suppose a perfect being alone in nature, we shall find it impossible to imagine any *succession of ideas*, any *flux of moments*, or any *alteration* or *increase* whatever in his knowledge and essence. Such duration as we are acquainted with can have no relation to an immutable Being, while supposed to exist alone; but as soon as he determined to exercise his several attributes in the production of something distinct from himself, then, and not till then, have we reason to think that *time*, *succession*, and *increase*, began. These atheistical questions, therefore, instead of containing an objection to the existence of a Deity, afford a plain demonstration of it: for since it is not more evident that something now exists than that something must have existed from eternity; and since it has been shown, that neither the world in its present state, nor time, nor any thing capable of change or succession, can possibly be eternal; it follows, that there must necessarily be some Being who, in the order of nature, is before time, and who, in the stability and immutable perfection of his own intelligence, comprehends at once his *yesterday*, *to-day*, and *for ever*. "The atheists (says the excellent Cudworth *) can here only smile, or make wry faces, and show their little wit in quibbling upon *nunc-stans*, or a *standing now of eternity*; as if that *standing eternity* of the *Deity* (which with so much reason hath been contended for by the ancient *genuine theists*) were nothing but a *pitiful small moment of time standing still*, and as if the duration of all beings whatsoever must needs be like our own: whereas the duration of every thing must of necessity be agreeable to its nature; and therefore, as that whose *imperfect nature* is ever *flowing* like a river, and consists in *continual motion* and *changes* one after another, must needs have accordingly a *successive* and *flowing duration* sliding perpetually from *present* into *past*, and always hasting on towards the *future*, expecting something of itself which is not yet in being; so must that whose perfect nature is *essentially immutable* have *permanent and unchanging duration*, never losing any thing of itself once present, nor yet running forward to meet something of itself which is not yet in being."

* *Intellectual System*, book i. chap. 5.

From the eternity of the Supreme Being we necessarily infer his independence or self-existence; for that which never had a *beginning* of existence cannot possibly have any cause of that existence, or in any manner depend upon any other being, but must exist of itself, or be *self-existent*. 289 who is self-existent, and

Eternity *ad partem post*, or *necessary existence*, or the impossibility of ever ceasing to be, follows from independence: For to the nature of that which exists without any cause, existence must be essential. But a being whose existence is of itself and essential to its nature, cannot be *indifferent* to existence or nonexistence, but must exist *necessarily*. And here it may be proper to observe, that the word *necessity*, when applied to existence, may be taken in two acceptations very different from each other †; either as it arises from the relation which the existence of that being, of which it is affirmed, has to the existence of *other things*; or from the relation which the *actual* existence of that thing has to the *manner* of its *own* existence. 290 cannot cease to be.

† *Notes to King on Evil*, and *Law's Inquiry into the Ideas of Space*, &c.

 In

(R) Των απειρων ουκ εϛιν ουδεν πρωτον, *Arist. Phys.* lib. viii. cap. 5. sect. 4.

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291 What is meant by necessary existence.

In the former sense, when necessity of existence has relation to the existence of other things, it denotes that the supposition of the *non*-existence of that thing of which necessity is affirmed, implies the nonexistence of things which we *know to exist*. Thus, some independent being does *necessarily exist;* because, to suppose *no independent* being, implies that there are *no dependent beings;* the contrary of which we know to be true.

In the second sense, when the necessity of existence arises from the relation which the actual existence of any thing has to the *manner* of its own existence, necessity means, that the thing, of which it is affirmed, exists after such a manner as that it never could in *time past* have *been nonexistent*, or can in *time future cease to be*. Thus, *every independent being*, as it exists without a cause, is *necessarily* existing; because existence is *essential* to such a being; so that it never could *begin* to exist, and never can *cease to be:* For to suppose a being to begin to exist, or to lose its existence, is to suppose a *change* from nonentity to entity, or *vice versa;* and to suppose such a change is to suppose a cause upon which that being depends. Every being, therefore, which is independent, i. e. which had no cause of its existence, must exist *necessarily*, and cannot possibly have begun to exist in time past, or cease to be in time future.

292 Only one necessarily-existent being in the former sense; and

These two kinds of necessity as applied to existence, though they have been often confounded, are in themselves perfectly distinct: For though a being cannot be necessarily existent in the *former* sense without being so in the latter also; yet may it be necessarily existent in the latter sense without being so in the former. For any thing that we know to the contrary, there may be two or more beings existing *necessarily* in the latter sense of the word *necessity*, i. e. with regard to *independence* and the *manner* of their own existence: but in the former sense of the word, i. e. in relation to *this system*, there can be but *one necessarily* existent being; for it is obvious that no more are necessary to account for the production of the *dependent* beings which we know to exist. To suppose the nonexistence of *all independent* beings, implies the nonexistence of all dependent beings, ourselves, and every thing else; but to suppose the nonexistence of all independent beings except *one*, involves in the supposition no such absurdity.

293 though there might be more than one in the latter, they would be no gods to us.

Thus the phenomena of nature lead us, by the strictest reasoning, to one first cause, which is sufficient for their production; and therefore none but *one* first cause can in this sense of the word be *necessary:* And though several more *independent* beings might possibly exist, yet they would be no gods to us: they would have no relation to us demonstrable by reason, nor we any thing to do with them. For if the supposition of their existence were not requisite to the production of this system, which it obviously would not be, we could *perceive* no necessity for it at all; we could never discover it by our own faculties, and therefore it could be nothing to us. And though two or three such beings should exist, and act in the formation and government of their *respective* systems, or *agree in one;* yet till their existence and operations were made known to us, and a natural relation discovered, nothing would be due from us to them. They would have no *religious* or *moral* relations to us; and we should have no reason to call more than one of them *our* creator, preserver, and governor, which is the proper sense of the word *God*.

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294 Impossible to demonstrate that there can be but one self-existent Being.

To show in this manner that there is only *one* eternal self-existent Being which bears the relation of *God to us*, seems to be going as far as is necessary, or as natural light will lead us. Those who endeavour to *demonstrate* that there *cannot possibly* be *more than one* self-existent Being, either reason in a circle, or proceed upon principles which their antagonists cannot be compelled to grant. When they deduce the Divine unity from independence or omnipotence, they evidently presuppose it in their definition of these attributes: and when they infer it from the nature of space and duration, which they consider as modes of the self-existent Being, they take it for granted, that space and duration have a real existence, independent of us and our thoughts; and that the one is infinite and the other eternal, contrary to what has been already proved, we think, with the force of demonstration. The celebrated Dr Clarke made much use of space and duration in his attempt to demonstrate that there can be but one self-existent Being; but he argues for the same thing from the nature of necessity as applied to existence.

295 Dr Clarke's first demonstration of the unity

"Necessity (says he *), absolute in itself, is *simple* and *uniform* and *universal*, without any possible *difference, difformity*, or *variety*, whatsoever: and all *variety* or *difference* of *existence* must needs arise from some *external* cause, and be *dependent upon it*, and *proportionable* to the efficiency of that *cause*, whatsoever it be. *Absolute necessity*, in which there can be *no variation* in *any kind* or *degree*, cannot be the *ground* of existence of a *number* of beings, however *similar* and *agreeing:* because, without any *other difference*, even *number* is itself a manifest *difformity* or *inequality* (if I may so speak) of *efficiency* or *causality*."

* *Demonstration of the Being and Attributes of God*, Prop. 7.

296 examined, and shown to be inconclusive.

Such is this great man's first argument from necessity, to prove that there cannot be more than one self-existent Being. But what is this *necessity* which proves so much? It is the ground of existence (he says) of that which exists of itself; and if so, it must, in the order of nature, and in our conceptions, be antecedent to that being of whose existence it is the ground. Concerning such *a* principle, there are but three suppositions which can possibly be made; and all of them may be shown to be absurd and contradictory. We may suppose either the *substance* itself, some *property* of that substance, or something *extrinsic* to both, to be this *antecedent ground* of existence prior in the order of nature to *the first cause*.

One would think, from the turn of the argument which here represents this antecedent necessity as *efficient* and *causal*, that it were considered as something *extrinsic* to the first cause †. Indeed if the words have any meaning in them at all, or any *force* of argument, they must be so understood, just as we understand them of any external cause producing its effect. But as an *extrinsic* principle is absurd in itself, and is besides rejected by Dr Clarke, who says expressly, that "of the thing which derives not its being from any other thing, this *necessity* or ground of existence must be *in* the thing itself," we need not say a word more of the last of these suppositions.

† *Dissertation on the Argument à priori*, added to *Law's Inquiry into the Ideas of Space, Time, Immensity*, &c.

Let

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Let us then conſider the firſt; let us take the *ſubſtance* itſelf, and try whether *it* can be conceived as *prior* or *antecedent* to itſelf in our conceptions or in the order of nature. Surely we need not obſerve that nothing can be more abſurd or contradictory than ſuch a ſuppoſition. Dr Clarke himſelf repeatedly affirms, and it would be ſtrange indeed if he did not affirm, that no *being*, no *thing* whatever, can be conceived as in any reſpect prior to the firſt cauſe.

The only remaining ſuppoſition is, that ſome *attribute* or *property* of the ſelf-exiſtent Being may be conceived as in the order of nature *antecedent* to that being. But this, if poſſible, is more abſurd than either of the two preceding ſuppoſitions. An *attribute* is *attributed* to its *ſubject* as its ground or ſupport, and *not* the *ſubject* to its *attribute*. A *property*, in the very notion of it, is *proper* to the ſubſtance to which it belongs, and *ſubſequent* to it both in our conceptions and in the order of nature. An *antecedent* attribute, or *antecedent* property, is a ſoleciſm as great, and a contradiction as flat, as an *antecedent ſubſequent* or *ſubſequent antecedent*, underſtood in the ſame ſenſe and in the ſame ſyllogiſm. Every property or attribute, as ſuch, preſuppoſes its ſubject; and cannot otherwiſe be underſtood. This is a truth ſo obvious and ſo forcible, that it ſometimes extorts the aſſent even of thoſe who upon other occaſions labour to obſcure it. It is confeſſed by Dr Clarke*, that "the ſcholaſtic way of proving the *exiſtence* of the ſelf-exiſtent Being from the abſolute perfection of his nature, is ὕστερον πρότερον. For all or any perfections (ſays he) preſuppoſe exiſtence; which is a *petitio principii.*" If therefore properties, modes, or attributes in God, be conſidered as perfections (and it is impoſſible to conſider them as any thing elſe), then, by this confeſſion of the great author himſelf, they muſt all or any of them *preſuppoſe* exiſtence. It is indeed immediately added in the ſame place, "that bare neceſſity of exiſtence does not preſuppoſe, but infer exiſtence;" which is true only if ſuch neceſſity be ſuppoſed to be a principle *extrinſic*, the abſurdity of which has been already ſhown, and is indeed univerſally confeſſed. If it be a *mode* or *property*, it muſt *preſuppoſe* the exiſtence of its ſubject, as certainly and as evidently as it is a *mode* or a *property*. It might perhaps *à poſteriori* infer the exiſtence of its ſubject, as effects may infer a cauſe; but that it ſhould infer in the other way *à priori* is altogether as impoſſible as that a *triangle* ſhould be a *ſquare*, or a *globe* a *parallelogram*.

* *Anſwer to the Sixth Letter.*

297 A ſecond demonſtration of the ſame author

Doubtful, as it would ſeem, of the force of his firſt argument, which even thoſe who pretend to be convinced by it acknowledge to be obſcure, the doctor gives a ſecond, which we muſt confeſs appears to us to be ſtill more obſcure, and if poſſible leſs concluſive. "To ſuppoſe two or more *diſtinct beings* exiſting *of themſelves* neceſſarily and *independent* of each other, implies (he ſays) this *contradiction*, that *each* of them being independent from the other, they may either of them be ſuppoſed to exiſt *alone*; ſo that it will be no contradiction to ſuppoſe the other not to exiſt; and conſequently *neither of them* will be neceſſarily exiſting. Whatſoever therefore exiſts neceſſarily is the one ſimple eſſence of the ſelf-exiſtent Being; and whatſoever differs from that is not neceſſarily exiſting, becauſe in abſolute neceſſity there can be no *difference* or *diverſity* of exiſtence.

"Neceſſity is uſed here in two different ſenſes*, both as *abſolute* and *relative*. In the former, neither of the two beings can exiſt without the other, i. e. without our ſuppoſing the other to exiſt alſo, ſince that is equally neceſſary. In the latter, either of them may exiſt alone, i. e. without the help of the other, or without the ſuppoſition of the other as requiſite to its own exiſtence. The conſequence, therefore, that either of them may exiſt alone, and ſo neither of them is neceſſary, is a mere *equivocation* on *neceſſity*, uſing it both in an abſolute and relative ſenſe at the ſame time." But as this is a queſtion of the higheſt importance, and as the author was a man of great worth, we ſhall conſider his argument upon the ſuppoſition that the word *neceſſity* has from the beginning to the end of it the ſame invariable meaning.

* *Law's Inquiry into the Ideas of Space*, &c. chap. 6.

298 examined, and ſhown to be equally inconcluſive.

It has been already obſerved, that there are only two ſenſes in which that word can be applied to the exiſtence of any being; and whether it be here uſed in the one or the other of theſe ſenſes, the reaſoning, if reſolved into a ſyllogiſm, will appear to be inconcluſive. If the word be taken in that ſenſe of neceſſity which ariſes from the relation that dependent beings which we know to exiſt bear to ſome one independent Being, the argument will ſtand thus:

> From a known effect no more cauſes can be *neceſſarily* inferred than what are ſufficient to account for that effect: but
>
> *One* ſelf exiſtent and independent Being is ſufficient to account for all the phenomena of nature; therefore, from the phenomena, &c.
>
> *No more* than *one* ſuch Being can be *neceſſarily* inferred to exiſt.

But though no more than *one* independent being can in this ſenſe of the word *neceſſarily* exiſt, it by no means follows from this ſyllogiſm, that two or more ſuch beings may not *poſſibly* exiſt. It is, indeed, a plain contradiction to ſay, that two or more ſelf-exiſtent beings are in this ſenſe *neceſſary*; but ſurely there is no contradiction in ſaying, that two or twenty ſuch beings are *poſſible*. We could not, therefore, by this argument convict a perſon of abſurdity, who ſhould affirm that two or more independent beings *actually* exiſt. We might, indeed, deny the exiſtence of them all but *one*, becauſe one is ſufficient to account for thoſe phenomena, from which alone we know that *any* independent being exiſts: but becauſe one of them might be ſuppoſed to exiſt *alone*, ſo that it would be no contradiction to ſuppoſe the other not to exiſt; we know not how the doctor came to affirm, in direct oppoſition to his own demonſtration, that *not one* of them would be neceſſarily exiſting.

Neceſſity, as applied to exiſtence, in the other ſenſe of the word, ariſes, as we have ſeen, from the relation which the *actual* exiſtence of the being, of which it may be affirmed, has to the *manner* of that being's exiſtence. It is the ſame neceſſity, we are told*, with that which is the cauſe of the unalterable proportion between two and four; and it is conſidered as the *formal* cauſe or *ground* of the exiſtence of an independent being. Were it not for the ſtrange expreſſions *formal cauſe* and *ground of exiſtence*, we ſhould have no objection to this account of that *neceſſity* by which a being independent undoubtedly exiſts: but this kind of

* *Anſwer to the Sixth Letter* from a Gentleman in Glouceſterſhire.

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of neceffity is a principle which will not fupport the fuperftructure which the learned author labours to raife upon it. The fame *neceffity* which is the caufe of the unalterable proportion between *two* and *four*, is likewife the caufe of the unalterable proportion between *three* and *fix*, between *four* and *eight*, and between *five* and *ten*, &c. But if it can be the caufe of fo many different proportions of the fame kind, why may it not be the *formal caufe* or *ground* of exiftence to as *many independent beings* of the fame kind as well as to *one?* The following fyllogifm, we apprehend, to be legitimate both in mode and figure, and its conclufion is directly contrary to the propofition which the doctor deduces from the fame notion of neceffity.

> If neceffity, confidered as a *formal caufe* or *ground of exiftence*, be in *one inftance* of its caufality the formal caufe or ground of exiftence to *many things* of the fame kind, it *may* likewife in *every other inftance* of its caufality, be the formal caufe or ground of exiftence to many things of the fame kind.
>
> But fuch neceffity, in that inftance of its caufality where it is the formal caufe or ground of exiftence to the unalterable proportion between two and four, *is* the formal caufe or ground of exiftence to *many proportions* of the fame kind.
>
> Therefore, the fame neceffity in that other inftance of its caufality, where it is faid to be the formal caufe or ground of exiftence to *one* independent being, undoubtedly *may be* the formal caufe or ground of exiftence to *many independent beings* of the fame kind.

299 Neceffity, a dangerous principle.

Thus it appears, that *neceffity*, in any fenfe in which it can be properly affirmed of exiftence, cannot be the foundation of any argument to prove the impoffibility of more than one felf-exiftent being. It is indeed a principle from which we apprehend that no pofitive conclufion whatever can be deduced by reafoning *à priori*. That neceffity of exiftence may be predicated of a being which is independent and uncreated, is felf-evident; becaufe to the *nature* of fuch a being exiftence is effential. But whilft *that nature* itfelf remains wholly *incomprehenfible* by us, it is impoffible that we fhould difcover, by our own unaffifted reafon, whether it can be the nature of *only one* or of *more than one* independent being. To argue from neceffity, as if it were the caufe or ground of exiftence to fuch a being, is certainly abfurd, if it be not impious; for if that to which exiftence is effential, does not exift without any caufe efficient or formal, we fhall be obliged to inquire after a caufe or ground of this caufe, and thus be involved in all the abfurdities and contradictions of an infinite feries. We have infifted the longer on this point, becaufe *neceffity*, as the foundation of the argument *à priori*, has fometimes been employed to very bad purpofes. Attempts have been made from the notion of *neceffary* exiftence, to prove that the Supreme Being cannot be a free agent, and to fet the firft principles of the religion of nature at variance with thofe which are revealed in the Scriptures.

300 The unity of God highly probable.

But though we are firmly perfuaded that the divine unity cannot be *demonftrated à priori*, we are far from thinking it incapable of any *proof*. On the contrary, the common arguments *à pofteriori* drawn from the *order* and *harmony* of the world, have always fatisfied us, and in our opinion muft fatisfy every perfon capable of proportioning his affent to evidence, that the Creator and Preferver of fuch a fyftem has but *one will* and *one intelligence*, and therefore is himfelf but *one being*. But *proof* is one thing, and *demonftration* is, in the proper fenfe of the word, another (G). And if we cannot arrive at *abfolute* certainty concerning this important truth by the light of nature, we ought to be the more thankful for that revelation, which has put the unity of God paft difpute to all who believe the holy Scriptures.

301 God omnipotent.

The being which is felf-exiftent and independent muft be alfo *omnipotent*. That fuch a being has *active power in fome degree*, is fhown at the fame time and by the fame medium that we prove his exiftence; and fince he depends upon no caufe for his exiftence or his power, he cannot depend upon any for the exertion of that power, and confequently no *limits* can be applied to it. Limitation is an *effect* of fome *fuperior caufe*, which in the prefent inftance there cannot be: confequently to fuppofe *limits* where there can be no *limiter*, is to fuppofe an *effect* without a *caufe*. For a being to be *limited* or *deficient* in any refpect *, is to be *dependent* in that refpect on fome *other* being which gave it juft fo much and no more; confequently that being which in *no refpect* depends upon any other is in *no refpect* limited or deficient. In all beings capable of increafe or diminution, and confequently incapable of *perfection* or *abfolute infinity*, *limitation* or *defect* is indeed a neceffary confequence of exiftence, and

* *Notes to King on Evil.*

(G) John Gerhard and John Voffius both cite *Gabriel Biel* as acknowledging the unity of God to be incapable of rigid demonftration; and with the fentiments of that fchoolman, thofe two learned divines profefs their own to agree.

Sed Biel (1. Sant. Dift. 2. Q. 10. Art. 3.), ftatuit "quod tantum *unum* effe Deum, fit *creditum* et *non-demonftratum* ratione naturali nobis in via poffibili." Id nos ita interpretamur; etiamfi ex *naturæ libro* rationes *non contemnendæ* pro *unitate* divinæ effentiæ afferenda erui poffint, eas tamen ad fidei πληροφοριαν cordibus noftris ingenerandam, non fatis efficaces effe. Ergo mens prius confirmanda eft ex *verbo Dei*, et illuftribus teftimoniis in quibus fe Deus generi humano patefecit: Poftea utiliter poteft addi confideratio philofophicarum demonftrationum. *Gerhard. Loc. Comm.* tom. i. p. 106.

Diffentit *Gabriel Biel*, qui ante annos hofce 140 *Tubingenfi* Gymnafio præfuit. Is cenfet *probabiles* magis rationes effe quam *evidentes* et *certas*.—Verum efto fane, ut folæ non fint αποδεικτικαι: At magnum iis pondus addit *traditio* vetus; tum autem quod argumenta ifthæc, fi non prorfus αποδεικτικα, faltem ufque adeo *probabilia* fint, ut της πολυθειας patroni nihil ullius momenti adferre vale a cur plufquam unum ftatuere deum potius conveniat. *Voff. de Idolatria*, lib. i. c. 2.

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and is only a *negation* of that perfection which is wholly incompatible with their nature; and therefore in theſe beings it requires no further cauſe. But in a being *naturally capable* of *perfection* or abſolute *infinity*, all *imperfection* or *finiteneſs*, as it cannot flow from the *nature* of that being, ſeems to require ſome *ground* or *reaſon*; which reaſon, as it is foreign from the being itſelf, muſt be the effect of ſome other external cauſe, and conſequently cannot have place in the *firſt cauſe*. That the ſelf-exiſtent being is *capable* of perfection or abſolute infinity muſt be granted, becauſe he is manifeſtly the ſubject of one infinite or perfect attribute, viz. *eternity*, or abſolute invariable exiſtence. In this reſpect his exiſtence has been ſhown to be perfect, and therefore it *may* be perfect in every other reſpect alſo. Now that which is the ſubject of one infinite attribute or perfection, muſt have all its attributes infinitely or in perfection; ſince to have any perfections in a finite limited manner, when the ſubject and theſe perfections are both *capable* of ſtrict *infinity*, would be the forementioned abſurdity of poſitive limitation without a cauſe. To ſuppoſe this eternal and independent being limited *in* or *by* its own *nature*, is to ſuppoſe ſome *antecedent nature* or *limiting quality* ſuperior to that being, to the exiſtence of which no *thing*, no *quality*, is in any reſpect *antecedent* or *ſuperior*. And to ſuppoſe that there is no ſuch thing as *active power* in a being which is evidently the fountain of all power, is the groſſeſt of all abſurdities. The ſame method of reaſoning will prove knowledge and every other perfection to be *infinite* in the Deity, when once we have proved that perfection to belong to him at all; at leaſt it will ſhow, that to ſuppoſe it limited is unreaſonable, ſince we can find no manner of *ground* for limitation in any reſpect; and this is as far as we need go, or perhaps as natural light will lead us.

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Omnipotence can do every thing which does not imply a contradiction.

Of the omnipotence of the ſupreme Being ſome philoſophers, as well theiſts as atheiſts, have talked very abſurdly. *Hobbes* *, with a view to make this attribute appear impoſſible and ridiculous, affirms "that God by his omnipotence or infinite power could turn a tree into a ſyllogiſm." And *Des Cartes* †, though certainly no atheiſt, childiſhly aſſerts, that all things whatever, even abſtract truth and falſehood, do ſo depend upon the arbitrary will and power of God, as that if he had pleaſed, "twice two ſhould not have been four, nor the three angles of a plain triangle equal to two right ones." But the true notion of Omnipotence, ſo far from implying a power to turn a tree into a ſyllogiſm, or to make twice two not equal to four, implies only that the being poſſeſſed of it can actually perform whatever can be conceived by the moſt perfect underſtanding; conception in this caſe being the meaſure of poſſibility. Now every thing may be conceived by a mind ſufficiently enlarged which does not involve in it a direct contradiction; but what we clearly diſcern to imply a contradiction, ſuch as that a thing may be and not be at the ſame inſtant, cannot be conceived by any intellect, or made to exiſt by any power.

* *Leviath.* chap. 3.
† *Reſponſ. ad Objectiones Sextas*, § 6.

And thus has this attribute of the Divinity been always ſtated, not only by the wiſer Chriſtians, but alſo by moſt of the ancient philoſophers themſelves, who expreſsly admit that "nothing is exempted from the divine power, but only to make that which hath been done to be undone (H)."

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Creation poſſible to Omnipotence.

And here it may be aſked, Whether creation, in the proper ſenſe of the word (ſee CREATION), be within the compaſs of infinite power. All the ancient philoſophers, who were unenlightened by the rays of divine revelation, held that it is not *; grounding their opinion upon this maxim, *Ex nihilo nihil fit.* But the maxim will ſupport no ſuch concluſion.—The ancients, or at leaſt the Peripatetic ſchool, with the metaphyſics of which we are beſt acquainted, conſidered four kinds of cauſes, the *efficient*, the *material*, the *formal*, and the *final*; and though they extended the maxim to the firſt *two*, if not to all theſe cauſes, it is a ſelf-evident truth only when applied to the *efficient cauſe*. Without the actual exertion of *power*, it is indeed moſt certain that nothing could be brought into exiſtence; but it is ſo far from being clear that pre-exiſtent matter, or, as Ariſtotle choſe to expreſs himſelf, a *material cauſe*, muſt be ſuppoſed for infinite power to operate upon, that, we think, every man may find complete evidence of the contrary in himſelf. That ſenſation, intelligence, conſciouſneſs, and volition, are not the reſult of any modifications of figure and motion, is a truth as evident as that conſciouſneſs is not ſwift, nor volition ſquare. If then theſe be the powers or properties of a being diſtinct from matter, which we think capable of the completeſt proof, every man who does not believe that his mind has exiſted and been conſcious from eternity, muſt be convinced that the power of creation has been exerted in himſelf. If it be denied that there is any immaterial *ſubſtance* in man, ſtill it muſt be confeſſed, that, as matter is not eſſentially conſcious, and cannot be made ſo by any particular organization, there is ſome real *thing* or *entity*, call it what you pleaſe, which has either exiſted and been conſcious from eternity, or been in time brought from non-entity into exiſtence by an exertion of infinite power.

* See *Moſheim's Diſſertation on this Subject, in his Edition on Cudworth's Intellectual Syſtem.*

To this perhaps ſome one may object, that upon our own ſuppoſition of the inability of the human mind to exert its faculties but in union with ſome material and organized ſyſtem, the mind of every man may have exiſted from eternity without being conſcious of its own exiſtence; and that, therefore, we have in ourſelves no evidence of *creation*, but only of the union of two ſelf-exiſtent ſubſtances, which in their prior ſtate had been diſtinct and ſeparate from each other. But ſuch an objection as this, we beg leave to reply, can ariſe from nothing but miſapprehenſion of our hypotheſis, and of the reaſons by which we think it ſupported. We ſuppoſe, that to the exertion of the human faculties, a body of ſome kind or other may be neceſſary as an inſtrument, not merely from what we obſerve of the dependence of percep-tion

(H) Το δε γεγονος ουκ ενδεχεται μη γενεσθαι· διο αγαθως Αγαθων.
Μονου γαρ αυτου και θεος στερισκεται,
Αγενητα ποιειν, άσσ᾽ αν ή πεπραγμενα. *Ariſt. ad Licomach.* lib. vi. cap. 2.

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tion and memory on the ſtate of the brain, but becauſe we cannot conceive a Creator of infinite wiſdom and goodneſs to immerſe in ſyſtems of matter, minds to which he knows that ſuch ſyſtems muſt be always uſeleſs and often hurtful. We believe, therefore, that our ſouls and bodies were created and formed for each other; but as our preſent adverſaries admit not of a Creator, we muſt aſk them, How their ſelf-exiſtent ſouls have been diſpoſed of from eternity, and by what power they have all in due ſucceſſion been united each to its proper body? As before the union they were not conſcious, they could not unite themſelves; and to ſuppoſe them united by ſome ſuperior intelligence, is to ſuppoſe them in ſome reſpects dependent on that intelligence, which ſeems not to accord with their ſelf-exiſtence. Whatever is ſelf-exiſtent and eternal muſt be independent; and if poſſeſſed of any power, cannot be conceived to have that power limited.—We repeat, therefore, that every man has in himſelf ſufficient evidence that creation is poſſible; for if infinite power can create an immaterial and percipient being, it may ſurely be ſuppoſed capable of creating dead and unintelligent matter.

But the creation of the material ſyſtem may be ſhown to be in the higheſt degree probable by other arguments. The ſame reaſoning which proves the impoſſibility of an infinite ſeries and of eternal time, proves that the univerſe cannot have exiſted from eternity in its preſent ſtate. But if it has not exiſted from eternity in its preſent ſtate, it belongs to the opponents of creation to ſay what was its former. We talk indeed of *chaos;* but ſuch language, when a Creator is not admitted, is moſt unphiloſophical trifling. It appears from the moſt accurate inquiries that have been made into the ſubſtance and eſſence of body *, that the atoms of which each maſs is compoſed are held together by a foreign force. If by chaos be meant matter, when this force is ſuppoſed to be removed, we muſt beg leave to ſay, that of ſuch a ſubſtance we have neither idea nor notion, and cannot diſtinguiſh it from nonentity. The original atoms of matter, we believe indeed to require no other agency to keep each entire than that *fiat* by which it was created; but ſtill, as thoſe atoms are conceived to be ſolid and extended, they muſt be capable of diviſion by infinite power; and if that *fiat* or influence which makes them ſolid and extended were removed, they would loſe ſolidity and extenſion, and of courſe become nothing. So far is it, therefore, from being true, that the creation of matter appears to be impoſſible, that we are compelled by every thing that we know of it to believe that matter cannot poſſibly be ſelf-exiſtent.

* *Baxter's Inquiry into the Nature of the Human Soul.*

"Becauſe it is undeniably certain, concerning ourſelves (ſays Cudworth †), and all imperfect beings, that none of theſe can create any *new ſubſtance*, men are apt to meaſure all things by their own ſcantling, and to ſuppoſe it univerſally impoſſible for any power whatever thus to create. But ſince it is certain, that imperfect beings can themſelves produce *ſome things* out of nothing pre-exiſting, as *new cogitations*, *new local motion*, and *new modifications* of things corporeal, it is ſurely reaſonable to think that an abſolutely perfect Being can do *ſomething more*, i. e. create *new ſubſtances*, or give them their whole being. And it may well be thought as eaſy for God or an Omnipotent Being, to make a whole world, matter and all, *ἐξ οὐκ ὄντων*, as it is for us to create *a thought* or to move a finger, or for the ſun to ſend out rays, or a candle light; or laſtly, for an opaque body to produce an image of itſelf in a glaſs or water, or to project a ſhadow: all theſe imperfect things being but the *energies*, *rays*, *images*, or *ſhadows*, of the Deity. For a ſubſtance to be made out of nothing by *God*, or a *Being infinitely perfect*, is not for it to be made out of nothing in the impoſſible ſenſe, becauſe it comes from him who is *all*. Nor can it be ſaid to be impoſſible for any thing whatever to be made by that which hath not only *infinitely greater perfection*, but alſo *infinite active power*. It is indeed true, that infinite power itſelf cannot do things in their own nature impoſſible; and, therefore, thoſe who deny creation, ought to prove, that it is abſolutely impoſſible for a *ſubſtance*, though not for an *accident* or *modification*, to be brought from nonexiſtence into *being*. But nothing is in itſelf impoſſible, which does not imply a contradiction: and though it be a contradiction for a thing to be and not to be at the ſame time, there is ſurely no contradiction in conceiving an imperfect being, which before was not, afterwards to be." To call in queſtion the poſſibility of creation, becauſe we have no *adequate conception* how a thing can be brought into exiſtence, would be in the higheſt degree abſurd; for it may be doubted, whether we have *adequate* conceptions of any thing except our own ideas and their various relations (1).

† *Intellectual Syſtem*, Book 1. chap. 5.

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The Being which is ſelf-exiſtent, omnipotent, and omniſcient, is not a *neceſſary*, but a *free* agent; for *active*

(1) "Ridicula foret et inepta ejus temeritas, qui corporum ideo creationem ſibi duceret negandum eſſe, quod ejus creationis *clarum et perſpicuam notionem* effingere cogitatione nobis haud licet. Infinita enim eſt rerum copia, quarum perſpicuis et apertis caremus notionibus. Et ſi omnia neganda continuo nobis eſſent, quorum confuſam tantum et imperfectam conſequi poſſumus notionem, omnia fere nobis eſſent neganda, exceptis *relationibus*, quas inter notiones quaſdam abſtractas eſſe intelligimus. Quis interiorem ſibi naturam rerum, tam corporum, quam ſpirituum, cognitam eſſe dixerit? Et eſſe tamen has naturas, omni plane dubitatione vacat. Quis quemadmodum altera harum naturarum agat in alteram, ſeſe ſcire, affirmet? Quis cauſas ſibi patere, propter quas hi vel illi effectus, quos videmus quotidie contingere, à certis veniant corporibus, jure glorietur? Nec tamen quiſquam eſt, qui vel illam animæ in corpus operationem, vel hos effectus in dubium revocare auſit. Teneamus igitur ea, quæ certo novimus, nec idcirco nos ab illis dimoveri patiamur, quod multa rurſus ſunt, quorum naturam ignoramus; contra multa nos fugere et cognitionem noſtram ſuperare, æquo at tranquillo feramus animo. *Joannis Clerici contra eos qui negant, ex nihilo ulla ratione fieri poſſe aliquid, obſervationes; in Moſhemii edit. Intellec. Syſt.*

tive power implies *freedom*, and *infinite* power *infinite* freedom. What, therefore, hath no bounds set to its power, what can have no opposition made to its will, nor restraint laid on its actions, must both will and act freely. "If the Supreme Cause were not a being endowed with liberty and choice, but a mere necessary agent, then would it follow, as Dr Clarke well observes *, that nothing which is not, could *possibly* have been; and that nothing which is, could *possibly* not have been; and that no mode or circumstance of the existence of any thing could *possibly* have been in any respect otherwise than it now actually is. All which being evidently most false and absurd; it follows, on the contrary, that the Supreme Cause is not a mere necessary agent, but a Being endued with liberty and choice."

* *Demonstration of the Being and Attributes of God.*

To this reasoning it has been lately replied †, that "Clarke must have known, that all those who contend against the free agency of the Deity, do of course acknowledge, that nothing could have happened, or does happen, or will happen, but what actually has happened, or doth happen, or will happen; and that it is most false and absurd to deny it." It is, therefore, according to the necessarians, absolutely impossible, that at present there could exist upon this earth more or fewer persons than are now actually alive; that the earth could move in any other direction than from west to east; or that there could be more or fewer planets in the solar system. Yet is it most certain, that there *have been fewer persons* on the earth than there are now; that there is not a cultivated country in Europe which could not contain *more* people than now inhabit it; that the comets move in very different directions from that of west to east; and that as, till very lately, we *conceived* only six primary planets in the system, it is evidently *possible* that the system *might contain* no more. Upon the supposition, therefore, that the Supreme Being acts under a physical necessity, the same things are possible and not possible at the same time, which is the grossest of all absurdities. It might have been objected with much more plausibility, that the First Cause cannot possibly be free, because he must needs do always what is best in the whole; but it will be seen by and by, that among different created systems, there is no reason for supposing any one absolutely *best*.

† *Cooper's Tracts.*

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Himself unchangeable.

But though this Being be *free*, and as such the author of *change* in other beings, yet he must himself be *unchangeable*; for all changes have a beginning, and consequently are effects of some *prior causes*. But there can be nothing prior to the existence of this Being, as he is *eternal*; neither any *cause* of it, as he is *independent*; nor consequently any *change* in it, except we could suppose him to *change himself*, which is the same absurdity as to *produce* himself, i. e. to be at *the same time both effect* and *cause*.

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Omniscience, &c. proved in a different manner.

Omniscience, as well as some of the foregoing attributes of the Supreme Being, may perhaps be more easily deduced thus ‡. We find in ourselves such qualities as *thought* and *intelligence*, *power* and *freedom*, &c. for which we have the evidence of consciousness as much as for our own existence. Indeed it is only by our consciousness of these that our existence is known to ourselves. We know likewise that these are *perfections*, and that to have them is better than to be without them. We find also that they have not been in us from eternity. They must, therefore, have had a *beginning*, and consequently some *cause*, for the very same reason that a *being* beginning to exist in time requires a cause. Now this cause, as it must be *superior* to its *effect*, must have those perfections in a *superior* degree; and if it be the *first cause*, it must have them in an *infinite* or *unlimited* degree, since *bounds*, or *limitation* without a limiter, would, as we have already shown, be an *effect* without a *cause*.

‡ *Notes to King on Evil.*

It is indeed obvious, that the *omniscience* of the Supreme Being is implied in his very existence. "For all things being not only present to him, but also entirely *depending* upon him, and having *received* both their *being* itself and all their powers and faculties *from him*, it is manifest that as he knows all things that are, and penetrates every part of their substance with his all-seeing eye, so must he likewise know *all possibilities* of things, that is, all effects that *can be*. For, being alone self-existent, and having alone given to all things all the powers and faculties with which they are endued, it is evident that he must of necessity know perfectly what all and each of these powers and faculties, *which are derived wholly from himself*, can possibly produce. And seeing at one boundless view, or more properly in his own ideas, all the possible compositions and divisions, variations, and changes, circumstances and dependencies of things, all their possible relations one to another, and their dispositions or fitnesses to certain and respective ends, he must without possibility of error know exactly what is best and properest in every one of the numberless possible cases, or methods of disposing things; and understand perfectly how to order and direct the respective means to bring about what he so knows to be in its kind, or on the whole, the best and fittest in the end. This is what is meant by infinite wisdom, or omniscience †;" and it has been readily admitted by every man who has believed in the existence of a God as the creator and preserver of all things.

† *Clarke's Demonstration, &c.*

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God foreknows the actions of free agents.

Doubts, however, have been entertained by theists, and pious theists, whether omniscience itself can certainly foreknow what are called contingent events, such as the actions of free agents; and some few there are professing to be even Christians, who have boldly pronounced such knowledge to be impossible. That we have no adequate notion *how* events, which are called contingent, can be certainly foreknown, must indeed be granted; but we are not, therefore, authorized to say that such knowledge is impossible, unless it can be clearly shown to imply a contradiction. They who suppose that it implies a contradiction, must likewise suppose, that, where there is not a chain of necessary causes, there can be no certainty of any future event; but this is evidently a mistake. "For let us suppose that there is in man a power of beginning motion, and of acting with what has been of late called *philosophical* freedom; and let us suppose farther that the actions of such a man cannot possibly be foreknown; will there not yet be in the nature of things, notwithstanding this supposition, the same *certainty of event* in every one of the man's actions, as if they were ever so fatal and necessary? For instance, suppose the man, by an internal principle of motion, and an absolute freedom of mind, to do some particular action *to-day*, and suppose it was

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was not possible that this action should have been foreseen *yesterday*, was there not nevertheless the same *certainty of event* as if it had been foreseen, and absolutely necessary? That is, would it not have been as *certain a truth* yesterday, and from eternity, that this action was in event *to be performed to-day*, notwithstanding the supposed freedom, as it is now a *certain and infallible truth* that it is performed? Mere *certainty of event*, therefore, does not in any measure imply *necessity* ‡." And surely it implies no contradiction to suppose, that every future event which in the nature of things is *now certain*, may *now be certainly known* by that intelligence which is omniscient. The *manner* how God can foreknow future events, without a *chain of necessary causes*, it is indeed impossible for us to explain: yet some sort of *general notion* of it we may conceive. "For, as a man who has no influence over another person's actions, can yet often perceive beforehand what that other will do; and a wiser and more experienced man, with still *greater probability* will foresee what another, with whose disposition he is perfectly acquainted, will in certain circumstances do; and an angel, with still *less degrees of error*, may have a further prospect into men's future actions: so it is very reasonable to conceive, that God, without influencing men's wills by his power, or subjecting them to a chain of necessary causes, cannot but have a knowledge of future free events, as much *more certain* than men or angels can possibly have, as the *perfection* of *his* nature is greater than that of *theirs*. *The distinct manner how* he foresees these things we cannot, indeed, explain; but neither can we explain the *manner* of numberless other things, of the reality of which, however, no man entertains a doubt *." We must therefore admit, so long as we perceive no contradiction in it, that God always knows all the free actions of men, and all other beings endued with liberty; otherwise he would know many things now of which he was once ignorant, and consequently his *omniscience* would receive addition from events, which has been already shown to be contrary to the true notion of infinity.—In a being incapable of change, knowledge has nothing to do with *before* or *after*. To every purpose of knowledge and power, all things are to him equally present. He knows perfectly every thing that is, and what to us is future he knows in the very same manner as he knows what to us is present.

‡ *Clarke's Demonstration.*

* *Clarke's Demonstration, &c.*

308 God infinitely perfect, all-sufficient, and omnipresent.

Thus have we demonstrated the necessary existence of a being who is *eternal*, *independent*, *unchangeable*, *omnipotent*, *free in his actions*, and *omniscient*; and this is the being whom we worship as GOD. *Eternity*, *independence*, *immutability*, *omnipotence*, *liberty*, and *omniscience*, which seem to be all the *natural* attributes which we can discover in the divine nature, as they are conceived to be differently combined, make us speak of him in different terms. His enjoying in an absolute manner every conceivable power or perfection, makes us call him a Being *infinitely perfect*. His being capable of no want, defect, or unhappiness of any kind, denotes him to be *all sufficient in himself*; and the unlimited exercise of his knowledge and power, demonstrates him to be *omnipresent*. That such a Being must be incomprehensible by us, and by every creature, is a truth self-evident; and yet in all ages men of the best intentions have been vainly attempting this impossibility. The manner of his omniscience, for instance, has been the subject of much disputation among those who ought to have reflected that they know not how their own minds were present to their own bodies.—The celebrated Dr Clarke and his adherents, who considered space as the *sine qua non* of all other things, insisted, that God must be infinitely extended; and that, as wherever his substance is, there his attributes must be, it is thus that his knowledge and power are present with every creature. But this notion labours under insuperable difficulties.

309 The manner of the divine omnipresence incomprehensible.

For "if the Divine substance be infinitely extended, then will there be part of it in this place and part in that. It must be commensurate with all particular beings, so that some will occupy more and some less of its dimensions. By this account it will be very proper and philosophical to say, that God is not in *heaven*, but only a *part* of him; and that an *elephant* or a *mountain*, a *whale* or a wicked *giant*, have more of the essence or presence of God with them, than the *holiest* or *best* man in the world, unless he be of equal size: all which, as has been well observed ‡, are at least harsh and grating expressions. As the attributes of the Divine Being must be considered in the same manner with his substance, we shall likewise, upon this notion of omnipresence, have a part of his knowledge and power in this place, and a part of them in that; and of these parts the one must be greater or less than the other, according to the dimensions of the place with which it is commensurate; which is a supposition that appears to us harsher, if possible, than even the former.

‡ *Watt's Essays*, and *Law's Inquiry into the Ideas Space, Time, Immensity*, &c.

"Should it be said that the divine attributes are not to be considered as having parts (though we see not how they can be considered otherwise than as their subject), they must then exist *completely* in every point of this immense expansion. Be it so; and what follows? Why, every point of this infinitely expanded being will be omniscient and omnipotent by itself; an inch of it will have as much wisdom and power as a yard, a mile, or the whole; and, instead of one infinite wisdom and power, we shall have millions: For as these parts of the substance are conceived *distinctly*, and one individual part is not another, so must the attributes be likewise conceived, and the individual power and knowledge of one part be distinct from that of another." And if so, it follows, that one point of this expanded being has equal power and intelligence with the whole; so that the notion of extension being *necessary* to God's presence with every creature, involves in it the most palpable contradiction. That God is at all times and in all places so present with every creature as to have an absolute knowledge of and power over it, is indeed capable of the strictest demonstration; but we think it great presumption to assign the particular *mode* of his presence, especially such a one as is neither agreeable to the nature of an absolutely perfect Being, nor in the least necessary to the exercise of any one perfection which he can be proved to possess. Philosophers and divines have offered several names for the manner in which God is present with his works; but we choose rather to confess, that the *manner* of his presence is to us, and probably to every creature, wholly incomprehensible. Nor need we be surprised or staggered at this, when we reflect that the manner in which our own minds are

present

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present with our bodies is to us as incomprehensible as the manner in which the supreme Mind is present with every thing in the universe. That our minds have a power over our limbs, we know by experience: but that they are not extended or substantially diffused through them, is certain; because men daily lose arms and legs, without losing any part of their understanding, or feeling their energies of volition in the smallest degree weakened. But we need pursue this subject no farther. It has been confessed by one of the most strenuous advocates * for the extension of the Deity and all minds, that "there is an incomprehensibleness in the *manner* of every thing, about which no controversy can or ought to be concerned."

* *Mr Jackson's Existence and Unity*, &c. page 110.

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God's moral attributes result from his natural perfections.

The moral attributes of God may be deduced from his natural ones, and are immediate consequences of them when exercised on other beings. They may be termed his *secondary relative* attributes, as they seem to be the perfection of his *external acts* rather than any *new internal* perfections. And though the existence of any moral quality or action is not capable of strict *demonstration*, because every moral action or quality, as such, depends upon the *will* of the agent, which must be absolutely free; yet we have as great assurance that there are moral qualities in God, and that he will always act according to these qualities, as the nature of the thing admits; and may be as well satisfied of it, as if it were capable of the most rigid demonstration. This important point, however, cannot be so clearly or so firmly established by abstract reasoning as by taking a scientific view of the works of creation, which evince the goodness, holiness, and justice, of their Author, as well as his perfect wisdom and infinite power. The consideration, therefore, of the moral attributes of God, together with his providence, and the duties thence incumbent on man, is the proper business of other articles (see Religion, Theology, and Moral *Philosophy*).

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How they ought to be conceived.

At present we shall only observe, that by reasoning *à priori* from his existence and his natural perfections, we must necessarily infer that his actions are the result of unmixed benevolence. Every wise agent has some end in view in all his actions; it being the very essence of folly to act for no end: but there cannot be an end of action which is not either selfish or benevolent. Selfishness is the offspring of want and imperfection, and is therefore the source of most *human* actions; because men are weak and imperfect beings, capable of daily additions to their happiness. When the thief plunders a house at midnight, when the highwayman robs a traveller on the road, and even when the assassin murders the man who never injured him; it will be found that their actions spring not from an innate desire to inflict misery upon others, but from a prospect of reaping advantage to themselves. The object of the thief and the robber is obvious: it is to gain money, which is the mean of procuring the comforts of life. Even the assassin has always the same selfish end in view: either he is *bribed* to commit the murder, or he fancies that his horrid deed will remove an *obstacle* from the way to his own happiness. But they are not vicious men *only* who act from selfish considerations: much of human *virtue*, when traced to its source, will be found to have its origin in the desire of happiness. When a man gives his money to feed the hungry and to clothe the naked, he believes that he is acting agreeably to the will of Him to whom he and the poor stand in the same relation; and he looks for a future and eternal reward. By continuing the practice, he soon acquires the habit of benevolence; after which, indeed, he looks for no further reward, when performing particular actions, than the immediate pleasure of doing good. This selfishness of man is the necessary consequence of his progressive state. But the Being who is independent, omnipotent, omniscient, and, in a word, possessed of every possible perfection, is incapable of progression, or of having any accession whatever made to his happiness. He is immutable; and must of necessity have been as happy from eternity, when existing alone, as after the creation of ten thousand worlds. When, therefore, he willed the existence of other beings, he could have nothing in view but to communicate some resemblance of his own perfections and happiness. That he had *some* end in view, follows undeniably from his infinite wisdom. That he could not have a *selfish* end, follows with equal certainty from his own infinite perfections; and as there is no medium, in the actions of a wise Being, between selfishness and benevolence, we must necessarily conclude, that the creation was the result of unmixed benevolence or perfect goodness. The other moral attributes of the Deity, his justice, mercy and truth, ought therefore to be considered only as so many different views of the same *goodness* in the *Creator*, and various sources of *happiness* to the *creature*. These are always *subordinate* to and *regulated* by this one principal perfection and brightest ray of the Divinity.

"Thus we conceive his *justice* to be exerted on any being no farther than his goodness necessarily requires, in order to make that being, or others, *sensible* of the *heinous nature* and *pernicious effects of sin* *, and thereby to bring them to as great a degree of happiness as their several natures are capable of. His *holiness* hates and abhors all wickedness, only as its necessary consequences are absolute and unavoidable misery; and his veracity or fa[illegible]thfulness seems to be concerned for truth, only because it is connected with and productive of the happiness of all rational beings; to provide the properest means for attaining which great end, is the exercise of of his *wisdom*." Such is the view of God's moral attributes, which the abstract contemplation of his natural perfections necessarily gives; and whether this way of conceiving them be not attended with less difficulty than the common manner of treating them under the notion of two infinites *diametrically opposite*, must be left to the judgement of the reader.

* *Notes to King on Evil.*

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The origin of evil.

But if the Creator and supreme Governor of all things be a Being of infinite power, perfect wisdom and pure benevolence, how came evil into the works of creation? This is a question which has employed the speculative mind from the first dawning of philosophy, and will continue to employ it till our faculties be enlarged in a future state, when philosophy shall give place to more perfect knowledge. To these meditations, as has been well observed ‡, humanity is not equal. Volumes have been written on the subject; but we believe that the following extract from Dr

‡ *Johnson's Review of a free Inquiry into the Origin of Evil.*

Of the Being and Attributes of God.

Dr Clarke contains all that can be advanced with certainty, and all that is neceſſary to vindicate the ways of God to man.

"All that we call evil (ſays that able reaſoner †), is either an *evil of imperfection*, as the want of certain faculties and excellencies which other creatures have; or *natural evil*, as pain, death, and the like; or *moral evil*, as all kinds of vice. The *firſt* of theſe is not properly an evil: for every power, faculty, or perfection, which any creature enjoys, being the free gift of God, which he was no more obliged to beſtow than he was to confer being or exiſtence itſelf, it is plain, that the want of any certain faculty or perfection in any kind of creatures, which never belonged to their nature, is no more an evil to them, than their never having been created or brought into being at all could properly be called an evil." To this we may add, that as no created being can be ſelf exiſtent and independent, imperfection is unavoidable in the creation, ſo that the evil of defect (as it is moſt abſurdly called) muſt have been admitted, or nothing could ever have exiſted but God. "The *ſecond* kind of evil, which we call *natural* evil, is either a neceſſary conſequence of the former, as *death* to a creature on whoſe nature immortality was never conferred; and then it is no more properly an evil than the former: Or elſe it is counterpoiſed in the whole with as great or greater good, as the *afflictions and ſufferings of good men*: and then alſo it is properly no evil: Or elſe it is a *puniſhment*; and then it is a neceſſary conſequence of the *third* and laſt ſort of evil, viz. *moral evil*. And *this* ariſes wholly from the abuſe of *liberty*, which God gave to his creatures for other purpoſes, and which it was reaſonable and fit to give them for the perfection and order of the whole creation: only they, contrary to God's intention and command, have abuſed what was neceſſary for the perfection of the whole, to the corruption and depravation of themſelves. And thus have all ſorts of evils entered into the world, without any diminution to the infinite goodneſs of its Creator and Governor."

† *Demonſtration of the Being and Attributes of God.*

313 Whether the preſent be the beſt ſyſtem poſſible.

But though evil could not be totally excluded from the univerſe, are we not authorized to infer, from the infinite power, wiſdom, and goodneſs of the Creator, that the preſent ſyſtem is upon the whole the very beſt ſyſtem poſſible? Undoubtedly we are, if of poſſible ſyſtems there *can be a beſt*: but this is ſo far from being evident, that we think it implies a contradiction. A beſt of beings there is, viz. God, who is poſſeſſed of infinite perfections; but there cannot be a beſt of creatures or of created ſyſtems. To prove this, we need only reflect, that wherever creation ſtops, it muſt ſtop infinitely ſhort of infinity; and that how perfect ſoever we conceive any creature or ſyſtem of creatures to be, yet the diſtance between that and God is not leſſened, but continues infinite. Hence it follows, that the nature of God and his omnipotence is ſuch, that whatever number of creatures he has made, he may ſtill add to that number; and that however good or perfect the ſyſtem may be on the whole, he might ſtill make others equally good and perfect.

314 Origin of that queſtion.

The diſpute, whether a being of infinite power, wiſdom, and benevolence, muſt be ſuppoſed to have created the *beſt poſſible ſyſtem*, and the embarraſſment of men's underſtandings about it, ſeem to have ariſen from their taking the words *good*, *better*, and *beſt*, for abſolute qualities inherent in the nature of things, whereas in truth they are only relations ariſing from certain appetites. They have indeed a foundation, as all relations have, in ſomething abſolute, and denote the thing in which they are founded; but yet they themſelves imply nothing more than a relation of congruity between ſome appetite and its objects. This is evident; becauſe the ſame object, when applied to an appetite to which it has a congruity, is good; and bad, when applied to an appetite to which it has no congruity. Thus, the earth and air to terreſtrial animals are good elements, and neceſſary to their preſervation: to thoſe animals the water is bad, which yet affords the beſt receptacle to fiſhes. *Good*, therefore, being relative to appetite, that muſt be reckoned the beſt creature by us which has the ſtrongeſt appetites, and the ſureſt means of ſatisfying them all, and ſecuring its own permanent happineſs. And though the *ſubſtance* of creatures is chiefly to be regarded as contributing to their perfection, yet we have no way of meaſuring the perfection of different ſubſtances but by their qualities, *i. e.* by their appetites by which they are ſenſible of good and evil, and by their powers to procure thoſe objects from which they receive that ſenſe of things which makes them happy.

315 No ſyſtem abſolutely beſt.

It is plain, therefore, that whatever ſyſtem we ſuppoſe in nature, God might have made another equal to it; his infinite wiſdom and power being able to make other creatures equal in every reſpect to any that we know or can conceive, and to give them equal or ſtronger appetites, and as certain or more certain ways of ſatisfying them. We ſee in many caſes, that very different means will anſwer the ſame end. A certain number of regular pyramids will fill a ſpace; and yet irregular ones will do it as well, if what we take from the one be added to another; and the ſame thing may be done by bodies of the moſt irregular and different figures in the ſame manner: and therefore we may very well conceive, that the anſwering of appetites, which is all the *natural good* that is in the world, may as well be obtained in another ſyſtem as in this; provided we ſuppoſe, that where the appetites of the ſentient beings are changed, the objects are alſo ſuited to them, and an equal congruity among the parts of the whole introduced. This is ſo eaſily conceived, that in an indefinite number of poſſible worlds, we do not ſee why it may not be done in numberleſs ways by infinite power and wiſdom.

316 God not neceſſitated by his goodneſs to create the preſent in preference to all other worlds.

If then it be plain, that there might have been many other worlds, or even but one, equal to this in all reſpects as to goodneſs, there could be no neceſſity, either phyſical or moral, that God ſhould create the one rather than the other; becauſe nothing could make the one better, or to him more agreeable, than the other, but his own free choice. Either, therefore, God muſt be poſſeſſed of abſolute freedom, or, among a number of poſſibilities equally perfect, he could not have made a choice, and ſo nothing would ever have been created. It is not, then, as Leibnitz and others argue, the natural and neceſſary goodneſs of ſome particular things, *repreſented by the divine ideas*, which determines God to prefer them to all others, if underſtood of his *firſt* act of producing them; but it is

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is his own free choice which, among many equal *potential* goods, makes some things *actually* good, and determines them into existence. When those are once supposed to exist, every thing or action becomes good which tends to their happiness and preservation; and to suppose their all-perfect Author to have any other end in view than their preservation and happiness, is the same absurdity as to suppose that knowledge may produce ignorance; power, weakness; or wisdom folly.

We have now finished what we proposed under the article Metaphysics. It has swelled in our hands to a large extent; and yet it can be considered as little more than an introduction to that science, which comprehends within its wide grasp every thing existing. The reader who wishes to pursue these interesting speculations, should study diligently the authors whom we have consulted, and to whom we have been careful to refer in the margin. Were we to make a selection, we should without hesitation recommend Aristotle and Plato among the ancients; and Cudworth, Locke, Hartley, and Reid, among the moderns. These philosophers, indeed, on many points, differ exceedingly from one another; but he who wishes not to adopt opinions at random, should know what can be said on both sides of every question.

Metaplasmus ‖ Metastasio.

METAPLASMUS, in *Grammar*, a transmutation or change made in a word, by adding, retrenching, or altering a syllable or letter thereof.

METAPONTUM, or METAPONTIUM, in *Ancient Geography*, a town of Lucania, on the Sinus Tarentinus, to the west of Tarentum; built by the Pylians who returned from Troy; and where Pythagoras is said to have taught in the time of Servius Tullius. *Metapontini*, the people; who pretended to show, in a temple of Minerva, the tools with which Epeus built the wooden horse, (Justin). Now a tower, called *Torre di Mare*, in the Basilicata of Naples.

METASTASIO, L'ABBE PIERRE BONAVENTURE, a celebrated Italian poet, whose real name was *Trapassi*, was born at Assise, on January 3d. 1698. His talent for poetry was first unfolded by the reading of Tasso; and he began to compose verses at ten years of age. "A prodigy of this nature (says Metastasio) made such an impression on my master, the celebrated Gravina, that he thenceforth considered me as a plant worthy of being cultivated by his own hands." Metastasio was only fourteen years of age when he composed his tragedy entitled *Il Giustino*; in which he appears too close and scrupulous an imitator of the Grecian drama. Our young poet unfortunately lost his patron in 1717; who left him his heir, "as being a young man of the most promising abilities." Metastasio, at the age of nineteen, being, in consequence of this inheritance, superior to those wants which repress the exertions of genius, and to which men of abilities are too often subject, gave full scope to his inclination for poetry. He began his dramatic career with the *Didonne Abandonnata*, which was acted at Naples in 1724; the music was composed by Sarro. He soon acquired such celebrity, that in 1729 he was invited to Vienna by the emperor Charles VI.; who appointed him imperial poet, and granted him a pension of 4000 florins. From that time some of his works were presented at every court festival; and notwithstanding the extreme magnificence of these entertainments, they would now be forgotten were it not for the verses which he composed upon the occasion. The courts of Vienna and Madrid vied with each other in the presents which they conferred upon him. From Maria Theresa he received a snuff-box and a port-folio set with diamonds, and a golden candlestick with a screen. Ferdinand VI. king of Spain, informed of the great merit of Metastasio by Farinelli, of whom he was a passionate admirer, sent him a present of a casket mounted with gold, and furnished with the different implements of writing. This favourite of kings and of the muses was of a cheerful temper, and was exceedingly temperate: to this he was probably indebted for the uninterrupted health which he enjoyed, and for the entire possession of his senses and faculties to the most advanced period of old age. He took his meals, arose, and went to bed, always at stated hours. This exactness and order were scrupulously observed even in the most trifling actions of his life. He used to say in jest, that he dreaded hell for no other reason but because it was a place *ubi nullus ordo, sed sempiternus horror inhabitat.* He had even his stated hours for making verses; to which he scrupulously adhered, without waiting for the moment of poetical enthusiasm. He was equally regular in the duties of the Christian as in the labours of the scholar. His behaviour was that of a true philosopher: his ambition extended no farther than the attainment of literary fame; and he despised every civil mark of distinction. When Charles VI. offered him the titles of *Count* or of *Baron*, which add no real worth or dignity to the possessor, but frequently make him appear in a more ridiculous light, he instantly begged the favour that he would allow him still to continue *Metastasio*. The empress Maria Theresa afterwards wished to bestow upon him the small cross of St Stephen; but he excused himself on account of his age, which would prevent him from assisting at the festivals of the order. He was attacked by a fever on the 2d of April 1782; and he died on the 12th of the same month, at the age of 84. Before his death he received the sacrament according to the form of the Romish church; and Pius VI. who was then at Vienna, sent him his apostolical benediction *in articulo mortis.* He left about 150,000 florins. He composed a great number of tragic operas, and several small dramatic pieces which have been set to music. We have different editions of them in 4to, 8vo, and 12mo; and M. Richelet has published a translation of them into French, in 12 vols, small 12mo.

The greatest part of Metastasio's writings will confer immortality on their author. His dialogue is natural,

tural, simple, and easy; his style is always pure and elegant, and sometimes sublime and pathetic. His subjects are noble, interesting, and excellently adapted for representation. He was perfectly acquainted with the resources of his art, and has subjected the opera to rules. He stripped it of its machinery, and of the marvellous, which was fitted to excite the gaze of astonishment, but which gave no instruction to the understanding, and made no impression on the heart. His descriptions are copied from nature; the situations of his characters never fail to raise an interest in the reader, and often excite the tear of pity. His fables are celebrated; his characters are noble and well supported; his plots are excellently conducted, and happily unravelled. "There are scenes (says Voltaire) worthy of Corneille when he does not declaim, and of Racine when he is not feeble." His operas, in point of the pathetic, may be compared with our finest tragedies; and may be read with great pleasure, independent of the charms of the music. We must not, however, expect to find in Metastasio that exact regularity, and that fertile simplicity, which constitutes the excellence of some of our tragic poets: But though he sometimes transgresses the unities of time and place, he always preserves the unity of interest. Notwithstanding all these advantages, some critics will not allow him the merit of invention, which is the first qualification of a poet. They consider him only as a successful imitator of the French tragic writers, from whom a great part of his beauties are borrowed, and place him at the head of the finest wits in Italy, but deny that he possessed genius. He was a fond admirer of the ancients; and this admiration, increasing with the solidity of his understanding, continued to the last period of his life. He recommended reading them, as he himself had done, in a chronological order. His memory was excellent, and continued unimpaired even in old age. Horace was his favourite author, and he could repeat almost the whole of his verses. Metastasio, who, as we have observed, was the pupil of the celebrated Gravina, added a gentleness of character peculiar to himself to the accuracy of thinking and great erudition of his master. His abilities and fame were respected by the critics in general; and whereas the life of most men of letters is one continued warfare, his days happily glided away in tranquillity and peace. The circumstance which occasioned the change of his name is thus related in a late anecdote: "Gravina's barber, who, like most of his profession, was a great talker, one day informed him, that in the *Place de la Valicella*, where he had his shop, a young boy came every evening, and sung extempore verses of his own composition, so harmonious and elegant that all the passengers stopped to listen to them. Gravina, upon this information, added one to the number of the young poet's audience, and found the verses so superior to the idea which he had formed of them from the account of the barber, and so much above the capacity of a child of ten or eleven years of age, that he instantly determined to undertake the cultivation of so promising a plant. His first care was to put the young *Trapassi* (which was the boy's name) to school; but apprehending that the ordinary methods of education might check the progress of so uncommon talents, he took him home to his own house, and changed his name into *Metastasio*, which signifies the same thing in Greek. In short, by a plan of education and by instructions suited to his genius, Gravina laid the foundation of that reputation which he predicted, and which Metastasio now enjoys." *Vies des Hommes Illustres d'Italie*, tom. i. p. 187.

METASTASIS, in medicine, a transposition or settlement of some humour or disease in some other part; and sometimes it signifies such an alteration of a disease as is succeeded by a solution.

METATARSUS (μετα *beyond*, and ταρσος *the tarsus*), in anatomy, that part of the human skeleton containing the middle of the foot. See ANATOMY, *Index*.

METATHESIS, in grammar, a species of the metaplasmus; being a figure whereby the letters or syllables of a word are transposed, or shifted out of their usual situations, as *pistris* for *pristis*, *Lybia* for *Libya*, &c.

This word is, by physicians, used with respect to morbific causes, which when they cannot be evacuated, are removed to places where they are less injurious.

METELIN, the modern name of the island of Lesbos. See LESBOS and MITYLENE.

In the Irish Philosophical Transactions for 1789, we have a description of this island by the earl of Charlemont, in which he speaks with raptures of its beauties. "The mountains, whose rugged tops exhibit a pleasing interspersion of rocks and fine groves, have their green sides, for many miles along the coast, covered with olives, whose less agreeable verdure is corrected, embellished, and brightened by a lively mixture of bays and laurels aspiring to the height of forest trees, of myrtles and pomegranates, of arbutes rich at once in blossom and in berry, of mulberries growing wild and laden with fruit, &c. Winter is here unknown, the verdure is perpetual, and the frequency of evergreens gives to December the colour of June. The parching heat of summer is never felt; the thick shade of trees, and thousands of crystal springs which everywhere arise and form themselves into unnumbered rivulets, joined to the refreshing sea breeze, the constant corrective and companion of noontide heat, qualify the burning air and render the year a never-ending May. The houses are constructed in such a manner as to have the best view of these natural beauties. Each is a square tower neatly built of hewn stone, so high as to overtop the trees, and to command a view of the sea and neighbouring islands. The lower stories are granaries and storehouses; and the habitable apartments are all at the top, to which you ascend by a stone stair, built for the most part on the outside, and surrounding the tower; so that from the apartment the trees are overlooked, and the whole country is seen; while the habitations themselves, which are very numerous, peering above the groves, add life and variety to the enchanting prospect, and give an air of human population to these woodlands, which might otherwise be supposed the region of Dryads, of Naiads, and of Satyrs."

The most remarkable thing, however, in this island is a custom by which the women have here openly usurped those rights of sovereignty which in other countries

Metelin. countries are fuppofed to belong effentially to the men. "Contrary (fays his lordfhip) to the ufage of all other countries, the eldeft daughter here inherits; and the fons, like daughters everywhere elfe, are portioned off with fmall dowers, or, which is ftill worfe, turned out pennylefs to feek their fortune. If a man have two daughters, the eldeft, at her marriage, is entitled to all her mother's poffeffions, which are by far the greater part of the family eftate, as the mother, keeping up her prerogative, never parts with the power over any portion of what fhe has brought into the family, until fhe is forced into it by the marriage of her daughter; and the father alfo is compelled to ruin himfelf by adding whatever he may have fcraped together by his induftry. The fecond daughter inherits nothing, and is condemned to perpetual celibacy. She is ftyled a *calogria*, which fignifies properly a religious woman or nun, and is in effect a menial fervant to her fifter, being employed by her in any office fhe may think fit to impofe, frequently ferving her as waitingmaid, as cook, and often in employments ftill more degrading. She wears a habit peculiar to her fituation, which fhe can never change; a fort of monaftic drefs, coarfe, and of a dark brown. One advantage, however, fhe enjoys over her fifter, that whereas the elder, before marriage, is never allowed to go abroad, or to fee any man, her neareft relations only excepted, the calogria, except when employed in domeftic toil, is in this refpect at perfect liberty. But when the fifter is married, the fituation of the poor calogria becomes defperate indeed, and is rendered ftill more humiliating by the comparifon between her condition and that of her happy miftrefs. The married fifter enjoys every fort of liberty; the whole family fortune is hers, and fhe fpends it as fhe pleafes; her hufband is her obfequious fervant, her father and mother are dependent upon her, fhe dreffes in a moft magnificent manner, covered all over, according to the fafhion of the ifland, with pearls and with pieces of gold, which are commonly fequins; thus continually carrying about her the enviable marks of affluence and fuperiority, while the wretched calogria follows her as a fervant, arrayed in fimple homefpun brown, and without the moft diftant hope of ever changing her condition. Such a difparity may feem intolerable, but what will not cuftom reconcile? Neither are the misfortunes of the family yet at an end. The father and mother, with what little is left them, contrive by their induftry to accumulate a fecond little fortune; and this, if they fhould have a third daughter, they are obliged to give to her upon her marriage; and the fourth, if there fhould be one, becomes her calogria; and fo on through all the daughters alternately. Whenever the daughter is marriageable, fhe can by cuftom compel the father to procure her a hufband; and the mother, fuch is the power of habit, is foolifh enough to join her in teafing him into an immediate compliance, though its confequences muft be equally fatal and ruinous to both of them. From hence it happens, that nothing is more common than to fee the old father and mother reduced to the utmoft indigence, and even begging about the ftreets, while their unnatural daughters are in affluence; and we ourfelves have frequently been fhown the eldeft daughter parading it through the town in the greateft fplendour, while her mother and fifter followed her as fervants, and made a melancholy part of her attendant train.

"The fons, as foon as they are of an age to gain a livelihood, are turned out of the family, fometimes with a fmall prefent or portion, but more frequently without any thing to fupport them; and thus reduced, they either endeavour to live by their labour, or, which is more ufual, go on board fome trading veffel as failors or as fervants, remaining abroad till they have got together fome compentency, and then return home to marry and to be henpecked. Some few there are who, taking advantage of the Turkifh law, break through this whimfical cuftom, who marry their calogrias, and retain to themfelves a competent provifion: but thefe are accounted men of a fingular and even criminal difpofition, and are hated and defpifed as conformifts to Turkifh manners, and deferters of their native cuftoms; fo that we may fuppofe they are few indeed who have the boldnefs to depart from the manners of their country, to adopt the cuftoms of their detefted mafters, and to brave the contempt, the derifion, and the hatred, of their neighbours and fellow-citizens.

"Of all thefe extraordinary particulars I was informed by the French conful, a man of fenfe and of indifputable veracity, who had refided in this ifland for feveral years, and who folemnly affured me that every circumftance was true: but indeed our own obfervation left us without the leaft room for doubt, and the fingular appearance and deportment of the ladies fully evinced the truth of our friend's relation. In walking through the town, it is eafy to perceive, from the whimfical manners of the female paffengers, that the women, according to the vulgar phrafe, *wear the breeches*. They frequently ftopped us in the ftreets, examined our drefs, interrogated us with a bold and manly air, laughed at our foreign garb and appearance; and fhowed fo little attention to that decent modefty which is or ought to be the true characteriftic of the fex, that there is every reafon to fuppofe they would, in fpite of their haughtinefs, be the kindeft ladies upon earth, if they were not ftrictly watched by the Turks, who are here very numerous, and would be ready to punifh any tranfgreffion of their ungallant laws with arbitrary fines. But nature and native manners will often baffle the efforts even of tyranny. In all their cuftoms thefe manly ladies feem to have changed fexes with the men. The woman rides aftride, the man fits fideways upon the horfe; nay, I have been affured that the hufband's diftinguifhing appellation is his wife's family name. The women have town and country houfes, in the management of which the hufband never dares interfere. Their gardens, their fervants, are all their own; and the hufband, from every circumftance of his behaviour, appears to be no other than his wife's firft domeftic, perpetually bound to her fervice, and flave to her caprice. Hence it is that a tradition obtains in the country, that this ifland was formerly inhabited by Amazons; a tradition, however, founded upon no ancient hiftory that I know of. Sappho indeed, the moft renowned female that this ifland has ever produced, is faid to have had manly inclinations; in which, as Lucian informs us, fhe did but conform with the fingular manners of her countrywomen: but I do not find that the mode in which fhe

Metelin. ſhe choſe to ſhow theſe inclinations is imitated by the preſent female inhabitants, who ſeem perfectly content with the dear prerogative of abſolute ſway, without endeavouring in any other particular to change the courſe of nature; yet will this circumſtance ſerve to ſhow, that the women of Leſbos had always ſomething peculiar, and even peculiarly maſculine, in their manners and propenſities. But be this as it may, it is certain that no country whatſoever can afford a more perfect idea of an Amazonian commonwealth, or better ſerve to render probable thoſe ancient relations which our manners would induce us to eſteem incredible, than this iſland of Metelin. Theſe lordly ladies are for the moſt part very handſome in ſpite of their dreſs, which is ſingular and diſadvantageous. Down to the girdle, which as in the old Grecian garb is raiſed far above what we uſually call the waiſt, they wear nothing but a ſhift of thin and tranſparent gauze, red, green, or brown, through which every thing is viſible, their breaſts only excepted, which they cover with a ſort of handkerchief; and this, as we were informed, the Turks have obliged them to wear, while they look upon it as an encumbrance, and as no inconſiderable portion of Turkiſh tyranny. Long ſleeves of the ſame thin material perfectly ſhow their arms even to the ſhoulder. Their principal ornaments are chains of pearl, to which they hang ſmall pieces of gold coin. Their eyes are large and fine; and the noſe, which we term Grecian, uſually prevails among them, as it does indeed among the women of all theſe iſlands. Their complexions are naturally fine; but they ſpoil them by paint, of which they make abundant uſe; and they disfigure their pretty faces by ſhaving the hinder part of the eyebrow, and replacing it with a ſtraight line of hair neatly applied with ſome ſort of gum, the brow being thus continued in a ſtraight and narrow line till it joins the hair on each ſide of their face. They are well made, of the middle ſize, and for the moſt part plump; but they are diſtinguiſhed by nothing ſo much and ſo univerſally as by a haughty, diſdainful, and ſupercilious air, with which they ſeem to look down upon all mankind as creatures of an inferior nature, born for their ſervice, and doomed to be their ſlaves; neither does this peculiarity of countenance in any degree diminiſh their natural beauty, but rather adds to it that ſort of bewitching attraction which the French call *piquant*."

His lordſhip has been at great pains to inveſtigate the origin of ſuch a ſingular cuſtom; but is unable to find any other example in hiſtory than that of the Lycians, who called themſelves by the names of their mothers, and not of their fathers. When aſked by their neighbours who they were? they deſcribed themſelves by their maternal genealogy. If a gentlewoman ſhould marry a ſlave, the children by that marriage were accounted noble; but ſhould the firſt man among them marry a foreign woman, the children would be accounted ignoble. This cuſtom is mentioned by ſeveral ancient authors. A difficulty of no little magnitude occurs, however, in accounting for the derivation of the inhabitants of Leſbos from the Lycians. This is ſolved in the following manner: In times of the moſt remote antiquity, the iſland of Leſbos was peopled by the Pelaſgi, who, under their leader Xanthus, the ſon of Trioppas king of Argos, firſt inhabited Leſbos: previous to that time they had dwelt in a certain part of Lycia which they had conquered; and in this country we may ſuppoſe they had learned the cuſtom in queſtion.

Metellus ‖ Metempſychoſis.

METELLUS, the ſurname of the family of the Cæcilii at Rome, the moſt known of whom were ——A general who defeated the Achæans, took Thebes, and invaded Macedonia, &c.—Q. Cæcilius, who rendered himſelf illuſtrious by his ſucceſſes againſt Jugurtha the Numidian king, from which he was ſurnamed *Numidicus*. Another who ſaved from the flames the palladium, when Veſta's temple was on fire. He was then high prieſt. He loſt his ſight and one of his arms in the action; and the ſenate, to reward his zeal and piety, permitted him always to be drawn to the ſenate houſe in a chariot, an honour which no one had ever before enjoyed. He alſo gained a great victory over the Carthaginians, &c. Q. Cæcilius Celer, another who diſtinguiſhed himſelf by his ſpirited exertions againſt Catiline. He married the ſiſter of Clodius, who diſgraced him by her incontinence and laſciviouſneſs. He died 57 years before Chriſt. He was greatly lamented by Cicero, who ſhed tears at the loſs of one of his moſt faithful and valuable friends. L. Cæcilius, a tribune in the civil wars of J. Cæſar and Pompey. He favoured the cauſe of Pompey, and oppoſed Cæſar when he entered Rome with a victorious army. He refuſed to open the gates of Saturn's temple, in which were depoſited great treaſures; upon which they were broke open by Cæſar, and Metellus retired when threatened with death. Q. Cæcilius, a warlike general who conquered Crete and Macedonia, and was ſurnamed *Macedonicus*. He had four ſons, of whom three were conſuls, and the other obtained a triumph, all during their father's lifetime. A general of the Roman armies againſt the Sicilians and Carthaginians. Before he marched, he offered ſacrifices to all the gods except Veſta; for which neglect the goddeſs was ſo incenſed, that ſhe demanded the blood of his daughter Metella. When Metella was going to be immolated, the goddeſs placed a heifer in her place, and carried her to a temple at Lanuvium, of which ſhe became the prieſteſs. Another, ſurnamed *Dalmaticus* from his conqueſt over Dalmatia, A. U. C. 634.—Cimber, one of the conſpirators againſt J. Cæſar. It was he who gave the ſignal to attack and murder the dictator in the ſenate houſe. —Pius, a general in Spain, againſt Sertorius, on whoſe head he ſet a price of 100 talents and 20,000 acres of land.

METEMPSYCHOSIS, (formed of μετα "beyond," and εμψυχω "I animate or enliven"), in the ancient philoſophy, the paſſage or tranſmigration of the ſoul of a man, after death, into the body of ſome other animal.

Pythagoras and his followers held, that after death men's ſouls paſſed into other bodies, of this or that kind, according to the manner of life they had led. If they had been vicious, they were impriſoned in the bodies of miſerable beaſts, there to do penance for ſeveral ages: at the expiration whereof, they returned afreſh to animate men. But, if they lived virtuouſly, ſome happier brute, or even a human creature, was to be their lot.

What led Pythagoras into this opinion was, the perſuaſion

perſuaſion he had that the ſoul was not of a periſhable nature: whence he concluded that it muſt remove into ſome other body upon its abandoning this. Lucan treats this doctrine as a kind of officious lie, contrived to mitigate the apprehenſion of death, by perſuading men that they only changed their lodging, and only ceaſed to live to begin a new life.

Reuchlin denies this doctrine; and maintains that the metempſychoſis of Pythagoras implied nothing more than a ſimilitude of manners, deſires, and ſtudies, formerly exiſting in ſome perſon deceaſed, and now revived in another alive. Thus when it was ſaid that Euphorbus was revived in Pythagoras, no more was meant than that the martial virtue which had ſhone in Euphorbus at the time of the Trojan war, was now, in ſome meaſure, revived in Pythagoras, by reaſon of the great reſpect he bore the *athletæ*. For thoſe people wondering how a philoſopher ſhould be ſo much taken with men of the ſword, he palliated the matter, by ſaying, that the ſoul of Euphorbus, i. e. his genius, diſpoſition, and inclinations, were revived in him. And this gave occaſion to the report, that Euphorbus's ſoul, who periſhed in the Trojan war, had tranſmigrated into Pythagoras.

Ficinus aſſerts, that what Plato ſpeaks of the migration of a human ſoul into a brute, is intended allegorically, and is to be underſtood only of the manners, affections, and habits, degenerated into a beaſtly nature by vice. Serranus, though he allows ſome force to this interpretation, yet inclines rather to underſtand the metempſychoſis of a reſurrection.

Pythagoras is ſaid to have borrowed the notion of a metempſychoſis from the Egyptians; others ſay, from the ancient Brachmans. It is ſtill retained among the Banians and other idolaters of India and China; and makes the principal foundation of their religion. So extremely are they bigotted to it, that they not only forbear eating any thing that has life, but many of them even refuſe to defend themſelves from wild beaſts. They burn no wood, leſt ſome little animalcule ſhould be in it; and are ſo very charitable, that they will redeem from the hands of ſtrangers any animals that they find ready to be killed. See PYTHAGOREANS.

METEMPTOSIS (from μετα *poſt*, and πιπτω *cado* "I fall,") a term in chronology, expreſſing the ſolar equation, neceſſary to prevent the new moon from happening a day too late. By which it ſtands contradiſtinguiſhed from *proemptoſis*, which ſignifies the lunar equation, neceſſary to prevent the new moon from happening a day too ſoon.

The new moons running a little backwards, that is, coming a day too ſoon at the end of 312 years and a half; by the proemptoſis, a day is added every 300 years, and another every 2400 years: on the other hand, by the metemptoſis, a biſſextile is ſuppreſſed each 134 years; that is, three times in 400 years. Theſe alterations are never made but at the end of each century; that period being very remarkable, and rendering the practice of the calendar eaſy.

There are three rules for making this addition or ſuppreſſion of the biſſextile day, and, by conſequence, for changing the index of the epacts. 1. When there is a metemptoſis without a proemptoſis, the next following, or lower index, muſt be taken. 2. When there is a proemptoſis without a metemptoſis, the next preceding or ſuperior index is to be taken. 3. When there are both a metemptoſis and a proemptoſis, or when there is neither the one nor the other, the ſame index is preſerved. Thus, in 1600, we had D: in 1700, by reaſon of the metemptoſis, C was taken: in 1800, there was both a proemptoſis and a metemptoſis; ſo the ſame index was retained. In 1900, there will be a metemptoſis again, when B will be taken; which will be preſerved in 2000, becauſe there will then be neither the one nor the other. This is as far as we need compute for it: But Clavius has calculated a cycle of 301,800 years; at the end of which period, the ſame indices return in the ſame order. See EPACT.

METEOR, (by the Greeks called μετεωρα, q. d. *ſublima* or "high raiſed;" by the Latins *impreſſiones* as making ſigns or impreſſions in the air), commonly denotes any bodies in the air that are of a tranſitory nature. Hence it is extended to the phenomena of hail, rain, ſnow, thunder, &c.; but is moſt commonly confined to thoſe unuſual and fiery appearances named *falling ſtars*, *ignes fatui*, *auroræ boreales*, &c. See METEOROLOGY.

METEROLITE. This term is derived from the Greek μετεωρα, a *meteor*, and λιθος, a *ſtone*; and denotes a ſtony ſubſtance, exhibiting peculiar characters, and whoſe deſcent to the earth is uſually accompanied by the appearance and exploſion of a fire-ball.

Luminous meteors have, in all ages, been obſerved in the atmoſphere. It is alſo well known that their diſappearance has frequently been attended with a loud noiſe; but that they ſhould moreover terminate in the fall of one or more ſolid bodies to the earth's ſurface, is a poſition ſo repugnant to our ordinary conceptions of the tenor of phyſical events, that we cannot admit it as a fact on ſlight or ſcanty evidence. With due deference, however, to ſome philoſophers of name, we are not prepared to aſſert, that it implies impoſſibility. For who has explored the higher regions of the atmoſphere? or who knows what may take place beyond its precincts? If a ſolid reſult from the combination of two aeriform ſubſtances, as muriatic acid and ammoniacal gaſes; if oxygen, the properties of which are moſt familiar to us in the ſtate of gas, can undergo fixation, and if fluids can paſs into cryſtalline forms, is it too bold to preſume, that the ſame, or ſimilar proceſſes, effected in the grand laboratory of the atmoſphere, may be within the range of poſſible occurrences? At all events, the ſame Being who called into exiſtence thoſe ſublime and countleſs maſſes of matter which revolve in ſpace, may, to ſerve purpoſes unknown to us, create bodies of dimenſions infinitely ſmaller, and deſtined to impinge on ſome planetary orb. The reaſoning of an angel may not convince us, that a part is greater than the whole, or that the value of two and two is equivalent to ſix; but a very ordinary logician may prove to our ſatisfaction, that the contact of particles of matter in portions of ſpace which lie beyond our globe, is no chimerical ſuppoſition. Every thing around us proclaims, that matter is ſubject to inceſſant change. New forms and new modifications are ever ſpringing into being: and can we doubt, that the ſame particles, as they may happen to be affected or influenced by various circumſtances, may exiſt in the ſtate of gas, of aqueous vapour, or of a concrete maſs?

Again,

Again, it ſurely will not be ſeriouſly maintained, that, from the rarity of a phenomenon, we are warranted to infer its nonexiſtence. The appearance of a comet is a rare, but not a fictitious, occurrence. Nay, we may ſafely advance a ſtep farther, and aſſert, without fear of confutation, that the exiſtence of a phenomenon, if otherwiſe well atteſted, cannot be diſproved by our inability to explain it. How multiplied, in fact, are the ſubjects, even of our daily and hourly obſervation, which we cannot ſatisfactorily expound? We cannot ſay why a ſmall ſeed ſhould gradually unfold into a large tree, why flame ſhould produce heat, why the hand ſhould act in immediate ſubſerviency to the will, or why a contuſion of the brain ſhould induce ſtupor, alienation of mind, or death. It is one thing to prove a fact, and it is another to account for it.

From theſe premiſes it follows in courſe, that we are not entitled to reject the exiſtence of meteoric ſtones, provided it be eſtabliſhed by valid teſtimony. Should the hiſtorical evidence, on a fair and diſpaſſionate review, be deemed concluſive, we may afterwards examine the theories which have been propoſed for the ſolution of the appearance.

From the Scriptures of the Old Teſtament we are not aware that any paſſage can be cited in direct corroboration of the deſcent of ſtones from the atmoſphere. The ingenious and fanciful Mr Edward King, indeed, in his "Remarks concerning ſtones ſaid to have fallen from the clouds, both in theſe days, and in ancient times," adverts to the 13th verſe of the 18th Pſalm.—The Lord alſo thundered out of heaven, and the Higheſt gave his thunder: hail-ſtones and *coals of fire.*" This laſt expreſſion has, no doubt, been conjectured to denote real hard bodies, in a ſtate of ignition; and the term *ανθρακες*, employed by the cautious Seventy, rather favours ſuch an interpretation. The ſame expreſſion, however, occurs in the preceding verſe, without admitting this interpretation; and the phraſe ſeems to be only a figurative mode of deſcribing lightning. In the ſober latitudes of the north, and even in colloquial language, we talk of *balls of fire* and *thunderbolts*, without any reference to ſolid matter. Mr King likewiſe quotes the 11th verſe of the 10th chapter of Joſhua.—"And it came to paſs, as they fled from before Iſrael, and were in the going down to Beth-horon, that the Lord caſt down *great ſtones* from heaven upon them unto Azekah, and they died: they were more which died with hail-ſtones, than they whom the children of Iſrael ſlew with the ſword." Here, the expreſſion, *great ſtones*, is leſs equivocal than *coals of fire;* yet the context hardly allows us to doubt, that the great ſtones were really hail-ſtones, or rather, perhaps, lumps of ice, conſolidated in the atmoſphere, ſuch as occaſionally fall in hot countries, and ſuch as alarmed the whole of Paris and its neighbourhood in 1788. At any rate, the ſlaughter of the Canaanites is repreſented as reſulting from the ſpecial interpoſition of divine power; and the conſideration of miracles is irrelevant to our preſent purpoſe.

If from ſacred, we turn to the early period of profane hiſtory, we ſhall find the annals of public events very copiouſly interſperſed with notices of ſtrange appearances, many of which may be ſafely aſcribed to the aſcendancy which ſuperſtition long obtained over the human mind. The ſcepticiſm of the learned is, however, ſometimes not leſs injudicious and indiſcriminate than the credulity of the ſavage; and he who ſhould reſolve every extraordinary event, which is recorded by the writers of Greece and Rome, into a "cunningly deviſed fable," would not be leſs reprehenſible for want of candour, than the untutored ruſtic, who yields his aſſent to every alledged miracle, is to be taxed with want of diſcernment.

Although theſe general poſitions can ſcarcely admit of diſpute, it becomes extremely difficult, after a lapſe of many ages, and in the collation of marvellous records, to ſeparate truth from falſehood. In our attempts to proſecute this analytical proceſs, we may ſometimes advance a certain length with perfect ſecurity, without being able to trace uniformly the preciſe lines of demarcation. Thus, in regard to the topic of our preſent diſcuſſion, we know, that in various periods of the world the vulgar have aſcribed a celeſtial origin to ſtones of a peculiar configuration, as to certain modifications of pyrites, to belemnites, orthoceratites, &c. which the ſubſequent obſervations of naturaliſts have proved to be of mineral formation, and to the heads of arrows and ſharpened flints, which have been faſhioned by the hand of man, and which, accordingly we are authorized to exclude from the ex-terreſtrial catalogue. But when ſubſtances diſſimilar from theſe, and coinciding in any one character or circumſtance with modern ſpecimens of atmoſpheric ſtone, are reported by the ancients to have fallen from the clouds, the diſtance of ages and the lameneſs of the documents may powerfully affect our appreciation of the reputed evidence.

When, therefore, we ſhortly touch on a few of the many inſtances which might be quoted from the annals of antiquity, we mean not to vouch for the truth even of theſe particular inſtances; but merely to admit their probability, and the weight which the mention of them may be conſidered to add to that of ſubſequent and recent narrations.

Through the miſt of fable which envelopes the hiſtory of the *bætuli*, we diſcern ſome characters which correſpond with thoſe of meteorolites. Thus, in the *Λιθικα*, a poem falſely aſcribed to Orpheus, the *σιδηριτης*, which M. Falconet properly claſſes with the bætuli, is ſaid to be *rough*, *heavy*, and *black*. Damaſcius, in an extract of his life of Iſidorus, preſerved by Photius, relates that the bætuli fell on Mount Libanus, in *a globe of fire*. A fragment of Sanchoniathon, preſerved in Euſebius, (Præpar. Evangel. i. 10.), moreover informs us, that theſe ſtones were fabricated by the god *Uranus* (or *Heaven*), one of whoſe four ſons was named *Bætul.* May not this mythological genealogy be regarded as merely emblematical of their deſcent from the upper regions of the atmoſphere? In the ſame chapter we are told that Aſtarte found a *ſtar* which had *fallen from heaven*, and honoured it with conſecration in the city of Tyre. The ſtone denominated "the mother of the gods," if we can believe Appian, Herodian, and Marcellinus, *fell from heaven.* Ariſtodemus, cited by the Greek ſcholiaſt on Pindar, aſſerts that it *fell encircled by fire*, on a hill, at the feet of the Theban bard. It is ſaid to have been of a *black* colour, and of an *irregular* ſhape. Herodian (lib. v.) expreſsly declares, that the Phœnicians had no ſtatue of the ſun, poliſhed by the hand; but only a certain ſtone, circular below, and terminated

Meteorolite.

terminated acutely above, in the form of a cone, of a *black* colour, and that, according to report, it *fell from heaven*, and was regarded as the image of the ſun.

Among various inſtances which might be ſelected from Livy, is that of a ſhower of ſtones on Mount Alba, in the reign of Tullus Hoſtilius, or about ſix hundred and fifty-two years before the birth of Chriſt. When the ſenate were told, that it had *rained ſtones*, they doubted the fact, and deputed commiſſioners to inquire into the particulars. They were then aſſured, that ſtones had really fallen, *haud aliter quam quum grandinem venti glomeratam in terras agunt*. On this occaſion, the hiſtorian mentions, that ſimilar events were celebrated by a feſtival of nine days. *Manſit ſolemne, ut quandocumque idem prodigium nuntiaretur, feriæ per novem dies agerentur.*

But one of the moſt remarkable caſes which occurs in the records of antiquity, is that which is mentioned in the 58th chapter of the ſecond book of Pliny's Natural Hiſtory, of a large ſtone which fell near Egoſpotamos, in Thrace, in the ſecond year of the ſeventy-eighth Olympiad, or, according to our chronology, about four hundred and ſixty-ſeven years before the Chriſtian era. Pliny aſſures us, that this extraordinary maſs was ſtill ſhewn in his day; and that it was as large as a cart, and of a *burnt colour*. The Greeks pretended that it had *fallen from the ſun*, and that Anaxagoras had predicted the day of its arrival on the earth's ſurface. According to Plutarch, in the life of Lyſander, the inhabitants of the Cherſoneſus held the Thracian ſtone in great veneration, and exhibited it as a public ſhow. His account of its firſt appearance is chiefly extracted from the relation of Daimachus of Platææ, and may be thus tranſlated. "During ſeventy-five ſucceſſive days before the ſtone fell, a large fiery body, like a cloud of flame, was obſerved in the heavens, not fixed to one point, but wandering about with a broken, irregular motion. By its violent agitation, ſeveral fiery fragments were forced from it, impelled in various directions, and darted with the velocity and brightneſs of ſo many ſhooting ſtars. After this body had fallen on the Cherſoneſus, and the people had aſſembled to examine it, they could find no inflammable matter, nor the ſlighteſt trace of combuſtion, but a real ſtone, which, though large, by no means correſponded to the dimenſions of the flaming globe which they had ſeen in the ſky, but ſeemed to be only a piece detached from it." Daimachus, it is true, may, on this occaſion, have given way to his reputed love of the marvellous; and we can eaſily believe that the *ſeventy-five continuous days* are either an error of the copyiſt, or an original exaggeration; yet, from the marked coincidence of ſome of the circumſtances with thoſe more fully detailed in the ſequel, there ariſes the preſumption that a meteorolite really fell at the place and period above aſſigned.

From this period, till near the cloſe of the fifteenth century, any hiſtorical notices which we have been enabled to collect, are ſo vague and ſcanty, that, in this abridged view of the ſubject, we may paſs them over in ſilence.

Profeſſor Bantenſchoen, of the central ſchool of Colmar, firſt directed the attention of naturaliſts to ſome of the old chronicles, which commemorate with much *naivete*, and in the true ſpirit of the times, the fall of the celebrated ſtone of Enſiſheim. The following account accompanied this very ſingular maſs, when it was ſuſpended in the church.

Meteorolite.

"In the year of the Lord 1492, on Wedneſday, which was Martinmas eve, the 7th of November, there happened a ſingular miracle: for, between eleven o'clock and noon, there was a loud peal of thunder, and a prolonged confuſed noiſe, which was heard to a great diſtance, and a ſtone fell from the air, in the juriſdiction of Enſiſheim, which weighed 260 pounds, and the confuſed noiſe was, moreover, much louder than here. There a child ſaw it ſtrike on a field, ſituated in the upper juriſdiction, towards the Rhine and Inn, near the diſtrict of Giſgard, which was ſown with wheat, and did it no harm, except that it made a hole there: and then they conveyed it from that ſpot; and many pieces were broken from it, which the landvogt forbade. They, therefore, cauſed it to be placed in the church, with the intention of ſuſpending it as a miracle; and many people came hither to ſee this ſtone. So there were remarkable converſations about this ſtone: but the learned ſaid, that they knew not what it was; for it was beyond the ordinary courſe of nature, that ſuch a large maſs ſhould ſmite the earth from the height of the air; but that it was really a miracle of God; for, before that time, never any thing was heard like it, nor ſeen, nor deſcribed. When the people found that ſtone, it had entered into the earth, to the depth of a man's ſtature, which every body explained to be the will of God, that it ſhould be found, and the noiſe of it was heard at Lucerne, at Villing, and in many other places, ſo loud, that it was believed that houſes had been overturned: And as the king (Maximilian) was here, the Monday after St Catherine's day, of the ſame year, his royal excellence ordered the ſtone which had fallen to be brought to the caſtle, and after having converſed a long time about it with the noblemen, he ſaid the people of Enſiſheim ſhould take it, and order it to be hung up in the church, and not allow any body to take any thing from it. However, his excellency took two pieces of it, of which he kept one, and ſent the other to the duke Sigiſmund of Auſtria; and they ſpoke a great deal about this ſtone, which they ſuſpended in the choir, where it ſtill is; and a great many people came to ſee it."

Trithemius, in his Hirſaugienſian Annals, employs language to this effect.—"In the ſame year, on the 7th day of November, in the village of Suntgaw, near the townlet of Enſiſheim, not far from Baſil, a city of Germany, a ſtone, called a thunder-ſtone, of a prodigious ſize, for we know from eye-witneſſes that it weighed 255 pounds, fell from the heavens. Its fall was ſo violent, that it broke into two pieces. The moſt conſiderable is ſtill exhibited at the door of the church of Enſiſheim, ſuſpended by an iron chain, as a proof of the fact which we have mentioned, and to preſerve it in the public recollection."—We learn alſo from Paul Lang that there aroſe a furious ſtorm on the 7th of November 1492, and that while the thunder roared, and the heavens appeared all on fire, a ſtone of enormous ſize fell near Enſiſheim. "Its form was that of the Greek delta, with a triangular point. They ſtill ſhow it at Enſiſheim as an aſtoniſhing phenomenon."

It is worthy of obſervation, that theſe chroniclers lived at the period which they aſſign to the deſcent of the

the ſtone; and that, though their names are haſtening to oblivion, Trithemius yielded to few of his contemporaries in labour and learning; while Lang, a German Benedictine as he was, travelled in ſearch of hiſtorical monuments, arraigned the licence of the catholic clergy, and applauded the independence of Luther and Melancthon.

Of the Enſiſheim ſtone, which has been tranſported to the national library at Colmar, and which, notwithſtanding various *dilapidations*, ſtill weighs 150 pounds, ſome intereſting ſpecimens may now be ſeen in the cabinets of the curious. Robert Ferguſon, Eſq. younger of Raith, has, in the moſt polite and obliging manner, gratified us with the ſight of a ſmall fragment, which belongs to his valuable collection of minerals at Raith houſe in Fifeſhire, Scotland.

We are fully aware, that M. Barthold has laboured to convince his readers (Journal de Phyſique, Ventoſe, year 8.) that the far-famed maſs of Enſiſheim is merely argillo-ferrugineous, of ſecondary formation, detached from an adjacent mountain, and conveyed to the ſpot on which it was found by ſome torrent or land-flood. In this opinion, we might partially acquieſce, did not the artleſſneſs of contemporary and concurring records militate againſt it, and had not the more accurate analyſis of Vauquelin detected the ſame conſtituent parts as in the other ſtony and metalline ſubſtances denominated meteoric. "It is certainly compoſed of ſilica," obſerves this celebrated chemiſt, "of magneſia, of iron, of nickel, of ſulphur, and of a ſmall quantity of lime.—Particular trials have convinced me of the preſence of ſulphur and nickel in the grains of malleable iron, and in the pyrites, though in different proportions. This ſtone, then, in every reſpect, reſembles others which have fallen from the atmoſphere."

In the Commentary of Surius, a Carthuſian monk of Cologne, mention is made of a ſhower of large ſtones in Lombardy, in 1510. Theſe ſtones were harder than flint, and ſmelled of ſulphur. The heavieſt weighed 120 pounds.—The ſame event is more particularly related by Cardan, in his work intitled *de Rerum Varietate* (lib. xiv. c. 72.) According to this author, near the river Adda, not far from Milan, and at five o'clock in the evening, about 1120 ſtones fell from the air, one of them weighing 120 pounds and another 60 pounds. Many were preſented to the French governor, and his deputy. At three o'clock P. M. the ſky appeared as if in a general blaze; and the paſſage, though ſomewhat ambiguous, would lead us to infer, that the meteor was viſibl for two hours. Like many of the learned and unlearned of his day, Cardan inſtantly connects the extraordinary appearance with the political tranſactions of his diſtrict.

We next paſs to an intereſting extract from the memoirs of the emperor Jehangire, written in Perſian, by himſelf, and tranſlated by Colonel Kirkpatrick,

"*A. H.* 1030, *or* 16th *year of the reign.*—The following is among the extraordinary occurrences of this period.

"Early on the 30th of Furverdeen of the preſent year (1620), and in the eaſtern quarter of the heavens, there aroſe in one of the villages of the purgunnah of Jalindher, ſuch a great and tremendous noiſe, as had nearly, by its dreadful nature, deprived the inhabitants of the place of their ſenſes. During this noiſe, a luminous body was obſerved to fall from above, on the earth, ſuggeſting to the beholders the idea that the firmament was raining fire. In a ſhort time, the noiſe having ſubſided, and the inhabitants having recovered from their alarm, a courier was diſpatched to *Mahommed Syeed*, the aumil of the aforeſaid purgunnah, to advertiſe him of this event. The aumil, inſtantly mounting his horſe, proceeded to the ſpot. Here he perceived the earth, to the extent of a dozen of yards in length and breadth, to be burned to ſuch a degree, that not the leaſt trace of verdure, or a blade of graſs remained; nor had the heat yet ſubſided entirely.

"*Mahommed Syeed* hereupon directed the aforeſaid ſpace of ground to be dug up; when the deeper it was dug, the greater was the heat of it found to be. At length a lump of iron made its appearance, the heat of which was ſo violent, that one might have ſuppoſed it to have been taken from a furnace. After ſome time it became cold: when the aumil conveyed it to his own habitation, from whence he afterwards diſpatched it in a ſealed bag to court.

"Here I had this ſubſtance weighed in my preſence. Its weight was 160 tolahs (A). I committed it to a ſkilful artiſan, with orders to make of it a ſabre, a knife, and a dagger. The workman reported, that the ſubſtance was not malleable, but ſhivered into pieces under the hammer.

"Upon this I ordered it to be mixed with other iron. Conformably to my orders, three parts of the *iron of lightning* (B) were mixed with one part of common iron; and from the mixture were made two ſabres, one knife, and one dagger."

Our limits will not permit us to give the whole of the extract, nor the remarks of the Right Hon. Charles Greville and Colonel Kirkpatrick, which were read before the Royal Society of London, on the 27th January, 1803. We feel, however, no heſitation in attaching to this document ſomething very nearly approaching to direct evidence of the fact in queſtion.

The celebrated Gaſſendi relates, that, on the 27th of November, 1627, about 10 o'clock A. M. during a very clear ſky, he ſaw a flaming ſtone, of the apparent diameter of four feet, fall on Mount *Vaiſion*, an eminence ſituated between the ſmall towns of Perne and Guillaumes, in Provence. This ſtone was ſurrounded by a luminous circle of different colours, nearly reſembling the rainbow, and its fall was accompanied with a noiſe like the diſcharge of artillery. It weighed 59 pounds; and its ſpecific gravity was to that of common marble as 14 to 11. It was of a dark metallic colour, and extremely hard. Though it was not ſubjected to chemical analyſis, and is not now to be found, the circumſtances which have been ſtated by the philoſopher are ſufficiently

(A) A tolah is about 180 grains, Troy weight.

(B) This expreſſion is equivalent to our term *thunder-bolt*.

Meteorolite.

sufficiently minute to operate on the conviction of those who are willing to be convinced.

From a curious book printed at Paris in 1672, and now become very scarce, entitled *Conversations tirées de l'Académie de M. l'Abbé Bourdelot, contenant diverses recherches et observations physiques, par le Sieur Legallois*, we make the ensuing extract.

"A member presents a fragment of two stones which fell near Verona, one of which weighed 300, and the other 200 pounds. These stones," says he, "fell during the night, when the weather was perfectly mild and serene. They seemed to be all on fire, and came from above, but in a slanting direction, and with a tremendous noise. This prodigy terribly alarmed 300 or 400 eye-witnesses, who were at a loss what to think of it. These stones fell with such rapidity, that they formed a ditch, in which after the noise had ceased, the spectators ventured to approach them, and examine them more closely. They then sent them to Verona, where they were deposited in the Academy, and that learned body sent fragments of them to different places." That which accompanied the above intimation was of a yellowish hue, very easily pulverized, and smelled of sulphur.—In the course of examining one of these stones, M. Laugier, professor of pharmacy at Paris, has recently detected the presence of chrome, by means of the caustic alkali.—The date of the Verona phenomena, if we have been correctly informed, is 1663.

In the Bornian collection there is a substance which is designated *Ferrum retractorium, granulis nitentibus, matrice virescenti immixtis* (*Ferrum virens Lin.*), *cujus fragmenta ab unius ad viginti usque librarum pondus, cortice nigro scoriaceo circumdata, ad Plann, prope Tabor, circuli Bechinensis Bohemiæ, passim reperiuntur.* The following note is subjoined. (*Quæ fragmenta 3 Julii anni* 1753, *inter tonitrua, è cælo pluisse creduliores quidam asserunt.*) The expression *creduliores quidam*, it may be alledged, at once destroys the evidence of this memorandum. It deserves, however, to be noted, that, in regard to our present subject, what was formerly accounted the credulity of the vulgar, may now, on several occasions, be construed into probability, if not into matter of fact; and that Mr Greville has found the identical fragment to have the same composition with other meteoric stones. Hence, we are compelled either to admit its ex-terrestrial origin, or the existence of a substance, originally belonging to the earth, and yet agreeing in character with those deemed atmospheric. The former part of the alternative is perfectly consonant with well-authenticated facts; whereas of the latter, we are not warranted to pronounce, that a single case has hitherto been established, to the satisfaction of any chemist or mineralogist.

But we have now to turn our attention to a report of M. de la Lande, inserted in the Historical Almanack of Bresse, for 1756.

In the month of September, 1753, about one o'clock P. M. when the weather was very hot, and very serene, without the least appearance of a cloud, a very loud noise, like the discharge of two or three cannons, was heard within the circumference of six leagues, but was of very short duration. This noise was loudest in the neighbourhood of Pont-de-Vesle; and at Liponas, a village three leagues from the last-mentioned place, it was even accompanied with a hissing, like that of a cracker. On the same evening there were found at Liponas and at Pin, two blackish masses, of a form nearly circular, but very uneven, which had fallen on ploughed ground, and sunk, by their own weight, to half a foot below the surface. One of them weighed about twenty pounds; and a fragment of one of them weighing 11¼lb. was preserved in the cabinet of M. Varenne de Beost, at Dijon. The basis of these masses resembled a grayish whinstone, and was very refractory; and some ferrugineous particles were disseminated in grains, filaments, or minute masses, through the substance of the stone, especially in its fissures. This iron, when subjected to a red heat, became obedient to the magnet. The black coating on the surface, M. de la Lande ascribes to fusion, induced by violent heat. This gentleman's acknowledged respectability and accuracy of observation, combined with the circumstances which he has adduced, circumstances, too, which, if mistated, lay so open to public investigation, powerfully plead in favour of his testimony.

On the 15th of September 1760, according to the abbé Bachelay, about half past four o'clock P. M. there appeared near the chateau de Chevabrie, in the neighbourhood of Lucé, a small town of the province of Maine, a stormy cloud, from which proceeded a loud peal of thunder, like the discharge of cannon, and followed by a noise which was mistaken by several people for the lowing of oxen. This sound was heard over a space of about two leagues and a half, but unaccompanied by any perceptible flame. The reapers in the parish of Perigué, about three leagues from Lucé, on hearing the same noise, looked up, and saw an opake body, which described a curve, and fell on soft turf, on the high road from Mons, near which they were at work. They all quickly ran up to it, and found a sort of stone, nearly half of which was buried in the earth, and the whole so hot that it could not be touched. At first they ran away in a panic; but on returning to the spot some time after, they found the stone precisely in the same situation, and sufficiently cooled to admit of being handled, and narrowly examined. It weighed seven ounces and a half, and was of a triangular form, presenting, as it were, three rounded horns, one of which, at the moment of the fall had entered into the ground, and was of a gray or ash colour, while the rest, which was exposed to the air, was very black. When the abbé presented this stone to the academy, that body appointed three of its number, namely, Messieurs Lavoisier, Fougeroux, and Cadet, to examine and analyse it. This task they performed with more care and accuracy than M. de la Lande had done on the preceding occasion; but their trial was confined to an integral part of the whole, considered as a homogeneous substance, in place of being repeated on each of the constituent parts. The substance was of a pale cinereous hue, speckled with an infinite number of small and shining metallic points, visible through a magnifying glass. That part of the outer surface which remained above ground was incrusted with a thin black coating, which seemed to have undergone fusion, and which gave a few sparks when struck with steel. The specific gravity of the mass was 3535. —Two other stones, nearly of the same characters, the one reported to have fallen at Aire, in Artois, and the

the other in the Cotentin, in Normandy, were preſented to the academy in the courſe of the ſame year by M. Gurſon de Boyaval, honorary lieutenant-general of the bailliage of Aire, and the younger M. Morand. According to the academical report, theſe three ſtones, when compared, preſented no difference to the eye, were of the ſame colour, and nearly of the ſame grain, exhibiting metallic and pyritous particles, and covered with a black and ferrugineous incruſtation. Although the coincidence of facts and circumſtances, in three places ſo remote from one another, did not convince the academy that theſe ſtones had been conveyed to the earth by lightning, yet it induced them to invite naturaliſts to proſecute the examination of the ſubject.

On the 20th of November 1768, a ſtone fell at Mauerkircken near the Inn, in Bavaria, that weighed 38lb. was of a triangular form, and only eight inches in thickneſs. Its fall was accompanied by a hiſſing noiſe, and great darkneſs in the atmoſphere. This meteorolite penetrated two feet and a half into the ſoil. Part of it is now in the muſeum of the right honourable Charles Greville, and a fragment may be ſeen in Mr Ferguſon's collection quoted above.

The next remarkable caſe on record occurred on the 20th of Auguſt 1789, at Barbotan, near Roquefort, in the *Landes* of Bordeaux, and is thus related by Citizen Lomet, who was known to ſeveral members of the inſtitute, and happened to be at Agen when the meteor appeared.

"It was a very bright fire-ball, luminous as the ſun, of the ſize of an ordinary balloon, and, after inſpiring the inhabitants with conſternation, burſt and diſappeared. A few days after, ſome peaſants brought ſtones, which they ſaid fell from the meteor; but the philoſophers to whom they offered them laughed at their aſſertions as fabulous. The peaſants would have now more reaſon to laugh at the philoſophers."—One of theſe ſtones broke through the roof of a cottage, and killed a herdſman and ſome cattle. Vauquelin, who received a *proces-verbal* of the circumſtances, alſo examined one of the ſpecimens. The fragment procured by Mr Ferguſon has viſibly all the characters of a genuine meteorolite.

A much more remarkable phenomenon, however, of the ſame deſcription, occurred near Agen, on the 24th of July 1790. An inhabitant of St Severe communicates the following particulars to M. Darcet the chemiſt, who was then reſident at Paris.

"Our towns-people were yeſterday very much alarmed. About a quarter paſt nine o'clock, in the evening, there ſuddenly appeared in the air a fire-ball, dragging a long train, which diffuſed a very vivid light over the horizon. This meteor ſoon diſappeared, and ſeemed to fall at one hundred paces from us. It was quickly followed by an exploſion louder than that of cannon or of thunder. Every body dreaded being buried under the ruins of his houſe, which ſeemed to give way from the concuſſion. The ſame phenomenon was ſeen, and the report heard, in the neighbouring towns, as Mont de Marſan, Tartas, and Dax. The weather in other reſpects was very calm, without a breath of wind or a cloud, and the moon ſhone in all her brightneſs."

M. Darcet's brother, a clergyman in that part of the country, ſent him a ſmall ſtone, which was picked up on the morning after the exploſion, and the hiſtory of which he was ſcrupulouſly anxious to inveſtigate. Being ſatisfied with reſpect to all the particulars, he at length diſpatched it to Paris, accompanied with ſome curious remarks. "When theſe ſtones fell," ſays he, "they had not their preſent degree of hardneſs. Some of them fell on ſtraw, bits of which ſtuck to the ſtones, and incorporated with them. I have ſeen one in this predicament. It is at preſent at la Baſtide; but I cannot perſuade the owner to part with it * * *. Thoſe which fell on the houſes produced a noiſe, not like that of ſtones, but rather of a ſubſtance which had not yet acquired compactneſs."

We ſubjoin the *proces-verbal*—a ſimple but authentic document.

"In the year one thouſand ſeven hundred and ninety, and the 30th day of the month of Auguſt, we, the Sieur Jean Duby, mayor, and Louis Mauilon, procurator of the commune of the municipality of La Grange de Juillac, and Jean Darmite, reſident in the pariſh of La Grange de Juillac, certify in truth and verity, that, on Saturday the 24th of July laſt, between nine and ten o'clock in the evening, there paſſed a great fire, and after it we heard in the air a very loud and extraordinary noiſe; and, about two minutes after, there fell ſtones from heaven, but fortunately there fell only a very few, and they fell about ten paces from one another in ſome places, and in others nearer, and finally, in ſome other places, farther, and falling, moſt of them, of the weight of about half a quarter of a pound each; ſome of about half a pound, like that found in our pariſh of La Grange; and on the borders of the pariſh of Creon, they were found of a pound weight; and in falling they ſeemed not to be inflamed, but very hard and black without, and within of the colour of ſteel; and, thank God, they occaſioned no harm to the people, nor the trees, but only to ſome trees which were broken on the houſes; and moſt of them fell gently, and others fell quickly, with a hiſſing noiſe; and ſome were found which had entered into the earth, but very few. In witneſs whereof we have written and ſigned theſe preſents. (Signed) Duby, Mayor—Darmite."

Monſieur Baudin mentions, that, as M. Carris of Barbotan and he were walking in the court of the caſtle of Mormes about half paſt nine o'clock, in the evening of the 24th of July 1790, when the air was perfectly calm, and the ſky cloudleſs, they found themſelves ſuddenly ſurrounded by a pale clear light, which obſcured that of the moon, though the latter was nearly full. On looking up, they obſerved, almoſt in their zenith, a fire-ball of a larger apparent diameter than that of the moon, dragging a tail, which ſeemed to be five or ſix times longer than the diameter of its body, and which gradually tapered to a point, the latter approaching to blood-red, though the reſt of the meteor was of a pale white. This luminous body proceeded with great velocity from ſouth to north, and in two ſeconds ſplit into portions of conſiderable ſize, like the fragment of a burſting bomb. Theſe fragments became extinguiſhed in the air, and ſome of them, as they fell, aſſumed that deep red colour, which had been obſerved at the point of the tail. Two or three minutes after M. Baudin and his friend heard a dreadful exploſion, like the ſimultaneous firing of ſeveral pieces of ordnance; but they were not ſenſible of any tremulous motion under their feet, though the concuſſion

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fion of the atmofphere fhook the windows in their frames, and threw down kitchen utenfils from their fhelves. When thefe gentlemen removed to the garden, the noife ftill continued, and feemed to be directly over their heads. Some time after it had ceafed, they heard a hollow found rolling, in echoes, for fifty miles, along the chain of the Pyrenees, and at the end of about four minutes gradually dying away in diftance. At the fame time, a ftrong fulphureous odour was diffufed in the atmofphere. The interval which occurred between the difruption of the meteor, and the loud report, induced M. Baudin to conjecture, that this fireball muft have been at leaft eight miles from the earth's furface, and that it fell about four miles from Mormes. "The latter part of my conjecture, fays he, was foon confirmed by an account which we received of a great many ftones having fallen from the atmofphere at Juillac and in the neighbourhood of Barbotan." It appears, indeed, from the concurring teftimony of intelligent perfons worthy of credit, that the meteor really exploded at a little diftance from Juillac, and that its fragments were found lying in an almoft circular fpace, of nearly two miles in diameter. Some of them weighed eighteen or twenty, and a few, it is alleged, even fifty pounds. M. de Carris procured one of 18lbs. which he tranfmitted to the Parifian Academy of Sciences. That examined by M. Baudin was fmall, but heavy in proportion to its fize, black on the outfide, grayifh within, and interfperfed with many minute, fhining, metallic particles. Thefe laft circumftances perfectly accord with the fragment of a Barbotan ftone preferved in Mr Fergufon's collection.

In one of his letters to Profeffor St Amand, M. Goyon d'Arzas remarks, that thefe ftones, though generally fmooth on the outfide, prefented fome longitudinal cracks, or fiffures, while their interior parts exhibited fymptoms of metallic veins, efpecially of a ferrugineous complexion. When yet red-hot, and fcattered in various directions, they formed that magnificent fire-work, that fhower of flame, which enlightened the horizon over a large tract of country; for this extraordinary meteor was feen at Bayonne, Auch, Pau, Tarbes, and even at Bordeaux and Touloufe. At the laft mentioned place it excited little attention, on account of its great diftance, and its appearing only a little brighter than a fhooting ftar. It, moreover, deferves to be noted, that the meteorolites in queftion were found on a bare moor, of an extremely thin foil, on which no fuch ftones, or indeed ftones of any defcription, had been obferved in the memory of man. They who are folicitous of additional information on this part of our fubject, may confult N^os. 23 and 24 of the *Journal des Sciences Utiles* of Montpelier, for 1790, and the *Decade Philofophique* for February 1796.

When all the circumftances of the cafe are duly confidered, we need not be furprifed, that they fhould produce conviction on the minds of many men of fcience, who, till then, poffeffed "an evil heart of unbelief." M. de St Amand ingenuoufly confeffed to M. Pictet of Geneva, that he had treated this novel topic with unmerited contempt, and that the evidence deduced from the fimilar characters of the ftones fhould not be rafhly rejected. The learned and the unlearned of the diftrict in which the phenomenon is ftated to have occurred, atteft its exiftence; the profeffor of natural hiftory in the central fchool of Agen renounces his former fcepticifm; Vauquelin analyfes a fpecimen, and finds it to contain the fame chemical fubftances as other meteorolites, and in nearly the fame proportions; and fhall we be fo unreafonable as to withhold our affent, merely becaufe we have not *ocular demonftration* of the alleged particulars?

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Our chronological feries of cafes has now brought us to the fall of feveral meteorolites near Sienna, the particulars of which, as reported by the late earl of Briftol and Sir William Hamilton, are recorded in the firft part of the Philofophical Tranfactions for 1795 (page 103). Mr King, likewife in the tract which we have already quoted, communicates fome interefting circumftances relative to this phenomenon, chiefly extracted from an account of it publifhed by Profeffor Soldani. While we refer our readers to thefe details, we cannot omit mentioning that, in regard to afpect and compofition, the Sienna ftones are perfectly analogous to others already noticed, and very different from any that occur in Tufcany. As the meteor from which they were difcharged appeared on the morning after a violent eruption of Vefuvius, they were at firft fuppofed to be volcanic, till cool reflection and examination betrayed the extravagance of fuch a hypothefis. The precife number of ftones which were collected on this occafion is not fpecified, but many of them were fmall, weighing from a quarter of an ounce to two ounces. A pretty entire fpecimen occurs in Mr Fergufon's collection.—The date of the Sienna meteor is the 16th of June, 1794.

On the 13th of December of the following year, about three o'clock in the afternoon, another of thefe fingular ftones, weighing 56 pounds, fell near the country houfe of Captain Topham, in Yorkfhire. The captain's report, which is inferted in the Gentleman's Magazine for 1796, is diftinct and fatisfactory; while the chemical examination of the mafs, detailed in Mr Howard's paper, in the Philofophical Tranfactions for 1802, affords a ftill more decifive proof of its atmofpheric origin. M. de Drée, alfo, found it to correfpond exactly in afpect and character, with fragments of meteor ftones from Benares and Ville-franche. The original mafs is in the poffeffion of Mr Sowerby author of Englifh Botany, &c. It is larger than a man's head.

Mr Southey, in his letters from Spain and Portugal, tranfcribes the authenticated relation of another inftance of the defcent of a ftone from the clouds on the 19th of February 1796. But we pafs to fome of the moft important details relative to the ftone which is affirmed to have fallen near Ville-franche, in the department of the Rhone, on the 12th of March, 1798. When it was tranfmitted to Profeffor Sage, member of the National Inftitute, he confidered it at firft, as only a pyritous and magnetical ore of iron, although it bore no refemblance to any known fpecies of ore of that metal, fince it contained nickel, filica, magnefia, and native iron, which fhone like fteel when polifhed. "It is of an afh gray colour, fays M. Sage, granulated and fpeckled with gray, fhining, and pyritous metallic points. One of its furfaces is covered with a dingy black enamel, about the third of a line in thicknefs. This ftone acts very powerfully on the magnetic needle. When the fenator Chaffet tranfmitted it to me, it

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was accompanied with an historical notice of similar import with that which M. Delievre, of Ville-franche, who saw and described the phenomenon on the spot."

At six o'clock in the evening, a round body, which diffused the most vivid light, was observed in the vicinity of Ville-franche, moving westward, and producing a hissing, like that of a bomb which traverses the air. This luminous body, which was seen at the same time at Lyons and on Mont-Cenis, marked its path by a red track of fire, and exploded, about 200 toises from the earth, with a tremendous report and concussion. One of the flaming fragments fell on the vineyard of Peter Crepier, an inhabitant of Sales. On the spot where this portion of the meteor was seen to fall, and in a fresh opening of about 20 inches in depth, and 18 in width, was found a black mass, 15 inches in diameter, and rounded on one side.

An account of the same meteor was published in the Journal de Physique, for Floreal, year 11, by M. de Drée. From his minute and deliberate investigation, it appears that the fire-ball had scarcely fixed the attention of the inhabitants of the Sales and of the adjacent villages, when its rapid approach, accompanied by a terrible whizzing noise, like that of an irregular hollow body, traversing the air with unusual velocity, inspired the whole commune with alarm, especially when they observed it passing over their heads, at an inconsiderable elevation. It left behind a long train of light, and emitted, with an almost unceasing crackling, small vivid flames, like little stars. Its fall was remarked, at the distance of only 50 paces, by three labourers, one of whom, named Montillard, let fall his coat and bundle of sticks that he might run the faster, while the other two, Chardon and Lapoces, fled with equal precipitation to Sales, where the alarm had become general.—These three witnesses attest the astonishing rapidity of the meteor's motion, and the hissing which proceeded from the spot where it fell. So terrified was Crepier at the explosion, that he locked himself up with his family, first in his cellar, and then in his private apartment, nor ventured abroad till next morning, when, in the company of M. Blandel, Chardon, Lapoces, and many others, he repaired to the opening which had been made by the fire-ball. At the bottom of this opening, which was 18 inches deep, including the entire thickness of the mould, they found a large black mass, of an irregularly ovoid form, having a fanciful resemblance to a calf's head. Though no longer hot, it smelled of gun-powder and was cracked in several places. When the observers broke it, and discovered nothing but stone, indifference succeeded to curiosity, and they coolly ascribed its appearance to causes more or less whimsical and supernatural.

The original weight of this stone was about twenty pounds. Its black vitrified surface gave fire with steel. Its interior was hard, earthy, ash-coloured, of a granular texture, presenting different substances scattered through it, namely, iron in grains, from the smallest size to a line or even more in diameter, somewhat malleable, but harder and whiter than forged iron; white pyrites, both lamellated and granular, and in colour approaching to nickel; some gray globules, which seemed to present the characters of trapp, and a very few and small particles of steatites, inclining to an olive hue. On account of its heterogeneous composition, its specific gravity could not be easily ascertained. One hundred parts of the mass gave, according to Vauquelin, 46 of silica, 38 oxide of iron, 15 magnesia, 2 nickel, and 2 lime. The excess of this result was ascribed to the absorption of oxygen by the native iron during the process. A small specimen of this mass belongs to Mr Ferguson's collection.

On the 19th of December 1798, about eight o'clock in the evening, the inhabitants of Benares and its neighbourhood observed in the heavens a very luminous meteor, in the form of a large ball of fire, which exploded with a loud noise, and from which a number of stones were precipitated near Krakhut, a village about fourteen miles from the city of Benares. Mr Davis, the judge and magistrate of the district, affirmed that its brilliancy equalled the brightest moonlight. Both he and Mr Erskine, the assistant collector, were induced to send persons in whom they could confide to the spot where this shower of stones was asserted to have taken place, and thus obtained additional evidence of the phenomenon, and several of the stones, which had penetrated about six inches into fields recently watered. Mr Maclane, a gentleman who resided near Krakhut, presented Mr Howard with part of a stone, which had been brought to him the morning after its descent, by the watchman who was on duty at his house, and through the roof of whose hut it had passed, and buried itself several inches in the floor, which was of consolidated earth. Before it was broken, it must have weighed upwards of two pounds.

At the time that this meteor appeared, the sky was perfectly serene; not the smallest vestige of a cloud had been seen since the 11th of the month, nor was any observed for many days after.

"Of these stones (says Mr Howard,) I have seen eight nearly perfect, besides parts of several others, which had been broken by the possessors, to distribute among their friends. The form of the more perfect ones appeared to be that of an irregular cube, rounded off at the edges; but the angles were to be observed on most of them. They were of various sizes, from about three to upwards of four inches in their largest diameter; one of them, measuring four inches and a quarter, weighed two pounds twelve ounces. In appearance they were exactly similar; externally they were covered with a hard black coat, or incrustation, which in some parts had the appearance of varnish or bitumen; and on most of them were fractures, which, from their being covered with a matter similar to that of the coat, seemed to have been made in the fall, by the stones striking against each other, and to have passed through some medium, probably an intense heat, previous to their reaching the earth. Internally they consisted of a number of small spherical bodies, of a slate colour, imbedded in a whitish gritty substance, interspersed with bright shining spiculæ, of a metallic or pyritical nature. The spherical bodies were much harder than the rest of the stone: the white gritty part readily crumbled, on being rubbed with a hard body; and, on being broken, a quantity attached itself to the magnet, but more particularly the outside coat or crust, which appeared almost wholly attractable by it."

Here we are furnished with another circumstantial and authenticated narrative, by individuals above the rank

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rank of fufpicion, and who were prompted folely by motives of curiofity, to examine with due deliberation the particulars which they have reported.

The hiftory of the extraordinary fhower of ftones which fell near l'Aigle, in Normandy, on the 26th of April 1803, firft appeared in the enfuing artlefs letter, addreffed by M. Marais, an inhabitant of the place, to his friend in Paris.

' *At l'Aigle, the 13th Floréal, year 11.*

" An aftonifhing miracle has juft occurred in our diftrict. Here it is, without alteration, addition, or diminution. It is certain, that it is the truth itfelf.

" On Friday laft, 6th Floréal (26th April), between one and two o'clock in the afternoon, we were roufed by a murmuring noife like thunder. On going out we were furprifed to fee the fky pretty clear, with the exception of fome fmall clouds. We took it for the noife of a carriage, or of fire in the neighbourhood. We were then in the meadow, to examine whence the noife proceeded, when we obferved all the inhabitants of the Pont de Pierre at their windows, and in gardens, inquiring concerning a cloud, which paffed in the direction of from fouth to north, and from which the noife iffued, although that cloud prefented nothing extraordinary in its appearance. But great was our aftonifhment when we learned, that many and large ftones had fallen from it, fome of them weighing ten, eleven, and even feventeen pounds, in the fpace between the houfe of the Buat family (half a league to the north-north-eaft of l'Aigle) and Glos, paffing by St Nicolas, St Pierre, &c. which ftruck us at firft as a fable, but which was afterwards found to be true.

" The following is the explanation given of this extraordinary event by all who witneffed it.

" They heard a noife like that of a cannon, then a double report ftill louder than the preceding, followed by a rumbling noife, which lafted about ten minutes, the fame which we alfo heard, accompanied with hiffings, caufed by thefe ftones, which were counteracted in their fall by the different currents of air, which is very natural in the cafe of fuch a fudden expanfion. Nothing more was heard; but it is remarkable, that previoufly to the explofion, the domeftic fowls were alarmed, and the cows bellowed in an unufual manner. All the country-folks were much difmayed, efpecially the women, who believed that the end of the world was at hand. A labourer at la Sapée fell proftrate on the ground, exclaiming, 'Good God! is it poffible that thou canft make me perifh thus? Pardon, I befeech thee, all the faults I have committed,' &c. The moft trifling objects, in fact, might create alarm, for it is not improbable, that hiftory offers no example of fuch a fhower of ftones as this. The piece which I fend was detached from a large one, weighing eleven pounds, which was found between the houfe of the Buats and le Fertey. It is faid, that a collector of curiofities purchafed one of feventeen pounds weight, that he might fend it to Paris. Every body in this part of the country is defirous of poffeffing a whole ftone, or a fragment of one, as an object of curiofity. The largeft were darted with fuch violence that they entered at leaft a foot into the earth. They are black on the outfide, and grayifh, as you fee, within, feeming to contain fome fpecies of metal and nitre. If you know before us of what ingredients they are compofed, you will inform us. One fell near M. Bois de la Ville, who lives near Glos. He was much afraid, and took fhelter under a tree. He has found a great number of them of different fizes, in his court-yard, his wheat fields, &c. without reckoning all thofe which the peafants have found elfewhere. Numberlefs ftories, more or lefs abfurd, have been circulated among the people. You know that our country is fertile in fuch tales. Coufin Moutardier fends one of thefe ftones to Mademoifelle Hébert; and he is not lefs eager than we are, to know how thefe fubftances can be compreffed and petrified in the air. Do try to explain the procefs.

" The perfon who gave me the largeft ftone which I fend to you, went to take it at the moment that it fell, but it was fo hot that it burned him. Several of his neighbours fhared the fame fate in attempting to lift it.

" The elder Buat has juft arrived, and defires us to add, that a fire-ball was obferved to hover over the meadow. Perhaps it was wild-fire."

At the fitting of the inftitute, on the 9th of May, Fourcroy read a letter, addreffed from l'Aigle to Vauquelin, and which fufficiently corroborates the preceding ftatements. But we pafs to the fubftance of M. Biot's letter, addreffed to the minifter of the interior, and publifhed in the *Journal des Débats*, (14th Thermidor, year 11.). The writer, who is advantageoufly known for his fcientific attainments, was deputed by government to repair to the fpot, and collect all the authentic facts. The contents of his letter have been fince expanded into the form of a memoir, which manifefts the caution and good fenfe which guided his inquiries, and which, we are furprifed to learn, has not appeared in an Englifh tranflation.

M. Biot left Paris on the 25th of June, and in place of proceeding directly to l'Aigle, went firft to Alençon, which lies fifteen leagues to the weft-fouth-weft of it. He was informed on his way, that a globe of fire had been obferved moving towards the north, and that its appearance was followed by a violent explofion. From Alençon he journeyed through various villages to l'Aigle, being directed in his progrefs by the accounts of the inhabitants, who had all heard the explofion on the day and at the hour fpecified. Almoft all the inhabitants of twenty hamlets, fcattered over an extent of upwards of two leagues fquare affirmed that they were eye-witneffes of a dreadful fhower of ftones which was darted from the meteor. The following is his fummary of the whole evidence.

" On Tuefday, 6th Floréal, year 11. about one o'clock, P. M. the weather being ferene, there was obferved from Caen, Pont d'Audemer, and the environs of Alençon, Falaife, and Verneuil, a fiery globe, of a very brilliant fplendor, and which moved in the atmofphere with great rapidity. Some moments after, there was heard at l'Aigle, and in the environs of that town, in the extent of more than thirty leagues in every direction, a violent explofion, which lafted five or fix minutes. At firft there were three or four reports, like thofe of cannon, followed by a kind of difcharge which refembled the firing of mufketry; after which there was heard a dreadful rumbling like the

the beating of a drum. The air was calm, and the ſky ſerene, except a few clouds, ſuch as are frequently obſerved.

"This noiſe proceeded from a ſmall cloud which had a rectangular form, the largeſt ſide being in a direction from eaſt to weſt. It appeared motionleſs all the time that the phenomenon laſted; but the vapours of which it was compoſed, were projected momentarily from different ſides, by the effect of the ſucceſſive exploſions. This cloud was about half a league to the north-north-weſt of the town of l'Aigle. It was at a great elevation in the atmoſphere, for the inhabitants of two hamlets, a league diſtant from each other, ſaw it at the ſame time above their heads. In the whole canton over which this cloud was ſuſpended, there was heard a hiſſing noiſe like that of a ſtone diſcharged from a ſling, and a great many mineral maſſes exactly ſimilar to thoſe diſtinguiſhed by the name of *meteor-ſtones* were ſeen to fall.

"The diſtrict in which theſe maſſes were projected, forms an elliptical extent of about two leagues and a half in length, and nearly one in breadth, the greateſt dimenſion being in a direction from ſouth-eaſt to north-weſt, forming a declination of about 22 degrees. This direction, which the meteor muſt have followed, is exactly that of the magnetic meridian, which is a remarkable reſult. The greateſt of theſe ſtones fell at the ſouth-eaſtern extremity of the large axis of the ellipſe, the middle-ſized in the centre, and the ſmaller at the other extremity. Hence it appears that the largeſt fell firſt, as might naturally be ſuppoſed. The largeſt of all thoſe that fell weighs ſeventeen pounds and a half. The ſmalleſt which I have ſeen weighs about two *gros* (a thouſandth part of the laſt). The number of all thoſe which fell is certainly above two or three thouſand."

As we cannot make room for an analyſis of M. Biot's more extended communication, we ſhall be contented to ſelect only two facts.

The *curé* of St Michael declared, that he obſerved one of the ſtones fall, with a hiſſing noiſe, at the feet of his niece, in the court-yard of his parſonage, and that it rebounded upwards of a foot from the pavement. He inſtantly requeſted his niece to fetch it to him; but as ſhe was too much alarmed, a woman who happened alſo to be on the ſpot, took it up; and it was found in every reſpect to reſemble the others.

As one *Piche*, a wire-manufacturer belonging to the village of *Armées*, was working with his men in the open air, a ſtone grazed his arm, and fell at his feet; but it was ſo hot, that, on attempting to take it up, he inſtantly let it fall again.

He who compares the various accounts of the l'Aigle meteor, with a critical eye, may detect ſome apparent contradictions, which, however, on reflection, are found to be ſtrictly conformable to truth. Thus, according to ſome, the meteor had a rapid motion, others believed it ſtationary; ſome ſaw a very luminous ball of fire, others only an ordinary cloud. Spectators, in fact, viewed it in different poſitions with reſpect to its direction. They who happened to be in its line of march, would ſee it ſtationary, for the ſame reaſon, that we fancy a ſhip under full ſail to be motionleſs, when we are placed in its wake, or when we view it from the harbour to which it is approaching in a ſtraight line. They, on the other hand, who had a ſide view of the meteor, would reckon its progreſs the more rapid, in proportion as their poſition approached to a right angle with its line of paſſage. They, again, who ſaw it from behind, as the inhabitants of l'Aigle, would perceive only the cloud of vapour, which it left in its train, and which, in the dark, would figure like a blazing tail, in the ſame manner as the ſmoke of a volcano appears black during the day and red at night. Laſtly, they who were placed in front of the meteor, would reckon it ſtationary, but brilliant and cloudleſs.

It deſerves to be remarked, that the l'Aigle ſtones were very friable for ſome days after their deſcent, that they gradually acquired hardneſs, and that after they had loſt the ſulphureous odour on their ſurface, they ſtill retained it in their ſubſtances, as was found by breaking them. Profeſſor Sage ſubmitted them to ſeveral comparative trials with thoſe of Ville-franche; and, though the l'Aigle ſpecimens preſent ſome globules of the ſize of a ſmall coriander ſeed, of a darker gray than the maſs, and not attractable by the magnet, yet, in reſpect of granular texture and general aſpect, the coincidence was ſo ſtriking as to lead one to ſuppoſe that they were all parts of the ſame maſs.

The l'Aigle ſtones, according to Fourcroy, are generally irregular, polygonal, often cuboid, ſometimes ſubcuneiform, and exceedingly various in their diameter and weight. All are covered with a black gravelly cruſt, conſiſting of a fuſed matter, and filled with ſmall agglutinated grains of iron. The greater part of them are broken at the corners, either by their ſhock againſt each other, or by falling on hard bodies. The internal parts reſemble thoſe of all the ſtones analyzed by Meſſrs. Howard and Vauquelin, being gray, a little varied in their ſhades, granulated, and as it were ſcaly, ſplit in many parts, and filled with brilliant metallic points, exactly of the ſame aſpect as thoſe of other ſtones of a like deſcription. The proportions of their conſtituent materials are ſtated as nearly, 54 ſilex, 36 oxidated iron, 9 magneſia, 3 nickel, 2 ſulphur, and 1 lime, the five per cent. of increaſe ariſing from the oxidation of the metals produced by the analyſis.

Of the two ſpecimens which M. Biot preſented to the celebrated Patrin, one was leſs compact, and of a lighter gray than the other, and likewiſe preſented ſmall patches of a ruſt colour. When immerſed in water, it gave a hiſſing ſound, like the humming of a fly, which is held by one wing. As it began to dry, it was obſerved to be marked by curvilinear and parallel layers. The more compact ſpecimens, when moiſtened, preſented no ſuch appearances, but aſſumed the aſpect of a gray porphyry, with a baſe of trap, mottled with ſmall white ſpots, and ſpeckled with metallic points.

Two fine ſpecimens of the l'Aigle ſtone, one of them nearly entire, may be ſeen in Mr Ferguſon's collection, which we have already repeatedly quoted.

Previouſly to the exploſion of the 26th of April 1803, no meteorolites had been found by the inhabitants of the l'Aigle diſtrict, nor in the mineralogical collections of the department; nor the ſlighteſt mention of them made in the geological documents of this portion of Normandy: the mines, founderies, and forges, had produced nothing ſimilar, in the form of droſs or ore, nor had the country exhibited any trace of volcanoes.

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canoes. The meteor at once appears, and a multitude of ſtones of the peculiar character noted above are ſeen ſcattered on a determined ſpace of ground, in a manner, and accompanied with circumſtances, which could not formerly have eſcaped obſervation. Let us likewiſe reflect, that the young and the old, ſimple peaſants dwelling at a diſtance from one another, ſagacious and rational workmen, reſpectable eccleſiaſtics, young ſoldiers devoid of timidity, individuals, in ſhort, of various manners, profeſſions, and opinions, united by no common ties, all agree in atteſting a fact, which contributed neither directly nor indirectly to promote their own intereſt, and they all aſſign the manifeſtation of this fact to the ſame day and hour. They, moreover, point to exiſting veſtiges of the deſcent of ſolid ſubſtances, and they declare, in terms unſuſceptible of miſconſtruction or ambiguity, that they ſaw the maſſes in queſtion roll down on roofs, break branches of trees, rebound from the pavement, and produce ſmoke where they fell. Theſe recitals, and theſe veſtiges, are limited to a tract of territory which has been accurately defined; while beyond the precincts of this tract, not a ſingle particle of a meteorolite has been found, nor a ſingle individual who pretends that he ſaw ſtone fall.

Having now, we preſume, advanced ample and ſatisfactory evidence of the exiſtence of meteorolites, we ſhall forbear to enlarge this article by dwelling on inſtances of inferior notoriety to thoſe which we have recounted, and ſhall merely note the dates of ſubſequent examples.

On the 4th of July 1803, a fire-ball ſtruck the White Bull Inn at Eaſt-Norton, and left behind it ſeveral meteoric fragments.—On the 13th of December of the ſame year, a ſimilar phenomenon occurred at the village of St Nicholas, in Bavaria.—At Poſſil, near Glaſgow in Scotland, a meteor-ſtone fell, with a loud and hiſſing noiſe, on the 5th April 1804.—The next inſtance which we have to mention occurred near Apt, in the department of Vaucluſe, on the 6th of October of the ſame year; and the laſt which has come to our knowledge happened at half paſt five o'clock, in the evening of the 15th March 1806, near Alais in Languedoc.

It ſeems reaſonable, however, to ſuppoſe, that the fall of meteoric ſubſtances takes place more frequently than is commonly ſuppoſed, ſince ſeveral foreign collections of foſſils contain ſpecimens of reputed celeſtial origin, and exhibiting the genuine atmoſpheric phyſiognomy. It is likewiſe worthy of remark, that many relations of the phenomenon may have ſunk into oblivion, from the contempt with which they were heard by the learned, and that, on a fair computation of chances, meteors may have ſometimes exploded on deſert tracts of land, and ſtill more frequently over the pathleſs expanſe of the waters.

That ſome of the relations to which we have alluded are vague and unſatisfactory, cannot be denied, but the circumſtantial teſtimony conveyed by others is more pointed and poſitive; and the whole maſs of hiſtorical proof, eſpecially when combined with the argument deduced from the identity of the phyſical and chemical conſtitution of the ſtones, appears to us to be altogether irreſiſtible.

In the courſe of our inquiry into this novel and intereſting ſubject, we have aſcertained a variety of circumſtances which render it highly probable, if not indubitable, that thoſe detached maſſes of native iron, whoſe hiſtory has ſo often ſtaggered and perplexed the geologiſt, are only modifications of meteoric depoſitions. The Tartars, for example, aſcribe the deſcent of the Siberian maſs deſcribed by Chladni, Pallas, Patrin, &c. to a period that is loſt in the remoteneſs of antiquity; and while tradition thus favours our hypotheſis, the analogy which is obviouſly obſervable in point of texture and chemical characters with thoſe of other ſolid bodies, whoſe fall is no longer queſtioned, ſtrengthens tradition. According to the diſcoveries of Prouſt and Klaproth, native iron, reputed meteoric, differs from that which occurs in a foſſil ſtate by the preſence of nickel. The former of theſe celebrated analyſts obtained 50 grains of ſulphate of nickel from 100 of the South American maſs, and his reſults are corroborated by Mr Howard and the Count de Bournon.

Of the two pieces of Siberian iron poſſeſſed by Mr Greville, one, which was tranſmitted by Dr Pallas, weighs ſeveral pounds; and another preſents a cellular and ramified texture, analogous to that of ſome very light and porous volcanic ſcoriæ. When attentively examined, there may be perceived in it not only empty cells, but alſo impreſſions or cavities of greater or leſs depth, and in ſome of which there remains a tranſparent ſubſtance, of a yellowiſh green colour. The iron itſelf is very malleable; and may be eaſily cut with a knife, or flattened under the hammer. The ſpecific gravity is 6487, which is obviouſly inferior to that of unforged iron that has undergone fuſion, and may be partly owing to the oxidizement of the ſurface of the iron, and partly to the many minute cavities in its ſubſtance, which are often rendered viſible by fracture, and which have their ſurface alſo oxidized. The fracture is ſhining and ſilvery, like that of white caſt iron; but its grain is much ſmoother and finer; and it is much more malleable when cold. The heavier ſpecimen is more ſolid and compact, exhibiting no cavities or pores, though its ſurface is ramified and cellular. So blended and incorporated is its compact part with the yellowiſh-green ſubſtance mentioned above, that if the whole of the latter could be ſubtracted, the remainder would conſiſt of iron in the metallic ſtate, and would diſplay the ſame cellular appearance as the preceding ſpecimen, or as the ſuperficial portion of that now deſcribed. This ſtony part of the compoſition uſually aſſumes the appearance of ſmall nodules, generally of an irregular ſhape, but ſometimes nearly globular, with a ſmooth, ſhining, and glaſſy ſurface. This ſubſtance, which is always more or leſs tranſparent, is hard enough to cut glaſs, but makes no impreſſion on quartz. It becomes electric by friction, is very refractory, and varies in ſpecific gravity from 3263 to 3300. Of all ſubſtances hitherto known, it approaches moſt to the peridot, or Wernerian chryſolite, which yielded to Klaproth nearly the ſame reſults which this ſubſtance did to Howard. In the maſs of iron, it is liable to decompoſition, changing to an opake white, and crumbling into a gritty dry powder, when lightly preſſed or ſqueezed between the fingers.—"I cannot help obſerving (ſays the count de Bournon), that there appears to exiſt a very intereſting analogy between theſe tranſparent nodules and the globules I deſcribed as making part of the ſtones ſaid to

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to have fallen on the earth. This analogy, though not a very ſtrong one, may lead us to ſuppoſe, that the two ſubſtances are ſimilar in their nature, but that the globules are leſs pure, and contain a greater quantity of iron."

The native iron from Bohemia is compact, like the large ſpecimen from Siberia, in Mr Greville's collection, and like it contains nodules, but not ſo numerous. They are beſides quite opake, and very much reſemble the globules in atmoſpheric ſtones. This iron contains nearly five per cent. of nickel. Between five and ſix per cent. of the ſame metal ſeems to exiſt in a piece of native iron brought from Senegal.

Though our limits will not permit us to dwell with minuteneſs on the phyſical and chemical characters of meteorolites, we ſhall ſhortly ſtate thoſe which the count de Bournon found to appertain to the ſpecimens from Benares, and which may ſerve as no unfair ſtandard of the aſpect and compoſition of the others.

Like all of the ſame origin which were ſubjected to the count's examination, the Benares ſtones are covered over the whole extent of their ſurface, with a thin cruſt, of a deep black colour, ſprinkled over with ſmall aſperities, which make it feel ſomewhat like ſhagreen or fiſh ſkin. Their fracture exhibits a grayiſh aſh colour, and a granulated texture, like that of coarſe grit-ſtone. By help of a lens, they are perceived to be compoſed of four different ſubſtances. One of theſe occurs in great abundance, in the form of ſmall bodies, ſome of which are perfectly globular, others rather elongated or elliptical, and all of various ſizes, from that of a ſmall pin's head to that of a pea, or nearly ſo. Theſe ſmall globules are uſually gray, ſometimes inclining much to brown, and always opake; they are eaſily broken in any direction, have a conchoidal fracture, and a fine, ſmooth, compact grain, with a ſlight degree of luſtre, approaching to enamel; laſtly, they can deſtroy the poliſh of glaſs without being able to cut it, and ſparkle faintly when ſtruck with ſteel. Another of theſe ſubſtances is martial pyrites, of an indeterminate form, and reddiſh yellow colour, ſlightly verging to the nickel tint, or to that of artificial pyrites; of a ſomewhat looſely granulated texture, and irregularly diſtinguiſhed in the maſs, being black when reduced to powder, and not attractible by the magnet. The third of theſe ſubſtances conſiſts of ſmall particles of iron, in a perfectly metallic ſtate, ſo that they may be eaſily flattened or extended under the hammer. Though in a much ſmaller proportion than the pyrites juſt mentioned, they impart the magnetic attraction to the ſtone. When a piece of the latter was pulverized, and the particles of iron ſeparated from it as accurately as poſſible, by means of a magnet, they appeared to compoſe about 200 parts of the weight of the ſtone. Theſe three ſubſtances are united by means of a fourth, which is nearly of an earthy conſiſtency, and of a whitiſh gray colour.—The black cruſt, or outward coating, though of very inconſiderable thickneſs, emits bright ſparks when ſtruck with ſteel, may be broken by the hammer, and ſeems to poſſeſs the ſame properties with the black oxide of iron, though, like the ſubſtance of the ſtone, it is occaſionally intermixed with ſmall particles of iron in the metallic ſtate. Theſe are eaſily diſtinguiſhed, by paſſing a file over the cruſt, which reveals their luſtre. The ſpecific gravity of the Benares ſtones is 3352. None of them, when breathed on, emit the argillaceous odour.

In conſequence of various experiments, M. Sage infers that meteorolites are compoſed of native iron, ſulphuret of nickel, quartz or ſilica, alumina, and magneſia; that the proportions of iron and nickel vary; that the quartz ſeems to form at leaſt the half of the ſtone, the alumina and magneſia the ſixth, and the ſulphur the 30th part. Theſe general reſults pretty nearly accord with the more ſpecial reports of Howard and Vauquelin, except that the latter makes no mention of alumina, the exiſtence of which in atmoſpheric ſtones is by no means diſtinctly aſcertained.

We ſhall only beg leave to add, on this part of our ſubject, that Laugier, an ingenious chemiſt, by employing the cauſtic alkali, has detected a ſmall portion of chrome. The reſults of his experiments, which are ſtated in the 58th volume of the *Annales de Chimie*, are 1ſt, That the five ſtones from Verona, Barbotan, Enſiſheim, l'Aigle, and the neighbourhood of Apt, beſides the principles already recognized, contain about one per cent. of chrome. 2dly, That it is very probable, that all meteorolites contain this principle, ſince they all reſemble one another in their phyſical and chemical properties, and have all, apparently, the ſame origin; and, 3dly, That in many caſes, the perfection of chemical analyſis requires, that the ſame ſubſtance ſhould be treated both by acids and alkalies, ſince experience has ſhown, that a principle which eluded the former method, has been revealed by the latter.

Having now, as we apprehend, ſufficiently eſtabliſhed the exiſtence and nature of meteorolites, we hope our readers will excuſe us from enlarging on the various cauſes which have been aſſigned for their origin, as theſe ſeem to lie beyond the reach of our preſent ſtate of knowledge. After a candid and patient review of the principal theories, we conceive that they are at beſt gratuitous, and that moſt of them are open to many and formidable objections.

The *terreſtrial* hypotheſes, we believe, begin already to be generally abandoned, as untenable. Until the phenomenon of exploding meteors had been diſtinctly obſerved and recorded, Lemery and others could maintain, with ſome degree of plauſibility, that lightning might tear up the ground, and convert ſoil into a compact maſs. But the appearances of a thunder ſtorm and of a fire-ball are now aſcertained to differ in various important reſpects. Spectators worthy of credit have ſeen the latter terminate in the fall of ſolid bodies; and the compoſition of theſe ſolid bodies has been found to differ from that of all the known foſſil ſubſtances on the ſurface of the globe. It is in vain, then, to allege, that they are formed on the ground by common lightning, which has often produced very extraordinary effects, but which never generated thouſands of ſtones in fine calm weather. The ſuppoſition, that ſuch ſtones have been projected from ſome of our volcanoes, is hardly leſs conceivable. The aſhes which accompany a violent eruption of Ætna or Veſuvius have, from their levity, been carried to a very conſiderable diſtance; but we are totally unacquainted with any projectile force which could dart ſolid maſſes many hundred miles, through ſuch a denſe medium as the atmoſphere. The compact lavas of burning mountains are never found

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found remote from the ſcene of their formation, and none of them preſent the characters and aſpect of the ſtones which we have deſcribed. M. Bory de St Vincent, indeed, in his *Voyage dans les quatre Principales Iſles des Mers d'Afrique*, very pompouſly expounds a doctrine, which, in our opinion, carries its confutation along with it. According to this writer, meteorolites were projected from immenſe depths, in an early ſtage of the earth's exiſtence, when ignivomous mountains were endued with propelling forces ſufficient to drive maſſes of matter into the regions of ſpace, where they were conſtrained to obey, for ages, the combined laws of impulſe and gravitation, until, in the progreſs of time, their ſpiral revolutions at length terminated on the ſurface of their native earth. Before we can adopt ſuch an extravagant hypotheſis, we muſt be convinced, that at one period of the hiſtory of our globe, the agency of ſubterraneous fire was adequate to communicate planetary motion to ſplinters of rock, without heaving up the rocks themſelves, and that the rotatory movement, though once eſtabliſhed, muſt gradually diminiſh and ceaſe. The demonſtration of theſe poſitions is ſurely not leſs arduous than the explanation of the phenomenon which they are intended to ſolve.

Of thoſe who contend for the *atmoſpherical* formation of meteorolites, ſcarcely any two agree in regard to the manner by which ſuch formation is effected. Patrin, who is ſolicitous to extend and illuſtrate his darling theory of volcanoes, labours at great length to maintain the exiſtence of a regular circulation of gaſeous fluids between the primitive ſchiſtoſe ſtrata of the globe, and its ſurrounding atmoſphere, and, from this fancied circulation, which he flatters himſelf he has *demonſtrated*, he deduces, quite at his eaſe, the occaſional ignition and concretion of portions of theſe fluids in the higher regions of the air. This ingenious mineralogiſt and geologiſt is ſo extremely tenacious of theſe ideas that we ſhall not attempt to diſturb his ſelf complacency; but he will excuſe us if we refuſe our aſſent to reſults which reſt on imaginary foundations. The celebrated Muſchenbroeck, in one part of his writings, aſcribes the deſcent of ſtones from the air to earthquakes and volcanic eruptions, an opinion which later obſervations have diſproved. In other paſſages, however, he ſeems to incline to a modification of the atmoſpherical hypotheſes, and endeavours to trace the origin of ſhooting ſtars to an accumulation of the volatile matters which are ſuſpended in the air. It is extremely probable, that ſhooting ſtars and fiery meteors have an intimate relation to one another, if they are not identical appearances; but it is certain that the former move at a much greater diſtance from our earth than fire-balls, and only occaſion a tranſient luminous appearance in their paſſage through the upper regions of the atmoſphere. Perhaps they are analogous to thoſe teleſcopic ſparks of light which were obſerved by M. Schröter. Muſchenbroeck, however, adopts the vulgar notion of their falling to the earth, and ſeems to confound their reſidue with *tremella noſtoc*. M. Salverte has given extenſion to the theory of formation from vapours, by having recourſe to the agency of hydrogen gas. According to him, in conſequence of the decompoſition of water, which is conſtantly going on at the ſurface of the earth, immenſe quantities of hydrogen gas are continually riſing into the atmoſphere, and aſcending to its higher regions. As this gas is capable of diſſolving metals, it carries along with it a portion of iron and nickel. During thunder ſtorms this gas is kindled by electricity; the metals are depoſited, reduced, melted, and vitrified; in other words, meteors are produced and ſtones formed. This hypotheſis is ſcarcely more ſatisfactory than the others. It does not account for the preſence of magneſia and ſilica, nor does it explain why the ſtones are always compoſed of the ſame materials. Beſides, the exiſtence of hydrogen gas in the atmoſphere has not been proved, far leſs that it forms a ſeparate atmoſphere, which is contrary to all experience; and it is well known, that a little hydrogen, mixed with a large portion of atmoſpheric air, cannot be fired by electricity. In general, we may obſerve, that if the origin of meteorolites be really atmoſpherical, the matters of which they are compoſed muſt have exiſted in one of two ſtates, namely, in very attenuated particles or concretions of the matters themſelves volatilized and held in ſolution in the air, or only in the *elements* of theſe matters. In the firſt caſe, when abandoned by their menſtruum to their reciprocal tendencies, they would unite by aggregation only; in the ſecond by chemical combination. Now, we can hardly ſuppoſe that diſengagement of light and violent detonation ſhould reſult from the mere affinity of aggregation, whereas they are ſtrictly ſymptomatic of the affinity of compoſition. This, and various other conſiderations which might be ſtated, if we could make room for them, induce us to regard the doctrine of combination as the moſt plauſible. M. Izarn, who has publiſhed a treatiſe on *Atmoſpheric Lithology*, has entered into a tedious and ſomewhat obſcure expoſition of his own theory, founded on this principle. We ſhall give the ſummary, as nearly as we can, in his own words.

"Gaſeous ſubſtances, arranged in ſpherical maſſes in the upper regions of the air, being admitted, the various agitations of the atmoſphere ſhould naturally waft ſome of theſe maſſes from their inſulating medium into one capable of combining with them. If the combination begins, the diſengagement of light is explained. In proportion as the combination advances, the ſpecific gravities are changed; and, conſequently, a change of place will commence, and that in the quarter which preſents leaſt reſiſtance, or where the medium is moſt rarefied, in courſe rather towards the ſouth than the north. Hence, moſt fire-balls are obſerved to move from north to ſouth, or from north-eaſt to ſouth-weſt. Motion being once impreſſed, the maſs traverſes other media, capable of ſupplying new principles, which ſtill increaſing the weight, determine the curve; and when at length the principles which are at work, and which iſſue in all directions, have attained the requiſite proportion for extinguiſhing the elements in the birth of the compound, the grand operation is announced by the exploſion, and the product takes its place among the ſolids."—That the ſtones in queſtion are produced by chemical combination in the higher regions of the atmoſphere, and that they are thus formed from their own elements, are ſuppoſitions fully as probable as any that have been advanced on the ſubject; but whether the union of their parts be effected in the manner detailed by M. Izarn, we are unable to determine, both becauſe we are uncertain if we perfectly comprehend

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his meaning, and becaufe our range of data is as yet too circumfcribed, to warrant any fpecific or decifive conclufions.

A much bolder theory has been fuggefted, and its *poffibility* demonftrated by the celebrated French aftronomer, La Place, who fhews, that meteorolites *may be* the products of lunar volcanoes. As this romantic view of the fubject has obtained the fuffrages of fome men of fcience, and has excited the ridicule of others, we fhall prefent the reafoning on which it is founded in the popular and perfpicuous language of Dr Hutton of Woolwich.

" As the attraction of gravitation extends through the whole planetary fyftem, a body placed at the furface of the moon is affected chiefly by two forces, one drawing it toward the centre of the earth, and another drawing it toward that of the moon. The latter of thefe forces, however, near the moon's furface, is incomparably the greater. But, as we recede from the moon, and approach toward the earth, this force decreafes, while the other augments; till at laft a point of ftation is found between the two planets, where thefe forces are exactly equal, fo that a body placed there muft remain at reft; but if it be removed ftill nearer to the earth, then this planet would have the fuperior attraction, and the body muft fall towards it. If a body then be projected from the moon towards the earth, with a force fufficient to carry it beyond the point of equal attraction, it muft neceffarily fall on the earth. Such then is the idea of the manner in which the bodies muft be made to pafs from the moon to the earth, if that can be done, the *poffibility* of which is now neceffary to be confidered.

" Now, fuppofing a mafs to be projected from the moon, in a direct line towards the earth, by a volcano, or by the production of fteam by fubterranean heat; and fuppofing for the prefent thefe two planets to remain at reft; then it has been demonftrated, on the Newtonian eftimation of the moon's mafs, that a force projecting the body with a velocity of 12,000 feet in a fecond, would be fufficient to carry it beyond the point of equal attraction. But this eftimate of the moon's mafs is now allowed to be much above the truth; and on M. la Place's calculation, it appears that a force of little more than half the above power would be fufficient to produce the effect, that is, a force capable of projecting a body with a velocity of lefs than a mile and a half per fecond. But we have known cannon balls projected by the force of gunpowder, with a velocity of 2500 feet per fecond or upwards, that is, about half a mile. It follows, therefore, that a projectile force, communicating a velocity about three times that of a cannon ball, would be fufficient to throw the body from the moon beyond the point of equal attraction, and caufe it to reach the earth. Now there can be little doubt that a force equal to that is exerted by volcanoes on the earth, as well as by the production of fteam by fubterranean heat, when we confider the huge maffes of rock, fo many times larger than cannon balls, thrown on fuch occafions to heights alfo fo much greater. We may eafily imagine, too, fuch caufe of motion to exift in the moon as well as in the earth, and that in a fuperior degree, if we may judge from the fuppofed fymptoms of volcanoes recently obferved in the moon by the powerful tubes of Dr Herfchel; and ftill more, if we confider that all projections from the earth fuffer an enormous refiftance and diminution, by the denfe atmofphere of this planet; while it has been rendered probable, from optical confiderations, that the moon has little or no atmofphere at all, to give any fuch refiftance to projectiles.

" Thus then we are fully authorized in concluding, that the cafe of *poffibility* is completely made out; that a known power exifts in nature, capable of producing the foregoing effect, of detaching a mafs of matter from the moon, and transferring it to the earth in the form of a flaming meteor, or burning ftone; at the fame time we are utterly ignorant of any other procefs in nature by which the fame phenomenon can be produced. Having thus difcovered a way in which it is poffible to produce thofe appearances, we fhall now endeavour to fhow, from all the concomitant circumftances, that thefe accord exceedingly well with the natural effects of the fuppofed caufe, and thence give it a very high degree of *probability*.

" This important defideratum will perhaps be beft attained, by examining the confequences of a fubftance fuppofed to be projected by a volcano from the moon into the fphere of the earth's fuperior attraction; and then comparing thofe with the known and vifible phenomena of the blazing meteors or burning ftones that fall through the air on the earth. And if in this comparifon a ftriking coincidence or refemblance fhall always or moftly be found, it will be difficult for the human mind to refift the perfuafion that the affumed caufe involves a degree of probability but little fhort of certainty itfelf. Now the chief phenomena attending thefe blazing meteors or burning ftones, are thefe: 1. That they appear or blaze out fuddenly. 2. That they move with a furprifing rapid motion, nearly horizontal, but a little inclined downwards. 3. That they move in feveral different directions with refpect to the points of the compafs. 4. That in their flight they yield a loud whizzing found. 5. That they commonly burft with a violent explofion and report. 6. That they fall on the earth with great force in a floping direction. 7. That they are very hot at firft, remain hot a confiderable time, and exhibit vifible tokens of fufion on their furface. 8. That the fallen ftony maffes have all the fame external appearance and contexture, as well as internally the fame nature and compofition. 9. That they are totally different from all our terreftrial bodies, both natural and artificial.

" Now thefe phenomena will naturally compare with the circumftances of a fubftance projected by a lunar volcano, and in the order in which they are here enumerated. And firft, with refpect to the leading circumftance, that of a fudden blazing meteoric appearance, which is not that of a fmall bright fpark, firft feen at an immenfe diftance, and then gradually increafing with the diminution of its diftance. And this circumftance appears very naturally to refult from the affumed caufe. For, the body being projected from a lunar volcano, may well be fuppofed in an ignited ftate, like inflamed matter thrown up by our terreftrial volcanoes, which paffing through the comparatively vacuum, in the fpace between the moon and the earth's fenfible atmofphere, it will probably enter the fuperior parts of this atmofphere with but little diminution of its original

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nal heat; from which circumftance, united with that of its violent motion, this being 10 or 12 times that of a cannon ball, and through a part of the atmofphere probably confifting chiefly of the inflammable gas rifing from the earth to the top of the atmofphere, the body may well be fuppofed to be fuddenly inflamed, as the natural effect of thefe circumftances; indeed it would be furprifing if it did not. From whence it appears that the fudden inflammation of the body, on entering the earth's atmofphere, is exactly what might be expected to happen.

" 2. To trace the body through the earth's atmofphere; we are to obferve that it enters the top of it with the great velocity acquired by defcending from the point of equal attraction, which is fuch as would carry the body to the earth's furface in a very few additional feconds of time if it met with no obftruction. But as it enters deeper in the atmofphere, it meets with ftill more and more refiftance from the increafing denfity of the air, by which the great velocity of fix miles per fecond muft foon be greatly reduced to one that will be uniform, and only a fmall part of its former great velocity. This remaining part of its motion will be various in different bodies, being more or lefs as the body is larger or fmaller, and as it is more or lefs fpecifically heavy; but, for a particular inftance, if the body were a globe of 12 inches diameter, and of the fame gravity as the atmofpheric ftones, the motion would decreafe fo as to be little more than a quarter of a mile per fecond of perpendicular defcent. Now while the body is thus defcending, the earth itfelf is affected by a twofold motion, both the diurnal and the annual one, with both of which the defcent of the body is to be compounded. The earth's motion of rotation at the equator is about 17 miles in a minute, or two-fevenths of a mile in a fecond; but in the middle latitudes of Europe little more than the half of that, or little above half a quarter of a mile in a fecond; and if we compound this motion with that of the defcending body, as in mechanics, this may caufe the body to appear to defcend obliquely, though but a little, the motion being nearer the perpendicular than the horizontal direction. But the other motion of the earth, or that in its annual courfe, is about 20 miles in a fecond, which is 80 times greater than the perpendicular defcent in the inftance above-mentioned; fo that, if this motion be compounded with the defcending one of the body, it muft neceffarily give it the appearance of a very rapid motion, in a direction nearly parallel to the horizon, but a little declining downwards. A circumftance which exactly agrees with the appearances of thefe meteoric bodies, as ftated in the fecond article of the enumerated phenomena.

" 3. Again, with regard to the apparent direction of the body; this will evidently be various, being that compounded of the body's defcent and the direction of the earth's annual motion at the time of the fall, which is itfelf various in the different feafons of the year, according to the direction of the feveral points of the ecliptic to the earth's meridian or axis. Ufually, however, from the great excefs of the earth's motion above that of the falling body, the direction of this muft appear to be nearly oppofite to that of the former. And in fact this exactly agrees with a remark made by Dr Halley, in his account of the meteors in his paper above given, where he fays that the direction of the meteor's motion was exactly oppofite to that of the earth in her orbit. And if this fhall generally be found to be the cafe, it will prove a powerful confirmation of this theory of the lunar fubftances. Unfortunately, however, the obfervations on this point are very few, and moftly inaccurate; the angle or direction of the fallen ftones has not been recorded; and that of the flying meteor commonly miftaken, all the various obfervers giving it a different courfe, fome even directly the reverfe of others. In future, it will be very advifable that the obfervers of fallen ftones, obferve and record the direction or bearing of the perforation made by the body in the earth, which will give us perhaps the courfe of the path nearer than any other obfervation.

" 4. In the flight of thefe meteoric ftones, it is commonly obferved, that they yield a loud whizzing found. Indeed it would be furprifing if they did not. For if the like found be given by the fmooth and regularly formed cannon ball, and heard at a confiderable diftance, how exceedingly great muft be that of a body fo much larger, which is of an irregular form and furface too, and ftriking the air with 50 or 100 times the velocity.

" 5. That they commonly burft and fly in pieces in their rapid flight, is a circumftance exceedingly likely to happen, both from the violent ftate of fufion on their furface, and from the extreme rapidity of their motion through the air. If a grinding ftone, from its quick rotation, be fometimes burft and fly in pieces, and if the fame thing happen to cannon balls when made of ftone and difcharged with confiderable velocity, merely by the friction and refiftance of the air; how much more is the fame to be expected to happen to the atmofpheric ftones, moving with more than 50 times the velocity, and when their furface may well be fuppofed to be partly loofened or diffolved by the extremity of the heat there.

" 6. That the ftones ftrike the ground with a great force, and penetrate to a confiderable depth, as is ufually obferved, is a circumftance only to be expected from the extreme rapidity of their motion, and their great weight, when we confider that a cannon ball, or a mortar fhell, will often bury itfelf many inches, or even fome feet in the earth.

" 7. That thefe ftones, when foon fought after and found, are hot, and exhibit the marks of recent fufion, are alfo the natural confequences of the extreme degree of inflammation in which their furface had been put during their flight through the air.

" 8. That thefe ftony maffes have all the fame external appearance and contexture, as well as internally the fame nature and compofition, are circumftances that ftrongly point out an identity of origin, whatever may be the caufe to which they owe fo generally uniform a conformation. And when it is confidered,

" 9 That in thofe refpects they differ totally from all terreftrial compofitions hitherto known or difcovered, they lead the mind ftrongly to afcribe them to fome other origin than the earth we inhabit; and none fo likely as coming from our neighbouring planet.

" Upon the whole then (continues Dr Hutton), it appears

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appears highly probable, that the flaming meteors, and the burning ftones, that fall on the earth, are one and the fame thing. It alfo appears impoffible, or in the extremeft degree improbable, to afcribe thefe either to a formation in the fuperior parts of the atmofphere, or to the eruptions of terreftrial volcanoes, or to the generation by lightning ftriking the earth. But, on the other hand, that it is poffible for fuch maffes to be projected from the moon fo as to reach the earth; and that all the phenomena of thefe meteors or falling ftones, having a furprifing conformity with the circumftances of maffes that may be expelled from the moon by natural caufes, unite in forming a body of ftrong evidence, that this is in all probability and actually the cafe.

M. Poiffon, an ingenious French mathematician, has fhown by an algebraical calculation, the poffibility of a projectile reaching our planet from the moon. His calculation, however, which may be found in the work of Izarn, quoted above, (p. 238. et feq.) proceeds on the fuppofition that our fatellite has no atmofphere, or next to none. There are, no doubt, appearances which feem to favour this fuppofition, but they do not amount to pofitive proof of the fact. Even could the latter be eftablifhed, the combuftion of a volcano, without the prefence of atmofpheric air, would remain to be explained. But, granting this difficulty too to be furmounted, there are other circumftances which we cannot eafily reconcile to the lunar hypothefis. The occafional arrival of fragments of lava on the earth's furface, would argue, on a fair computation of chances, fuch a copious difcharge of volcanic matters, that the moon, by this time, would confift of hardly any thing elfe. Again, if we may be allowed to reafon from analogy, the volcanic productions of the moon fhould exhibit varieties of afpect and compofition like thofe with which we are acquainted, and not a definite and precife number of the fame ingredients. We may alfo remark, that the foft and incoherent ftate of feveral of the recent fpecimens of meteorolites can ill accord with their fuppofed paffage through any confiderable portion of fpace; and that the l'Aigle phenomenon, which is fo diftinctly recorded, evidently fuggefts the notion of inftantaneous formation in the atmofphere. And, though this view of the fubject may be regarded by fome as inexplicable, we cannot conceive that it is more fo than the doctrine of cryftallization, or than many of the refults of chemical combination, whofe exiftence it is impoffible to deny. Thefe and other arguments may, we apprehend, be fairly urged againft any theory which attempts to explain the hiftory of meteors by the agency of lunar volcanoes.

The hypothefis of Dr Chladni, which likewife boafts of its advocates, though ftill more extravagant than the preceding, deferves to be ftated. As earthy, metallic, and other particles form the principal component parts of our planet, among which iron is the prevailing part, other planetary bodies, he affirms, may confift of fimilar, or, perhaps, the fame component parts, though combined and modified in a very different manner. There may alfo be denfe matters accumulated in fmaller maffes, without being in immediate connexion with the larger planetary bodies, difperfed throughout infinite fpace, and which, being impelled either by fome projecting power or attraction, continue to move until they approach the earth, or fome other body; when, being overcome by attractive force, they immediately fall down. By their exceeding great velocity, ftill increafed by the attraction of the earth and the violent friction in the atmofphere, a ftrong electricity and heat muft neceffarily be excited, by which means they are reduced to a flaming and melted condition, and great quantities of vapour and different kinds of gafes are thus difengaged, which diftend the liquid mafs to a monftrous fize, till, by a ftill farther expanfion of thefe elaftic fluids, they muft at length difplode. That portions of cofmical matter are allowed to revolve in fpace, and to terminate their career on the furface of a planet, is a pofition too gratuitous and vague, to be readily admitted, but the belief of which involves no principle of atheifm or impiety, as fome of Dr Chladni's antagonifts have very unhandfomely infinuated. If worlds difappear and others fpring into exiftence, a fportive imagination may be permitted to indulge in the innocent fuppofition, that fragments of their materials are detached from their fractured maffes, and obey thofe laws of attraction which feem to extend their influence to the remoteft corners of the univerfe.

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Such of our readers as are folicitous of obtaining more ample information on the fubject of this article, may confult *Izarn's Lithologie Atmofpherique; Biot's Relation d'un Voyage fait dans le département de l'Orne, pour conftater la réalité d'un Météore obfervé à l'Aigle; Böttiger's Obfervations on the Accounts given by ancient authors of Stones faid to have fallen from the Clouds; Fulda's Memoir on Fire-balls; Cavallo's Elements of Natural Philofophy; Klaproth on Meteoric Stones; Soldani's Account of the Tufcan Meteor; Chladni's Treatife on the Siberian Mafs of Iron; Mr Edward King's Remarks concerning Stones faid to have fallen from the Clouds*; and feveral of the more recent tranfactions of learned focieties and periodical fcientific communications, as thofe of the Royal Society of London, of the Inftitute at Paris, the Journal de Phyfique, Annales de Chimie, Bibliotheque Britannique, Decade Philofophique. Journal des Mines, Philofophical Magazine, Nicholfon's Journal, &c. &c.

METEOROLOGICAL, fomething belonging to meteors.

Meteorological Journal, is a table recording the daily ftate of the air, exhibited by the barometer, thermometer, hygrometer, anemometer, and other meteorological inftruments. We have many journals of this kind, kept at the houfe of the Royal Society, and by different obfervers in other places, in the Philofophical Tranfactions, the Memoirs of the Academy of Sciences, and fimilar publications.

METEOROLOGY.

INTRODUCTION.

1 Object of meteorology. METEOROLOGY is that part of natural science which treats of the changes that take place in our atmosphere, as they are perceptible to our senses, or as they are indicated by certain instruments which the ingenuity of man or accident has discovered to answer that purpose. In as far as it describes the phenomena produced by such changes, meteorology is a department of natural history; but in its attempts to account for the appearances, it is almost entirely dependent on NATURAL PHILOSOPHY and CHEMISTRY.

2 Its connection with chemistry. The connection of METEOROLOGY with CHEMISTRY is sufficiently evident to those who take only a superficial view of the subject, though it has only of late attracted the notice of philosophers. That the air is sometimes hotter and sometimes colder than usual; that it is at one time much rarefied, and at another greatly condensed; now uncommonly dry, and now surcharged with moisture—are circumstances that daily meet the senses of the most casual observer, as they are circumstances that powerfully, and often unpleasantly, arrest his attention. That these changes are the result of decompositions and combinations that are continually going on in the atmosphere, and of new modifications of its component principles, is manifest to him who is acquainted merely with the first elements of modern chemistry.

3 Indeed to modern chemistry this science is indebted for the progress it has made within the last 50 years; a period which may be considered as the second epoch of meteorology. In fact, this science is still in its infancy; but from the ardour with which it is now cultivated, from the abilities of the philosophers who are engaged in the study, and from the progress that is daily making in the kindred sciences, we may reasonably look forward to a period, at no great distance, when it shall please the great Author of nature to unveil many of those wonders which are now involved in darkness and obscurity, and permit us to controul the jarring elements, as he has allowed us to exercise dominion over the beasts of the earth, the fowls of the air, and the fishes of the sea.

4 Means of improving meteorology. A late ingenious writer on the climate of Britain has suggested some useful hints for the improvement of meteorology, which we shall here extract. "With this view, our first step must be *that* recommended by Mr Kirwan and others, to establish corresponding societies in different parts of the world; these societies must be furnished with similar apparatus, equally adjusted, and graduated in their construction, for making observations on the weather. In our own island it will be necessary to procure registers, carefully kept, from the different parts of the sea coast, and from those parts of the country situated in the interior. The various states of the barometer, thermometer, hygrometer, and electroscope, should be carefully noted; with the variations and the degrees of wind, as well as the diurnal and nocturnal aspect of the heavens discriminately marked; the appearance of the sky; and in familiar language, such as might be understood by the respective and distant observers; for instance, whether the sun is totally or partially obscured by vapour;—whether the clouds are mottled, or fleaky;—whether they assume the appearance of horizontal streaks, or appear in radii apparently from a centre—or in masses of dense vapour—or loose and fleecy—or those familiarly known by the name of *mare-tail* clouds—with any other new or accustomed phenomena. The common terms *fair*, *cloudy*, or *wet*, are insufficient for forming a judgement of the weather; as the term fair is generally at present expressed only in opposition to *rain*, without distinguishing whether the atmosphere is obscure, dull, or bright. The appearance of the stratum of air on the earth's surface, *that is*, *the space between the clouds and the earth*, should be always accurately described. Is there a blue haze, white mist, and dense fog? or is the air transparent? which is the case when distant objects appear more than commonly distinct and near to the eye of the observer: the temperature of the ocean at *full tide* should be frequently ascertained, as it will be found to have considerable influence in these respects on an insular country. By the remarks of observers, stationed in various parts of our coasts, we should soon be enabled to discover when vapour is wafted in from the sea, or generated by the aqueous and vegetable surface of our island. During a north-west wind, which is frequently attended with storms of hail and rain, and usually experienced in the spring, an observer stationed on the coast of Sligo in Ireland, or Denbighshire in Wales, might ascertain whether the disposition of the atmosphere to storm and cloud came in with the air from the Atlantic ocean, or was generated by the vapours of our own island. It would be desirable also again, that the temperature and blue hazy appearance of the atmosphere during the north-east winds, so common in May and June, should be noticed by observers on the north-east coast, in the counties of York, Lincoln, Essex and Kent; and by others, on the opposite western coasts of Pembroke, Devon, and Cornwall, so as to determine what changes in temperature this wind undergoes in its passage over the island; and whether or not the degree of haze increases or diminishes by its progress from either quarter; and whether the vapour is more or less disposed to produce storms?

By such comparative observations on the coast, conjoined with those made by others in the central parts of the kingdom, we might rapidly proceed in meteorological science, or, as it is commonly called, a knowledge of the weather. The observations made in the interior of the country would enable us at all times to trace the origin and progress of storms: in situations where tillage or pasturage is most attended to, the effects of spring frosts and blights should be particularly noticed, as well as the first appearance of the aphis and coccus, the caterpillar and larvæ of other insects, on fruit trees, and particularly those peculiar to the hop *plantations*. The first opening of the vernal foliage on trees

trees and hedges in the ſpring, ſhould likewiſe be remarked, and compared with the ſtarting up graſs on the highly manured paſtures in the neighbourhood of towns, and on thoſe alſo aſſiſted with manure, as well as the natural herbage on the commons and waſtes. Some attention ſhould be paid to the effects of thunder ſtorms, in deſtroying the aphis and other deſtructive inſects, the peſt of fruit and hop plantations; and the firſt appearance of the mildew or ruſt on wheat ſhould be particularly obſerved, and remarks made to aſcertain, whether or not the moiſture, which occaſions the diſeaſe in its commencement was attended with wind and rain, or a cloſe damp ſtate of the air. The different kinds of ſoil, where the crops, from the diſeaſe, ſuffered moſt, ſhould be noticed, and the ſituation of the land for ventilation, with the height of the fences, ſize of incloſures, and vicinity to coppices, trees, or hedge-rows *."

* *Williams on the Climate of Britain.*

5 Importance of the ſcience.

The importance of the ſtudy of meteorology requires little elucidation. In climates where the ſucceſſion of ſeaſons is nearly ſtated and regular, where the periods of parching drought or deluging torrents, of the tempeſtuous hurricane or the refreſhing breeze, are fixed and aſcertained, mankind has little to do, but expect the dreaded changes, and provide againſt their devaſtations; but in countries like our own, where all the viciſſitudes of ſeaſons may take place in the courſe of a few hours, it is of the higheſt conſequence to inveſtigate the nature of the change, and the circumſtances that precede or accompany it. To the farmer, the mariner, the traveller, the phyſician, meteorology is in ſome meaſure a ſtudy of neceſſity; to the philoſopher it is a ſtudy of intereſt and delight; and to the obſerver of nature it affords objects of grandeur and ſublimity not to be found in any other department of his favourite ſcience. Surely nothing can contribute more to elevate the mind of man, to raiſe it "from nature up to nature's God," than the contemplation of the ſweeping whirlwind, the dazzling lightning, or the awful thunder.

Our limits will not admit of our entering into a hiſtorical detail of the progreſs of meteorology; but it may be proper in this place to enumerate the principal writers on this ſcience both in our own country and on the continent.

6 Writers on meteorology.

In this country, we may reckon Dr Kirwan, (in his "Eſtimate of the Temperature of different Climates," his "Eſſay on the Variations of the Atmoſphere," and in the "Iriſh Tranſactions"), Mr John Dalton (chiefly in the "Mancheſter Memoirs"), Col. Capper (in his "Obſervations on the Winds and Monſoons"), Mr Williams (in his "Climate of Great Britain"), and Mr Luke Howard (in the Philoſophical Magazine), as the principal cultivators of meteorological knowledge; and on the continent, the names of Cotte ("*Traite de Meteorologie*," and *Journal de Phyſique*), Sauſſure ("*Eſſai ſur l'Hygrometrie*," and *Voyage aux Alpes*"), De Luc (A) ("*Recherches ſur les Modifications de l'Atmoſphere*", *Idees ſur la Meteorologie*," and other works), and Lamarck (See *Journ. de Phyſ.* paſſim) ſtand moſt conſpicuous in this branch of natural ſcience.

7

In conſidering the ſubject of meteorology, we may properly divide it into ſeven general heads: 1. of the changes which take place in the gravity of the air; 2. of the changes of the temperature of the air; 3. of the changes produced by evaporation and rain; 4. of the changes produced by winds; 5. of atmoſpherical electricity; 6. of meteors or thoſe viſible phenomena accompanied with light, which take place in the atmoſphere or near the ſurface of the earth; and 7. the application of the principles of meteorology to the uſeful purpoſes of life. Of theſe heads, the fifth has been already fully conſidered under ELECTRICITY, and much of the ſixth has been exhauſted under METEOROLITE. The remaining circumſtances will form the ſubjects of the following chapters.

CHAP. I. *Of the Changes which take place in the Gravity of the Air.*

MANY of the facts relating to this part of our ſubject have been already anticipated under the article BAROMETER, and ſeveral circumſtances fall to be conſidered more properly under PNEUMATICS than in this place. We ſhall here confine ourſelves to a general view of the changes in the gravity of the atmoſphere, as indicated by the barometer, in various ſituations on or near the ſurface of the earth, and briefly examine the concluſions that may be drawn from them.

8 Mercury ſtands higheſt at the level of the ſea.

The moſt general fact indicated by the barometer is, that this inſtrument ſhews us the weight of a column of air

(A) In again mentioning the name of a philoſopher ſo reſpectable as M. de Luc, we embrace the firſt opportunity of doing him juſtice, and of vindicating his character againſt an unfortunate miſconception of the late Profeſſor Robiſon, a miſtake which we have inadvertently contributed to diſſeminate, by quoting Dr Robiſon's ſtatement in our account of Dr Black, where M. de Luc is accuſed of having arrogated to himſelf Dr Black's diſcovery of *latent heat*.

M. de Luc's vindication of himſelf (as printed in the 12th number of the Edinburgh Review) is before the public. We owe it to candour and juſtice to acknowledge our conviction that Dr Robiſon was too haſty in his aſſertion, and that M. de Luc, ſo far from arrogating to himſelf the doctrine of *latent heat*, has, in various parts of his numerous writings, expreſsly mentioned Dr Black as the author of that doctrine. This will appear from the following citations. In his "Introduction à la Phyſique terreſtre," p. 102, M. de Luc thus expreſſes himſelf. "Ne connoiſſant point le *feu latent*, dans la vapeur à toute temperature, *dont la premiere decouverte eſt due au* Dr Black, &c. Again, p. 232 of the ſame work. "Ce qui developpoit l'idée de *chaleur latente par laquelle le Dr Black avoit deſigné ce phénomêne*,"—and at p. 385, "Le Dr Black ayant découvert qu'une certaine quantité de chaleur diſparoit quand la vapeur de l'eau bouillante ſe forme, *nomma ce phénomène chaleur latente* dans la vapeur."

We truſt that theſe quotations, with M. de Luc's own juſtification of himſelf above referred to, will be ſufficient to exculpate him from the charge of *literary felony* ſo warmly brought againſt him by Profeſſor Robiſon; and we have no doubt the Profeſſor himſelf, were he ſtill alive, would under ſuch evidence retract his accuſation.

Gravity of the Air.

air whoſe baſe is equal to the diameter of the mercury in the tube, and whoſe height is equal to the extent of the atmoſphere above the place of obſervation. As the height of this column muſt vary in different ſituations, and muſt, *cæteris paribus*, be greateſt, at the level of the ſea, the mercury in the tube will, under the ſame circumſtances, ſtand higheſt in ſuch a ſituation.

9 Medium height 30 inches.

The medium height of the barometer at the level of the ſea is 30 inches, as has been found by obſervations in the Britiſh channel, and in the Mediterranean ſea, at the temperatures of 55° and 60°; on the coaſt of Peru at the temperature of 84°, and in latitude 80°. As we aſcend above the ſurface of the earth, the medium height of the mercury diminiſhes; and ſome late obſervations made in balloons at a conſiderable diſtance above the tops of the higheſt mountains, have ſhewn that in the higher regions of the air, the column of mercury is very conſiderably ſhortened. This fact, as we have ſeen (ſee BAROMETER), has been uſefully applied to the meaſuring of heights and depths that cannot be aſcertained by the uſual geometrical methods. As the abſolute gravity of the atmoſphere is conſtantly varying, even in the ſame place, the column of air preſſing on the ſurface of the mercury without the tube, muſt preſs with more or leſs force, in proportion as theſe changes are greater; and hence the barometer points out theſe variations, falling when the atmoſphere is lighter, and riſing when it is heavier than uſual. For an account of the obſervations that were made on the riſe and fall of the barometer by the earlier philoſophers, and the attempts which were made by them to explain theſe phenomena, ſee BAROMETER.

It will be of advantage here to conſider the variations of the barometer, as they take place in different ſituations, in order, if poſſible, to point out the cauſe by which theſe variations are produced, as this cauſe muſt have conſiderable influence on the changes of the weather.

10 Variation of the barometer between the tropics very ſmall.

It is found, that between the tropics the variations of the barometer are exceedingly ſmall, and it is remarkable, that in that part of the world it does not deſcend above half as much for every 200 feet of elevation as it does beyond the tropics *. In the torrid zone, too, the barometer is elevated about $\frac{2}{3}$ of a line twice every day; and this elevation happens at the ſame time with the tides of the ſea †.

* *Jour. de Phyſ.* 1790, p. 268.
† *Ibid.*

As the latitude advances towards the poles, the range of the barometer gradually increaſes, till at laſt it amounts to two or three inches. This gradual increaſe will appear from the following table.

Table of the Range of the Barometer.

Latitude.		Places.	Range of the Barometer.	
			Greateſt.	Annual.
0°		Peru	0.20 *	
22	23′	Calcutta	0.77 †	
40	55	Naples	1.00 ‡	
51	8	Dover	2.47 §	1.80
53	13	Middlewick	3.00 §	1.94
53	23	Liverpool	2.89 ‖	1.96
59	56	Peterſburgh	3.45 **	2.77

* Kirw. *Iriſh Tranſ.* vol. iii. 47.
† *Aſiatic Reſearches*, vol. ii. Appendix.
‡ *Mancheſt. Mem.* vol. iv.
§ *Edin. Tranſ.* vol. ii.
‖ *Tranſ. Philadelph.* vol. ii.
** *Edin. Tranſ.* vol. ii. p. 229.

There is, however, ſome exception to this general rule, as in North America the range of the barometer is much leſs than in the correſponding European latitudes.

The range of the barometer is greater at the level of the ſea than on mountains, and in the ſame degree of latitude the extent of the range is in the inverſe ratio of the height of the place above the level of the ſea.

It appears probable that the barometer has a tendency to riſe during the day from morning to evening, and that this tendency is greateſt between 2 and 9 P. M. the greateſt elevation being at this laſt period. The elevation at 2 differs from that at 9 by $\frac{4}{12}$, while that at 2 differs from the morning elevation only by $\frac{1}{12}$; and that in certain climates the greateſt elevation takes place at 2 o'clock *.

* *Jour. de Phyſ.* 1790.

11

The range of the barometer is greater in winter than in ſummer, as appears from ſome obſervations made at Kendal during five years; the mean range from October to March being 7.982, and that from April to September being only 5.447 †.

† *Mancheſt. Mem* vol. iv. p. 547.

When the atmoſphere is ſerene and ſettled the mercury is generally high; and in calm weather, when it is inclined to rain, the mercury is low. On the approach of high winds it ſinks, as it does with a ſoutherly wind, but riſes very high on the approach of eaſterly and northerly winds. It is found, however, that at Calcutta the mercury is higheſt with north-weſterly and northerly, and loweſt with ſouth-eaſterly winds.

The mercury ſuddenly falls on the approach of tempeſts, and during their continuance undergoes great oſcillations.

12 Cotte's axioms on the barometer.

To theſe general facts that have been obſerved on the riſe and fall of the barometer, we ſhall annex the following axioms by M. Cotte.

1. The greateſt changes of the barometer commonly take place during clear weather, with a north wind; and the ſmall riſings during cloudy, rainy, or windy weather, with a ſouth, or nearly ſouth wind.

2. The ſtate of the mercury changes more in the winter than in the ſummer months; ſo that its greateſt riſing and falling takes place in winter; but its mean elevation is greater in ſummer than in winter.

3. The changes of the ſtate of the barometer are nearly null at the equator, and become greater the more one removes from it towards the poles.

4. They are more conſiderable in valleys than on mountains.

5. The more variable the wind, the more changeable the ſtate of the barometer.

6. It is lower at midnight and noon than at other periods of the day; its greateſt daily height is towards evening.

7. Between 10 at night and 2 in the morning, and alſo in the day, the riſing and falling of the mercury are leſs; the contrary is the caſe between 6 and 10 in the morning and evening.

8. Between 2 and 6 in the morning and evening it riſes as often as it falls; but in ſuch a manner that it oftener riſes about that time in the winter months, and falls oftener in the ſummer months.

9. The oſcillations are leſs in ſummer, greater in winter, and very great at the equinoxes.

10. They

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10. They are greater alſo in the daytime than during the night.

11. The higher the ſun riſes above the horizon, the leſs are the oſcillations; they increaſe as he approaches the weſtern ſide of the horizon, and are exceedingly great when he comes oppoſite to the eaſtern part of the horizon.

12. They are, to a certain degree, independent of the changes of temperature.

13. The mercury generally riſes between the new and the full moon, and falls between the latter and the new moon.

14. It riſes more in the apogee than the perigee; it uſually riſes between the northern luniſtice and the ſouthern, and falls between the ſouthern luniſtice and the northern.

15. In general, a compariſon of the variations of the mercury with the poſitions of the moon gives nothing certain; the reſults of N° 13. and 14. are the moſt conſtant.

16. In the neighbourhood of Paris the barometer never continues 24 hours without changing.

17. The barometers in the weſtern diſtricts riſe and fall ſooner than thoſe in the more eaſtern.

18. When the ſun paſſes the meridian, the mercury, if falling, continues to fall, and its fall is often haſtened.

19. When the mercury at the ſame period is riſing, it falls, remains ſtationary, or riſes more ſlowly.

20. When the mercury, under the ſame circumſtances, is ſtationary, it falls, unleſs before or after it becomes ſtationary, it has been in the act of riſing.

21. The above changes commonly take place between 11 in the morning and 1 in the afternoon, but oftener before than after noon.

22 Before high tides there is almoſt always a great fall of the mercury; this takes place oftener at the full than the new moon.

Such is a general view of the variations in the gravity of the air, as far as they have been obſerved by the barometer; and we ſhall now endeavour to give ſome plauſible theory of them.

13 Atmoſphere forms two inclined planes meeting at the equator.

It is evident that the denſity of the atmoſphere is leaſt at the equator, and greateſt at the poles; for at the equator the centrifugal force, the diſtance from the centre of the earth, and the heat (all of which tend to diminiſh the denſity of the air), are at their maximum, while at the poles they are at their minimum. The mean height of the barometer at the level of the ſea, all over the globe, is 30 inches; the weight of the atmoſphere, therefore, is the ſame all over the globe. This weight depends on the denſity and height of the air; where the denſity is greateſt, its height muſt be leaſt; and on the contrary, where its denſity is leaſt, its height muſt be greateſt. The height of the atmoſphere, therefore, muſt be greateſt at the equator, and leaſt at the poles; and it muſt decreaſe gradually between the equator and the poles, ſo that its upper ſurface will reſemble two inclined planes, meeting above the equator their higheſt part *.

During ſummer, when the ſun is in our hemiſphere, the mean heat between the equator and the pole does not differ ſo much as in winter. Hence the rarity of the atmoſphere at the pole, and conſequently its height, will be increaſed. The upper ſurface of the atmoſphere, therefore, in the northern hemiſphere, will be leſs inclined; while that of the ſouthern hemiſphere, from contrary cauſes, will be much more inclined. The reverſe will take place during our winter.

* *Iriſh. Tranſ.* vol. ii. p. 43, &c.

The denſity of the atmoſphere depends in a great meaſure on the preſſure of the ſuperincumbent column, and therefore decreaſes according to the height, as the preſſure of the ſuperincumbent column conſtantly decreaſes. But the denſity of the atmoſphere in the torrid zone will not decreaſe ſo faſt as in the temperate and frigid zones, becauſe its column is larger, and becauſe there is a greater proportion of air in the higher part of this column. This accounts for the obſervation of Mr Caſſon, that the barometer ſinks only half as much for every 200 feet of elevation in the torrid as in the temperate zones. The denſity of the atmoſphere at the equator, therefore, though at the ſurface of the earth it is leſs, muſt at a certain height equal, and at a ſtill greater muſt exceed, the denſity of the atmoſphere in the temperate zones and at the poles.

14 Why the mercury is higheſt in winter in northern latitudes.

We ſhall preſently endeavour to prove, that a quantity of air is conſtantly aſcending at the equator, and that part of it at leaſt reaches and continues in the higher parts of the atmoſphere. From the fluidity of air, it is evident that it cannot accumulate above the equator, but muſt roll down the inclined plane which the upper ſurface of the atmoſphere aſſumes towards the poles. As the ſurface of the atmoſphere of the northern hemiſphere is more inclined during our winter than that of the ſouthern hemiſphere, a greater quantity of the equatorial current of air muſt flow over upon the northern than upon the ſouthern hemiſphere; ſo that the quantity of our atmoſphere will be greater during winter than that of the ſouthern hemiſphere; but during ſummer the reverſe will take place. Hence the greateſt mercurial heights take place during winter, and the range of the barometer is leſs in ſummer than in winter.

The denſity of the atmoſphere is in a great meaſure regulated by the heat of the place; wherever the cold is greateſt, there the denſity of the atmoſphere will be greateſt, and its column ſhorteſt. High countries, and ranges of lofty mountains, the tops of which are covered with ſnow the greateſt part of the year, muſt be much colder than other places ſituated in the ſame degree of latitude, and conſequently the column of air over them much ſhorter. The current of ſuperior air will linger and accumulate over theſe places in its paſſage towards the poles, and thus occaſion an irregularity in its motion, which will produce a ſimilar irregularity in the barometer. Such accumulations will be formed over the north-weſtern parts of Aſia, and over North America; hence the barometer uſually ſtands higher, and varies leſs there, than in Europe. Accumulations alſo are formed upon the Pyrenees, the Alps, the mountains of Africa, Turkey in Europe, Tartary, and Tibet. When theſe accumulations have gone on for ſome time, the denſity of the air becomes too great to be balanced by the ſurrounding atmoſphere; it ruſhes down on the neighbouring countries, and produces cold winds which raiſe the barometer. Hence the riſe of the barometer which generally attends north-eaſt winds in Europe, as they proceed from accumulations in the north-weſt of Aſia, or about the pole; hence, too, the north-weſt wind from the mountains of Tibet raiſes the barometer at Calcutta.

We

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We shall presently endeavour to shew, that considerable quantities of air are occasionally destroyed in the north polar regions. When this happens, the atmosphere to the south rushes in to supply the deficiency. Hence south-west winds take place, and the barometer falls.

As the mean heat of our hemisphere differs in different years, the density of the atmosphere, and consequently the quantity of equatorial air which flows towards the poles, must also be variable. Does this range correspond to the mean annual heat; that is to say, Is the range greatest when the heat is least, and least when the heat is greatest? In some years greater accumulations than usual take place in the mountainous parts in the south of Europe and Asia, owing, perhaps, to earlier falls of snow, or to the rays of the sun having been excluded by long-continued fogs. When this takes place, the atmosphere in the polar regions will be proportionably lighter. Hence the prevalence of southerly winds during some winters more than others.

As the heat in the torrid zone never differs much, the density, and consequently the height, of the atmosphere, will not vary much. Hence the range of the barometer within the tropics is comparatively small; and it increases gradually as we approach the poles, because the difference of the temperature, and consequently of the density, of the atmosphere, increases with the latitude.

The diurnal elevation of the barometer in the torrid zone corresponding to the tides, observed by Mr Casson and others, must be owing to the influence of the moon on the atmosphere. This influence, notwithstanding the ingenious attempts of D'Alembert and several other philosophers, seems altogether inadequate to account for the various phenomena of the winds. It is not so easy to account for the tendency which the barometer has to rise as the day advances. Perhaps it may be accounted for by the additional quantity of vapour added to the atmosphere, which, by increasing the quantity of the atmosphere, may possibly be adequate to produce the effect.

The falls of the barometer which precede, and the oscillations which accompany, violent storms and hurricanes, shew us that these phenomena are produced by very great rarefactions, or perhaps destructions of air, in particular parts of the atmosphere. The falls of the barometer, too, that accompany winds proceed from the same cause. The observation made by Mr Copland, that a high barometer is accompanied by a temperature above the mean, will be easily accounted for by every one acquainted with Dr Black's theory of latent heat. The higher the mercury stands, the denser the atmosphere must be; and the denser it becomes, the more latent heat it must give out. It is well known that air evolves heat when condensed artificially. The falling of the barometer, which generally precedes rain, remains still to be accounted for; but we know too little about the causes by which rain is produced, to be able to account for it in a satisfactory manner.

It has been for some time suspected that the variation of the barometer is affected by the changes of the moon. The theory of lunar influence has been discussed on the continent chiefly by Lamarck and Cotte, (see Journal de Physique, *passim*); and in this country by Mr Luke Howard. Mr Howard's suspicions of this influence on the barometer were first conceived, in consequence of the printed charts, of which he made use in keeping a register of the barometer, having the phases of the moon marked on them, and of his observing a remarkable coincidence between these and certain states of the mercury. This coincidence consists in the depression of the barometrical line on the approach of the new and full moon, and its elevation on that of the quarters. In above 30 out of the 50 lunar weeks in the year 1798, the barometer was found to have changed its general direction once in each week, in such a manner as to be either rising or at its *maximum*, for the week preceding and following, about the time of each quarter; and to be either falling or at its *minimum*, for the two weeks, about the new and full. It is remarkable, that the point of greatest depression during the year, viz. to 28.67, was found about 12 hours after the new moon on the 8th of November; and that at its greatest and extraordinary elevation to 30.89, on the 7th of February, at the time of the last quarter. Moreover, this coincidence appeared to take place most regularly in fair and moderate weather; and, in general, when the barometer fell, during the interval between the new or full moon and the quarters, an evident perturbation in the atmosphere accompanied; of which may be instanced February 15. to 23. when the barometer, after an uncommon rise, continued to fall rapidly after the new moon, with severe cold, which ended suddenly in stormy and wet weather; again, June 14. to 20. when two weeks of fair weather ended in a thunder storm. In the greater part of December the usual coincidence disappeared, and the converse took place; the barometer being low at the quarter and high at the full, amidst continual alternations of rain, frost, and snow, and, for part of the time, high winds. On the two days preceding the last quarter, the barometer rose rapidly, and rain followed.

On the whole, Mr Howard thought there appeared sufficient ground, on the evidence of the year 1798, to suppose that the gravity of our atmosphere, as indicated by the barometer, may be subject to certain periodical changes, effected by a cause more steady and regular than either change of temperature, currents, or solution and precipitation of water, to which he believes the whole variation has been heretofore attributed.

The mean of the register at large appeared to be 29.89, whence it appears that the depression at the new and full moon either amounted to more, on the whole, than the elevations at the quarters, or that they fell out nearer to the time. He was quite satisfied, in passing through this register, that if he had allowed himself to choose the higher rotations about the quarters, and the lower about the new and full, with a latitude of 24 or 36 hours, it would have made the results as much more favourable to his conclusions as in her former case.

Now, to omit the consideration of other proofs for the present, it appeared to him evident, that the atmosphere is subject to a periodical change of gravity, whereby the barometer, on a mean of ten years, is depressed at least one-tenth of an inch while the moon is passing from the quarters to the full and new; and elevated, in the same proportion, during the return to the quarter. To what causes shall we attribute this periodical change, other than the attraction of the sun and moon for the matter composing the atmosphere?

The atmosphere is a gravitating fluid, differing, in a physical

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physical sense, from the water, chiefly in possessing less gravity; and it is demonstrated *à priori* on the principles of the Newtonian philosophy, that it ought to have its tides as well as the ocean, although in a degree as much less perceptible as is its gravity.

He supposes, therefore, that the joint attractions of the sun and moon at the new moon, and the attraction of the moon predominating over the sun's weaker attraction at the full, tend to depress the barometer, by taking off from the gravity of the atmosphere, as they produce a high tide in the waters, by taking off from their gravity; and, again, that the attraction of the moon being diminished by that of the sun at her quarters, this diminution tends to make a high barometer, together with a low tide, by permitting each fluid to press with additional gravity upon the earth *.

* *Phil. Mag.* vol. vii. p. 355.

Chap. II. *Of the Changes which take place in the Temperature of the Air.*

It is obvious to the most careless observer, that the temperature of the air varies considerably even in the same place, and at the same season. This constant variation must be attributed to the reflected rays of the sun, which communicate heat from the surface of the earth to the surrounding atmosphere. As from this cause the heat of those places which are so situated as to be most warmed by the sun's rays is always greatest, and as this temperature varies in every place with the season of the year, and diminishes according to the height of the air above the surface; and as the earth at the equator is exposed to the most perpendicular rays of the sun, the earth is there hottest, and its heat diminishes gradually from the equator to the poles. Of course, the temperature of the air must vary in the same manner, being hottest over the equator, and diminishing in temperature towards the poles, where it is coldest. Though it it hottest at the equator, its heat, as in all other situations, gradually diminishes there, as we ascend above the surface of the earth.

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Though there is a considerable difference in every part of the world between the temperature of the atmosphere in summer and in winter; though in the same season the temperature of almost every day, and even every hour, differs from that which precedes and follows it; though the heat varies continually in the most irregular and seemingly capricious manner—still there is a certain mean temperature in every climate, which the atmosphere has always a tendency to observe, and which it neither exceeds nor comes short of beyond a certain number of degrees. What this temperature is, may be known by taking the mean of tables of observations kept for a number of years; and our knowledge of it must be the more accurate the greater the number of observations is.

15 Mean annual temperature greatest at the equator.

The mean annual temperature is greatest at the equator (or at least a degree or two on the north side of it), and it diminishes gradually towards the poles, where it is least. This diminution takes place in arithmetical progression, or, to speak more properly, the annual temperatures of all the latitudes are arithmetical means between the mean annual temperature of the equator and that of the pole. This was first ascertained by Mr Meyer; and Dr Kirwan improving on Meyer's hint, has calculated in the following table the mean annual temperature of every latitude between the equator and the pole. It must be remarked, however, that this table is calculated only for a particular part of the earth's surface, viz. that part of the Atlantic ocean which lies between the 80° of northern, and the 45° of southern latitude, extending westward as far as the Gulf stream, and to within a few leagues of the coast of America, and for all that part of the Pacific ocean that reaches from 45° of north latitude to 40° of south latitude, and extending between the 20th and 275th degree of longitude east from London. This part of the ocean is called by Dr Kirwan the standard, and was best suited to his purpose, as the rest of the ocean is subject to irregularities, which will be noticed presently (D).

Lat.	Temper.	Lat.	Temper.	Lat.	Temper.	Lat.	Temper.	Lat.	Temper.	Lat.	Temper.	Lat.	Temper.
90	31.	77	33.7	64	41.2	51	52.4	38	63.9	25	74.5	12	81.7
89	31.04	76	34.1	63	41.9	50	52.9	37	64.8	24	75.4	11	82.0
88	31.10	75	34.5	62	42.7	49	53.8	36	65.7	23	75.9	10	82.3
87	31.14	74	35.0	61	43.5	48	54.7	35	66.6	22	76.5	9	82.7
86	31.2	73	35.5	60	44.3	47	55.6	34	67.4	21	77.2	8	82.9
85	31.4	72	36.0	59	45.09	46	56.4	33	68.3	20	77.8	7	83.2
84	31.5	71	36.6	58	45.8	45	57.5	32	69.1	19	78.3	6	83.4
83	31.7	70	37.2	57	46.7	44	58.4	31	69.9	18	78.9	5	83.6
82	32.0	69	37.8	56	47.5	43	59.4	30	70.7	17	79.4	0	84.0
81	32.2	68	38.4	55	48.4	42	60.3	29	71.5	16	79.9		
80	32.6	67	39.1	54	49.2	41	61.2	28	72.3	15	80.4		
79	32.9	66	39.7	53	50.2	40	62.0	27	72.8	14	80.8		
78	33.2	65	40.4	52	51.1	39	63.0	26	73.8	13	81.3		

Dr

(D) In calculating this table, Dr Kirwan proceeded on the following principle. Let the mean annual heat at the equator be m and at the pole $m-n$; put φ for any other latitude; the mean annual temperature of that latitude will be $m-n \times \text{sin.}\ \varphi^2$. If, therefore, the temperature of any two latitudes be known, the value of m and n may be found. Now, the temperature of north latitude 40° has been found by the best observations to be 62.1°,

and

Dr Kirwan has alſo calculated in the following table the mean monthly temperature of the ſame ſtandard (E).

Latit.	80°	79°	78°	77°	76°	75°	74°	73°	72°	71°	70°	69°	68°	67°	66°	65°	64°	63°	62°
Jan.	22.	22.5	23.	23.5	24.	24.5	25.	25.5	26.	26.5	27.	27.5	27.5	28.	28.	28.	29.	30.	31.
Feb.	23.	23.	23.5	24.	24.5	25.	25.5	26.	26.5	27.	27.5	28.	28.	28.5	29.	30.	31.	32.	33.
March	27.	27.5	28.	28.5	29.	29.5	30.	30.5	31.	31.5	32.	32.5	33.	33.5	34.	35.	36.	37.	38.
April	32.6	32.9	33.2	33.7	34.1	34.5	35.	35.5	36.	36.6	37.2	37.8	38.4	39.1	39.7	40.4	41.2	41.9	42.7
May	36.5	36.5	37.	37.5	38.	38.5	39.	39.5	40.	40.5	41.	41.5	42.	42.5	43.	44.	45.	46.	47.
June	51.	51.	51.5	52.	52.	52.	52.5	53.	53.5	54.	54.	54.5	54.5	54.5	55.	55.	55.5	55.5	56.
July	50.	50.	50.5	51.	51.	51.	51.5	52.	52.5	53.	53.5	53.5	53.5	54.	54.5	54.5	55.	55.	55.5
Aug.	39.5	40.	41.	41.5	42.	42.5	43.	43.5	44.	44.5	45.	45.5	46.	47.	48.	48.5	49.	50.	51.
Sept.	33.5	34.	34.5	35.	35.5	36.	36.5	37.	38.	38.5	39.	39.5	40.	41.	42.	43.	44.	45.	46.
Oct.	28.5	29.	29.5	30.	30.5	31.	31.5	32.	32.5	33.	33.5	34.	34.	35.	36.	37.	37.5	38.	39.
Nov.	23.	23.5	24.	24.5	25.	25.5	26.	26.5	27.	27.5	28.	28.5	29.	30.	31.	32.	32.5	33.	34.
Dec.	22.5	23.	23.5	24.	24.5	25.	25.5	26.	26.5	27.	27.5	28.	28.	29.	30.	30.5	31.	31.	32.

Latit.	61°	60°	59°	58°	57°	56°	55°	54°	53°	52°	51°	50°	49°	48°	47°	46°	45°	44°	43°
Jan.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	42.5	43.5	43.	42.5	44.	44.5	45.	45.5
Feb.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	44.5	44.5	45.	45.5	46.	46.5	47.	48.
March	39.	40.	41.	42.	43.	44.6	45.	46.	48.	49.	50.	50.5	51.	52.5	53.	53.5	54.5	55.5	56.5
April	43.5	44.3	45.09	45.8	46.7	47.5	48.4	49.2	50.2	51.1	52.4	52.9	53.8	54.7	55.6	56.4	57.5	58.4	59.4
May	48.	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.	58.5	59.	60.	61.	62.	63.	64.	65.
June	56.	56.	56.5	57.	57.	57.5	58.	58.5	59.	59.	60.	61.	62.	63.	64.	65.	66.	67.	68.
July	55.5	56.	56.5	57.	57.5	58.	59.	60.	61.	62.	63.	63.5	64.	65.	66.	67.	68.	69.	69.5
Aug.	52.	53.	54.	55.	56.	57.	58.	59.	60.	61.	62.	63.5	64.	65.	66.	67.	68.	69.	69.5
Sept.	47.	48.	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.5	59.	60.	61.	62.	63.	64.	66.
Oct.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	50.5	51.	52.	53.	54.	55.	56.	57.
Nov.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.5	46.	46.5	47.	48.	49.	50.	51.	52.	53.
Dec.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	44.	44.5	45.	46.	47.	48.	49.	50.	51.

Latit.	42°	41°	40°	39°	38°	37°	36°	35°	34°	33°	32°	31°	30°	29°	28°	27°	26°	25°	24°
Jan.	46.	46.5	49.5	51.	52.	53.5	55.	56.5	59.5	63.	63.	63.	63.5	63.5	63.5	64.	64.5	65.5	67.
Feb.	49.	50.	53.	56.5	58.	60.	61.	62.	63.	64.5	66.	67.	68.5	68.5	69.5	69.5	70.5	71.	72.
March	58.5	59.5	60.	60.5	61.	62.	63.	64.	65.	66.5	67.5	68.5	69.5	71.	72.	72.5	73.	73.5	74.5
April	60.3	61.2	62.1	63.	63.9	64.8	65.7	66.6	67.4	68.3	69.1	69.9	70.7	71.5	72.3	72.8	73.8	74.5	75.4
May	66.	67.	68.	69.	70.	70.5	71.	71.5	72.	72.5	73.	73.	73.5	74.5	75.5	76.	76.5	77.5	78.
June	69.	70.	70.5	71.	71.	71.	71.5	71.5	72.	72.5	73.	73.	73.5	74.5	75.5	76.	76.5	78.	78.5
July	70.	70.	71.	71.	72.	72.	72.5	72.5	72.5	72.5	73.	73.	73.5	74.5	75.5	76.	76.5	78.	78.5
Aug.	70.	70.	71.	71.	72.	72.	72.5	72.5	72.5	72.5	73.	73.	73.5	74.5	75.5	76.	76.5	78.	78.5
Sept.	68.	69.5	70.5	71.	71.5	72.	72.5	72.5	72.5	72.5	73.	73.	73.5	74.	75.5	76.	76.5	77.5	78.
Oct.	58.	59.	60.	61.	62.	63.	64.	65.	66.	67.5	68.5	69.5	70.5	71.	72.5	72.5	73.	73.5	74.5
Nov.	54.	55.	56.	57.	58.	59.	60.	61.	62.	63.	64.5	65.5	66.5	68.	69.	69.5	71.5	72.	73.5
Dec.	52.	53.	54.	55.	56.	57.	58.	59.	60.	61.	62.5	63.5	64.5	66.	67.	67.5	68.5	69.5	70.

Latit.

and that of latitude 50°, 52.9°. The ſquare of the ſine of 40° is nearly 0.419, and the ſquare of the ſine of 50° is nearly 0.586. Therefore,

$$m - 0.41\,n = 62.1, \text{ and}$$
$$m - 0.58\,n = 52.9\text{; therefore,}$$
$$62.1 + 0.41\,n = 52.9 + 058\,n,$$

as each of them, from the two firſt equations, is equal to m. From this laſt equation the value of n is found to be nearly 53; and m is nearly equal to 84. The mean temperature of the equator, therefore, is 84°, and that of the pole 31°. To find the mean temperature for every other latitude we have only to find 88 arithmetical means between 84 and 31.

(E) In calculating the table of mean monthly temperature, Dr Kirwan proceeded on the following principles. The mean temperature of April ſeems to approach very nearly to the mean temperature of the whole year, and as far as heat depends on the action of the ſolar rays, the mean heat of each month may be conſidered as proportional

Temperature of the Air.

Latit.	23°	22°	21°	20°	19°	18°	17°	16°	15°	14°	13°	12°	11°	10°
Jan.	68.	69.	71.	72.	72.5	73.	73.5	74.	74.5	75.	76.	76.5	77.	77.5
Feb.	72.	72.5	74.	75.	76.	76.5	77.	77.5	78.	78.5	79.	79.5	79.8	80.
March	75.	75.5	76.	77.	77.5	78.	78.5	79.	79.5	80.	80.8	81.	81.5	81.8
April	75.9	76.5	77.2	77.8	78.3	78.9	79.4	79.9	80.4	80.8	81.3	81.7	82.	82.3
May	78.5	79.5	80.	80.5	81.	81.5	82.	82.5	83.	83.	83.5	84.	84.	84.3
June	79.	79.5	80.	80.5	81.5	82.	82.5	83.	83.5	83.8	84.	84.3	84.6	84.8
July	79.	79.5	80.	80.5	81.5	82.	82.5	83.	83.5	83.8	84.	84.3	84.6	84.8
Aug.	79.	79.5	80.	80.5	81.5	82.	82.5	83.	83.5	83.8	84.	84.3	84.6	84.8
Sept.	78.5	79.	79.5	80.	81.	81.5	82.	82.5	83.	83.	83.5	84.	84.3	84.6
Oct.	75.	75.5	77.	78.	79.	80.	81.	81.5	82.	82.5	83.	83.5	83.8	84.
Nov.	74.	74.5	75.	75.5	76.	77.	78.	78.5	79.	79.5	80.	80.5	80.8	81.
Dec.	71.	71.5	72.	72.5	73.	74.	75.	75.5	76.	76.5	77.	77.5	78.	78.5

16 It appears from the above table that January is the coldeſt month in every latitude; that July is the warmeſt month in all latitudes above 48°; that in lower latitudes Auguſt is generally the warmeſt month; that the difference between the hotteſt and coldeſt months increaſes according to the diſtance of the place from the equator. All habitable latitudes are found to enjoy a medium heat of 60° for at leaſt 2 months, which is a very favourable circumſtance, as probably no corn could be produced under a lower medium temperature. The temperatures within 10° of the poles differ very little, nor do they differ much within 10° of the equator. Hence it was unneceſſary to note theſe latitudes in the table. The temperatures of different years vary but little near the equator, but this difference increaſes more and more as the latitudes approach the poles.

17 Temperature decreaſes as we aſcend in the air.

It is well known that the temperature of the atmoſphere gradually diminiſhes according to the height of the place above the level of the ſea. It was found by Dr Hutton of Edinburgh, that a thermometer kept on the top of Arthur's ſeat, a height of about 800 feet, uſually ſtood 3° lower than one kept at the foot of this hill; and Bouguer obſerved that on the top of Pinchincha, a height of about 15564 feet, a thermometer ſtood 54° lower than it did at the level of the ſea in the ſame latitude.

We are indebted to Dr Kirwan for a very ingenious method of determining the rate of the diminution in the temperature in particular caſes, having the temperature of the ſurface of the earth given. The temperature of the atmoſphere conſtantly diminiſhing as we riſe above the level of the ſea, we muſt at a certain height arrive at a point where a perpetual congelation takes place. This point muſt vary in height according to the latitude, being higheſt at the equator, and coming gradually nearer the earth as we approach the poles; it muſt vary alſo with the ſeaſon, being higheſt in ſummer, and loweſt in winter. 18

18 Term of perpetual congelation.

The cold on the top of Pinchincha was found by M. Bouguer to extend from 7° to 9° below the freezing point every morning juſt before ſunriſe; hence he concluded that between the tropics the medium height of the term of congelation (where it freezes at ſome part of the day all the year round) ſhould be fixed at 15577 feet above the level of the ſea; but in latitude 28°, and during the ſummer, at 13440 feet. If we take the difference between the temperature at the equator, and the freezing point, this difference will bear the ſame proportion to the term of congelation at the equator, that the difference between the medium temperature at any other latitude and the freezing point bears to the term of congelation at that latitude. Suppoſe the medium heat at the equator to be 84°, the difference between which and 32° is 52°; and ſuppoſe the medium heat of latitude 28° to be $72\frac{3}{10}$°, the difference between which and 32° is $40\frac{2}{10}$°. Then by the following proportion, $52° : 15577 = 40\frac{3}{10} : 12.72°$ gives us the term of congelation at 28°. In this way Dr Kirwan proceeded in calculating the following table.

Lat.

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tional to the mean altitude of the ſine, or rather to the ſine of that altitude. If, therefore, we have the mean heat of April, and the ſine of the ſun's altitude given, the mean heat of May be found by the following proportion:

As the ſine of the ſun's mean altitude in April : the mean heat of April = the ſine of the ſun's mean altitude in May : mean heat of May.

In the ſame manner the mean heat of June, July, and Auguſt may be found; but for the temperature of the ſucceeding months we muſt take into conſideration another circumſtance, ſince the above rule would make the temperature of theſe months too low, as it does not take in the heat derived from the earth, which is nearly equal to the mean annual temperature. The real mean heats of theſe months muſt be conſidered as an arithmetical mean between the aſtronomical and terreſtrial heats. Thus, for latitude 51°, the aſtronomical heat of September being 44.6°, and the mean annual heat 52.4°, the real heat of September ought to be $\frac{44.6+52.4}{2} = 48.5$. Dr Kirwan, however, after going through a tedious calculation, found the reſults to correſpond ſo little with actual obſervation, that he drew up the table partly from calculating from principles, and partly from an examination of ſeveral ſea journals.

Temperature of the Air.

Lat.	Mean height of the term of congelation, in feet.	Lat.	Mean height of the term of congelation, in feet.
0°	15577	45°	7658
5	15457	50	6260
10	15067	55	4912
15	14498	60	3684
20	13719	65	2516
25	13030	70	1557
30	11592	75	748
35	10664	80	120
40	9016		

This laſt height of 120 feet M. Bouguer called the lower term of congelation. He alſo diſtinguiſhed another term of congelation above which no viſible vapour riſes, and this he called the upper term of congelation. This line is conſidered by Kirwan as much leſs variable during the ſummer months than the lower line, and it has therefore been adopted by him to determine the rate of diminution in the temperature as we aſcend into the atmoſphere. He has calculated its height for every degree of north latitude in the following table.

N. Lat.	Feet.	N. Lat.	Feet.	N. Lat.	Feet.	N. Lat.	Feet.
0	28000	26	22906	48	12245	70	4413
5	27784	27	22389	49	11750	71	4354
6	27644	28	21872	50	11253	72	4295
7	27504	29	21355	51	10124	73	4236
8	27364	30	20838	52	8965	74	4177
9	27224	31	20492	53	7806	75	4119
10	27084	32	20146	54	6647	76	4067
11	26880	33	19800	55	5617	77	4015
12	26676	34	19454	56	5533	78	3963
13	26472	35	19169	57	5439	79	3911
14	26268	36	18577	58	5345	80	3861
15	26061	37	17985	59	5251	81	3815
16	25781	38	17393	60	5148	82	3769
17	25501	39	16801	61	5068	83	3723
18	25221	40	16207	62	4989	84	3677
19	24941	41	15712	63	4910	85	3631
20	24661	42	15217	64	4831	86	3592
21	24404	43	14722	65	4752	87	3553
22	24147	44	14227	66	4684	88	3514
23	23890	45	13730	67	4616	89	3475
24	23633	46	13235	68	4548	90	3432
25	23423	47	12740	69	4480		(F)

From the modes of eſtimating the diminution of temperature now given, which agree extremely well with obſervation, we find that the temperature diminiſhes in arithmetical progreſſion, and hence we infer that the temperature of the air at a diſtance from the earth is owing to the conducting power of the air, and not to the aſcent of hot air from the ſurface of the earth.

19 Temperature of the air above the earth owing to the conducting power of the air.

It is however found that in winter the upper ſtrata of the air are often warmer than the lower; and this ſuperior heat, almoſt conſtantly obſerved in winter, is attributed by Dr Kirwan to a current of warm air from the equator, rolling towards the north pole during our winter *.

* *Iriſh Tranſ.* vol. viii. p. 375.

We have now given the general method of finding the medium annual temperature all over the globe; but there are ſeveral exceptions to our general inferences which muſt be particularly mentioned.

20 Temperature of the North Pacific ocean.

That part of the Pacific ocean which lies between north latitude 52° and 66° is no broader at its northern extremity than 42 miles, and at its ſouthern extremity its breadth ſcarcely exceeds 1300 miles: it is reaſonable to ſuppoſe, therefore, that its temperature will be conſiderably influenced by the ſurrounding land, which conſiſts of ranges of mountains, covered a great part of the year with ſnow; and there are beſides a great many high, and conſequently cold, iſlands ſcattered through it. For theſe reaſons Dr Kirwan concludes, that its temperature is at leaſt 4° or 5° below the ſtandard. But we are not yet furniſhed with a ſufficient number of obſervations to determine this with accuracy.

21 Of the ſouthern hemiſphere.

It is the general opinion, that the ſouthern hemiſphere beyond the 40° of latitude is conſiderably colder than the correſponding parts of the northern hemiſphere. See America.

22 Of ſmall ſeas.

Small ſeas ſurrounded with land, at leaſt in temperate and cold climates, are generally warmer in ſummer and colder in winter than the ſtandard ocean, becauſe they are much influenced by the temperature of the land. The gulf of Bothnia, for inſtance, is for the moſt part frozen in winter; but in ſummer it is ſometimes heated to 70°, a degree of heat never to be found in the oppoſite part of the Atlantic. The German ſea is above 3° colder in winter, and 5° warmer in ſummer, than the Atlantic. The Mediterranean ſea is, for the greater part of its extent, warmer both in ſummer and winter than the Atlantic, which therefore flows into it. The Black ſea is colder than the Mediterranean, and flows into it.

The eaſtern parts of North America are much colder than the oppoſite coaſt of Europe, and fall ſhort of the ſtandard

(F) Dr Kirwan has given us the following rule for aſcertaining the temperature at any required height, ſuppoſing we know the temperature of the ſurface of the earth.

For the temperature obſerved at the ſurface of the earth, put m; for the given height h, and t for the height of the upper term of congelation at the given latitude; then $\frac{m-32}{\frac{t}{100}-1}$ = the diminution of temperature for every 100 feet of elevation; or it is the common difference of the terms of the progreſſion required. Let this common difference thus found be denoted by c; then $c \times \frac{h}{100}$ gives us the whole diminution of temperature from the ſurface of the earth to the given height. Let this diminution be denoted by d, then $m-d$ is obviouſly the

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ſtandard by about 10° or 12°, as appears from American meteorological tables. The cauſes of this remarkable difference are many. The higheſt part of North America lies between 40° and 50° of north latitude, and 100° and 110° of longitude weſt from London, for there the greateſt rivers originate. The very height, therefore, makes this ſpot colder than it would otherwiſe be. It is covered with immenſe foreſts, and abounds with large ſwamps and moraſſes, which render it incapable of receiving any great degree of hea-; ſo that the rigour of winter is much leſs tempered by the heat of the earth than in the old continent. To the eaſt lie a number of very large lakes, and farther north, Hudſon's bay; about 50 miles on the ſouth of which there is a range of mountains which prevent its receiving any heat from that quarter. This bay is bounded on the eaſt by the mountainous country of Labrador and by a number of iſlands. Hence the coldneſs of the north-weſt winds and the lowneſs of the temperature. But as the cultivated parts of North America are now much warmer than formerly, there is reaſon to expect that the climate will become ſtill milder when the country is better cleared of woods, though perhaps it will never equal the temperature of the old continent.

23 Of iſlands.

Iſlands are warmer than continents in the ſame degree of latitude; and countries lying to the windward of extenſive mountains or foreſts are warmer than thoſe lying to the leeward. Stones or ſand have a leſs capacity for heat than earth has, which is always ſomewhat moiſt; they heat or cool, therefore, more rapidly and to a greater degree. Hence the violent heat of Arabia and Africa, and the intenſe cold of Terra del Fuego. Living vegetables alter their temperature very ſlowly, but their evaporation is great; and if they be tall and cloſe, as in foreſts, they exclude the ſun's rays from the earth, and ſhelter the winter ſnow from the wind and the ſun. Woody countries, therefore, are much colder than thoſe which are cultivated.

We ſhall conclude this chapter with a ſeries of meteorological axioms reſpecting the temperature of the air, by M. Cotte.

24 Cotte's axioms reſpecting temperature.

1. The extreme degrees of heat are almoſt every where the ſame; this, however, is not the caſe in regard to the extreme degrees of cold.

2. The thermometer riſes to its extreme height oftener in the temperate zones than in the torrid zone.

3. It changes very little between the tropics; its variations, like thoſe of the barometer, are greater the more one proceeds from the equator towards the poles.

4. It riſes higher in the plains than on mountains.

5. It does not fall ſo much in the neighbourhood of the ſea as in inland parts.

6. The wind has no influence on its motions.

7. Moiſture has a peculiar influence on it, if followed by a wind which diſperſes it.

8. The greateſt heat, and the greateſt cold, take place about ſix weeks after the northern or ſouthern ſolſtice.

9. The thermometer changes more in ſummer than in winter.

10. The coldeſt period of the day is before ſun-riſe.

11. The greateſt heat in the ſun and the ſhade ſeldom takes place on the ſame day.

12. The heat decreaſes with far more rapidity from September and October, than it increaſed from July to September.

13. It is not true, that a very cold winter is the prognoſtic of a very hot ſummer.

Chap. III. *Of the Changes which take place in the Air with reſpect to Evaporation and Rain.*

Evaporation and Rain.

25 Qualities of vapour.

There ſeems no reaſon to doubt that water exiſts in the atmoſphere in an intermediate ſtate between that of a fluid and that of abſolute ſteam. This is the ſtate of vapour, of the qualities of which it is proper that we ſhould here take a general view.

We are indebted to the experiments of Sauſſure and de Luc for much of our knowledge of the qualities of vapour. It is an elaſtic inviſible fluid like common air, but lighter; being to common air, according to Sauſſure, as 10 to 14, or, according to Kirwan, as 10 to 12; it cannot paſs beyond a certain maximum of denſity, otherwiſe the particles of water which compoſe it unite together, and form ſmall, hollow, viſible veſicles, called *veſicular vapour;* which is of the ſame ſpecific gravity with atmoſpherical air. It is of this vapour that clouds and fogs are compoſed. This maximum increaſes with the temperature; and at the heat of boiling water is ſo great, that ſteam can reſiſt the whole preſſure of the air, and exiſt in the atmoſphere in any quantity.

After what has been ſtated under Chemistry with reſpect to the nature and properties of vapour, we have nothing here to add on that ſubject, except to give the reſult of obſervations that have been made on the ſtate of vapour in the atmoſphere.

26 Evaporation confined to the ſurface.

It is found that the evaporation of water into the air is confined entirely to the ſurface, and hence it is always proportional to the ſurface expoſed to the action of the air. Accordingly, obſervation ſhows that in maritime countries, and in marſhy ſituations, in the neighbourhood of lakes, rivers, &c. the evaporation is much greater than in inland countries, and dry ſituations.

27 Proportional to the temperature of the air.

It is found that evaporation is greateſt in hot weather; whence it muſt depend, in ſome degree, on the temperature

the temperature required. An example will make this rule ſufficiently obvious. In latitude 56° the heat below being 54°; required the temperature of the air at the height of 803 feet?

$$\text{Here } m=54,\ t=5533,\ \frac{m-32}{\frac{t}{100}-1}=\frac{22}{54\cdot33}=0404=c, \text{ and } c\times\frac{h}{100}=0.404\times8.03=3.24=d, \text{ and } m-d=$$

$54-3\cdot24=50\cdot75$. Hence we ſee that the temperature of the air at the height of 803 feet above the ſurface is $50^\circ\cdot75$.

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ture of the air. This was ascertained by Mr Dalton from actual experiments, the result of which was, that the quantity evaporated per minute from a given surface of water at a given temperature, is to the quantity evaporated from the surface at 212°, as the force of vapour at the given temperature is to the force of vapour at 212°. By means of the table expressing the force of vapour at various temperatures given under CHEMISTRY, p. 468, we may discover by the above rule the quantity of water at a given temperature lost by evaporation.

There are several circumstances that affect the quantity of vapour rising from water, even at the same temperature. Thus, we find that evaporation is least in calm weather, increases when there is wind, and is greater in proportion as the wind is stronger. This evidently arises from the agitation of the water, by which a new surface is perpetually exposed to the action of the air.

Evaporation and Rain.

We shall here insert a table by Mr Dalton, expressing the quantity of vapour raised in various atmospheric temperatures, from a circular surface six inches in diameter.

Temperature.	Force of vapour in inches.	Evaporating force in grains.			Temperature.	Force of vapour in inches.	Evaporating force in grains.		
212°	30	120	154	189	212°	30	120	154	189
20°	.129	.52	.67	.82	53°	.415	1.66	2.13	2.61
21	.134	.54	.69	.85	54	.429	1.71	2.20	2.69
22	.139	.56	.71	.88	55	.443	1.77	2.28	2.78
23	.144	.58	.73	.91	56	.458	1.83	2.35	2.88
24	.150	.60	.77	.94	57	.474	1.90	2.43	2.98
25	.156	.62	.79	.97	58	.490	1.96	2.52	3.08
26	.162	.65	.82	1.02	59	.507	2.03	2.61	3.19
27	.168	.67	.86	1.05	60	.524	2.10	2.70	3.30
28	.174	.70	.90	1.10	61	.542	2.17	2.79	3.41
29	.180	.72	.93	1.13	62	.560	2.24	2.88	3.52
30	.186	.74	.95	1.17	63	.578	2.31	2.97	3.63
31	.193	.77	.99	1.21	64	.597	2.39	3.07	3.76
32	.200	.80	1.03	1.26	65	.616	2.46	3.16	3.87
33	.207	.83	1.07	1.30	66	.635	2.54	3.27	3.99
34	.214	.86	1.11	1.35	67	.655	2.62	3.37	4.12
35	.221	.89	1.14	1.39	68	.676	2.70	3.47	4.24
36	.229	.92	1.18	1.45	69	.698	2.79	3.59	4.38
37	.237	.95	1.22	1.49	70	.721	2.88	3.70	4.53
38	.245	.98	1.26	1.54	71	.745	2.98	3.83	4.68
39	.254	1.02	1.31	1.60	72	.770	3.08	3.96	4.84
40	.263	1.05	1.35	1.65	73	.796	3.18	4.09	5.00
41	.273	1.09	1.40	1.71	74	.823	3.29	4.23	5.17
42	.283	1.13	1.45	1.78	75	.851	3.40	4.37	5.34
43	.294	1.18	1.51	1.85	76	.880	3.52	4.52	5.53
44	.305	1.22	1.57	1.92	77	.910	3.65	4.68	5.72
45	.316	1.26	1.62	1.99	78	.940	3.76	4.83	5.91
46	.327	1.31	1.68	2.06	79	.971	3.88	4.99	6.10
47	.339	1.36	1.75	2.13	80	1.00	4.00	5.14	6.29
48	.351	1.40	1.80	2.20	81	1.04	4.16	5.35	6.54
49	.363	1.45	1.86	2.28	82	1.07	4.28	5.50	6.73
50	.375	1.50	1.92	2.36	83	1.10	4.40	5.66	6.91
51	.388	1.55	1.99	2.44	84	1.14	4.56	5.86	7.17
52	.401	1.60	2.06	2.51	85	1.17	4.68	6.07	7.46

The first column of the above table expresses the temperature; the second, the corresponding force of vapour; the other three columns give the number of grains of water that would be evaporated from a surface of six inches in diameter in the respective temperatures, on the supposition of there being previously no aqueous vapour in the atmosphere. These columns present the extremes and the mean of evaporation likely to be noticed, or nearly such; for the first is calculated upon the supposition of 35 grains loss per minute from the vessel of three inches and a quarter in diameter; the second 45, and the third 55 grains per minute.

As yet we have stated only the degree of evaporation that would take place under various circumstances, provided that the atmosphere were, at the time, entirely free from moisture; but as this can scarcely happen, it becomes necessary to ascertain the rate of evaporation when qualified by the vapour already existing in the atmosphere. This is readily done by first finding the force of the vapour already in the atmosphere, as above directed, and subtracting it from the force of vapour at the given temperature. The remainder is the actual force of evaporation, from which, by the last table, we find the required rate of evaporation.

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tion. Suppoſe, for inſtance, it be required to know the rate of evaporation at the temperature of 59°. From the laſt table we ſee that the force of vapour at 59° is about 0.5 or $\frac{1}{60}$ its force at 212°. Now, ſuppoſe that by trials we find the force of the vapour which already exiſts in the atmoſphere to be 0.25 or $\frac{1}{120}=\frac{1}{2}$ of $\frac{1}{60}$. Subtracting the latter from the former, we have for a remainder 0.25=the force of evaporation required, which is therefore juſt the half of what it would be if the atmoſphere were entirely free from vapour.

The force of vapour exiſting in the atmoſphere is ſcarcely ever equal to the force of vapour of the temperature of the atmoſphere. Hence evaporation may, with a few exceptions, be conſidered as going on without intermiſſion. Attempts have been made to aſcertain the quantity of evaporation that takes place in the courſe of a year; but the inveſtigation of this problem is ſo difficult, that theſe attempts have ſucceeded only in obtaining approximations towards the truth. Mr Dobſon of Liverpool, from a courſe of experiments made in 1772, 1773, 1774, and 1775, concludes that the mean annual evaporation from the ſurface of water, amounted to 36.78 inches. The proportions for each month are as follows.

	Inches.		Inches.
January	1.50	July	5.11
February	1.77	Auguſt	5.01
March	2.64	September	3.18
April	3.30	October	2.51
May	4.34	November	1.51
June	4.41	December	1.49

The experiments of Mr Dalton ſhew that the evaporation from the ſurface of water in a very dry and hot ſummer day, was rather more than two tenths of an inch.

Several experiments have been made on the quantity of evaporation from land, eſpecially by Mr Williams in America, and Dr Watſon, Mr Dalton and Mr Hoyle in Britain.

Mr Williams's experiments appear to ſhew that the evaporation from the ſurface of ſuch land as is covered with trees and other vegetables is about one third greater than the evaporation from the ſurface of water, though much reliance is not laid on theſe experiments.

28 Evaporation from land.

From an experiment made by Dr Watſon during ſummer, when the earth had been parched by a month's drought, it appeared that 1600 gallons of water were evaporated from a ſingle acre in 12 hours *. Dr Watſon's experiment, however, was of a nature that did not admit of great preciſion.

29 Experiments by Dalton and Hoyle.

The experiments made by Mr Dalton and Mr Hoyle in the years 1796, 1797, and 1798, are the moſt exact that have been made on this ſubject, and we ſhall therefore conſider them more at large. They were made with the following apparatus. Having procured a cylindrical veſſel made of tin plate, three feet deep and ten inches in diameter, they inſerted into it two pipes directed downwards, ſo that water might paſs through them into two bottles. One pipe was fixed near the bottom of the veſſel, and the other about an inch from the top. The veſſel was filled up for a few inches with gravel and ſand, and all the reſt with good freſh ſoil. It was then put into a hole in the ground, and the ſpace around filled up with earth except on one ſide, for the convenience of putting bottles to the two pipes; then ſome water was poured on the earth to ſadden it, and all that would drain off was ſuffered to eſcape. Hence the earth may be conſidered as ſaturated with moiſture. The ſoil was kept for ſome weeks above the level of the upper pipe, but after that it was conſtantly allowed to be a little below it, thus preventing any water from running off through that pipe. The top of the ſoil for the firſt year was bare; but for the two laſt years it was covered with graſs like other turf. The apparatus being thus prepared, a correct regiſter was kept of the quantity of rain water which ran off from the ſurface of the earth by the upper pipe, as long as that was below the earth, and alſo of the quantity of water which paſſed through the three feet of earth, and ran off by the lower pipe; and a rain gauge of an equal diameter with the cylinder was kept near it, for the purpoſe of meaſuring the quantity of rain which fell in any correſponding time. Then, by ſubtracting the quantity of water which paſſed through the pipes from that in the rain gauge, the remainder was conſidered as equal to the quantity evaporated from the ſurface of the earth in the cylinder. The mean annual reſult of theſe experiments is ſhewn in the following table.

* Watſon's Chemical Eſſays, vol. iii. 54.

30 Reſult.

	Water through the two pipes.			Mean.	Mean Rain.	Mean Evap.
	1796. Inch.	1797. Inch.	1798. Inch.	Inch.	Inch.	Inch.
January	1.897—	.680—	1.774+	1.450+	2.458	1.008
February	1.778—	.918—	1.122	1.273	1.801	.528
March	.431—	.070—	.335	.279	.902	.623
April	.220—	.295—	.180	.232	1.717	1.485
May	2.027—	2.443+	.010	1.493+	4.177	2.684
June	.171—	.726	—	.299	2.483	2.184
July	.153—	.025	—	.059	4.154	4.095
Auguſt	—	—	.504	.168	3.554	3.386
September	—	.976	—	.325	3.279	2.954
October	—	.680	—	.227	2.899	2.672
November	—	1.044	1.594	.879	2.934	2.055
December	.200	3.077	1.878+	1.718+	3.202	1.484
	6.877—	10.934—	7.379	8.402	33.560	25.158
Rain	30.629—	38.791—	31.259			
Evap.	23.725—	27.857—	23.862			

It

Evaporation and Rain.

It appears from theſe experiments, that at Mancheſter the mean annual evaporation of water is above 25 inches; and if we add to this with Mr Dalton 5 inches for the dew which falls, the whole quantity evaporated in a year will be 30 inches. On the whole, we may perhaps eſtimate the mean annual evaporation from the whole ſurface of the globe at 35 inches from every ſquare inch of ſurface, making the whole water annually evaporated over the whole globe equal to 94,450 cubic miles.

31
Mean annual evaporation over the globe.

Were this prodigious maſs of water all to ſubſiſt in the atmoſphere at once, it would increaſe its maſs by about $\frac{1}{11}$, and raiſe the barometer nearly 3 inches. But this never happens, no day paſſes without rain in ſome part of the earth; ſo that part of the evaporated water is continually precipitated again. Indeed it would be impoſſible for the whole of the evaporated water to ſubſiſt in the atmoſphere at once, at leaſt in the ſtate of vapour.

The higher regions of the atmoſphere contain leſs vapour than the ſtrata near the ſurface of the earth. This was obſerved both by M. de Sauſſure and M. de Luc.

32
At ſome height above the tops of mountains the atmoſphere is probably ſtill drier, for it was obſerved by Sauſſure, that on the tops of mountains the moiſture of the air was rather leſs during the night than the day. And there can be little doubt that every ſtratum of air deſcends a little lower during the night than it was during the day, owing to the cooling and condenſing of the ſtratum neareſt the earth. Vapours, however, muſt aſcend very high, for we ſee clouds forming far above the tops of the higheſt mountains.

Rain never begins to fall while the air is tranſparent; the inviſible vapours firſt paſs their maximum, and are changed into veſicular vapours; clouds are formed, and theſe clouds gradually diſſolve in rain. Clouds, however, are not formed in all parts of the horizon at once; the formation begins in one particular ſpot, while the reſt of the air remains clear as before; this cloud rapidly increaſes till it overſpreads the whole horizon, and then the rain begins.

33
Clouds always form at ſome height.

It is remarkable, that though the greateſt quantity of vapour exiſts in the lower ſtrata of the atmoſphere, clouds never begin to form there, but always at ſome conſiderable height. It is remarkable too, that the part of the atmoſphere at which they form has not arrived at the point of extreme moiſture, nor near that point, even a moment before their formation. They are not formed then becauſe a greater quantity of vapour had got into the atmoſphere than could remain there without paſſing its maximum. It is ſtill more remarkable, that when clouds are formed, the temperature of the ſpot in which they are formed is not always lowered, though this may ſometimes be the caſe. On the contrary, the heat of the clouds themſelves is ſometimes greater than that of the ſurrounding air *. Nor is the formation of clouds owing to the capacity of air for combining with moiſture being leſſened by cold; ſo far from that, we often ſee clouds which had remained in the atmoſphere during the heat of the day, diſappear in the night, after the heat of the air was diminiſhed.

* *De Luc la Meteorol.* vol. ii. 100.

34
The formation of clouds and rain as yet unexplained.

The formation of clouds and rain cannot be accounted for by a ſingle principle with which we are acquainted. It is neither owing to the ſaturation of the atmoſphere, nor the diminution of the heat; nor the mixture of airs of different temperatures, as Dr Hutton ſuppoſes: for clouds are often formed without any wind at all either above or below them; and even if this mixture conſtantly took place, the precipitation, inſtead of accounting for rain, would be almoſt imperceptible.

It is a very remarkable fact, that evaporation often goes on for a month together in hot weather without any rain. This ſometimes happens in this country; it happens every year in the torrid zone. Thus at Calcutta, during January 1785, it never rained at all; the mean of the thermometer for the whole month was $66\frac{1}{2}$°; there was no high wind, and indeed during great part of the month little wind at all.

The quantity of water evaporated during ſuch a drought muſt be very great; yet the moiſture of the air, inſtead of being increaſed, is conſtantly diminiſhing, and at laſt diſappears almoſt entirely. For the dew, which is at firſt copious, diminiſhes every night; and if Dr Watſon's experiment formerly mentioned be attended to, it will not be objected that the quantity of evaporation is alſo very much diminiſhed. Of the very dry ſtate to which the atmoſphere is reduced during long droughts, the violent thunder-ſtorms with which they often conclude is a very deciſive proof. Now what becomes of all this moiſture? It is not accumulated in the atmoſphere above the country from which it was evaporated, otherwiſe the whole atmoſphere would in a much leſs period than a month be perfectly ſaturated with moiſture. If it be carried up daily through the different ſtrata of the atmoſphere, and wafted to other regions by ſuperior currents of air, how is it poſſible to account for the different electrical ſtate of the clouds ſituated between different ſtrata, which often produces the moſt violent thunder-ſtorms? They could not have remained in the lower ſtrata of the atmoſphere, and been daily carried off by winds to other countries; for there are often no winds at all during ſeveral days to perform this office; nor in that caſe would the dews diminiſh, nor could their preſence fail to be indicated by the hygrometer.

It is impoſſible for us to account for this remarkable fact upon any principle with which we are acquainted. The water can neither remain in the atmoſphere, nor paſs through it in the ſtate of vapour. It muſt therefore aſſume ſome other form; but what that form is, or how it aſſumes it, we know not. There are, therefore, two ſteps of the proceſs which takes place between evaporation and rain, with which we are entirely unacquainted; firſt, the ſtate of the vapour after it enters into the atmoſphere, and ſecond, the cauſe by which it is made to lay aſide the new form which it aſſumed, return to its ſtate of vapour, and deſcend in form of rain. Several theories have been contrived to account for this phenomenon, but they are all untenable on the preſent known laws of chemical action.

The mean annual quantity of rain is greateſt at the equator, and decreaſes gradually as we approach the poles. Thus at Granada, Antilles, 12° N. Lat. it is 126 inches.

Cape François, St Domingo	19°	46′	120
Calcutta	22	23	81
Rome	41	54	39
England	33	0	32
Peterſburgh	59	16	16

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On the contrary, the number of rainy days is ſmalleſt at the equator, and increaſes in proportion to the diſtance from it. From N. Lat. 12° to 43° the mean number of rainy days is 78; from 43° to 46° the mean number is 103; from 46° to 50° it is 134; from 51° to 60°, 161 days.

35
Rainy days often more numerous in winter.

The number of rainy days is often greater in winter than in ſummer; but the quantity of rain is greater in ſummer than in winter. At Peterſburgh, the number of rainy or ſnowy days during winter is 84, and the quantity which falls is only about 5 inches; during ſummer the number of rainy days is nearly the ſame, but the quantity which falls is about 11 inches.

More rain falls in mountainous countries than in plains. Among the Andes it is ſaid to rain almoſt perpetually, while in Egypt it ſcarcely ever rains at all. If a rain-gauge be placed on the ground, and another at ſome height perpendicularly above it, more rain will be collected into the lower than into the higher; a proof that the quantity of rain increaſes as it deſcends, owing perhaps to the drops attracting vapour during their paſſage through the lower ſtrata of the atmoſphere where the greateſt quantity reſides. This, however, is not always the caſe, as Mr Copland of Dumfries diſcovered in the courſe of his experiments. He obſerved alſo, that when the quantity of rain collected in the lower gage was greateſt, the rain commonly continued for ſome time; and that the greateſt quantity was collected in the higher gage only either at the end of great rains, or during rains which did not laſt long. Theſe obſervations are important, and may, if followed out, give us new knowledge of the cauſes of rain. They ſeem to ſhow, that during rain the atmoſphere is ſomehow or other brought into a ſtate which induces it to part with its moiſture; and that the rain continues as long as this ſtate continues. Were a ſufficient number of obſervations made on this ſubject in different places, and were the atmoſphere carefully analyſed during dry weather, during rain, and immediately after rain, we might ſoon perhaps diſcover the true theory of rain.

36
More rain falls in the day than in the night.

Rain falls in all ſeaſons of the year, at all times of the day, and during the night as well as the day; though, according to M. Toaldo, a greater quantity falls during the day than the night. The cauſe of rain, then, whatever it may be, muſt be ſomething which operates at all times and ſeaſons. Rain falls alſo during the continuance of every wind, but ofteneſt when the wind blows from the ſouth. Falls of rain often happen likewiſe during perfect calms.

37
Mean annual quantity of rain in Great Britain.

It appears from a paper publiſhed by M. Cotte in the *Journal de Phyſique* for October 1791, containing the mean quantity of rain falling at 147 places, ſituated between N. Lat. 11° and 60°, deduced from tables kept at theſe places, that the mean annual quantity of rain falling in all theſe places is 34.7 inches. Let us ſuppoſe then (which cannot be very far from the truth), that the mean annual quantity of rain for the whole is 34 inches. The ſuperficies of the globe conſiſts of 170,981,012 ſquare miles, or 686,401,498,471,475,200 ſquare inches. The quantity of rain therefore falling annually will amount to 23,337,650,812,030,156,800 cubic inches, or ſomewhat more than 91.751 cubic miles of water. This is 16,191 cubic miles of water leſs than the quantity of water evaporated. It ſeems probable therefore, if the imperfection of our data warrant any concluſion, that ſome of the vapour is actually decompoſed in the atmoſphere, and converted into oxygen and hydrogen gas.

The dry land amounts to 52,745,253 ſquare miles; the quantity of rain falling on it annually therefore will amount to 30,960 cubic miles. The quantity of water running annually into the ſea is 13,140 cubic miles; a quantity of water equal to which muſt be ſupplied by evaporation from the ſea, otherwiſe the land would ſoon be completely drained of its moiſture.

The quantity of rain falling annually in Great Britain may be ſeen from the following table.

Years of obſervation.	Places.	Rain in Inches.
3	Dover -	37.52
5	Ware, Hertfordſhire	23.6
8	London - -	17.5
8	Kimbolton -	23.9
45	Lyndon - -	22.21
5	Chatſworth, Derbyſhire	27.865
8	Mancheſter - -	43.1
18	Liverpool - -	34.41
7	Lancaſter - -	40.3
5	Kendal - -	61.223
14	Dumfries - -	36.127
10	Branxholm, 44 miles S. W. of Berwick - -	31.26
5	Langholm -	36.73
5	Dalkeith - -	25.124
20	Glaſgow - -	31.
8	Hawkhill - -	28.966
	Mean	32.532

Mr Dalton has eſtimated the quantity of rain that falls in England at 21 inches; but as no account is taken of what falls in Wales and Scotland, this eſtimate probably falls much ſhort of the real annual quantity. In this country it generally rains leſs in March than in November, in the proportion at a medium of 7 to 12. It generally rains leſs in April than October, in the proportion of 1 to 2 nearly at a medium. It generally rains leſs in May than September; the chances that it does ſo are at leaſt at 4 to 3: but when it rains plentifully in May, it generally rains but little in September; and when it rains one inch or leſs in May, it rains plentifully in September.

The degree of moiſture that is preſent in the atmoſphere at any given time, is meaſured by the hygrometer. Under the article HYGROMETER we have amply deſcribed ſeveral of the moſt important inſtruments of that kind; but there is one hygrometer, viz. that of Mr Leſlie, which remains to be deſcribed in this place. Figures of the inſtrument are given in Plate CCLXXVI. fig. 13, 14.

38
Leſlie's hygrometer.

The principal part of the inſtrument is compoſed of two glaſs tubes terminated by hollow balls, one tranſparent and the other opaque. The tubes are ſelected, as regular as poſſible, from 4 to 8 inches long, and about $\frac{3}{10}$ of an inch thick, or as ſlender as thoſe employed for

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for thermometers, but with a much wider bore. This, in one tube, muſt be from $\frac{1}{40}$ to the $\frac{1}{60}$ of an inch in diameter, and an exact calibre, at leaſt not differing by $\frac{1}{50}$ between both its extremities. To the end of it a ſmall piece of black enamel is attached, and blown into an opaque ball, from 4 to $\frac{1}{10}$ of an inch diameter. The correſponding tube may have its bore of the ſame, or rather a greater width, but its uniformity is not at all eſſential. Near the extremity it is ſwelled out into a thin cylinder, almoſt $\frac{1}{10}$ of an inch wide, and from $\frac{3}{10}$ to $\frac{6}{10}$ long; the inner cavity only being enlarged, without altering the exterior regularity of the tube. The ſhort bit of glaſs where this cylinder terminates, is now blown into a thin pellucid ball, as nearly of the ſize of the former as the eye can judge. The exact equality of the balls would be unattainable, and fortunately the theory of the inſtrument does not require it. When a dark and a bright object are viewed together, the latter, from an optical deception, appears always larger than the reality; and for this reaſon, ſays Mr Leſlie, I prefer making the clear ball a ſlight degree ſmaller than the black one. In the mean time a coloured liquor is prepared by diſſolving carmine in concentrated ſulphuric acid, in a phial with a ground ſtopper, taking care to avoid heat, as by this the colouring-matter would be charred, and the beauty of the liquor deſtroyed.

The tubes are now cut to nearly equal lengths, and the end of each ſwelled out a little, to facilitate their junction. Cloſe to the black ball, the tube is bent by the flame of a candle into a ſhoulder, ſuch, that the root of the ball ſhall come into a line with the inner edge of the tube. This ball, being then warmed, the end of the tube is dipt into the acid liquor, and as much of it allowed to riſe and flow into the cavity, as may be gueſſed ſufficient to fill both tubes, excepting the cylinder. The two tubes are then, by the help of a blow-pipe, ſolidly joined together in one ſtraight piece, without having any knot or protuberance. About half an inch from the joining, and nearer the cylinder, it is gently bent round by the flame of a candle, till the clear ball is brought to touch the tube $\frac{3}{4}$ inch directly below the black one. The inſtrument is now to be graduated; and the ſcale choſen by Mr Leſlie is that which correſponds to the centigrade thermometer. Mr Leſlie thus deſcribes the mode of graduating the inſtrument.—The inſtrument is held in an oblique poſition, that the coloured liquor may collect at the bottom of the black ball, into which a few minute portions of air muſt, from time to time, be forced over, by heating the oppoſite ball with the hand. In this way, the interpoſed liquid will gradually be made to deſcend into the tube, and aſſume its proper place; and it ſhould remain for a week or two in an inclined poſition, to let every particle drain out of the black ball. If any trace of fluid collects in rings within the bore, they are eaſily diſpelled with a little dexterity and manipulation, which, though it would be difficult to deſcribe, is moſt readily learnt and practiſed. The ſmall cavity at the joining facilitates the rectification, by affording the means of ſending a globule of air in either direction. In fixing the zero of the ſcale, Mr Leſlie ſet the inſtrument in a remote corner of the room, or partly cloſed the window-ſhutters. When completely adjuſted, the top of the coloured liquor, if held upright, ſhould ſtand nearly oppoſite to the middle of the cylindrical reſervoir.

In this ſtate of preparation, the inſtrument is ready for being graduated. The clear ball and the contiguous part of the parallel tube are therefore covered with two or three folds of thin bibulous paper, moiſtened with pure water, to make it act as a hygrometer; and there is attached to the ſame tube a temporary ſcale, by means of a ſoft cement compoſed of bees-wax and roſin. A flat round piece of wood being provided with four or five pillars that ſcrew into it, the inſtrument is fixed to one of them in an erect poſition, and on each ſide is diſpoſed a fine correſponding thermometer, inverted, and at the ſame height, the one having its bulb covered with wet bibulous paper. Then half a yard of flannel is dried as much as poſſible without ſingeing, before a good fire, and rolling it up like a ſleeve, it is lapped looſly round the lower part of the pillars, and the whole is incloſed under a large bell-glaſs. The flannel powerfully abſorbs moiſture from the confined air, and creates an artificial dryneſs of 80 or 100 degrees. In the ſpace of a quarter or half an hour, the full effect is produced, and the quantities being noted at two or three ſeparate times, the mean reſults are adopted. The deſcent, meaſured by the temporary ſcale, being then augmented in the proportion of ten to the difference of the two thermometers, will give the length that correſponds to 100°. After the ſtandard inſtrument is conſtructed, others are thence graduated with the utmoſt eaſe; the firſt being planted in the centre, and the reſt, with their temporary ſcales, ſtuck to the encircling pillars. For greater accuracy, the obſervation ſhould be made in a room without a fire, or a ſcreen ought to be interpoſed between the fire and the apparatus.

The ſlips of ivory intended for the ſcales are divided into equal parts, and ſhould contain from 100° to 150°. The edges are filed down and chamfered, to fit eaſily between the parallel tubes; and they are ſecured in their place by a ſtrong ſolution of iſinglaſs. The lower ball and its annexed cylinder, are covered with thin ſilk of the ſame colour as the upper ball, and a few threads are likewiſe lapped about that part of the tube which it touches. The inſtrument is laſtly cemented into a piece of wood, either end of which admits a cylindrical caſe that ſerves equally to protect or to hold it. On other occaſions, the hygrometer is inſerted into the ſocket of a round bottom-piece where it ſtands vertical.

The above deſcription refers particularly to fig. 14. Fig. 13. differs from this, only in having the balls of an equal height, and bended in oppoſite directions, which Mr Leſlie conſiders as more convenient for ſome purpoſes to which the inſtrument is applied, to be mentioned hereafter, but which renders the inſtrument leſs portable.

39
Theory of the inſtrument.

The action of this hygrometer depends on the following principle; *That the cold produced by evaporation will accurately denote the degree of dryneſs of the air, or its diſtance from the point of ſaturation.* To diſcover the dryneſs or humidity of the air, therefore, we have only to find the change of temperature induced in a body of water inſulated, or expoſed on all ſides to evaporation. The ſteps which led Mr Leſlie from theſe ſimple

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ſimple principles to the conſtruction of the preſent ingenious inſtrument, are detailed by him in a paper publiſhed in Nicholſon's Journal for January 1800, to which we muſt refer our readers for the particulars, contenting ourſelves with the following ſummary view.

If two thermometers be filled with any expanſible fluid, and having the bulb of the one wet and the other dry, they will, by their difference, denote the ſtate of the air in reſpect to humidity. Mr Leſlie's object was to combine two ſuch inſtruments, ſo that they ſhould indicate merely their difference of temperature; and this object he has completely attained by the preſent inſtrument. In ordinary caſes, the intermediate liquor would continue ſtationary; for the air in both balls having the ſame temperature, and conſequently the ſame elaſticity, the oppoſite preſſures would preciſely counteract each other; but if, from the action of the external air on the moiſtened ſurface, one ball became colder, it is manifeſt the liquor would be puſhed towards it by the ſuperior elaſticity of the air included in the other ball, ſo as to mark, by the ſpace of its approach, the depreſſion of temperature induced by evaporation.

This inſtrnment does not merely point out the dryneſs of the air; it enables us to determine the *abſolute quantity* of moiſture which it is capable of imbibing; for the converſion of water into ſteam is found to conſume 524° of the centigrade diviſion; and evaporation, analogous in its effects, may be preſumed to occaſion the ſame waſte of heat. If, therefore, air had the ſame capacity as water, for each degree of the hygrometer it would depoſit as much heat as it would abſtract by diſſolving the $\frac{1}{3240}$ part of its weight of humidity. But the capacity of air is to that of water as 11 to ſix, and conſequently it would require in that proportion a greater evaporation to produce the ſame effect. We may hence conclude, that, for each hygrometric degree, the air would require $\frac{11}{6} \times \frac{1}{3240}$ or $\frac{1}{2858}$ part by weight of water to effect ſaturation.

Strictly ſpeaking, the degrees marked by this hygrometer do not meaſure the dryneſs of the air at its actual temperature, but only its ſtate of dryneſs when cooled down to the ſtandard of the wet ball. The law, however, being known of the diſſolving power of air as affected by heat, it is eaſy, from the diſpoſition of the air with reſpect to humidity at one temperature to derive that at any other. It will ſuffice to mention the reſult of a number of careful experiments:—Suppoſing air at the freezing point to be capable of holding 50 parts of moiſture; at 10° centigrade, it will hold 100; at 20°, 200; at 30°, 400; thus doubling at each increaſe of 10°. Hence a table may be conſtructed by which theſe converſions will be eaſily made.

To omit nothing that tends to elucidate the theory of the inſtrument, we muſt obſerve that the air in its contact with the humid ſurface is not abſolutely cooled to the ſame temperature; the air and water really meet each other at an intermediate point determined by their compounded denſity and capacity. Conſequently the indications of the hygrometer ought to be augmented by the $\frac{1}{464}$ part, or $\frac{11}{6} + \frac{1}{850}$. But this quantity is too ſmall in any caſe to be regarded.

Wind.

Chap. IV. *Of the Changes produced in the Air by Winds.*

In conſidering the ſubject of winds, we ſhall firſt briefly detail their natural hiſtory, ſo far as it has not been already anticipated, and ſhall then endeavour to trace the laws by which they are regulated, or explain the manner in which their varieties are produced. As the direction of the winds is of the greateſt conſequence, eſpecially in a commercial view, we ſhall firſt point out the direction of the moſt prevalent winds in various quarters of the world. 40

41 Trade-winds.

Between the tropics the winds are the moſt regular. In thoſe parts of the Pacific and Atlantic oceans which lie neareſt the equator, there is a regular wind during the whole year called the *trade-wind.* On the north ſide of the equator it blows from the north eaſt, varying frequently a point or two towards the north or eaſt; and on the ſouth ſide of it, from the ſouth-eaſt, changing ſometimes in the ſame manner towards the ſouth or eaſt. The ſpace included between the ſecond and fifth degrees of north latitude is the internal limit of theſe two winds. There the winds can neither be ſaid to blow from the north nor the ſouth; calms and violent ſtorms are frequent. This ſpace varies a little in latitude as the ſun approaches either of the tropics. In the Atlantic ocean the trade winds extend farther north on the American than on the African coaſt; and as we advance weſtward, they become gradually more eaſterly, and decreaſe in ſtrength. Their force diminiſhes likewiſe as we approach their utmoſt boundaries. It has been remarked alſo, that as the ſun approaches the tropic of cancer, the ſouth-eaſt winds become gradually more ſoutherly, and the north-eaſt winds more eaſterly: exactly the contrary takes place when the ſun is approaching the tropic of capricorn.

42 Monſoons.

The trade-wind blows conſtantly in the Indian ocean from 10° ſouth latitude to near 30°; but to the northward of this the winds change every ſix months, and blow directly oppoſite to their former courſe. Theſe regular winds are called *monſoons*, from the Malay word *mooſſin*, which ſignifies a ſeaſon. When they ſhift their direction, variable winds and violent ſtorms ſucceed, which laſt for a month, and frequently longer; and during that time it is dangerous for veſſels to continue at ſea.

The monſoons in the Indian ocean may be reduced to two; one on the north and another on the ſouth ſide of the equator; which extend from Africa to the longitude of New Holland and the eaſt coaſt of China, and which ſuffer partial changes in particular places from the ſituation and inflection of the neighbouring countries.

Between 3° and 10° of ſouth latitude the ſouth-eaſt trade-wind continues from April to October; but during the reſt of the year the wind blows from the north-weſt. Between Sumatra and New Holland this monſoon blows from the ſouth during our ſummer months, approaching gradually to the ſouth-eaſt as we advance towards the coaſt of New Holland; it changes about the end of September, and continues in the oppoſite direction till April. Between Africa and Madagaſcar its direction is influenced by the coaſt; for it blows

blows from the north-eaſt from October to April, and during the reſt of the year from the ſouth-weſt.

43 Direction of the trade-winds throughout the year.

Over all the Indian ocean to the northward of the third degree of ſouth latitude, the north-eaſt trade-wind blows from October to April, and a ſouth-weſt wind from April to October. From Borneo, along the coaſt of Malacca, and as far as China, this monſoon in ſummer blows nearly from the ſouth, and in winter from the north by eaſt. Near the coaſt of Africa, between Mozambique and Cape Guardafeu, the winds are irregular during the whole year, owing to the different monſoons which ſurround that particular place.—Monſoons are likewiſe regular in the Red ſea; between April and October they blow from the north-weſt, and during the other months from the ſouth-eaſt, keeping conſtantly parallel to the coaſt of Arabia.

44 Of monſoons.

Monſoons are not altogether confined to the Indian ocean; on the coaſt of Brazil, between Cape St Auguſtine and the iſland of St Catharine, the wind blows between September and April from the eaſt or north-eaſt, and between April and September from the ſouth-weſt. The bay of Panama is the only place on the weſt ſide of a great continent where the wind ſhifts regularly at different ſeaſons: there it is eaſterly between September and March; but between March and September it blows chiefly from the ſouth and ſouth-weſt.

Such in general is the direction of the winds in the torrid zone all over the Atlantic, Pacific, and Indian oceans; but they are ſubject to particular exceptions, which we ſhall now endeavour to enumerate. On the coaſt of Africa, from Cape Bayador to Cape Verde, the winds are generally north-weſt; from thence to the iſland of St Thomas near the equator they blow almoſt perpendicular to the ſhore, bending gradually as we advance ſouthwards, firſt to the weſt and then to the ſouth-weſt. On the coaſt of New Spain likewiſe, from California to the bay of Panama, the winds blow almoſt conſtantly from the weſt or ſouth-weſt, except during May, June, and July, when land-winds prevail, called by the Spaniards *Popogayos*. On the coaſt of Chili and Peru, from 20° to 30° ſouth latitude, to the equator, and on the parallel coaſt of Africa, the wind blows during the whole year from the ſouth, varying according to the direction of the land towards which it inclines, and extending much farther out to ſea on the American than the African coaſt. The trade-winds are alſo interrupted ſometimes by weſterly winds in the bay of Campeachy and the bay of Honduras.

As to the countries between the tropics, we are too little acquainted with them to be able to give a ſatisfactory hiſtory of their winds,

45 Of ſea and land breezes.

In all maritime countries between the tropics, of any extent, the wind blows during a certain number of hours every day from the ſea, and during a certain number towards the ſea from the land; theſe winds are called the *ſea and land breezes*. The ſea breeze generally ſets in about 10 in the forenoon, and blows till ſix in the evening; at ſeven the land breeze begins and continues till eight in the morning, when it dies away. During ſummer the ſea breeze is very perceptible on all the coaſts of the Mediterranean ſea, and even ſometimes as far north as Norway.

In the iſland of St Lewis on the coaſt of Africa, in 16° north latitude, and 16° weſt longitude, the wind during the rainy ſeaſon, which laſts from the middle of July to the middle of October, is generally between the ſouth and the eaſt: during the reſt of the year it is for the moſt part eaſt or north-eaſt in the morning; but as the ſun riſes, the wind approaches gradually towards the north, till about noon it gets to the weſt of north, and is called a *ſea breeze*. Sometimes it ſhifts to the eaſt as the ſun deſcends, and continues there during the whole night. In February, March, April, May and June, it blows almoſt conſtantly between the north and weſt. In the iſland of Bulama, which likewiſe lies on the weſt coaſt of Africa, in 11° north latitude, the wind during nine months of the year blows from the ſouth-weſt; but in November and December, a very cold wind blows from the north-eaſt.

In the kingdom of Bornou, which lies between 16° and 20° north latitude, the warm ſeaſon is introduced about the middle of April by ſultry winds from the ſouth-eaſt, which bring along with them a deluge of rain. In Fezzan, in 25° north latitude, and 35° eaſt longitude, the wind from May to Auguſt blows from the eaſt ſouth-eaſt, or ſouth-weſt, and is intenſely hot.

46 Winds in Abyſſinia.

In Abyſſinia the winds generally blow from the weſt, north-weſt, north, and north-eaſt. During the months of June, July, Auguſt, September and October, the north and north-eaſt winds blow almoſt conſtantly, eſpecially in the morning and evening; and during the reſt of the year they are much more frequent than any other winds.

47 At Calcutta.

At Calcutta, in the province of Bengal, the wind blows during January and February from the ſouth-weſt and ſouth; in March, April, and May from the ſouth; in June, July, Auguſt and September, from the ſouth and ſouth-eaſt; in October, November, and December, from the north-weſt. At Madras the moſt frequent winds are the north and north-eaſt.—At Tivoli in St Domingo, and the iſles des Vaches, the wind blows ofteneſt from the ſouth and ſouth-eaſt. From theſe facts it appears, that in moſt tropical countries with which we are acquainted, the wind generally blows from the neareſt ocean, except during the coldeſt months, when it blows towards it.

48 In the temperate zones.

In the temperate zones the direction of the wind is by no means ſo regular as between the tropics. Even in the ſame degree of latitude, we find them often blowing in different directions at the ſame time, while their changes are often ſo ſudden and capricious, that to account for them has been hitherto found impoſſible. When winds are violent and continue long, they generally extend over a large tract of country; and this is more certainly the caſe when they blow from the north-eaſt, than from any other points. By the multiplication and compariſon of meteorological tables, ſome regular connection between the changes of the atmoſphere in different places may in time be obſerved, which will at laſt lead to a ſatisfactory theory of the winds. It is from ſuch tables chiefly that the following facts have been collected.

49 In Virginia.

In Virginia, the prevailing winds are between the *ſouth-weſt*, *weſt*, *north*, and *north-weſt*; the moſt frequent is the *ſouth-weſt*, which blows more conſtantly in June, July, and Auguſt, than at any other ſeaſon. The north-weſt winds blow moſt conſtantly in Novem-

ber,

Winds.

ber, December, January, and February. At Ipſwich in New England, the prevailing winds are alſo between the ſouth-weſt, weſt, north, and north-eaſt; the moſt frequent is the north weſt. But at Cambridge, in the ſame province, the moſt frequent wind is the ſouth-eaſt. The predominant winds at New York are the north and weſt. In Nova Scotia north-weſt winds blow for three-fourths of the year. The ſame wind blows moſt frequently at Montreal in Canada, but at Quebec the wind generally follows the direction of the river St Lawrence, blowing either from the north-eaſt or ſouth-weſt. At Hudſon's bay weſterly winds blow for three-fourths of the year; the north-weſt wind occaſions the greateſt cold; but the north and north-eaſt are the vehicles of ſnow.

It appears from theſe facts, that weſterly winds are moſt frequent over the whole eaſtern coaſt of North America; that in the ſouthern provinces ſouth-weſt winds predominate, and that the north-weſt become gradually more frequent as we approach the frigid zone.

50 In Egypt.

In Egypt, during part of May, and during June, July, Auguſt, and September, the wind blows almoſt conſtantly from the *north*, varying ſometimes in June to the weſt, and in July to the weſt and the eaſt; during part of September, and in October and November, the winds are variable, but blow more regularly from the eaſt than any other quarter; in December, January, and February, they blow from the north, north-weſt, and weſt; towards the end of February they change to the ſouth, in which quarter they continue till near the end of March; during the laſt days of March and in April they blow from the ſouth-eaſt, ſouth, and ſouth-weſt, and at laſt from the eaſt; and in this direction they continue during a part of May.

51 In the Mediterranean.

In the Mediterranean the wind blows nearly three-fourths of the year from the north; about the equinoxes there is always an eaſterly wind in that ſea, which is generally more conſtant in ſpring than in autumn. Theſe obſervations do not apply to the gut of Gibraltar, where there are ſeldom any winds except the eaſt and the weſt. At Baſtia, in the iſland of Corſica, the prevailing wind is the ſouth-weſt.

52 In Syria.

In Syria the north wind blows from the autumnal equinox to November; during December, January, and February, the winds blow from the weſt and ſouth-weſt; in March they blow from the ſouth, in May from the eaſt, and in June from the north. From this month to the autumnal equinox the wind changes gradually as the ſun approaches the equator; firſt to the eaſt, then to the ſouth, and laſtly to the weſt. At Bagdad the moſt frequent winds are the ſouth-weſt and north-weſt; at Pekin, the north and the ſouth; at Kamtſchatka, on the north-eaſt coaſt of Aſia, the prevailing winds blow from the weſt.

53 In Italy.

In Italy the prevailing winds differ conſiderably according to the ſituation of the places where the obſervations have been made. At Rome and Padua they are northerly, at Milan eaſterly. All that we have been able to learn reſpecting Spain and Portugal is, that on the weſt coaſt of theſe countries the weſt is by far the moſt common wind, particularly in ſummer; and that at Madrid the wind is north-eaſt for the greateſt part of the ſummer, blowing almoſt conſtantly from the Pyrenean mountains. At Berne in Switzerland, the prevailing winds are the north and weſt; at St Gothard, the north-eaſt; at Lauſanne the north-weſt and ſouth-weſt.

54 Reſult of M. Cotte's obſervations on the direction of the winds in France.

M. Cotte has given us the reſult of obſervations made at 86 different places of France, from which it appears, that along the whole ſouth coaſt of that empire the wind blows moſt frequently from the north, north-weſt, and north-eaſt: on the weſt coaſt, from the weſt, ſouth-weſt, and north-weſt; and on the north coaſt from the ſouth-weſt. That in the interior parts of France the ſouth weſt wind blows moſt frequently in 18 places; the weſt wind in 14; the north in 13; the ſouth in 6; the north-eaſt in 4; the ſouth eaſt in 2; the eaſt and north-weſt each of them in one. On the weſt coaſt of the Netherlands, as far north as Rotterdam, the prevailing winds are probably the ſouth-weſt; at leaſt this is the caſe at Dunkirk and Rotterdam. It is probable alſo, that along the reſt of this coaſt, from the Hague to Hamburgh, the prevailing winds are the north-weſt, at leaſt theſe winds are moſt frequent at the Hague and at Franeker. The prevailing wind at Delft is the ſouth-eaſt, and at Breda the north and the eaſt.

55 Direction of the winds in Germany.

In Germany the eaſt wind is moſt frequent at Gottingen, Munich, Weiſſemburg, Duſſeldorff, Saganum, Erford, and at Buda in Hungary; the ſouth-eaſt at Prague and Wirtſburg; the north-eaſt at Ratiſbon, and the weſt at Manheim and Berlin.

56 At London.

From an average of 10 years of the regiſter kept by order of the Royal Society, it appears, that at London the winds blow in the following order:

Winds.	*Days.*	*Winds.*	*Days.*
South-weſt	112	South-eaſt	32
North-eaſt	58	Eaſt	26
North-weſt	50	South	18
Weſt	53	North	16

It appears from the ſame regiſter, that the ſouth-weſt wind blows at an average more frequently than any other wind during every month of the year, and that it blows longeſt in July and Auguſt; that the north-eaſt blows moſt conſtantly during January, March, April, May, and June, and moſt ſeldom during February, July, September, and December; and that the north-weſt wind blows oftener from November to March, and more ſeldom during September and October, than any other months. The ſouth-weſt winds are alſo moſt frequent at Briſtol, and next to them are the north-eaſt.

57 Table of winds at Lancaſter.

The following table of the winds at Lancaſter has been drawn up from a regiſter kept for ſeven years at that place.

Winds.	*Days.*	*Winds.*	*Days.*
South-weſt	92	South-eaſt	35
North-eaſt	67	North	30
South	51	North-weſt	26
Weſt	41	Eaſt	17

58 At Dumfries.

The following table is an abſtract of nine years obſervations made at Dumfries by Mr Copland.

Winds.	*Days.*	*Winds.*	*Days.*
South	$82\frac{1}{2}$	North	$36\frac{1}{2}$
Weſt	69	North-weſt	$25\frac{1}{2}$
Eaſt	68	South-eaſt	$18\frac{1}{2}$
South-weſt	$50\frac{1}{2}$	North-eaſt	$14\frac{1}{2}$

The

Winds.

59 At Cambuſlang. The following table is an abſtract of ſeven years obſervations, made by Dr Meek at Cambuſlang, near Glaſgow.

Winds.	*Days.*	*Winds.*	*Days.*
South-weſt	174	North-eaſt	104
North-weſt	40	South-eaſt	47

It appears from the regiſter from which this table was extracted, that the north-eaſt wind blows much more frequently in April, May, and June, and the ſouth-weſt in July, Auguſt, and September, than at any other period. We learn from the Statiſtical Account of Scotland, that the ſouth-weſt is by far the moſt frequent wind all over that kingdom, eſpecially on the weſt coaſt. At Saltcoats in Ayrſhire, for inſtance, it blows three fourths of the year; and along the whole coaſt of Murray on the north-eaſt ſide of Scotland, it blows for two-thirds of the year. Eaſt winds are common over all Great Britain during April and May; but their influence is felt moſt ſeverely on the eaſtern coaſt.

The following table exhibits a view of the number of days during which the weſterly and eaſterly winds blow in a year, at different parts of the iſland. Under the term weſterly are included the north-weſt, weſt, ſouth-weſt, and ſouth; the term eaſterly is taken in the ſame latitude.

Years of obſervation.	Places.	Wind. Weſterly	Eaſterly.
10	London	233	132
7	Lancaſter	216	149
51	Liverpool	190	175
9	Dumfries	227.5	137.5
10	Branxholm	232	133
7	Cambuſlang	214	151
8	Hawkhill near Edin.	229.5	135.5
	Medium	220.3	144.7

60 Direction of the winds in Ireland. In Ireland the ſouth-weſt and weſt are the grand trade-winds, blowing moſt in ſummer, autumn, and winter, and leaſt in ſpring. The north-eaſt blows moſt in ſpring, and nearly double to what it does in autumn and winter. The ſouth-weſt and north-weſt are nearly equal, and are moſt frequent after the ſouth-weſt and weſt.

61 At Copenhagen, and in Ruſſia. At Copenhagen the prevailing winds are the eaſt and ſouth-eaſt; at Stockholm, the weſt and north. In Ruſſia, from an average of a regiſter of 16 years, the winds blow from November to April in the following order.

	W.	N.W.	E.	S.W.	S.	N.E.	N.	S.E.
Days	45	26	23	22	20	19	14	12

And during the other ſix months,

	W.	N.W.	E.	S.W.	S.	N.E.	N.	S.E.
Days	27	27	19	24	22	15	32	18

The weſt wind blows during the whole year 72 days; the north-weſt 53, the ſouth-weſt and north 46 days each. During ſummer it is calm for 41 days, and during winter for 21. In Norway the moſt frequent winds are the ſouth, the ſouth-weſt and ſouth eaſt. The wind at Bergen is ſeldom directly weſt, but generally ſouth-weſt or ſouth-eaſt; a north-weſt, and eſpecially a north-eaſt wind, are but little known there.

From the whole of theſe facts, it appears that the moſt frequent winds on the ſouth coaſts of Europe are the north, the north eaſt and north-weſt, and on the weſtern coaſt the ſouth-weſt; that in the interior parts which lie moſt contiguous to the Atlantic ocean, ſouth-weſt winds are alſo moſt frequent; but that eaſterly winds prevail in Germany. Weſterly winds are alſo moſt frequent on the north-eaſt coaſt of Aſia.

It is probable that the winds are more conſtant in the ſouth temperate zone, which is in a great meaſure covered with water, than in the north temperate zones, where their direction muſt be frequently interrupted and altered by mountains and other cauſes.

62 Main winds at the Cape of Good Hope. M. de la Bailie, who was ſent thither by the French king to make aſtronomical obſervations, informs us, that at the Cape of Good Hope the main winds are the ſouth-eaſt and north-weſt; that other winds ſeldom laſt longer than a few hours; and that the eaſt and north-eaſt winds blow very ſeldom. The ſouth-eaſt wind blows in moſt months of the year, but chiefly from October to April; the north-weſt prevails during the other ſix months, bringing along with it rain, and tempeſts, and hurricanes. Between the Cape of Good Hope and New Holland the winds are commonly weſterly, and blow in the following order: north-weſt, ſouth-weſt, weſt, north.

63 In the Pacific ocean. In the great South ſea, from latitude 30° to 40° ſouth, the ſouth eaſt trade-wind blows moſt frequently, eſpecially when the ſun approaches the tropic of Capricorn; the wind next to it in frequency is the north-weſt, and next to that is the ſouth-weſt.

Thus it appears that the trade-winds ſometimes extend farther into the ſouth temperate zone than their uſual limits, particularly during ſummer; that beyond their influence the winds are commonly weſterly, and that they blow in the following order: north-weſt, ſouth-weſt, weſt.

64 Theory of the winds. We have now conſidered pretty much at large the direction of the winds in different parts of the earth's ſurface. Another very curious part of the hiſtory of the winds relates to their violence, and the effects with which they are attended, or to the hiſtory of hurricanes, whirlwinds, tornadoes, &c. Of ſome of theſe we have already treated under the articles HURRICANE and HARMATTAN; and the confined limits of this article oblige us to refer our readers for more particulars to Capper's Obſervations on the Winds and Monſoons.

65 Velocity of the winds almoſt infinitely various. As to the velocity of the wind, its variations are almoſt infinite, from the gentleſt breeze, to the hurricane which tears up trees and blows down houſes. Our moſt violent winds take place when neither the heat nor the cold is greateſt; violent winds generally extend over a large tract of country, and they are accompanied with ſudden and great falls in the mercury of the barometer. The wind is ſometimes very violent at a diſtance from the earth, while it is quite calm at its ſurface. On one occaſion Lunardi went at the rate of 70 miles an hour in his balloon, though it was quite calm at Edinburgh when he aſcended, and continued ſo during his whole voyage.

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66 Velocity of the winds.

A pretty good idea of the velocity of the wind, under different circumſtances, may be formed from the following table, which was drawn up by Mr Smeaton.

Miles per Hour.	Feet per Second.	Perpendicular force on one ſquare foot, in Avoirdupois pounds and Paris.	
1	1.47	.005	Hardly perceptible.
2	2.93	.020	Juſt perceptible.
3	4.4	.044	
4	5.87	.079	Gently pleaſant.
5	7.33	.123	
10	14.67	.492	Pleaſant, briſk.
15	22.	1.107	
20	29.34	1.968	Very briſk.
25	36.67	3.075	
30	44.01	4.429	High wind.
35	51.34	6.027	
40	58.68	7.873	Very high wind.
45	66.01	9.963	
50	73.35	12.300	Storm or tempeſt.
60	88.02	17.715	Great ſtorm.
80	117.36	31.490	Hurricane.
100	146.7	49.200	Hurricane that tears up trees and carries buildings before it.

For the means of aſcertaining the velocity of the winds, ſee ANEMOMETER and ANEMOSCOPE.

We ſhall now endeavour to explain the phenomena that we have been deſcribing, or to form a plauſible theory of the winds.

The atmoſphere is a fluid ſurrounding the earth, and extending to an unknown height. Now all fluids tend invariably to a level: if a quantity of water be taken out of any part of a veſſel, the ſurrounding water will immediately flow in to ſupply its place, and the ſurface will become level as before; or if an additional quantity of water be poured into any part of the veſſel, it will not remain there, but diffuſe itſelf equally over the whole. Such exactly would be the caſe with the atmoſphere. Whatever therefore deſtroys the equilibrium of this fluid, either by increaſing or diminiſhing its bulk in any particular place, muſt at the ſame time occaſion a wind.

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Air, beſides its qualities in common with other fluids, is alſo capable of being dilated and compreſſed. Suppoſe a veſſel filled with air: if half the quantity which it contains be drawn out by means of an air-pump, the remainder will ſtill fill the veſſel completely; or if twice or three times the original quantity be forced in by a condenſer, the veſſel will ſtill be capable of holding it.

Rarefied air is lighter, and condenſed air heavier than common air. When fluids of unequal ſpecific gravities are mixed together, the heavier always deſcend and the lighter aſcend. Were quickſilver, water, and oil, thrown into the ſame veſſel together, the quickſilver would uniformly occupy the bottom; the water the middle, and the oil the top. Were water to be thrown into a veſſel of oil, it would immediately deſcend, becauſe it is heavier than oil. Exactly the ſame thing takes place in the atmoſphere. Were a quantity of air, for inſtance, to be ſuddenly condenſed at a diſtance from the ſurface of the earth, being now heavier than before, it would deſcend till it came to air of its own denſity; or, were a portion of the atmoſphere at the ſurface of the earth to be ſuddenly rarefied, being now lighter than the ſurrounding air, it would immediately aſcend.

68 Cauſe of the trade-winds.

If a bladder half filled with air be expoſed to the heat of a fire, the air within will ſoon expand, and diſtend the bladder; if it be now removed to a cold place, it will ſoon become flaccid as before. This ſhews that heat rarefies, and that cold condenſes air. The ſurface of the torrid zone is much more heated by the rays of the ſun than the frozen or temperate zones, becauſe the rays fall upon it much more perpendicularly. This heat is communicated to the air near the ſurface of the torrid zone, which being thereby rarefied, aſcends, and its place is ſupplied by colder air, which ruſhes in from the north and ſouth.

The diurnal motion of the earth is greateſt at the equator, and diminiſhes gradually as we approach the poles, where it ceaſes altogether. Every ſpot of the earth's ſurface at the equator moves at the rate of 15 geographical miles in a minute; at 40° of latitude it moves at about 11 miles and a half in a minute, and at the 30° at nearly 13 miles. The atmoſphere, by moving continually round along with the earth, has acquired the ſame degree of motion, ſo that thoſe parts of it which are above the equator move faſter than thoſe which are at a diſtance. Were a portion of the atmoſphere to be tranſported in an inſtant from latitude 30° to the equator, it would not immediately acquire the velocity of the equator; the eminences of the earth, therefore, would ſtrike againſt it, and it would aſſume the appearance of an eaſt wind. This is the caſe in a ſmaller degree with the air that flows towards the equator, to ſupply the place of the rarefied air which is continually aſcending; and this, when combined with its real motion from north to ſouth, muſt cauſe it to aſſume the appearance of a north-eaſterly wind on this ſide the equator, and of a ſouth-eaſterly beyond it.

The motion weſtward occaſioned by this difference in celerity alone, would be very ſmall; but it is increaſed by another circumſtance. Since the rarefaction of the air in the torrid zone is owing to the heat derived from the contiguous earth, and ſince this heat is owing to the perpendicular rays of the ſun, thoſe parts muſt be hotteſt where the ſun is actually vertical; and conſequently the air above them muſt be moſt rarefied; the contiguous parts of the atmoſphere will therefore be drawn moſt forcibly to that particular ſpot. Now, ſince the diurnal motion of the earth is from eaſt to weſt, this hotteſt ſpot will be continually ſhifting weſtwards, and this will occaſion a current of the atmoſphere in that direction. That this cauſe really operates, appears from a circumſtance already mentioned: When the ſun approaches either of the tropics, the trade-wind on the ſame ſide of the equator aſſumes a more eaſterly direction, evidently from the cauſe here mentioned, while the oppoſite trade-wind being deprived of this additional impulſe, blows in a direction more perpendicular to the equator.

69 What increaſes the weſterly direction of the trade-wind.

The weſterly direction of the trade-wind is ſtill farther increaſed by another cauſe. Since the attraction of the ſun and moon produces ſo remarkable an effect

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effect upon the ocean, we cannot but ſuppoſe that an effect equally great, at leaſt, is produced upon the atmoſphere. Indeed as the atmoſphere is nearer the moon than the ſea is, the effects produced by attraction upon it ought to be greater. When we add to this the elaſticity of the air, or that diſpoſition which it has to dilate itſelf when freed from any of its preſſure, we cannot but conclude, that the tides in the atmoſphere are conſiderable. Now ſince the apparent diurnal motion of the moon is from eaſt to weſt, the tides muſt follow it in the ſame manner, and conſequently produce a conſtant motion in the atmoſphere from eaſt to weſt. This reaſoning is confirmed by the obſervations of ſeveral philoſophers, particularly of M. Caſſon, that in the torrid zone the barometer is always two-thirds of a line higher twice every 24 hours than during the reſt of the day; and that the time of this riſe always correſponds with the tides of the ſea; a proof that it proceeds from the ſame cauſe.

All theſe different cauſes probably combine in the production of the trade-winds; and from their being ſometimes united, and ſometimes diſtinct or oppoſite, ariſe all thoſe little irregularities which take place in the direction and force of the trade-winds.

Since the great cauſe of theſe winds is the rarefaction of the atmoſphere by the heat of the ſun, its aſcenſion and the conſequent ruſhing in of colder air from the north and ſouth, the internal boundary of the trade-winds muſt be that parallel of the torrid zone which is hotteſt, becauſe there the aſcenſion of the rarefied air muſt take place. Now ſince the ſun does not remain ſtationary, but is conſtantly ſhifting from one tropic to the other, we ought naturally to expect that this boundary would vary together with its exciting cauſe; that therefore, when the ſun is perpendicular to the tropic of Cancer, the north-eaſt trade-wind would extend no farther ſouth than north latitude 23° 30′; that the ſouth-eaſt wind would extend as far north; and that, when the ſun was in the tropic of Capricorn, the very contrary would take place. We have ſeen, however, that though this boundary be ſubject to conſiderable changes from this very cauſe, it may in general be conſidered as fixed between the ſecond and fifth degrees of north latitude.

Though the ſun be perpendicular to each of the tropics during part of the year, he is for one half of it at a conſiderable diſtance, ſo that the heat which they acquire, while he is preſent, is more than loſt during his abſence. But the ſun is perpendicular to the equator twice in a year, and never farther diſtant from it than 23½°; being therefore twice every year as much heated, and never ſo much cooled as the tropics, its mean heat muſt be greater, and the atmoſphere in conſequence generally moſt rarefied at that place. Why then, it will be aſked, is not the equator the boundary of the two trade-winds? To ſpeak more accurately than we have hitherto done, the internal limit of theſe winds muſt be that parallel where the mean heat of the earth is greateſt. This would be the equator, were it not for a reaſon that ſhall now be explained.

It has been ſhewn by aſtronomers, that the orbit of the earth is an ellipſis, and that the ſun is placed in one of the foci. Were this orbit to be divided into two parts by a ſtraight line perpendicular to the tranſverſe axis, and paſſing through the centre of the ſun, one of theſe parts would be leſs than the other; and the earth during its paſſage through the ſmall part of its orbit, would conſtantly be nearer the ſun than while it moved through the other portion. The celerity of the earth's motion in any part of its orbit is always proportioned to its diſtance from the ſun; the nearer it is to the ſun it moves the faſter; the farther diſtant, the ſlower. The earth paſſes over the ſmaller portion of its orbit during our winter, which muſt therefore be ſhorter than our ſummer, both on account of this part of the orbit being ſmaller than the other, and on account of the increaſed celerity of the earth's motion. The difference, according to Caſſini, is 7 days, 23 hours, 53 minutes. While it is winter in the northern, it is ſummer in the ſouthern hemiſphere; wherefore the ſummer in the ſouthern hemiſphere muſt be juſt as much ſhorter than the winter, as our winter is ſhorter than our ſummer. The difference, therefore, between the length of the ſummer in the two hemiſpheres is almoſt 16 days. The ſummer in the northern hemiſphere conſiſts of 190½ days, while in the ſouthern it conſiſts only of 174½. They are to one another nearly in the proportion of 14 to 12.8; and the heat of the two hemiſpheres may probably have nearly the ſame proportion to one another. The internal limit of the trade-winds ought to be that parallel where the mean heat of the globe is greateſt; this would be the equator, if both hemiſpheres were equally hot; but ſince the northern hemiſphere is the hotteſt, that parallel ought to be ſituated ſomewhere in it; and ſince the difference between the heat of the two hemiſpheres is not great, the parallel ought not to be ſo far diſtant from the equator.

The trade-wind would blow regularly round the whole globe if the torrid zone were all covered with water. If the Indian ocean were not bounded by land on the north, it would blow there in the ſame manner as it does in the Atlantic and Pacific oceans. The rays of light paſs through a tranſparent body without communicating any, or at leaſt but a ſmall degree of heat. If a piece of wood be incloſed in a glaſs veſſel, and the focus of a burning-glaſs directed upon it, the wood will burn to aſhes, while the glaſs through which all the rays paſſed is not even heated. When an opaque body is expoſed to the ſun's rays, it is heated in proportion to its opacity. If the bulb of a thermometer be expoſed to the ſun, the mercury will not riſe ſo high as it would do if this bulb were painted black. Land is much more opaque than water; it becomes therefore much warmer when both are equally expoſed to the influence of the ſun. For this reaſon, when the ſun approaches the tropic of Cancer, India, China, and the adjacent countries, become much hotter than the ocean which waſhes their ſouthern coaſts. The air over them becomes rarefied, and aſcends, while colder air ruſhes in from the Indian ocean to ſupply its place. As this current of air moves from the equator northward, it muſt, for a reaſon already explained, aſſume the appearance of a ſouth-weſt wind; and this tendency eaſtward is increaſed by the ſituation of the countries to which it flows. This is the cauſe of the ſouth-weſt monſoon, which blows during ſummer in the northern parts of the Indian ocean. Between Borneo and the coaſt of China, its direction is almoſt due north, be-

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caufe the country to which the current is directed lies rather to the weft of north; a circumftance which counteracts its greater velocity.

In winter, when the fun is on the fouth fide of the equator, thefe countries become cool, and the north-eaft trade-wind refumes its courfe, which, had it not been for the interference of thefe countries, would have continued the whole year.

As the fun approaches the tropic of Capricorn, it becomes almoft perpendicular to New Holland; that continent is heated in its turn, the air over it is rarefied, and colder air rufhes in from the north and weft to fupply its place. This is the caufe of the north-weft monfoon, which blows from October to April, from 3° to 10° fouth latitude. Near Sumatra its direction is regulated by the coaft: this is the cafe alfo between Africa and Madagafcar.

The fame caufe which occafions the monfoons, gives rife to the winds which blow on the weft coafts of Africa and America. The air above the land is hotter and rarer, and confequently lighter than the air above the fea; the fea air, therefore, flows in, and forces the lighter land atmofphere to afcend.

The fame thing will account for the phenomena of the fea and land breezes. During the day, the cool air of the fea, loaded with vapours, flows in upon the land, and takes the place of the rarefied land air. As the fun declines, the rarefaction of the land air is diminifhed; thus an equilibrium is reftored. As the fea is not fo much heated during the day as the land, neither is it fo much cooled during the night, becaufe it is conftantly expofing a new furface to the atmofphere. As the night approaches, therefore, the cooler and denfer air of the hills (for where there are no hills there are no fea and land breezes) falls down upon the plains, and preffing upon the now comparatively lighter air of the fea, caufes the land breeze.

The rarefied air which afcends between 2° and 5° north latitude, has been fhewn to be the principal caufe of the trade-winds. As this air afcends, it muft become gradually colder, and confequently heavier; it would therefore defcend again if it were not buoyed up by the conftant afcent of new rarefied air. It muft therefore fpread itfelf to the north and fouth, and gradually mix in its paffage with the lower air; and the greater part of it probably does not reach far beyond 30°, which is the external limit of the trade-wind. Thus there is a conftant circulation of the atmofphere in the torrid zone; it afcends near the equator, diffufes itfelf toward the north and fouth, defcends gradually as it approaches 30°, and, returning again towards the equator, performs the fame circuit. It has been the opinion of the greater part of thofe who have confidered this fubject, that the whole of the rarefied air which afcends near the equator, advances towards the poles and defcends there. But if this were the cafe, a conftant wind would blow from both poles towards the equator, and the trade winds would extend over the whole earth; for otherwife the afcent of air in the torrid zone would very foon ceafe. A little reflection muft convince us that it cannot be true. Rarefied air differs in nothing from the common air, except in containing a greater quantity of heat. As it afcends, it gradually lofes this fuperfluous heat. What then fhould hinder it from defcending, and mixing with the atmofphere below? That there is a conftant current of fuperior air, however, towards the poles, cannot be doubted; but it confifts principally of hydrogen gas. We fhall immediately attempt to affign the reafon why its accumulation at the pole is not always attended with a north wind.

If the attraction of the moon and the diurnal motion of the fun have any effect upon the atmofphere, and that they have fome effect can hardly be difputed, there muft be a real motion of the air weftwards within the limits of the trade-winds. When this body of air reaches America, its further paffage weftwards is ftopt by the mountains which extend from one extremity of that continent to the other. From the momentum of this air, when it ftrikes againft the fides of thefe mountains, and from its elafticity, it muft acquire from them a confiderable velocity, in a direction contrary to the firft, and would therefore return eaftwards again if this were not prevented by the trade-winds. It muft therefore rufh forwards in that direction where it meets with the leaft refiftance; that is, towards the north and fouth. As air is nearly a perfectly elaftic body, when it ftrikes againft the fides of the American mountains, its velocity will not be perceptibly diminifhed, though its direction be changed. Continuing to move, therefore, with the velocity of the equator, when it arrives at the temperate zones it will affume the appearance of a north-eaft or fouth-eaft wind. To this is to be afcribed the frequency of fouth-weft winds over the Atlantic ocean and weftern parts of Europe. Whether thefe winds are equally frequent in the northern Pacific ocean, we have not been able to afcertain; but it is probable that the mountains in Afia produce the fame effect as thofe in America.

It is not impoffible that another circumftance may alfo contribute to the production of thefe winds. The oxygen, which is rather heavier than common air, may mix with the atmofphere; but the hydrogen (a cubic foot of which weighs only 41.41 grains, while a cubic foot of oxygen weighs 593.32 grains) may afcend to the higher regions of the atmofphere.

By what means the decompofition is accomplifhed (if it takes place at all) we cannot tell. There are probably a thoufand caufes in nature of which we are entirely ignorant. Whether heat and light, when long applied to vapours, may not be able to decompound them, by uniting with the hydrogen, which feems to have a greater attraction for heat than oxygen has, or whether the electrical fluid may not be capable of producing this effect, are queftions which future obfervations and experiments muft determine. Dr Franklin filled a glafs tube with water, and paffed an electrical fhock through it; the tube was broken in pieces, and the whole water difappeared. He repeated the experiment with ink inftead of water, and placed the tube upon white paper: the fame effects followed, and the ink, though it difappeared completely, left no ftain on the paper. Whether the water in thefe cafes was decompofed or not, it is impoffible to fay; but the fuppofition that it was, is not improbable. An experiment might eafily be contrived to determine the point.

This decompofition would account for the frequency of fouth-weft winds, particularly in fummer; for this new air is furnifhed to fupply the place of that which is forced northwards by the caufes already explained.

Perhaps

Perhaps it may be a confirmation of this conjecture, that the ſouth-weſt winds generally extend over a greater tract of country than moſt other winds which blow in the temperate zones. What has been ſaid of ſouth-weſt winds holds equally with regard to north-weſt winds in the ſouth temperate zone.

After ſouth-weſt winds have blown for ſome time, a great quantity of air will be accumulated at the pole, at leaſt if they extend over all the northern hemiſphere; and it appears, from comparing the tables kept by ſome of our late navigators in the northern Pacific ocean with ſimilar tables kept in this iſland, that this is ſometimes the caſe ſo far as relates to the Atlantic and Pacific oceans. When this accumulation becomes great, it muſt, from the nature of fluids, and from the elaſticity of the air, preſs with a conſiderable and increaſing force on the advancing air; ſo that in time it becomes ſtronger than the ſouth-weſt wind. This will occaſion at firſt a calm, and afterwards a north wind, which will become gradually eaſterly as it advances ſouthwards, from its not aſſuming immediately the velocity of the earth. The maſs of the atmoſphere will be increaſed in all thoſe places over which this north-eaſt wind blows; this is confirmed by the almoſt conſtant riſe of the barometer during a north-eaſt wind.

Whatever tends to increaſe the bulk of the atmoſphere near the pole, muſt tend alſo to increaſe the frequency of north-eaſt winds; and if there be any ſeaſon when this increaſe takes place more particularly, that ſeaſon will be moſt liable to theſe winds. During winter the northern parts of Europe are covered with ſnow, which is melted in the beginning of ſummer, when the heat of the ſun becomes more powerful. Great quantities of vapour are during that time raiſed, which will augment both the bulk and weight of the atmoſphere, eſpecially if the conjecture about the converſion of vapour into air has any foundation. Hence north-eaſt winds are moſt prevalent during May and June.

But it will be ſaid, if this hypotheſis were true, the ſouth-weſt and north-eaſt winds ought to blow alternately, and continue each of them for a ſtated time; whereas the ſouth-weſt wind blows ſometimes longer and ſometimes ſhorter, neither is it always followed by a north-eaſt wind.

If the conjecture about the decompoſition of vapour in the torrid zone be true, the hydrogen which formed a part of it will aſcend from its lightneſs, and form a ſtratum above the atmoſpherical air, and gradually extend itſelf, as additional hydrogen riſes, towards the north and ſouth, till at laſt it reaches the poles. The lightneſs of hydrogen is owing to the great quantity of heat which it contains; as it approaches the poles it muſt loſe a great part of this heat, and may in conſequence become heavy enough to mix with the atmoſphere below. Oxygen makes a part of the atmoſphere; and its proportion near the poles may ſometimes be greater than ordinary, on account of the additional quantity brought thither from the torrid zone. Mr Cavendiſh mixed oxygen and hydrogen together in a glaſs jar; and upon making an electrical ſpark paſs through them, they immediately combined and formed water.

That there is electric matter at the poles, cannot be doubted. The abbé Chappe informs us, that he ſaw thunder and lightning much more frequently at Toboľſki and other parts of Siberia, than in any other part of the world. In the north of Europe, the air, during very cold weather, is exceedingly electric; ſparks can be drawn from a perſon's hands and face, by combing his hair, or even powdering him with a puff. Æpinus was an eye-witneſs to this fact, and to ſtill more aſtoniſhing proofs of the electricity of the atmoſphere during great colds.

May not the appearance of the aurora borealis be owing to the union of oxygen and hydrogen by the intervention of the electric fluid? That it is an electrical phenomenon, at leaſt, can hardly be doubted. Artificial electricity is much ſtrengthened during an aurora, as M. Volta and Mr Canton have obſerved; and the magnetic needle moves with the ſame irregularity during an aurora that has been obſerved in other electrical phenomena. This fact we learn from Bergman and De la Lande. Many philoſophers have attempted to demonſtrate, that auroræ boreales are beyond the earth's atmoſphere; but the very different reſults of their calculations evidently prove that they were not poſſeſſed of ſufficient data.

If this conjecture be true, part of the atmoſphere near the poles muſt at times be converted into water. This would account for the long continuance of ſouth-weſt winds at particular times; when they do ſo, a decompoſition of the atmoſphere is going on at the pole. It would render this conjecture more probable, if the barometer fell always when a ſouth-weſt wind continues long.

70 South-weſt winds very common after auroræ boreales.

If this hypotheſis be true, a ſouth-weſt wind ought always to blow after auroræ boreales; and we are informed by Mr Winn, that this is actually the caſe. This he found never to fail in 23 inſtances. He obſerved alſo, that when the aurora was bright, the gale came on within 24 hours, but did not laſt long; but if it was faint and dull, the gale was longer in beginning, and leſs violent, but it continued longer. This looks like a confirmation of our conjecture. Bright auroræ are probably nearer than thoſe which are dull. Now, if the aurora borealis be attended with a decompoſition of a quantity of air, that part of the atmoſphere which is neareſt muſt firſt ruſh in to ſupply the diſtant parts. Juſt as if a hole were bored in the end of a long veſſel filled with water, the water neareſt the hole would flow out immediately, and it would be ſome time before the water at the other end of the veſſel began to move. The nearer we are to the place of precipitation, the ſooner will we feel the ſouth-weſt wind. It ought therefore to begin ſooner after a bright aurora, becauſe it is nearer than a dull and faint one. Precipitations of the atmoſphere at a diſtance from the pole cannot be ſo great as thoſe which take place near it; becauſe the cold will not be ſufficient to condenſe ſo great a quantity of hydrogen; ſouth-weſt winds, therefore, ought not to laſt ſo long after bright as after dull auroræ. Winds are more violent after bright auroræ, becauſe they are nearer the place of precipitation; juſt as the water near the hole of the veſſel runs ſwifter than that which is at a conſiderable diſtance.

71 Probable cauſes of ſouth-weſt winds.

If theſe conjectures have any foundation in nature, there are two ſources of ſouth-weſt winds; the firſt has its origin in the trade-winds, the ſecond in precipitations of the atmoſphere near the pole. When they originate from the firſt cauſe, they will blow in countries farther

Winds.

farther south for some time before they are felt in those which are farther north; but the contrary will take place when they are owing to the second cause. In this last case, too, the barometer will sink considerably; and it actually does so constantly after auroræ, as we are informed by Mr Madison, who paid particular attention to this subject. By keeping accurate meteorological tables in different latitudes, it might easily be discovered whether these consequences be true, and of course whether the above conjectures be well or ill grounded.

72
Winds commonly begin at the place towards which they blow.

It appears that winds generally commence at that point towards which they blow; and hence they must arise from a rarefaction and consequent displacing of the air in some particular place, by the action of heat, or some other cause. Perhaps, according to the idea of Mr Williams, this cause may be an increased precipitation of the superior strata of air, rendered unusually dense from its being surcharged with moisture in the place where the wind begins to blow, or from an increased evaporation from a humid surface in the opposite direction.

Hurricanes are constantly preceded by a great depression of the thermometer; and in these cases the wind often seems to blow from every direction towards the quarter where this fall of the barometer is observed.

Violent winds from the north-east have repeatedly been observed to begin at the quarter towards which they blow. In 1740 Dr Franklin was prevented from observing an eclipse of the moon at Philadelphia by a north-east storm, which came on about seven o'clock in the evening. He was surprised to find afterwards that it had not come on at Boston till near 11 o'clock; and, upon comparing all the accounts which he received from the several colonies of the beginning of this and other storms of the same kind, he found it to be always an hour later the farther north-east, for every 100 miles. "From hence (says he) I formed an idea of the course of the storm, which I will explain by a familiar instance. I suppose a long canal of water stopped at the end by a gate. The water is at rest till the gate is opened; then it begins to move out through the gate, and the water next the gate is first in motion, and moves on towards the gate, and so on successively, till the water at the head of the canal is in motion, which it is last of all. In this case the water moves indeed towards the gate; but the successive times of beginning the motion are in the contrary way, viz. from the gate back to the head of the canal. Thus to produce a north-east storm, I suppose some great rarefaction of the air in or near the gulf of Mexico; the air rising thence has its place supplied by the next more northern, cooler, and therefore denser and heavier air; a successive current is formed, to which our coast and inland mountains give a north-east direction."

Several instances of a similar kind have occurred. In 1802, Dr Mitchell observed a storm which began at Charlestown on the 21st of February, at two o'clock P. M. but was not observed at Washington, several hundred miles to the north-east, till five o'clock; at New York till 10, nor at Albany till daybreak of the following morning. Hence it appears that it must have moved at the rate of 1100 miles in 11 hours, or 100 miles an hour.

A remarkable storm of this kind, in which the wind was easterly, and attended with a heavy fall of snow, was observed in Scotland on the 8th of February 1799; but the motion of the wind was much slower. It began to snow at Falkirk on the 7th of February at six in the evening, but at Edinburgh not till one o'clock A. M. on the 8th; and the snow was not observed at Dunbar till seven hours after. The storm continued 11 hours, during which time it did not travel more than 100 miles.

Currents of air from the poles naturally assume a north east direction as they advance southwards, because their diurnal motion becomes less than that of the earth. Various circumstances, however, may change this direction, and cause them to become north, or even north-west winds. The south-west winds themselves may often prove sufficient for this; and violent rains, or great heat, by lessening or rarefying the atmosphere in any country, will produce the same effect in countries to the westwards, when north winds happen to be blowing.

In North America, the north-west winds become gradually more frequent as we advance northwards. The east coast of this continent, where the observations were made from which this conclusion was drawn, is alone cultivated; the rest of the country is covered with wood. Now cultivated countries are generally considered as warmer than those which are uncultivated, though Mr Williams is of a different opinion; and on this circumstance founds his hypothesis of the climate of Britain being much deteriorated during the last 50 years. The air, therefore, in the interior parts of the country should be constantly colder than the east coast. This difference will scarcely be perceptible in the southern parts, because there the influence of the sun is very powerful; but it will become gradually greater as we advance northwards, because the influence of the sun diminishes, and the continent becomes broader. Hence north-west winds ought to become more frequent upon the east coast as we advance northwards; and they will probably cease to blow so often as soon as the whole continent of North America becomes cultivated.

73
Different currents often appear in the atmosphere at the same time.

There is one curious circumstance which deserves attention. One current of air is often observed to blow at the surface of the earth, while a current in the contrary direction is flowing in a superior part of the atmosphere. Dr Thomson on one occasion observed three currents of this kind blowing all at the same time in contrary directions. It has been affirmed that changes of weather commonly commence in the upper strata, and that they are gradually extended by the current of air that commences above, proceeding towards the lower parts of the atmosphere.

74
Partial winds.

Besides these more general winds, there are others which extend only over a very small part of the earth. These originate from many different causes. The atmosphere is principally composed of three different kinds of air, oxygen, azote, and carbonic acid, to which may be added water. Great quantities of each of these ingredients are constantly changing their aërial form, and combining with various substances; or they are separating from other bodies, assuming the form of air, and mixing with the atmosphere. Partial deficiences, therefore, and partial accumulations, must be continually

Meteors. ally taking place in different parts of the atmosphere, which will occasion winds varying in direction, violence, and continuance, according to the suddenness and the quantity of air destroyed or produced. Besides these, there are many other ingredients constantly mixing with the atmosphere, and many partial causes of condensation and rarefaction in particular places. To these, and probably to other causes hitherto unknown, are to be ascribed all those winds which blow in any place besides the general ones already explained; and which, as they depend on causes hitherto at least reckoned contingent, will probably for ever prevent uniformity and regularity in the winds. All these causes, however, may, and probably will, be discovered: the circumstances in which they will take place, and the effects they will produce, may be known; and whenever this is the case, the winds of any place may in some measure be reduced to calculation.

Chap. V. *Of Meteors.*

75 Meteors. The principal luminous phenomena denominated meteors, have been fully considered under Atmospheric Electricity. Those meteors that burst in the air, and are followed by the falling of stones or other mineral substances, have been fully described and accounted for under Meteorolite. We have here only to notice briefly the meteors called *falling stars*, and *ignes fatui*.

76 Falling star. The falling or shooting star is a very common phenomenon, and takes place more especially at those seasons and in those situations where the aurora borealis is most frequently observed. Indeed they are considered by most philosophers as modifications of the same phenomenon, and depending on the same cause. We have seen good reason to conclude that the aurora borealis is an electrical meteor; and if the falling star is so nearly allied to the aurora as is supposed, it must also be produced by electricity. Mr G. Morgan seems to have no doubt of the electrical nature of this meteor, and remarks that if what appears as an undulating flash in the aurora, could be concentrated, or confined within smaller dimensions, it would probably assume the appearance of a falling star. He founds this opinion chiefly on the following experiment.

Into a tube 48 inches long, and $\frac{1}{4}$ inch diameter, Mr Morgan conveyed as much air, as under the common pressure of the atmosphere, would fill two inches in length of the same tube. (The tube we presume was previously exhausted of air.) One extremity of the tube he connected with the ground by means of good conductors, and fastened to the other a metallic ball. Through the tube thus filled with rarefied air, he sent electric sparks of different magnitudes, by bringing the ball within the striking distance of different fixed conductors. When the sparks were small, a flash like that of the aurora borealis, seemed to fill the whole tube; but when the spark was what might be made to strike through 10 inches in the open air, it appeared to strike through the whole length of the tube, with all the brilliancy and straightness of a falling star. If, however, he extracted part of the air out of the tube, by the air-pump, he could never make the electric fluid assume any form excepting that of a flash; but by exchanging the tube for another with a thermometrical ball, and treating it in the same manner as the preceding, the flash never appeared, but the fluid in its passage assumed all the brilliancy of a falling star. Meteors.

It is easy to trace the similarity of circumstances that take place in this experiment, and in the natural phenomenon of the falling star. Both take place in rarefied air; both are remarkable for the brightness of their light, and for the straightness of their direction. That falling stars are frequently, if not always, the concentration of an aurora borealis, may be inferred from their being the constant attendants of a very electrical state of the atmosphere; and from their frequent appearance near that portion of the heavens which is illumined by the northern lights at the time of their appearance.

Mr Morgan was riding towards Norwich late at night, when to the north east of the town he beheld a fine conical stream of the aurora borealis. The whole body every now and then flashed, as if an additional quantity of electric fluid were thrown into it; and nearly at the same instant he perceived what is vulgarly called a falling star, darting from its summit. This appearance he observed twice successively.

The *ignis fatuus*, or *will-with the-wisp*, that appears so often in boggy, marshy and damp situations, decoying the unwary traveller, and terrifying the superstitious vulgar, seems to be rather of a phosphoric than an electric nature, similar to the light which is emitted by stale fish, rotten wood, and other putrescent substances. Sir Isaac Newton defined it to be a vapour shining without heat. 77 Ignis fatuus.

A remarkable *ignis fatuus* was observed by Mr Derham, in some boggy ground, between two rocky hills. He was so fortunate as to be able to approach it within two or three yards. It moved with a brisk and desultory motion about a dead thistle, till a slight agitation of the air, occasioned, as he supposed, by his near approach to it, occasioned it to jump to another place; and as he approached, it kept flying before him. He was near enough to satisfy himself, that it could not be the shining of glow-worms or other insects—it was one uniform body of light.

M. Beccaria mentions two of these luminous appearances, which were frequently observed in the neighbourhood of Bologna, and which emitted a light equal to that of an ordinary faggot. Their motions were unequal, sometimes rising, and sometimes sinking towards the earth; sometimes totally disappearing, though in general they continued hovering about six feet from the ground. They differed in size and figure; and indeed, the form of each was fluctuating, sometimes floating like waves, and dropping sparks of fire. He was assured there was not a dark night in the whole year in which they did not appear; nor was their appearance at all affected by the weather, whether cold or hot, snow or rain. They have been known to change their colour from red to yellow; and generally grew fainter as any person approached, vanishing entirely when the observer came very near to them, and appearing again at some distance.

Dr Shaw also describes a singular *ignis fatuus*, which he saw in the Holy Land. It was sometimes globular, or in the form of the flame of a candle; and immediately afterwards spread itself so much, as to involve the whole company in a pale inoffensive light, and

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and then was observed to contract itself again, and suddenly disappear. In less than a minute, however, it would become visible as before, and run along from one place to another; or would expand itself over more than three acres of the adjacent mountains. The atmosphere at this time was thick and hazy.

All these lumi ous appearances are probably owing to the extrication of hydrogen gas so slightly impregnated with phosphorus as to continue emitting a faint light, without producing that brilliant flash which follows the sudden extrication into the air, of the common phosphorated hydrogen gas obtained in the usual chemical experiment of throwing phosphuret of lime into water.

Chap. VI. *Of the Application of Meteorology to Prognosticating the Weather.*

It has ever been a principal object among mankind, to foretel the changes of weather that are likely to follow particular appearances in the sky, among the heavenly bodies, &c.; and it has been often alleged, that in this respect the philosopher is far behind the husbandman and the shepherd. Were the former, however, to add to his scientific researches the observations to which the latter are indebted for their judgement of the weather, he would soon be far superior to them in this respect.

79 Kirwan's conclusions on the weather.

Dr Kirwan has lately endeavoured to discover probable rules for prognosticating the weather in different seasons, as far as regards this climate, from tables of observation alone; and from comparing a number of these observations made in England, from 1677 to 1789, he found,

1. That when there has been no storm before or after the vernal equinox, the ensuing summer is generally *dry*, at least five times in six.

2. That when a storm happens from an easterly point, either on the 19th, 20th, or 21st of May, the succeeding summer is generally *dry* four times in five.

3. That when a storm arises on the 26th, 27th, or 29th of May (and not before), in any point, the succeeding summer is generally *dry* four times in five.

4. If there be a storm at south-west or west-south-west on the 19th, 20th, 21st, or 22d of March, the succeeding summer is generally *wet* five times in six.

In this country winters and springs, if dry, are most commonly cold; if moist, warm: on the contrary, dry summers and autumns are usually *hot*, and moist summers cold. So that if we know the moistness or dryness of a season, we can judge pretty accurately of its temperature.

From a table of the weather kept by Dr Rutty, in Dublin, for 41 years, Dr Kirwan endeavoured to calculate the probabilities of particular seasons being followed by others. Though his rules relate chiefly to the climate of Ireland, yet as probably there is not much difference between that island and Britain, in the general appearance of the seasons, we shall mention his conclusions here.

In 41 years there were six wet springs, 22 dry, and 13 variable; 20 wet summers, 16 dry, and five variable; 11 wet autumns, 11 dry, and 19 variable. A season according to Dr Kirwan, is counted *wet*, when it contains two wet months. In general, the quantity of rain which falls in dry seasons is less than five inches; in wet seasons more. Variable seasons are those in which there falls between 30 and 36 pounds, a pound being equal to .157637 of an inch.

80 Probable succession of seasons.

The order in which the different seasons succeeded each other, was as in the following table.

	Has been followed by a		Times	Probability.
A dry spring	dry	Summer	11	$\frac{11}{22}$
	wet	Summer	8	$\frac{8}{22}$
	variable	Summer	3	$\frac{3}{22}$
A wet spring	dry	Summer	0	0
	wet	Summer	5	$\frac{5}{6}$
	variable	Summer	1	$\frac{1}{6}$
A variable spring	dry	Summer	5	$\frac{5}{13}$
	wet	Summer	7	$\frac{7}{13}$
	variable	Summer	1	$\frac{1}{13}$
A dry summer	dry	Autumn	5	$\frac{5}{16}$
	wet	Autumn	5	$\frac{5}{16}$
	variable	Autumn	6	$\frac{6}{16}$
A wet summer	dry	Autumn	5	$\frac{5}{20}$
	wet	Autumn	3	$\frac{3}{20}$
	variable	Autumn	12	$\frac{12}{20}$
A variable summer	dry	Autumn	1	$\frac{1}{5}$
	wet	Autumn	3	$\frac{3}{5}$
	variable	Autumn	1	$\frac{1}{5}$
A dry spring and dry summer	dry	Autumn	3	$\frac{3}{11}$
	wet	Autumn	4	$\frac{4}{11}$
	variable	Autumn	4	$\frac{4}{11}$
A dry spring and wet summer	dry	Autumn	2	$\frac{2}{8}$
	wet	Autumn	0	0
	variable	Autumn	6	$\frac{6}{8}$
A wet spring and dry summer	dry	Autumn	0	0
	wet	Autumn	0	0
	variable	Autumn	0	0
A wet spring and wet summer	dry	Autumn	2	$\frac{2}{5}$
	wet	Autumn	1	$\frac{1}{5}$
	variable	Autumn	2	$\frac{2}{5}$
A wet spring and variable summer	dry	Autumn	1	$\frac{1}{41}$
	wet	Autumn	0	0
	variable	Autumn	0	0
A dry spring and variable summer	dry	Autumn	0	0
	wet	Autumn	2	$\frac{2}{3}$
	variable	Autumn	1	$\frac{1}{3}$
A variable spring and dry summer	dry	Autumn	2	$\frac{2}{4}$
	wet	Autumn	0	0
	variable	Autumn	2	$\frac{2}{4}$
A variable spring and wet summer	dry	Autumn	1	$\frac{1}{7}$
	wet	Autumn	1	$\frac{1}{7}$
	variable	Autumn	5	$\frac{5}{7}$
A variable spring and variable summer	dry	Autumn	0	0
	wet	Autumn	1	$\frac{1}{41}$
	variable	Autumn	0	0

81 Rules for prognosticating the weather.

Hence Dr Kirwan deduced the probability of the kind of seasons which would follow others. This probability is expressed in the last column of the table, and is to be understood in this manner. The probability

that

Weather. that a dry summer will follow a dry spring is $\frac{11}{12}$; that a wet summer will follow a dry spring, $\frac{8}{21}$; that a variable summer will follow a dry spring, $\frac{3}{22}$, and so on.

This method of Dr Kirwan, if there is such a connexion between the different seasons that a particular kind of weather in one has a tendency to produce a particular kind of weather in the next, as it is reasonable to expect from theory, may in time, by multiplying observations, come to a great degree of accuracy, and may at last, perhaps, lead to that great desideratum, a rational theory of the weather. As we wish to throw as much light as possible on this important subject, we shall add to these a few maxims, the truth of which has either been confirmed by long observation, or which the knowledge we have already acquired of the causes of the weather has established on tolerably good grounds.

1. A moist autumn with a mild winter is generally followed by a cold and dry spring, which greatly retards vegetation. Such was the year 1741.

2. If the summer be remarkably rainy, it is probable that the ensuing winter will be severe; for the unusual evaporation will have carried off the heat of the earth. Wet summers are generally attended with an unusual quantity of seed on the white thorn and dog-rose bushes. Hence the unusual fruitfulness of these shrubs is a sign of a severe winter.

3. The appearance of cranes and birds of passage early in autumn announces a very severe winter; for it is a sign it has already begun in the northern countries.

4. When it rains plentifully in May, it will rain but little in September, and *vice versa*.

5. When the wind is south-west during summer or autumn, and the temperature of the air unusually cold for the season, both to the feeling and the thermometer, with a low barometer, much rain is to be expected.

6. Violent temperatures, as storms or great rains, produce a sort of crisis in the atmosphere, which produces a constant temperature, good or bad, for some months.

7. A rainy winter predicts a steril year: a severe autumn announces a windy winter.

To the above we shall add the following maxims, drawn from observation, and with these shall conclude this

82 Signs of rain from birds. article.—Sea and fresh water-fowls, such as cormorants, sea-gulls, muir-hens, &c. flying from sea, or the fresh waters, to land, shew bad weather at hand: land fowls flying to waters, and these shaking, washing, and noisy, especially in the evening, denote the same; geese, ducks, cats, &c. picking, shaking, washing, and noisy; rooks and crows in flocks, and suddenly disappearing; pyes and jays in flocks, and very noisy; the raven or hooded-crow crying in the morning, with an interruption in their notes, or crows being very clamorous at even; the heron, bittern, and swallow flying low; birds forsaking their meat and flying to their nests; poultry going to roost, or pigeons to their dove-house; tame fowls grubbing in the dust, and clapping their wings; small birds seeming to duck and wash in the sand; the late and early crowing of the cock, and clapping his wings; the early singing of wood-larks; the early chirping of sparrows; the early note of the chaffinch near houses; the dull appearance of robin-redbreast near houses; peacocks and owls unusually clamorous.

Sea and fresh-water fowls gathering in flocks to the banks, and there sporting, especially in the morning; 83 Wind from birds. wild-geese flying high, and in flocks, and directing their course eastward; coots restless and clamorous; the hoopoe loud in his note; the king's-fisher taking to land; rooks darting or shooting in the air, or sporting on the banks of fresh waters; and lastly, the appearance of the malefigie at sea, is a certain forerunner of violent winds, and (early in the morning) denotes horrible tempests at hand.

Halcyons, sea-ducks, &c. leaving the land and 84 Fair weather from birds. flocking to the sea; kites, herons, bitterns, and swallows flying high and loud in their notes; lapwings restless and clamorous; sparrows after sunrise restless and noisy; ravens, hawks, and kestrils (in the morning), loud in their notes; robin-redbreast mounted high, and loud in his song; larks soaring high, and loud in their songs; owls hooting with an easy and clear note; bats appearing early in the evening.

Asses braying more frequently than usual; hogs 85 Rain from beasts. playing, scattering their food, or carrying straw in their mouths; oxen snuffing the air, looking to the south, while lying on their sides, or licking their hoofs; cattle gasping for air at noon; calves running violently and gamboling; deer, sheep, or goats, leaping, fighting, or pushing; cats washing their face and ears; dogs eagerly scraping up earth; foxes barking, or wolves howling; moles throwing up earth more than usual; rats and mice more restless than usual; a grumbling noise in the belly of hounds.

Worms crawling out of the earth in great abundance; 86 Rain from insects. spiders falling from their webs; flies dull and restless; ants hastening to their nests; bees hastening home, and keeping close in their hives; frogs and toads drawing nigh to houses; frogs croaking from ditches; toads crying on eminences; gnats singing more than usual; but, if gnats play in the open air, or if hornets, wasps, and glow-worms appear plentifully in the evening, or if spiders webs are seen in the air, or on the grass, or trees, these do all denote fair and warm weather at hand.

Sun rising dim or waterish; rising red with blackish 87 Rain from the sun. beams mixed along with his rays; rising in a musty or muddy colour; rising red and turning blackish; setting under a thick cloud; setting with a red sky in the east.

N. B. Sudden rains never last long; but when the air grows thick by degrees, and the sun, moon, and stars shine dimmer and dimmer, then it is like to rain six hours usually.

Sun rising pale and setting red, with an iris; rising 88 Wind from the sun. large in surface; rising with a red sky in the north; setting of a bloody colour; setting pale, with one or more dark circles, or accompanied with red streaks; seeming concave or hollow; seeming divided, great storms; parhelia, or mock suns, never appear, but are followed by tempests.

Sun rising clear, having set clear the night before; 89 Fair weather from the sun. rising while the clouds about him are driving to the west; rising with an iris around him; and that iris wearing away equally on all sides, then expect fair and settled weather; rising clear and not hot; setting in red clouds, according to the old observation:

The

The evening red and morning gray,
Is the ſure ſign of a fair day.

90 Rain from the moon. Moon pale in colour, rain; horns blunt at firſt riſing, rain; horns blunt, at or within two or three days after the change, denotes rain for that quarter; an iris with a ſouth wind, rain next day; wind ſouth third night after change, rain next day; the wind ſouth, and the moon not ſeen before the fourth night, rain moſt of that month; full moon in April, new and full moon in Auguſt, for moſt part bring rain; mock moons are the forerunners of great rains, land floods, and inundations.

91 Wind from the moon. Moon ſeeming greatly enlarged; appearing of a red colour; horns ſharp and blackiſh; if included with a clear and ruddy iris; if the iris be double or ſeem to be broken in parts, tempeſts.

N. B. On the new moon, the wind for the moſt part changes.

When the moon, at four days old, has her horns ſharp, ſhe foretels a tempeſt at ſea, unleſs ſhe has a circle about her, and that too entire, becauſe, by that ſhe ſhews that it is not like to be bad weather, till it is full moon.

92 Fair weather from the moon. Moon ſeeming to exhibit bright ſpots; a clear iris with full moon; horns ſharp fourth day, fair till full; horns blunt at firſt riſing, or within two or three days after change, denotes rain for that quarter; but fair weather the other three quarters; moon clear three days after change and before full, always denotes fair weather. After every change and full, rains for the moſt part, ſucceeded by fair ſettled weather; moon clear and bright, always fair weather.

93 Weather from the ſtars. Stars ſeeming large, dull, and pale of colour, rain; or when their twinkling is not perceptible, or if encompaſſed withan ir is. In ſummer, when the wind is at eaſt, and ſtars ſeem greater than uſual, then expect ſudden rain; ſtars appearing great in number, yet clear and bright, ſeeming to ſhoot or dart, denote fair weather in ſummer, and in winter froſt.

94 Rain from the clouds. In cloudy weather, when the wind falls, rain follows; clouds growing bigger, or ſeeming like rocks or towers ſettling on tops of mountains; coming from the ſouth, or often changing their courſe; many in number at north-weſt in the even; being black in colour from the eaſt, rain at night; but out of the weſt, rain next day; being like fleece of wool, from the eaſt, rain for two or three days; lying like ridges about mid day in the ſouth-weſt, ſhews great ſtorms both of wind and

95 Wind from the clouds. rain to be nigh. Clouds flying to and fro; appearing ſuddenly from the ſouth or weſt; appearing red, or accompanied with redneſs in the air, eſpecially in the morning; being of a leadiſh colour in the north-weſt; ſingle clouds denote wind from whence they come; but if at ſunſet, clouds appear with golden edges, or diminiſh in bulk, or ſmall clouds ſink low, or draw againſt the wind, or appear ſmall, white, and ſcattered in the north-weſt (ſuch as are vulgarly called mackerel) when the ſun is high, theſe are ſigns of fair weather.

N. B. It is often obſerved, that though the mackerel ſky denotes fair weather for that day, yet for the moſt part, rain follows in a day or two after.

96 Rain from a rainbow. After a long drought, the rainbow denotes ſudden and heavy rains; if green be the predominant colour, it denotes rain, but if red, wind with rain; if the clouds grow darker, rain; if the bow ſeems broken, violent ſtorms; if appearing at noon, much rain; if in the weſt great rain, with thunder.

N. B. It is obſerved, that if the laſt week in February, and the firſt fortnight of March, be moſtly rainy, and attended with frequent appearances of the bow, a wet ſpring and ſummer may be expected.

The rainbow appearing after rains, denotes fair weather at hand, if the colours grow lighter, fair; if the bow ſuddenly diſappears, fair; if the bow appear in the morning, it is the ſign of ſmall rains, followed by fair weather; and if appearing at night, fair weather; if appearing in the eaſt in the evening, fair; if the bow appear double, it denotes fair weather at preſent but rain in a few days; if in autumn, it continues fair for two days after the appearance of the aurora borealis, expect fair weather for at leaſt eight days more. 97 Fair weather from the rainbow.

If miſts be attracted to the tops of hills then expect rain in a day or two; if, in dry weather, they be obſerved to aſcend more than uſual, then expect ſudden rain; miſts in the new moon foreſhew rain in the old; miſts alſo in the old moon denote rain to happen in the new; a miſty white ſcare, in a clear ſky in the ſouth-eaſt, is always a forerunner of rain. 98 Rain from miſts.

If miſts diſſipate quickly, or deſcend after rain, it is a ſure ſign of fair weather; a general miſt before ſunriſing near the full moon, denotes fair weather for about a fortnight running. If after ſunſet or before ſunriſe, a white miſt ariſe from the waters and meads, it denotes warm and fair weather next day. A miſty dew on the inſide of glaſs windows ſhews fair weather for that day. 99 Fair weather from miſts.

Wood ſwelling, or ſtones ſeeming to ſweat; lute or viol ſtrings breaking; printed canvas or paſted maps relaxing; ſalt becoming moiſt; rivers ſinking, or floods ſuddenly abating; remarkable halo about the candle; great dryneſs of the earth; pools ſeeming troubled or muddy; yellow ſcum on the ſurface of ſtagnant waters; dandelion or pimpernel ſhutting up; trefoil ſwelling in ſtalk, while the leaves bow down. 100 Rain from inanimate bodies.

N. B. A dry ſpring is always attended with a rainy winter.

Wind ſhifting to the oppoſite point; ſea calm, with a murmuring noiſe; a murmuring noiſe from the woods and rocks when the air is calm; leaves and feathers ſeeming much agitated; tides high when the thermometer is high; trembling or flexuous burning of flames; coal burning white with a murmuring noiſe; thunder in the morning with a clear ſky; thunder from the north. 101 Wind from inanimate bodies.

N. B. Whenſoever the wind begins to ſhift, it will not reſt till it come to the oppoſite point; and if the wind be in the north, it will be cold; if in the north-eaſt colder; if in the ſouth; it brings rain; but if in the ſouth-weſt more rain.

The ſudden cloſing of gaps in the earth; the remarkable riſing of ſprings or rivers; if the rain begins an hour or two before ſunriſe it is like to be fair ere noon; but if an hour or two after ſunriſe; it for the moſt part happens to continue all day and then to ceaſe; when it begins to rain from the ſouth with a high wind for two or three hours, and that the wind falls, and it ſtill continues raining, it is then like to continue for 12 hours or more, and then to ceaſe. 102 Signs of rain ceaſing.

N. B.

N. B. These long rains seldom hold above 24 hours, or happen above once a year.

103 Of wind ceasing. A hasty shower after raging winds is a sure sign of the storm being near an end. If the water ruckles and frequent bubbles arise, or if the halcyon or king's-fisher attempts the sea while the storm lasts, or moles come out of their holes, or sparrows chirp merrily, these are all certain signs of the storm ceasing.

Both sea and fresh water fishes by their frequent rising and fluttering on the surface of the water, foretel the storm nigh over, but especially dolphins spouting up water in a storm foretel a calm.

N. B. Let the wind be in what quarter it will, upon the new moon, it presently changes.

104 Signs of hail. Clouds white, inclining to yellow, and moving heavily though the wind be high, is a sure sign of hail; if the eastern sky before sunrise be pale, and refracted rays appear in thick clouds, then expect great storms of hail: white clouds in summer are a sign of hail, but in winter they denote snow, especially when we perceive the air to be a little warm; in spring or winter, when clouds appear of blueish white, and expand much, expect small hail or drizzling, which properly is no other than frozen mists.

105 Signs of thunder. Meteors shooting in the summer's evening, or chops and clefts in the earth, when the weather is sultry, always foretel thunder is nigh; in summer or harvest, when the wind has been south two or three days, and the thermometer high, and clouds rise with great white tops like towers, as if one were upon the top of another, and joined with black on the nether side, expect rain and thunder suddenly; if two such clouds arise, one on either hand, it is then time to look for shelter, as the thunder is very nigh.

N. B, It is observed that it thunders most with a south wind and least with an east.

106 Signs of cold and frosty weather. Sea-pyes, starlings, fieldfares, with other migratory birds, appearing early, denote a cold season to ensue; the early appearance of small birds in flocks, and of robin-redbreasts near houses; sun in harvest setting in a mist or broader than usual; moon bright, with sharp horns, after change; wind shifting to the east or north after change; sky full of twinkling stars; small clouds hovering low in the north; snow falling small, while clouds appear on heaps like rocks.

N. B. Frosts in autumn are always succeeded with rain.

107 Signs of thaw. Snow falling in large flakes while the wind is at south; cracks appearing in the ice; sun looking waterish; the moon's horns blunted; stars looking dull; wind turning to the south; wind extremely shifting. It is also observed, that, if October and November be frost and snow, January and February are like to be open and mild.

Fair weather for a week together, while the wind is all that time in the south, is, for the most part, followed by a great drought; if February be for most rainy, spring and summer quarters are like to be so too; but if it happen to be altogether fair, then expect a drought to follow; if lightning follow after 24 hours of dry and fair weather, drought will follow, but if within 24 hours, expect great rains. 108 Signs of drought.

A moist and cold summer, and mild autumn, are sure signs of a hard and severe winter: store of hips and haws denote the same; the hazel-tree flowering is ever observed to foretel the same; acorns found without any insect is a sure prognostic of a hard winter. 109 Signs of a hard winter.

A dry and cold winter with a southerly wind; a very rainy spring, sickness in summer; if summer be dry with the wind northerly, great sickness is like to follow; great heats in spring time without winds; roots having a luscious taste, while the wind has been long southerly without rain; and lastly, great quantities of stinking atoms, insects or animals, as flies, frogs, snakes, locusts, &c. 110 Signs of pestilential seasons.

Inclose the leech worm in an eight ounce phial glass, three fourths filled with water, covered with a bit of linen; let the water be changed once a week in summer, and once a fortnight in winter. 111 Experiments with the leech.

If the leech lies motionless at the bottom in a spiral form, fair weather; if crept to the top, rain; if restless, wind; if very restless, and without the water, thunder; if in winter at bottom, frost; but if in the winter it pitches its dwelling on the mouth of the phial, snow. See HELMINTHOLOGY (F).

In calm weather, when the air is inclined to rain, the mercury is low; but when tending to fair, it will rise; in very hot weather when falling, it foreshews thunder; if rising in winter, frost; but if falling in frost, thaw; if rising in a continued frost, snow; if foul weather quickly on its falling, soon over; if fair weather quickly on its rising, soon over; also if rising high in foul weather, and so continuing for two or three days, before the foul weather is over, then expect a continuance of fair weather; but, if in fair weather the mercury fall low, and so continue for two or three days, then expect much rain, and probably high winds. 112 Signs of the weather from the barometer.

N. B. In an east wind, the mercury always rises and falls lowest before great winds. *

* *Nicholson's Journal*, Feb. 1804, p. 149.

It was intended to insert in this article a summary view of the opinions of Toaldo, Cotte, and Lamarck, respecting the influence of the moon in producing changes in our atmosphere; but peculiar circumstances render it necessary to postpone this view till we come to the article MOON.

(F) In compliance with the writer of this paper, we have retained this passage on the leech; though, as we stated, when treating of the *Hirudo medicinalis*, in HELMINTHOLOGY, we are very sceptical respecting the *weather-judging* faculties of that worm.

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3 *Thaw*,

Meteoromancy || Methodists.

METEOROMANCY, a species of divination by meteors, principally by lightning and thunder. This method of divination passed from the Tuscans to the Romans, with whom, as Seneca informs us, it was held in high esteem.

METESSIB, an officer of the eastern nations, who has the care and oversight of all the public weights and measures, and sees that things are made justly according to them.

METHEGLIN, a species of mead; one of the most pleasant and general drinks which the northern parts of Europe afford, and much used among the ancient inhabitants: (See MEAD). The word is Welsh, *meddyglin*, where it signifies the same.—There are divers ways of making it; one of the best whereof follows: Put as much new honey, naturally running from the comb, into spring water, as that when the honey is thoroughly dissolved an egg will not sink to the bottom, but be just suspended in it; boil this liquor for an hour or more, till such time as the egg swim above the liquor about the breadth of a groat; when very cool, next morning it may be barrelled up; adding to each 15 gallons an ounce of ginger, as much of mace and cloves, and half as much cinnamon, all grossly pounded; a spoonful of yeast may be also added at the bung hole to promote the fermentation. When it has done working, it may be closely stopped up; and after it has stood a month, it should be drawn off into bottles.

METHOD, the arrangement of our ideas in such a regular order, that their mutual connexion and dependence may be readily comprehended. See LOGIC, Part iv.

METHODISTS, in ecclesiastical history, is a denomination applied to different sects, both Papists and Protestants.

I. The *Popish Methodists* were those polemical doctors, of whom the most eminent arose in France towards the middle of the 17th century, in opposition to the Huguenots or Protestants. Those Methodists, from their different manner of treating the controversy with their opponents, may be divided into two classes. The one may comprehend those doctors, whose method of disputing with the Protestants was disingenuous and unreasonable, and who followed the examples of those military chiefs, who shut up their troops in intrenchments and strong holds, in order to cover them from the attacks of the enemy. Of this number were the Jesuit Veron, who required the Protestants to prove the tenets of their church by plain passages of scripture, without being allowed the liberty of illustrating those passages, reasoning upon them, or drawing any conclusions from them; Nihusius, an apostate from the Protestant religion; the two Walenburgs, and others, who confined themselves to the business of answering objections and repelling attacks; and Cardinal Richelieu, who confined the whole controversy to the single article of the divine institution and authority of the church. The Methodists of the second class were of opinion, that the most expedient manner of reducing the Protestants to silence, was not to attack them by piecemeal, but to overwhelm them at once, by the weight of some general principle or presumption, some universal argument, which comprehended or might be applied to all the points contested between the two churches: thus imitating the conduct of those military leaders who, instead of spending their time and strength in sieges and skirmishes, endeavoured to put an end to the war by a general and decisive action. These polemics rested the defence of Popery upon prescription; the wicked lives of Protestant princes who had left the church of Rome; the crime of religious schism; the variety of opinions among Protestants with regard to doctrine and discipline;

Methodists. pline; and the uniformity of the tenets and worship of the church of Rome. To this class belong Nicolle the Jansenist doctor, the famous Bossuet, &c.

II. The *Protestant Methodists* form a very considerable body in this country. The sect was founded in the year 1729 by one Mr Morgan and Mr John Wesley. In the month of November that year, the latter being then fellow of Lincoln college, began to spend some evenings in reading the Greek New Testament, along with Charles Wesley student, Mr Morgan commoner of Christ church, and Mr Kirkham of Merton college. Next year two or three of the pupils of Mr John Wesley, and one pupil of Mr Charles Wesley, obtained leave to attend these meetings. Two years after they were joined by Mr Ingham of Queen's college, Mr Broughton of Exeter, and Mr James Hervey; and in 1735 they were joined by the celebrated Mr Whitefield, then in his 18th year.

At this time it is said that the whole kingdom of England was tending fast to infidelity. "It is come (says Bishop Butler), I know not how, to be taken for granted by many persons, that Christianity is not so much as a subject of inquiry, but that it is now at length discovered to be fictitious; and accordingly they treat it as if in the present age this were an agreement among all people of discernment, and nothing remained but to set it up as a principal subject of mirth and ridicule, as it were by way of reprisals, for its having so long interrupted the pleasures of the world." The Methodists are said, with great probability, to have been very instrumental in stemming this torrent. They obtained their name from the exact regularity of their lives; which gave occasion to a young gentleman of Christ church to say, "Here is a new set of *Methodists* sprung up;" alluding to a sect of ancient physicians which went by that name. This extreme regularity, however, soon brought a charge against them, perhaps not altogether without foundation, of being too scrupulous, and carrying their sanctity to too great a height. In particular it was urged, that they laid too much stress upon the rubrics and canons of the church, insisted too much on observing the rules of the university, and took the scriptures in too literal a sense; and to the name of *Methodists* two others were quickly added, viz. those of *Sacramentarians* and the *Godly Club*.

The principal person in this club while in its infancy appears to have been Mr Morgan, and next to him Mr John Wesley. They visited the sick, and instituted a fund for the relief of the poor; and the better to accomplish their benevolent designs, Mr Wesley abridged himself of all his superfluities, and even of some of the necessaries of life; and by proposing the scheme to some gentleman, they quickly increased their funds to 80l. *per annum*. This, which one should have thought would have been attended with praise instead of censure, quickly drew upon them a kind of persecution; some of the seniors of the university began to interfere, and it was reported "that the college censors were going to blow up the Godly Club *." They found themselves, however, patronised and encouraged by some men eminent for their learning and virtue; so that the society still continued, though they had suffered a severe loss in 1730 in the death of Mr Morgan, who had indeed been the founder of it. In the month of October 1735, John and Charles Wesley, Mr Ingham, and Mr Delamotte son to a merchant in London, embarked for Georgia along with Mr Oglethorpe, afterwards General Oglethorpe. The design of this voyage was to preach the gospel to the Indians. By this time, however, it appears that Mr Wesley had embraced such notions as may without the least breach of charity be accounted fanatical. Thus in a letter to his brother Samuel, he conjures him to banish from his school "the classics with their poison, and to introduce instead of them such Christian authors as would work together with him in "building up his flock in the knowledge and love of God."

* See *Wesley's Life*, p. 105.

During the voyage such a profusion of worship was observed, as we cannot help thinking savoured more of a Pharisaical than Christian behaviour; an account of which, as a similar strictness would certainly be inculcated upon the disciples, and consequently must give a just idea of the principles of the early Methodists, we shall here transcribe from Mr Wesley's life. "From four in the morning till five, each of us used private prayer; from five to seven we read the Bible together, carefully comparing it (that we might not lean to our own understandings) with the writings of the earliest ages; at seven we breakfasted; at eight were the public prayers; from nine to twelve learned the languages and instructed the children; at twelve we met to give an account to one another what we had done since our last meeting, and what we designed to do before our next; at one we dined; the time from dinner to four we spent in reading to those of whom each of us had taken charge, or in speaking to them separately as need required; at four were the evening prayers, when either the second lesson was explained (as it always was in the morning), or the children were catechised and instructed before the congregation; from five to six we again used private prayer; from six to seven I read in our cabin to two or three of the passengers, of whom there were about 80 English on board, and each of my brethern to a few more in theirs; at seven I joined with the Germans in their public service, while Mr Ingham was reading between decks to as many as desired to hear; at eight we met again, to instruct and exhort one another; between nine and ten we went to bed, when neither the roaring of the sea nor the motion of the ship could take away the refreshing sleep which God gave us."

As they proceeded in their passage, this austerity instead of being diminished was increased. Mr Wesley discontinued the use of wine and flesh; confining himself to vegetables, chiefly rice and biscuit. He ate no supper; and his bed having been made wet by the sea, he lay upon the floor, and slept soundly till morning. In his Journal he says, "I believe I shall not find it needful to go to bed, *as it is called*, any more;" but whether this was really done or not, we cannot say.

The missionaries, after their arrival, were at first very favourably received, but in a short time lost the affections of the people entirely. This was owing to the behaviour of Mr Wesley himself, who appeared not only capricious but frequently despotic. He particularly gave offence by insisting upon the baptism of children by immersion; and his excessive austerity with regard to himself

himself did not tend to give his hearers any favourable opinion either of the superior sanctity or wisdom of their teacher. At last, on account of a difference with Mr Causton the storekeeper and chief magistrate of Savannah which ended in a law-suit, he was obliged to return to England.

Thus the cause of Methodism seemed to be entirely lost in Georgia. But Mr Wesley was soon succeeded by a more popular and successful champion, viz. Mr George Whitefield; who having spent his time during the voyage in converting the soldiers with whom he sailed, arrived at Savannah in Georgia on the 7th of May 1738. Here he was received by Mr Delamotte, was joined by several of Mr Wesley's hearers, and became intimate with some other ministers. Mr Ingham had made some progress in converting a few runaway Creek Indians, who had a settlement about four miles from Savannah; but being obliged to return to England in a few months, this design was frustrated, and the Indians in a few years separated. During the short time that Mr Whitefield resided at Savannah, he became extremely popular; and indeed the instances of his success in the way of making converts are very surprising. However, he was obliged to return to England in the autumn of that year, that he might receive priests orders. On his return to America in October 1739, he landed at Philadelphia, and instantly began his spiritual labours as in other places; being attended with astonishing success not only there but wherever he went. Passing through the colonies of Virginia, Maryland, North and South Carolina, the number of converts continually increased; but on his arrival at Savannah, he found the colony almost deserted. He now resumed the scheme he had formerly projected of building an Orphan-house; and for this he made the first collection at Charlestown in South Carolina, amounting to about 70l. sterling. His zeal in the cause of religion, or of the colony, were not, however, sufficient to procure him the favour of those in power. On his return to Philadelphia, after a short stay at Savannah, the churches were denied him; but he was made ample amends by the success which attended his field preachings and private efforts. Religious societies were everywhere set up, and many were converted with symptoms of enthusiasm, different according to their various tempers and constitutions. During this excursion, he was so successful in his collection for the Orphan-house, that on his return to Savannah he brought along with him money and provisions to the value of 500l. sterling.

The success in Georgia was now greater than ever; but the many charities which it was necessary to supply, rendered it necessary in a short time for him to undertake another journey to Charlestown. Here his principles met with the greatest opposition. He had lost the favour of the commissary by his field-preaching, and was denied the sacrament. The opposition, however, was altogether fruitless; the number of converts increased wherever he went, and he now undertook a voyage to New England. In this place also the established clergy were his enemies; but the usual success attended his other endeavours, and procured 500l. more for the use of the orphans in Georgia.

From the year 1741 to 1743 America was deprived of Mr Whitefield's preaching, he having spent that interval in England; but in 1744 he again set out for the western continent. The remarkable success which had hitherto attended his labours now stirred up many opponents; and these had met with the greater success, as none of the Methodist preachers whom he had left were possessed of such abilities either to gain the favour of those who heard them, or to defend their doctrines against objections. Mr Whitefield's success, however, was the same as before: he even found means to inspire the military class with such sentiments of devotion, that Colonel Pepperell could not undertake his expedition against Louisbourg without first consulting Mr Whitefield; and great numbers of New-Englanders went volunteers, confident of victory, in consequence of the discourses of their teacher.

From the continent of America Mr Whitefield took a voyage to the Bermudas islands; and here, as everywhere else, he met with the most surprising success. Here also collections were made for the Orphan-house in Savannah, which were transmitted to that place.

Supposing it to be better for his cause to visit different countries, than to take up a permanent residence in one, Mr Whitefield left Bermudas in a few months, and did not return to America till 1751, when the Orphan-house was found to be in a very flourishing situation. After a short stay, he set sail again for Britain. Here he remained two years, and then set out on another visit to America, landing at Charlestown on the 27th of May 1754. His presence constantly revived the spirits and cause of his party, and added to their numbers wherever he went. Next year he returned to England; but after labouring in the usual manner, and meeting with the usual success there till the year 1763, he set sail again for America, and arrived at Virginia in the latter end of August. He now visited all the colonies, and found that great progress had been made in converting the Indians. On his arrival at Georgia, matters were found in a very flourishing situation, and he received the thanks of the governor and principal people for the great benefit he had been to the colony; which shows, that the stories which had been so industriously propagated, concerning the avarice of him and other Methodist preachers, were, partly at least, unfounded. In 1765 he returned to England; and in 1769 made his seventh and last voyage to America, landing at Charlestown on the 30th of November the same year. He was still attended with the same success; and indeed it is impossible to read, without admiration, an account of the efforts made by himself and Mr Wesley, to propagate their tenets in the different parts of the world.

For a very considerable time Mr Whitefield was the only Methodist who paid any attention to America; and in that country he was more popular than even in Europe. Towards the end of his life, several Methodists having emigrated from Britain, formed distinct societies in New York and Philadelphia. These quickly increased in number; and, about the time that the war with Britain began, their numbers amounted to about 3000 in Virginia, Maryland, New York, and Pennsylvania. They would probably have increased much more, had it not been for the imprudence of some of their preachers, who introduced

Methodists. troduced politics into their discourses, and thus rendered themselves obnoxious to the people among whom they lived. Among those who hurt the cause in this manner was Mr Wesley himself, who, by writing a piece entitled *A Calm Address to the American Colonies*, would in all probability have ruined it, had not a gentlemen, with whom he was connected, destroyed or sent back to England the whole impression as soon as it arrived in America, so that its existence was scarce known in that continent. At the conclusion of the war, Dr Coke, who in 1776 had left a curacy in England in order to join Mr Wesley, paid a visit to his friends in America; though it had been imagined that a total separation had taken place between the American and European Methodists. This breach was, however, made up by a manœuvre of Mr Wesley; for no sooner had the Americans obtained their independence, than he, who had hitherto branded them with the name of *rebels*, sent a congratulatory letter on their freedom from the "State and the Hierarchy," and exhorting them to "stand fast in that liberty with which God had so strangely made them free." To show his zeal in their service still farther, he gave ordination, by laying on of hands, to several preachers who were to embark for America, and consecrated Dr Coke one of the bishops of the Methodist Episcopal church in that country. He extracted also from the liturgy of the English church one for the American Methodists, taking particular care to expunge every expression that had a particular respect to the regal authority.

Such proceedings in one who had formerly professed such extraordinary attachment to the English church, could not but require an apology; and this was accordingly made in a pastoral letter transmitted to the American societies, and addressed "to Dr Coke, Mr Astbury, and our brethren in North America." In this letter he makes the following defence of his conduct. "Lord King's account of the primitive church convinced me, many years ago, that bishops and presbyters are the same order, and consequently have the same right to ordain. For many years I have been importuned, from time to time, to exercise this right, by ordaining part of our travelling preachers. But I have still refused, not only for the sake of peace, but because I was determined, as little as possible, to violate the established order of the national church to which I belonged. But the case is widely different between England and North America. Here there are bishops who have a legal jurisdiction; in America there are none, neither any parish ministers: so that for some hundred miles together, there is none either to baptize, or to administer the Lord's supper. Here, therefore, my scruples are at an end; and I conceive myself at full liberty, as I violate no order, and invade no man's right, by appointing and sending labourers into the harvest. It has indeed been proposed to desire the English bishops to ordain part of our preachers for America; but to this I object. 1. I desired the bishop of London to ordain only one, but could not prevail. 2. If they consented, we know the slowness of their proceedings; but the matter admits of no delay. 3. If they would ordain them now, they would likewise expect to govern them; and how grievously would that entangle us. 4. As our American brethren are now totally disentangled, both from the state and the English hierarchy, we dare not entangle them again either with the one or the other. They are now at full liberty simply to follow the scripture and the primitive church; and we judge it best, that they should stand fast in that liberty wherewith God has so strangely made them free."

Dr Coke, on the consecration of Mr Astbury to the office of a bishop, made another apology. "The church of England (says he), of which the society of Methodists in general have till lately professed themselves a part, did for many years groan in America under grievances of the heaviest kind. Subjected to a hierarchy which weighs every thing in the scale of politics, its most important interests were repeatedly sacrificed to the supposed advantages of England. The churches were in general filled with the parasites and bottle-companions of the rich and great. The humble and most importunate entreaties of the oppressed flocks, yea the representations of a general assembly itself, were contemned and despised. Every thing sacred must bow down at the feet of a party; the holiness and happiness of mankind be sacrificed to their views; and the drunkard, the fornicator, and the extortioner, triumphed over bleeding Zion, because they were faithful abettors of the ruling powers. The memorable revolution has struck off these intolerable fetters, and broken the antichristian union which before subsisted between church and state. And had there been no other advantage arising from that glorious epoch, this itself, I believe, would have made ample compensation for all the calamities of the war; one happy consequence of which was the expulsion of most of those hirelings, who "ate the fat, and clothed themselves with the wool, but strengthened not the diseased," &c. The parochial churches in general being hereby vacant, our people were deprived of the sacraments through the greatest part of these states, and continue so still. What method can we take in so critical a juncture? God has given us sufficient resources in ourselves; and, after mature deliberation, we believe that we are called to draw them forth.

"But what right have you to ordain?" The same right as most of the churches in Christendom; our ordination, in its lowest view, being equal to any of the presbyterian, as originating with three presbyters of the church of England. "But what right have you to exercise the episcopal office?" To me the most manifest and clear. God has been pleased to raise up, by Mr Wesley, in America and Europe, a numerous society well known by the name of *Methodists*. The whole body have invariably esteemed this man as their chief pastor under Christ. He has constantly appointed all their religious officers from the highest to the lowest, by himself or his delegate. And we are fully persuaded there is no church office which he judges expedient for the welfare of the people intrusted to his charge, but, as essential to his station, he has power to ordain. "But, do not you break the succession?" The uninterrupted succession of bishops is a point that has long been given up by the most able Protestant defenders of episcopacy. Bishop Hoadley himself, in his celebrated controversy with Dr Calamy, allows it to be unnecessary. His words are, 'To the 13th question I answer, that I think not an uninterrupted line of succession

Methodists. cession of regularly ordained bishops necessary.' He also grants the authenticity of the anecdote given us by St Jerome, which informs us, that the church of Alexandria had no regular succession from the time of St Mark the evangelist, the first bishop of that church, to the time of Dionysius, a space of 200 years; but the college of presbyters, on the death of a bishop, elected another in his stead. We are also informed, from the epistle of St Clement to the Corinthians, written soon after the death of St Paul, a writer whose works are next in precedence to the canon of scripture, and probably written by immediate inspiration, that the church of Corinth was then governed only by a college of presbyters. And from the epistle of Polycarp to the church of Philippi, written in 116, we also find that the Christian Philippians were then governed only by a college of presbyters. So that the primitive Christians were so far from esteeming the regular succession as essential to the constitution of a Christian church, that, in some instances, episcopacy itself was wholly omitted.

Such was the defence urged by Mr Wesley for this extraordinary assumption of episcopal powers: a conduct, however, of which he afterwards repented, as tending to make a final separation betwixt his followers and the church of England. Yet it does not appear that this had any bad effect on the minds of his American brethren; for Dr Coke, on his arrival on the western continent, found the societies numerous and flourishing. His first efforts were directed against the slave trade; and not only the abolition of that traffic, but the release of all those who were actually slaves at the time, seem to have been his favourite objects. By interfering in this matter, however, perhaps with too much zeal, he involved himself in danger. Some riots took place, and a lady offered the mob 50 guineas if they would give the Doctor 100 lashes. This piece of discipline would have been inflicted, had it not been for the interposition of a sturdy colonel; and the Doctor had not only the satisfaction of escaping the intended punishment, but of seeing his doctrine so far attended to, that some slaves were emancipated.

Mr Hanson, in his Memoirs of Mr Wesley, observes, that "the colonists, in the infancy of Methodism, conducted themselves with more propriety than the English. There was little or no persecution, nor any thing like a riot, except in one or two instances which have been mentioned as the consequence of the animadversions on slavery; and even these were productive of no mischief. Not a creature was materially injured; no bones were broken, nor any lives lost; which was not the case in this country. Here many thousands of innocent people were subjected to the grossest indignities, and several were eventually sacrificed to the fury of their persecutors.

"While we commend the Americans for their behaviour in opposition to the brutality of English mobs, it may be proper to inquire into the sources of this distinction. Something of this may have arisen from similarity of sentiment. The Americans, from the first beginnings of colonization, had been accustomed to the doctrines of the old puritans and nonconformists, which in many respects have a near affinity to the Methodistic tenets. The origin of Methodism in America was seldom, if ever, attended, either under the discourses of Mr Whitefield's or Mr Wesley's preachers, with those ridiculous effects with which it was accompanied in these kingdoms. Most of the preachers, who went over to the continent, having laboured for some years in Europe previous to their having crossed the water, had exhausted their wildfire; so that their discourses were more scriptural and rational than those of the primitive Methodists. Another reason may be found in the education of the Americans. As a people, they are better cultivated than the body of the English; they are chiefly composed of merchants and a respectable yeomanry: and there is but a small proportion of that class, so superabundant here, which we distinguish by the name of *mob*.

"The only exception we have heard, to their exemption from the extravagancies which in this country marked the infancy of Methodism, is a custom they have introduced in Maryland and Virginia. Frequently, at the conclusion of a sermon, the whole congregation begin to pray and to praise God aloud. The uproar which this must create may easily be conceived. Some we are told, are great admirers of this species of enthusiasm, in which every man is his own minister, and one sings and another prays, with the most discordant devotion. But we will not dignify such indecency with such a name. Its proper appellation is *fanaticism*. We hope, that, for the future, religion will never appear in this country under so odious a form; and greatly is it to be lamented, that, among the friends of Christianity, any such absurdities should arise, to furnish infidels with occasions of triumph."

Our author informs us, that the occupation of the Methodist preachers in America was very laborious. In the course of the day they frequently rode 20 or 30 miles, preaching twice or thrice, and sometimes to considerable congregations. Notwithstanding this labour, however, few or none of them ever thought of returning to Britain. Several reasons may be assigned for the pleasure they took in this laborious exercise. "Their excursions (says Mr Hanson) through immense forests abounding in trees of all sorts and sizes, were often highly romantic. Innumerable rivers and falls of water; vistas opening to the view, in contrast with the uncultivated wild; deer now shooting across the road, and now scouring through the woods, while the eye was frequently relieved by the appearance of orchards and plantations, and the houses of gentlemen and farmers peeping through the trees; formed a scenery so various and picturesque, as to produce a variety of reflection, and present, we will not say to a philosophic eye, but to the mind of every reasonable creature, the most sublime and agreeable images.

"Their worship partook of the general simplicity. It was frequently conducted in the open air. The woods resounded to the voice of the preacher, or to the singing of his numerous congregations; while their horses, fastened to the trees, formed a singular addition to the solemnity. It was indeed a striking picture; and might naturally impress the mind with a retrospect of the antediluvian days, when the hills and valleys re-echoed the patriarchal devotions, and a Seth or an Enoch, in the shadow of a projecting rock, or beneath the foliage of of fome venerable oak, delivered his primeval lectures, and was a " preacher of righteoufnefs to the people."

The American hofpitality is fuppofed by Mr Hanfon to have been another reafon for the affiduity of the Methodift teachers, as well as the confcioufnefs of being well employed, and the fatisfaction refulting from confiderations of public utility. As many of the preachers were men of fervent piety, this reflection would have its full weight; and the inftruction of the ignorant and the reformation of the profligate would be confidered as the beft recompenfe of their labours. Spreading themfelves through the continent, they took in Nova Scotia, Georgia, with the principal places in both Carolinas, Virginia, Maryland, Delaware, Pennfylvania, New Jerfey, and New York; numbering upwards of 43,000 members of their fociety, exclufive of about 80 itinerants, and a confiderable number of local preachers, who took no circuits, but affifted occafionally in the neighbourhood of their refpective refidence.

The large and expenfive buildings which the colonifts have erected for public worfhip, almoft exceed credibility; and feveral colleges are founded for the inftruction of youth. How far the propofed plan of uniting genuine religion and extenfive learning will be carried into execution, time only can difcover. It muft materially depend on the character of the prefidents and tutors, and the provifion that fhall be made for their fupport. Men of real erudition will never be procured at low falaries; and it is in vain to attempt eftablifhments of this fort without a liberal provifion for the profeffors in every branch of fcience. Two of thefe places are called *Cokefbury* and *Wefley Colleges*. How they are endowed, or whether they propofe to obtain authority to confer degrees, we are not informed. But perhaps they are rather fchools than colleges; which indeed is a circumftance to be wifhed, as good grammar fchools are of the utmoft fervice to the progrefs of literature.

The great fuccefs which attended the Methodift preachers in America naturally determined Mr Wefley to try the Weft India iflands. The Moravians had already attempted to eftablifh their principles in fome of thefe iflands; and in 1786 fome preachers were fent from the Methodifts in England to the Weft Indies. In many of thefe they met with fuccefs. Societies were formed in Barbadoes, St Vincent's, Dominica, St Chriftopher's, Nevis, Antigua, St Euftatius, Tortola, and St Croix, amounting in all to near 5000 perfons. At this time the whole number of Methodifts in America and the Weft Indies amounted to about 48,302. Thefe focieties confifted both of whites and blacks: on the continent they were moftly whites, but in the iflands negroes. " But it is to be obferved (fays Mr Hanfon) that the fubjection of the negroes, and the obedience in which they are trained, muft inculcate a docility peculiarly favourable to the purpofes of a miffion." Some of the miffionaries went alfo to St Vincent's, where they met with fome fuccefs, and have eftablifhed fome fchools, in which their children are carefully inftructed in the principles of religion.

" In January 1789 (fays our author), Dr Coke paid a vifit to Jamaica, and gave them feveral fermons. As he made but a fhort ftay, it could hardly be confidered as a fair trial. Should a miffion be eftablifhed here, as well as in the other iflands, which will probably be the cafe, it is hoped it will be the means of correcting one vice at leaft, and that is duelling; a favage relict of Gothic barbarity, by which all the iflands have for many years been diftinguifhed. Perhaps too it will give fome check to the fpirit of luxury and diffipation; and teach the planters, if it be found impracticable to emancipate their flaves, at leaft to treat them with humanity."

It has been debated among the leading men of the Methodiftical profeffion, whether the caufe might not be ferved by fending miffionaries to the Eaft Indies and to Africa; but thefe projects were dropped, as there was no invitation, nor any profpect of fuccefs if it had been adopted. A miffion has been formed to the new fettlement called *Kentucky*, on the confines of the Indian territories, near the Miffiffippi. The danger of the miffionaries at the time they undertook this fervice was certainly very great; yet fuch was their zeal for the caufe, that they voluntarily offered themfelves: but we are not yet informed what fuccefs they have met with.

While Methodifm was thus making rapid progrefs in America, its teachers were equally indefatigable in Britain. A moft remarkable particular, however, occurs with regard to Mr Wefley himfelf; for though he had gone to Georgia, as has been already related, to convert the Indians to Chriftianity, yet on his return to England in 1738, he took it into his head that he, their teacher, was not yet converted: the reafon was, that he had not the faith of affurance. This, however, was not long wanting. He arrived in England on the firft day of February, and was bleft with the affurance on the fixth of March following. This was immediately announced to the public; and the confequence, if we may believe him, was, that God then began to work by his miniftry, which he had not done before. Being joined by one Kinchin, a fellow of Corpus, they travelled to Manchefter, Holms Chapel, Newcaftle in Staffordfhire, and other places, where they preached, exhorted, and converfed on religious fubjects, in public houfes, ftables, &c. fometimes meeting with fuccefs and fometimes not. During this peregrination Mr Wefley certainly difplayed a great deal of fuperftition, which we muft undoubtedly fuppofe to have been communicated to his hearers, and to have caufed them act on many occafions in a very ridiculous manner. An inftance follows:— " The next day (fays he), March 11th, we dined at Birmingham, and, foon after we left it, were reproved for our negligence there (in letting thofe who attended us go without either exhortation or inftruction) by a fevere fhower of hail!" About the latter end of March or beginning of April he and his companion began to pray *extempore*, leaving off entirely the forms of the church of England, to which he had formerly been fo devoted. The doctrine of inftantaneous converfion, which his imagination had fuggefted to him as a work performed on himfelf, was greedily received by fome of his hearers; and all the converts to the new doctrine confirmed themfelves, and contributed greatly to perfuade others, by declarations of their *experiences*, as they called them: how-

ever

Methodiſts. ever, though a knowledge of the ſaving aſſurance had been given on March 6th, he does not date his converſion ſooner than May 24th of the ſame year.

This new doctrine of an inſtantaneous, and in fact miraculous impulſe, though greatly reliſhed by the enthuſiaſtical part of the ſociety, was very much diſliked by others, particularly Mr Charles Weſley his brother, who warned him of the miſchief he was doing; though he himſelf was ſoon converted, and, what is very aſtoniſhing, two days before John Weſley himſelf. The particulars related of theſe miraculous converſions are truly diſgraceful, and could not but bring into contempt the ſociety which conſiſted of ſuch enthuſiaſts. "Many (ſays Mr Hanſon) are repreſented as falling ſuddenly to the ground, in horror and agony not to be conceived, and riſing again with equal expreſſions of peace and conſolation."—Their converſions were uſually attended with theſe violent ſymptoms; and, for ſeveral years, few meetings occurred where Mr Weſley preſided, without one or more inſtances of the ſame kind. It was not poſſible that ſuch tranſactions ſhould paſs without notice. The confuſion that too often prevailed, the emotions of the perſons affected, and the exultations of the reſt, which were ſeverally animadverted upon, gave great and general offence. Many inſiſted, that it muſt either be occaſioned by the heat of the rooms, and the agitation of the animal ſpirits under diſcourſes of the moſt alarming nature; or that it was mere artifice and hypocriſy.

In the mean time, two of the ſons of a Mrs Hutton in London, happening to become converts to the new doctrine, this lady was ſo much offended, that ſhe wrote to Mr Samuel Weſley, informing him, that ſhe was of opinion his brother John had loſt his ſenſes; and requeſting, that the next time he came to his houſe, he, Mr Samuel, would either confine or convert him. All that could be done, however, to prevent the progreſs of the new doctrine was inſufficient; and the firſt Methodiſt ſociety was formed in London on the firſt of May 1738, when about 50 agreed to meet together once a-week, for free converſation, begun and ended with ſinging and prayer.

All this time, however, it ſeems that the converſion of Mr Weſley was far from being ſo complete as that of many of his hearers. He had preached and converted others, while he himſelf was abſolutely unconverted. The knowledge of the true ſaving faith was only revealed to him on the 6th of March, and he did not experience its power till the 24th of May; and even after this, his doubts and fears were ſtill ſo great, that on the 13th of June he undertook a voyage to Germany, where, in the company of Count Zinzendorff, his faith ſeems to have been thoroughly confirmed.

On Mr Weſley's return, September 16th, 1738, he applied himſelf with the greateſt aſſiduity and ſucceſs to the propagation of his doctrine. Multitudes of converts were made in various parts of the kingdom; and the reproaches poured upon him by his opponents, ſeemed to have rendered his zeal more fervent if poſſible than before. It is remarkable, however, that ſome of his old friends were now ſo much offended with his conduct or his principles, that they abſolutely refuſed to keep company with him. His original plan ſeems to have been, to make an union of clergymen, and diſſeminate his principles by their means. But in this he ſucceeded ſo ill, that in a letter written in 1742, he wiſhed for a clerical aſſiſtant, were he only in deacons orders: but adds, "I know of none ſuch, who is willing to caſt in his lot with us; and I ſcarce expect I ſhall, becauſe I know how faſt they are rivetted in the ſervice of the devil and the world before they leave the univerſity."—Finding at laſt that nothing could be done with them, he was obliged to have recourſe to lay preachers; and eaſily ſelected thoſe who appeared to have the greateſt talents for prayer and exhortation in the private meetings appointed for that purpoſe. Thus he at once raiſed himſelf to be the head of a ſect; as the lay preachers willingly yielded obedience to him who had the advantages of ſuperior learning and abilities, and was beſides in orders as a clergyman; and this obedience he did not fail on every occaſion to exact.

If his doctrine had formerly given offence to the eſtabliſhed clergy, the appointment of lay preachers was reckoned much worſe; and their being appointed without any form of ordination whatever, which almoſt all of them were, ſubjected them to contempt and reproach, which their want of learning, and very often of natural abilities, did not contribute to remove. Thus finding the churches ſhut againſt him and his followers, he was obliged to preach in the fields, and made his firſt eſſay in this way on the ſecond of April 1739, in the neighbourhood of Briſtol; Mr Whitefield having ſet him an example the day before.

The ſucceſs of thoſe ignorant and itinerant preachers, with their abſurd and uncharitable diſcourſes and behaviour, ſo provoked their adverſaries, that a perſecution was ſoon commenced againſt them. Mr Weſley himſelf was calumniated in the harſheſt manner, being ſometimes ſaid to be a Jeſuit, ſometimes an illiterate enthuſiaſt, as the people took it into their heads. Many pretended to anſwer him in writing, without being able to do ſo: the conſequence was, that their deficiency of argument was ſupplied by invective, and the moſt ſcandalous performances made their appearance. Some of the Engliſh clergy ſo far forgot themſelves as to inſtigate the mob againſt them, and the moſt cruel outrages were committed upon them in various places. For ſome time the perſecuted party adhered to the doctrines of paſſive obedience and nonreſiſtance, which their inhuman adverſaries did not fail to take the advantage of.—The leſs they were oppoſed, the more inſolent they became. The Methodiſts were frequently in danger of their lives. Men, women with child, and even children, were knocked down and abuſed with the ſame undiſtinguiſhing fury. Houſes were ſtripped of their furniture, vaſt quantities of furniture carried off, featherbeds cut in pieces and ſtrewed over the ſtreets, ſeveral reputable people were forced into the army, &c. To the diſgrace of magiſtracy alſo it was found, that when application was made to the juſtices of the peace, redreſs was commonly denied; nor was a ſtop put to theſe ſhameful proceedings without a royal mandate for the purpoſe.

From the year 1738 to 1747 Mr Weſley and his itinerants were employed in various parts of England.

In

Methodists. In 1747 he went over to Dublin, where a society had been formed by one Mr Williams a clergyman.—Here they proved so successful, notwithstanding the number of Papists, and the violence of their other opponents, that in 1750 they had erected meeting-houses in every part of the kingdom, and had formed 29 circuits, which employed 67 itinerants, besides a considerable number of local preachers. An invitation was given to Mr Wesley, in 1751, to visit Scotland, by an officer in quarters at Musselburgh. He accordingly took a journey thither the same year; but left the place, after preaching in it once or twice. In 1753 he returned to Scotland, and visited Glasgow. Societies were at length formed in that city, as well as at Edinburgh, Dundee, Aberdeen, Inverness, and a few other places: but his success was by no means equal to what it had been in other parts; for in 1790 the number of circuits in Scotland was no more than eight, which were supplied by 20 itinerants.

Mr Whitefield, the other great labourer in the vineyard, was equally indefatigable, and probably more successful than Mr Wesley. Before entering into orders, he had formed a society of religious persons at Gloucester: here he preached his first sermon on the Necessity and Benefit of Religious Society; here he became extremely popular, as well as at Bristol and London, while preparing to set sail for Georgia for the first time; and in all places to which he came, large collections were made for the poor. He maintained the same doctrine with Mr Wesley as to the new birth; which likewise gave offence to the clergy when delivered by him, as it had done with Mr Wesley. In the various intervals of his voyages to America, he employed himself with the very same assiduity in Britain and in Ireland, which we have already taken notice of in the western continent. His success was everywhere prodigious. In 1741 he was invited to Scotland, and preached his first sermon there at Dunfermline. From thence he went to Edinburgh, and preached in several of the established churches, but differed with Messrs Ralph and Ebenezer Erskine; so that he, as well as Mr Wesley, proved unsuccessful in forming a coalition with any other religious party. In the private way, however, his success was very considerable, at Edinburgh, Glasgow, Aberdeen, Dundee, and other places. In 1742 he paid a second visit to Scotland, and a third one in 1748. In 1751 he visited Ireland for the first time; and preached to great multitudes, without being molested, even in places where others had been mobbed. From thence he returned to Scotland the same year, and speaks in very favourable terms of the attention the people there paid to their Bibles. In 1752 and 1753 he again visited the same kingdom, and the last time distinguished himself by preaching against the playhouse in Glasgow. In 1756 he returned; and by his animated discourses at Edinburgh against Popery and arbitrary power, was owned to have contributed very much to the increase of courage and loyalty in this country. Next year he again visited the Scottish capital during the time that the General Assembly sat, and his sermons were attended by several of the members. At Glasgow he made a large collection for the poor of that city, and from thence took a voyage to Ireland. He was received with the usual affection by the lower classes of Protestants; but the Popish rabble, exasperated at his success, almost murdered him with stones. After passing through a great part of Ireland, visiting England and Wales, he paid another visit to Scotland, where four clergymen now lent him their pulpits. His last visit was in the summer of 1758, when his congregations were as large as ever; and it is to his endeavours principally that we are to ascribe the great number of Methodist societies now existing in Scotland.

With regard to the religious principles of the Methodists, we cannot enter into any particular detail; neither indeed are there any doctrines peculiar to all included under that name, except the single one of universal redemption. In March 1741, Mr Whitefield being returned to England, entirely separated from Mr Wesley and his friends, "because he did not hold the decrees."—Here was the first breach, which warm men persuaded Mr Whitefield to make, merely for a difference of opinion. Those indeed who believed universal redemption, had no desire at all to separate: but those who held particular redemption, would not hear of any accommodation, being determined to have no fellowship with men that "were in such dangerous errors." So there were now two sorts of Methodists so called; those for particular, and those for general, redemption.

History of Methodism, &c.

Not many years passed, before William Cudworth and James Relly separated from Mr Whitefield.—These were properly Antinomians, absolute avowed enemies to the law of God, which they never preached or professed to preach, but termed all *legalists* who did. With them, preaching the law was an abomination. They had nothing to do with the law. They would preach Christ, as they called it; but without one word either of holiness or good works. Yet these were still denominated *Methodists*, although differing from Mr Whitefield both in judgement and practice, abundantly more than Mr Whitefield did from Mr Wesley.

In the mean time, Mr Venn and Mr Romaine began to be spoken of: and not long after Mr Madan and Mr Berridge, with a few other clergymen, who, although they had no connexion with each other, yet preaching salvation by faith, and endeavouring to live accordingly, to be Bible Christians, were soon included in the general name of *Methodists*. And so indeed were all others who preached salvation by faith, and appeared more serious than their neighbours. Some of these were quite regular in their manner of preaching: some were quite irregular, (though not by choice; but necessity was laid upon them, they must preach irregularly, or not at all): and others were between both; regular in most, though not in all particulars.

In 1762, George Bell and a few other persons began to speak great words. In the latter end of the year they foretold that the world would be at an end on the 28th of February. Mr Wesley, with whom they were then connected, withstood them both in public and private. This they would not endure: so, in January and February 1763, they separated from him, under the care of Mr Maxfield, one of Mr Wesley's preachers. But still Mr Maxfield and his adherents,

rents, even the wildeft enthufiafts among them, go under the general name of *Methodifts*, and fo bring a fcandal upon thofe with whom they have no connexion.

At prefent, thofe who remain with Mr Wefley are moftly Church of England men. They love her articles, her homilies, her liturgy, her difcipline, and unwillingly vary from it in any inftance. Mean time, all who preach among them declare, *we are all by nature children of wrath*, but *by grace we are faved through faith*: faved from both the guilt and from the power of fin. They endeavour to live according to what they preach, to be plain Bible Chriftians; and they meet together at convenient times, to encourage one another therein. They tenderly love many that are Calvinifts, though they do not love their opinions. Yea, they love the Antinomians themfelves; but it is with a love of compaffion only, for they hate their doctrines with a perfect hatred; they abhor them as they do hell fire: being convinced nothing can fo effectually deftroy all faith, all holinefs, and all good works.

We fhall conclude this article with the words of Mr Hanfon, which muft certainly be accounted juft, whatever objections may be made to fome parts of the principles or behavour of the Methodifts. "If they poffefs not much knowledge, which, however, we do not know to be the cafe, it is at leaft certain, they are not deficient in zeal: and without any paffionate defire to imitate their example, we may at leaft commend their endeavours for the general good. Every good man will contemplate with pleafure the operation of the fpirit of reformation, whether foreign or domeftic; and will rejoice in every attempt to propagate Chriftianity in the barbarous parts of the world. An attempt which, if in any tolerable degree fuccefsful, will do infinitely more for their civilization and happinefs, than all the united energies of thofe boafted benefactors of mankind, the philofophic infidels."

The minutes of the laft conference of the Methodifts held at Leeds in Auguft, 1806, reprefent the numbers of that fociety to be as follows:

In Great Britain, - -	110,803
In Ireland, - -	23,773
Gibraltar, - -	40
Nova Scotia, New Brunfwick, and Newfoundland, - -	1,418
Weft Indies, whites 1775, coloured people 13,165, - -	14,940
United States, whites 95,628, coloured people 24,316, - -	119,945
Total,	270,919

Methodists (*Methodici*), in the hiftory of medicine, a fect of ancient phyficians, who reduced the whole art of healing to a few common principles or appearances. The Methodifts were the followers of Theffalus; whence they were alfo called *Theffalici*. They were ftrenuoufly oppofed by Galen in feveral of his writings; who fcrupled not to affert, that the methodical herefy ruined every thing that was good in the art. According to Quincy, the *Methodifts* (*Methodici*) are thofe phyficians who adhere to the doctrine of Galen, and the fchools; and who cure with bleeding, purges, &c. duly applied according to the fymptoms, circumftances, &c. in oppofition to empirics and chemifts, who ufe violent medicines, and pretended fecrets or noftrums.

METHUSELAH, the fon of Enoch and father of Lamech, was born in the year of the world 687, begat Lamech in 874, and died in 1656, being the very year of the deluge, at the age of 969, which is the greateft age that has been attained to by any mortal man upon earth (Gen. v. 21, 22, &c.) According to the text of the feptuagint, Methufelah muft have lived 14 years after the deluge; and according to other copies, he died fix years before it: but it is generally agreed on, that thefe copies, as well as the feptuagint, are corrupted in this place.

METHYMNA, in *Ancient Geography*, a town of the ifland of Lefbos. It was the fecond city of the ifland in greatnefs, population, and opulence. Its territory was fruitful, and the wines it produced excellent. It was the native place of Theophraftus, and of Arion the mufician. When the whole ifland of Lefbos revolted from the power of the Athenians, Methymna alone remained firm to its ancient allies.

METŒCI, a name given by the Athenians to fuch as had their fixed habitations in Attica, though foreigners by birth. The *metœci* were admitted by the council of Areopagus, and entered in the public regifter. They differed both from the πολιται and ξενοι; becaufe the *politæ* or "citizens" were freemen of Athens, and the *xeni* or "ftrangers" had lodgings only for a fhort time; whereas the *metœci*, though not freemen of Athens, conftantly refided upon the fpot whither they had removed.

METONYMY, in *Rhetoric*, is a trope in which one name is put for another, on account of the near relation there is between them. See Oratory, N° 51.

METOPE, in *Architecture*, is the interval or fquare fpace between the triglyphs of the Doric frieze, which among the ancients ufed to be painted or adorned with carved work, reprefenting the heads of oxen or utenfils ufed in facrifices.

METOPOSCOPY, the pretended art of knowing a perfon's difpofitions and manners by viewing the traces and lines in the face. Ciro Spontoni, who has written exprefsly on metopofcopy, fays, that feven lines are examined in the forehead, and that each line is confidered as having its particular planet: the firft is the line of Saturn, the fecond of Jupiter, the third of Mars, &c. Metopofcopy is only a branch of phyfiognomy, which founds its conjectures on all the parts of the body.

METRE, μετρια, in *Poetry*, a fyftem of feet of a juft length.

The different metres in poetry, are the different manners of ordering and combining the quantities, or the long and fhort fyllables; thus hexameter, pentameter, iambic, fapphic verfes, &c. confift of different metres or meafures. See Hexameter.

In Englifh verfes, the metres are extremely various and arbitrary, every poet being at liberty to introduce any new form that he pleafes. The moft ufual are the heroic, generally confifting of five long and five fhort fyllables, and verfes of four feet, and of three feet, and a cæfura or fingle fyllable.

The ancients, by varioufly combining and tranfpofing their quantities, made a vaft variety of different meafures, measure, by forming spondees, &c. of different feet. See Poetry.

METRETES, a Grecian measure, containing something more than nine English gallons. See Measure.

METRICAL verses, are those consisting of a determinate number of long and short syllables; as those of the Greek and Latin poets.—Capellus observes, that the genius of the Hebrew language is incompatible with metrical poetry.

METROCOMIA (from μήτηρ *mother*, and κωμη *town* or *village*), a term in the ancient church-history, signifying "a borough or village that had other villages under its jurisdiction."—What a metropolis was among cities, a *metracomia* was among country towns. The ancient *metrocomiæ* had each its choriepiscopus or rural dean, and here was his see or residence. See Metropolis and Choriepiscopus.

METRONOMII, the name given by the Athenians to five officers in the city and ten in the *Piræus*, whose duty it was to inspect all sorts of measures except those of corn. The *Piræus* was the greatest mart in Attica.

METROPOLIS (from μητηρ *mother*, and πολις *city*), the capital of a country or province; or the principal city, and as it were mother of all the rest.

The term metropolis is also applied to archiepiscopal churches, and sometimes to the principal or mother-church of a city. The Roman empire having been divided into 13 dioceses and 120 provinces, each diocese and each province had its metropolis or capital city, where the proconsul had his residence. To this civil division the ecclesiastical was afterwards adapted, and the bishop of the capital city had the direction of affairs, and the pre-eminence over all the bishops of the province. His residence in the metropolis gave him the title of *metropolitan*. This erection of metropolitans is referred to the end of the third century, and was confirmed by the council of Nice. A metropolitan has the privilege of ordaining his suffragans; and appeals from sentences passed by the suffragans are preferred to the metropolitan.

Metropolis, in *Ancient Geography*, a town of Acarnania, a little to the south of Stratos.—Another, of Lydia; situated between Colophon and Priene, near the Cayster.—A third, of Phrygia; sacred to the mother of the gods, who was here worshipped.—A fourth Metropolis of Estiotis, a district in Thessaly, to the east of Gomphi, and the last town of that district. *Metropolitæ*, the people.

METULUM, in *Ancient Geography*, a considerable city of Liburnia, at the siege of which Octavius Cæsar was wounded. Said to be the metropolis, and situated on two eminences, intersected by a valley (Appian.) Now generally thought to be *Metling* in Carniola. E. Long. 16. N. Lat. 46. 5.

METZ, an ancient, large, and strong town of France, and capital of the territory of Messin, with a citadel and a bishop's see, whose bishop used to hold the title of a prince of the empire. The cathedral church is one of the finest in Europe, and the square called *Costin* and the house of the governor are worth seeing. The Jews live in a part of the town by themselves, where they have a synagogue. The sweetmeats they make here are in high esteem. It is seated at the confluence of the rivers Moselle and Seille. E. Long. 6. 16. N. Lat. 49. 7.

MEVANIA, in *Ancient Geography*, a town of the Cisapennine Umbria; seated at the confluence of the Tina and Clitumnus, on the Via Flaminia, famous for its herds of white cattle brought up there for sacrifice; the white colour said to be owing to the waters of the Clitumnus (Virgil). Mevania was the country of Propertius. *Mevenates* the people. Now said to be *Bevagna*, in the territory of the Pope.

MEURSIUS, John, a learned and laborious writer, was born at Losdun, near the Hague, in 1579. He early discovered a fondness for polite literature and the sciences; and went to study law at Orleans with the son of Barneveldt, whom he accompanied in his travels. In 1610 he was made professor of history at Leyden, and afterwards Greek professor. In the following year, the magistrates of the United Provinces proved how high their opinion was of his abilities, by fixing on him to write the history of his country. Meursius married in the year 1612. His wife, Anna Catherina Bilberbeccia, descended from a very ancient and noble family in Angermond a city of Pomerania, possessed many amiable qualities, and rendered his domestic life remarkably happy, while he discharged the duties of his professorship with an assiduity equal to his abilities. At the same time the republic of letters did not lose the advantages to be derived from his labours; for during the fourteen years of his residence at Leyden, the works which he published were more numerous than those which had been presented to the world by the whole body of professors from the original foundation of the university in 1575.

Meursius's writings had now spread his reputation in every part of Europe; nor was the fame of his diligence and talents as a professor less known. In so high a rank, indeed, did he stand among his literary contemporaries, that Christian IV. king of Denmark conferred on him the place of historiographer royal, and invited him to undertake the professorship of history and politics in the academy of Sora, which was founded by King Frederick II. although the revival of its honours and dignities may be dated from this period, when it seemed to be again founded under the auspices of Christian IV. Meursius and his family left Leyden in the year 1635. On his arrival at Sora, he was received with the most friendly tokens of regard by his majesty and the Danish nobility, and more particularly by Chancellor Rosenkrantz, on whom he has bestowed very ample praises in one of his letters. Here he resided, equally beloved and admired, for above twelve years. His pupils were not very numerous, but his exertions never relaxed. Those hours likewise which were not devoted to the duties of his professorship, he employed in revising the works of the ancients and in philological disquisitions.

His health did not suffer by the intenseness of application, till in the year 1638 he had a violent attack of the stone, from which disorder he had suffered severely. In a letter to Vossius he thus describes his melancholy condition: "The state of my health during the whole of the last winter has been truly deplorable. My sufferings from the stone have been really

Meurſius. really dreadful. I have voided ſo many, that the repeated diſcharges brought on a wound which emitted blood for above four months. I was next attacked by a tertian fever, which increaſed conſtantly, and produced an univerſal laſſitude of body, a dejection of ſpirits, and a total loſs of appetite. But, thank heaven, I have now in ſome meaſure recovered my ſtrength, and gotten the better of theſe complaints." He recovered from this attack; but in the following year the diſorder returned with redoubled violence, and brought on a conſumption which terminated his exiſtence on the 20th day of September 1639. He left behind him a ſon who was named after him, and one daughter.

So mild were the diſpoſitions of Meurſius, that in all his writings he conſtantly avoided literary diſputes. He was ſometimes unavoidably drawn into them; but conſtantly endeavoured to promote a reconciliation rather than widen any breach, by his replies to the attacks of his adverſaries. In his friendſhips he was firm and affectionate. Of his domeſtic life, whatever is known has been gathered from his letters. The ſame eaſy tranquillity ſeems to have attended him in every ſituation. In his family he was particularly fortunate. In his ſon, to whom he gave his own name, he ſeemed to behold his own youth renewed. The ſame application, the ſame eagerneſs in the purſuit of knowledge, marked the conduct of this promiſing young man; who did not long ſurvive his father, but died ſoon after he had recommended himſelf to the notice of the learned world by his publications. They were only three in number; but diſplayed ſo much ſolid learning, that they have been aſſigned to the father, John Meurſius, by l'Abbé Beughem and others. This miſtake was occaſioned as much by the ſimilitude of their names, as by the nature of their works, and their manner of treating philological ſubjects.

His works may be divided into four claſſes, of which each might form a ſeparate volume if they were ever to be republiſhed. Meurſius himſelf indeed, in one of his letters to Voſſius, propoſes ſuch a diviſion. From that epiſtle, and from another which the younger Meurſius ſent to G. I. Voſſius, who ſtrongly adviſed him to republiſh the whole of his father's writings, and from the collections of his poſthumous works which have appeared from Struvius, Groſchupſius, Moller, and ſome others, a catalogue of his works might be formed. Some aſſiſtance will alſo be derived from the indexes publiſhed in their reſpective works, by Hankins, Deſſelius, Wettenius, and Bartholinus. The plan which Meurſius recommends for publiſhing his works, is to inſert in the firſt volume all that he has written relative to Athens; in the ſecond, his hiſtorical pieces; in the third, his miſcellaneous diſſertations; and in the fourth, the various authors which he publiſhed, with his notes and corrections.

A ſcandalous and indecent work, which is entitled *Meurſii elegantiæ Latini ſermonis*, and has *Aloiſiæ Sigeæ Satyræ Sotadicæ* annexed to it, is very falſely attributed to Meurſius; nor indeed are the *Satires* with more reaſon aſſigned to Aloiſia Sigea, who was a Spaniſh lady eminent for her piety and virtue. The real author of theſe infamous productions was Weſtrenius, an advocate at Copenhagen, who probably aſſumed the name of Meurſius, in order to ſhield himſelf from the diſgrace which would naturally have attended the writer of ſuch a performance.

Mew || Mexico.

MEW, SEA-MEW, or *Sea-mall.* } See LARUS, ORNI-
Winter MEW, or *Coddy-moddy.* } THOLOGY *Index.*

MEWING, the falling off or change of hair, feathers, ſkin, horns, or other parts of animals, which happens in ſome annually, in others only at certain ſtages of their lives; but the generality of beaſts mew in the ſpring. An old hart caſts his horns ſooner than a young one, which is commonly in the months of February and March, after which they begin to button in March or April: and as the ſun grows ſtrong, and the ſeaſon of the year puts forth the fruits of the earth, ſo their heads grow, and are ſummed full by the middle of June. It is to be obſerved, that if a hart be gelt before he has a head, he will never have any; and if he be gelt after he has a head, he will never caſt his horns; again, if he be gelt when he has a velvet head, it will always be ſo, without fraying or burniſhing.

MEXICO, a province of the Spaniſh empire in America, once a celebrated kingdom, the moſt powerful and civilized in the new world; lying between the 14th and 21ſt degrees of north latitude, and between 91 and 103 degrees weſt longitude; being near 2000 miles in length, and in ſome places 600 miles in breadth. 1 Toltecans the firſt inhabitants.

The Toltecans are the moſt ancient Mexican nation of which we know any thing. They were expelled, as we are told, from their own country (ſuppoſed by Clavigero to have been *Tollan*, to the northward of Mexico) in the year 472; and for ſome time led a wandering life. In whatever place they determined to reſide for any conſiderable time, they erected houſes and cultivated the ground. Thus their migrations were extremely ſlow, and it was not till 104 years after they ſet out that they reached a place about 50 miles to the eaſtward of the city of Mexico, where they ſettled for 20 years, giving to their new place of reſidence the name of *Tollantzinco*. From thence they proceeded about 40 miles farther to the weſt, where they built a city called, from the name of their country, *Tollan*, or *Tula*. 2 Their hiſtory.

After the final ſettlement of the Toltecans, the government was changed into a monarchy. Their firſt king began his reign in 667, and their monarchy laſted 384 years, during which time they reckon juſt eight princes. We are not, however, to imagine that each of their kings lived long enough to make up this ſpace. It was a cuſtom among them that the name of the king ſhould be continued for 52 years, and no longer, from the time he aſcended the throne. If he died within that period, the government was carried on in his name by a regency; if he ſurvived, he was obliged to reſign his authority. During the four centuries that the Toltecan monarchy continued, they had increaſed very conſiderably in number, and had built many cities; but when in the height of proſperity, almoſt the whole nation was deſtroyed by a famine occaſioned by drought; and a peſtilence, probably the conſequence of the former. "According to Torquemada (ſays our author), at a certain feſtival-ball made by the *Toltecans*, the *ſad-looking* devil appeared to them of a gigantic ſize, with immenſe arms, and in the midſt of the entertainment he embraced and ſuffocated them; that then he appeared in the form of a child with a putrid head, and

Mexico. and brought the plague; and, finally, at the persuasion of the same devil, they abandoned the country of Tula."

3 Succeeded by the Chichemecas. They were succeeded by the Chichemecas, a much more barbarous people, who came from an unknown country called *Amaquemecan*, where they had for a long time resided; but of which no traces of remembrance can be found among any of the American nations known to Europeans; so that Clavigero supposes it must have been very far to the northward.

The motive which the Chichemecas had for leaving their own country is not known. They were eighteen months on their journey, and took possession of the desolate country of the Toltecas about an hundred years after the former had left it. They were much more uncivilized than the Toltecans; but, however, had a regular form of monarchical government, and in other respects were less disgusting in their manners than some of the neighbouring nations. The last king who reigned in Amaquemecan before the departure of the Chichemecas, had left his dominions between his two sons Auchcauhtli and Xolotl, and the latter conducted the new colony. Having proceeded from the ruins of Tula towards Chempoalla and Tepepolio, Xolotl sent his son to survey the country. The prince crossed the borders of the lakes and the mountains which surround the vale of Mexico; then ascending to the top of a very high one, he viewed the whole country, and took possession of it in the name of his father, by shooting four arrows to the four winds.

4 Xolotl their first king. Xolotl being informed by his son of the nature of the country, chose for the capital of his kingdom Tenayuca, about six miles to the northward of the city of Mexico, and distributed his people in the neighbouring territory; but as most of them went to the northward, that part obtained the name of the country of the Chichemecas, in distinction from the rest. Here a review of the people was taken, and their number, according to Torquemada, was more than a million.

Xolotl finding himself peacefully settled in his new dominion, sent one of his officers to explore the sources of some of the rivers of the country. While performing this task he came to the habitations of some Toltecans, who it seems had still kept together, and were likely once more to become a nation. As these people were not inclined to war, and greatly esteemed for

5 His people civilized by the Toltecans. their knowledge and skill in the arts, the Chichemecas entered into a strict alliance with them, and Prince Nopaltzin, who had first surveyed the country, married a Toltecan princess. The consequence of this alliance was the introduction of the arts and knowledge of the Toltecans among the Chichemecas. Till now the latter had subsisted entirely by hunting, and such fruits and roots as the earth spontaneously produced. They were clad in the skins of wild beasts, and, like these beasts, they are said to have sucked the blood of the animals they caught; but after their connection with the Toltecans they began to sow corn, to learn the art of digging and working metals, to cut stones, manufacture cotton, and, in every respect, to make great improvements.

6 New inhabitants arrive and obtain settlements. When Xolotl had reigned about eight years in his new territories, an embassy of six persons arrived from a distant country not far from *Amaquemecan*, expressing a desire of coming with their people to reside in the country of the Chichemecas. The king gave them a gracious reception, and assigned them a district; and, in a few years after, three other princes, with a great army of Acolhuans, who were likewise neighbours of Amaquemecan, made their appearance. The king was at that time at Tezcuco, to which place he had removed his court: and here he was accosted by the princes, who, in a submissive and flattering manner, requested him to allow them a place in his happy country, where the people enjoyed such an excellent government. Xolotl not only gave them a favourable reception, but offered them his two daughters in marriage, expressing his concern that he had no more, that none might have been excluded from the royal alliance. On the third prince, however, he bestowed a noble virgin of Chalco, in whom the Toltecan and Chichemecan blood were united. The nuptials were celebrated with extraordinary pomp; and the two nations, after the example of the sovereigns, continued to intermarry. As the Acolhuans were the more civilized nation of the two, the name of Chichemecas began to be appropriated to the more rude and barbarous part, who preferred hunting to agriculture, or chose a life of savage liberty in the mountains to the restraints of social laws. These barbarians associated with the Otomies, another savage nation who lived to the northward, occupying a tract of more than three hundred miles in extent; and by their descendants the Spaniards were harassed for many years after the conquest of Mexico.

As soon as the nuptial rejoicings were over, Xolotl divided his territories into three parts, assigning one to each of the princes. Acolhuatzin, who had married his eldest daughter, had Azcopazalco, 18 miles to the westward of Tezcuco; Chiconquauhtli, who married the other, had a territory named Xaltocan; and Tzontecomatl, who married the lady of inferior rank, had one named Coatlichan. The country continued for some time to flourish, population increased greatly, and with it the civilization of the people; but as these advanced, the vices of luxury and ambition increased in proportion. Xolotl found himself obliged to treat his subjects with more severity than formerly, and even to put some of them to death.—This produced a conspiracy against him, which, however, he had the good fortune to escape; but while he meditated a severe revenge on the conspirators, he was seized with the distemper of which he died, in the fortieth year of his reign, and in a very advanced age. 7 Division of the dominions of Xolotl.

Xolotl was succeeded by his son Nopaltzin, who at the time of his accession is supposed to have been about sixty years of age. In his time, the tranquillity of the kingdom, which had begun to suffer disturbance under his father, underwent much more violent shocks, and civil wars took place. Acolhuatzin, the only one of the three princes who remained alive, thinking the territory he possessed too narrow, made war upon the lord of a neighbouring province named Tapotzotlan, and deprived him of his territory. Huetzin, son to the late Prince Tzontecomatl, lord of Coatlichan, fell in love with the grand-daughter of the queen, a celebrated beauty, but was rivalled by a neighbouring lord, who determined to support his pretensions 8 Nopaltzin the second king.

pretenſions by force of arms. Huetzin, however, got the better, defeated and killed his adverſary, and then poſſeſſed himſelf of the lady and his eſtate. This was followed by a rebellion of the whole province of Tollantzinco, ſo that the king himſelf was obliged to take the field. As the rebels were very numerous, the royal army was at firſt defeated; but having at laſt received a ſtrong reinforcement, the rebels were overcome, and their ringleaders ſeverely puniſhed. The king did not long ſurvive the reſtoration of tranquillity to his dominions. He died in the thirty-ſecond year of his reign, and ninety-ſecond of his age, leaving the throne to his eldeſt ſon Tlotzin, who was an excellent prince, and reigned thirty-ſix years.

9 Quinatzin a luxurious prince.

Quinatzin, the ſon and ſucceſſor of Tlotzin, proved a vain and luxurious prince. His acceſſion to the throne was celebrated with much greater pomp than any of his predeceſſors. Xolotl had removed his court from Tenayuca to Tezcuco; but being diſguſted with this laſt place, on account of the conſpiracy formed againſt him there, he had returned to Tenayuca.—There the court continued till the reign of Quinatzin, who removed it back to Tezcuco.

10 Diſturbances in various parts.

The reign of Quinatzin, though tranquil at firſt, was ſoon diſturbed by dangerous revolts and rebellions. Theſe firſt broke out in two ſtates, named Maztillen and Totopec, ſituated among the northern mountains. The king, having collected a great army, marched without delay againſt the rebels, and challenged their leaders to come down and fight him in the plain.—This challenge being accepted, a furious engagement enſued, in which, though great numbers fell on both ſides, no deciſive advantage was gained by either party. Frequent engagements took place for the ſpace of forty days, until at laſt the rebels, perceiving that their own numbers were daily diminiſhing, without any poſſibility of being recruited like the royal army, made a final ſurrender to the king, who puniſhed the ringleaders with great ſeverity. Tranquillity, however, was not yet reſtored: the rebellion ſpread to ſuch a degree, that the king was obliged not only to take the field in perſon, but to employ ſix other armies, under the command of faithful and experienced generals, to reduce the rebels. Thoſe proved ſo ſucceſsful in their enterpriſes, that in a ſhort time the rebellious cities were reduced to obedience, and the kingdom enjoyed the bleſſings of peace during the long reign of Quinatzin, who is ſaid to have ſat on the throne for no leſs than ſixty years. He was ſucceeded by his ſon Techotlatla; but as the affairs of the Acolhuans now began to be connected with thoſe of the Mexicans, it will be proper to give ſome account of that people.

11 Migrations of the Mexicans.

The Mexicans, called alſo the Aztecas, dwelt till the year 1160 in a country called *Aztlan*, ſituated to the north of the gulf of California, as appears by the route they purſued in their journey; but how far to the northward we are not certainly informed. Betancourt makes it no leſs than 2700 miles, and Boturini ſays it was a province of Aſia. The cauſe of their migration is ſaid to have been as follows:

Among the Aztecas was a perſon of great authority, named *Huiztilin*, to whoſe opinion every one paid the utmoſt deference. He had conceived a deſign to perſuade his countrymen to change their reſidence; and to effect this he fell upon the following ſtratagem. Having heard, while meditating on his ſcheme, a little bird ſinging on the branches of a tree, the notes of which reſembled the word *Tihui*, which in the Azteca language ſignified "let us go," he took that opportunity to work upon the ſuperſtition of the people. With this view, he took along with him a reſpectable perſon, and made him attend to the note of the bird. "What can it mean (ſays he), but that we muſt leave this country, and find ourſelves another? Without doubt it is the warning of ſome ſecret divinity who watches over our welfare: let us obey, therefore, his voice, and not draw his anger upon us by a refuſal." Tecpaltzin, for that was the name of his friend, readily agreed to the interpretation; and both of them being perſons of great influence, their united perſuaſions ſoon gained over to their project the bulk of the nation, and they accordingly ſet out.

12 Separation of the tribes.

The Aztecas, when they left their original habitations, were divided into ſix tribes; but at Culiacan the Mexicans were left with their god * by five of them, viz. the Xochimilcas, Tepanecas, Chalceſe, Tlahuicas, and Tlaſcalans. The cauſe of this ſeparation is not known, but it was probably occaſioned by ſome diſagreement among themſelves; for the remaining tribe was divided into two violent factions, which perſecuted one another: neither did they afterwards conſtruct any more edifices. However, they always travelled together, in order to enjoy the company of their imaginary god. At every place where they ſtopped an altar was erected to him; and at their departure they left behind them all their ſick, and probably alſo ſome others to take care of them, or ſuch as were not willing to endure the fatigue of farther journeys. They ſtopped in Tula nine years, and eleven more in the neighbouring parts. At laſt, in 1216, they arrived at Zumpanco, a conſiderable city in the vale of Mexico, where they were received in a very hoſpitable manner by the lord of that diſtrict. He not only aſſigned them proper habitations, but became very much attached to them; and even demanded from among them a wife for his ſon Ilhuicatl. This requeſt was complied with; and from this marriage all the Mexican kings deſcended.

* A wooden image.

13 The Mexicans perſecuted,

The Mexicans continued to migrate from one place to another along the lake of Tezcuco. Xolotl, who was then on the throne of the Acolhuans or Chichemecas, allowed them to ſettle in whatever places of his dominions they thought proper; but ſome of them finding themſelves haraſſed by a neighbouring lord, were obliged, in 1245, to retire to Chapoltepec, a mountain on the weſtern borders of the lake, ſcarcely two miles diſtant from the ſite of Mexico. This took place in the reign of Nopaltzin, when diſturbances began to take place in the Acolhuan dominions. The Mexicans, however, did not find themſelves any more ſecure in their new place of reſidence than formerly: they were perſecuted by the neighbouring lords, and obliged to take refuge in a number of ſmall iſlands, named *Acocolco*, at the ſouthern extremity of the lake of Mexico. Here for 52 years they lived in the moſt miſerable manner, ſubſiſting on fiſh, inſects, roots, &c. and clothing themſelves with the leaves of the amoxtli, which abounds in that lake.

14 and enſlaved.

In this miſerable plight the Mexicans continued till the year 1314, when they were reduced to a ſtate of the

Mexico the moſt abſolute ſlavery. This was done by the king of a petty ſtate named Colhuacan, who, it is ſaid, being unwilling to allow the Mexicans to maintain themſelves in his territories without paying tribute, made war upon them, ſubdued and enſlaved them. Others affirm that, pretending compaſſion for their miſerable ſituation, he offered them a more commodious place of reſidence. The Mexicans readily accepted the offer; but had ſcarcely ſet out to take poſſeſſion of their new place of reſidence when they were attacked by the Colhuans, made priſoners, and carried off for ſlaves.

15 Regain their liberty by cruelty.

After ſome years a war broke out betwixt the Colhuans and Xochimilcas, in which the latter gained ſuch advantages, that they were obliged to employ their ſlaves to aſſiſt them. They accordingly ordered them to prepare for war, but without furniſhing them with arms neceſſary for a military enterpriſe; ſo that the Mexicans were obliged to content themſelves with long ſtaves, having their points hardened in the fire; they alſo made knives of the ſtone itztli, and ſhields of reeds woven together. They agreed not to waſte their time in making priſoners, but to content themſelves with cutting off one ear of their enemies, and then leaving them without farther injury. They adhered punctually to this reſolution; and ruſhing furiouſly upon the Xochimilcas, cut off an ear from as many as they could, killing thoſe who ſtruggled to ſuch a degree that they could not effect their purpoſe. In ſhort, ſo well did the Mexicans acquit themſelves in this engagement, that the Xochimilcas fled, and took refuge among the mountains. After the battle, the Colhuan ſoldiers preſented themſelves before their general with the priſoners they had taken, by the number of which alone they judged of their valour. The Mexicans had taken only four, and theſe they kept concealed for the abominable purpoſe of ſacrificing them. The Colhuans, therefore, ſeeing no trophies of their valour, began to reproach them with cowardice; but the Mexicans, producing their baſkets of ears, deſired them to judge from theſe how many priſoners they might have taken, had they not been unwilling to retard their victory by taking up time in binding them.

Notwithſtanding the valour diſplayed by the Mexicans in this engagement, it doth not appear that their haughty maſters were in the leaſt inclined to afford them eaſier terms than before. Having erected an altar to their god, they demanded of their lord ſomething precious to offer in ſacrifice to him; but he in diſdain ſent them a dirty cloth, encloſing the filthy carcaſs of a vile bird. This was carried by Colhuan prieſts; and without any ceremony laid upon the altar. The Mexicans, with apparent unconcern, removed this filthy offering, and put in its place a knife made of itztli, and an odoriferous herb. On the day of conſecration, the Colhuan prince attended with his nobility; not with a view to do honour to the feſtival, but to make a mockery of the Mexicans. Their deriſion, however, was ſoon changed into horror, when the Mexicans, after a ſolemn dance, brought forth the four Xochimilcan priſoners they had taken; and, after having made them dance a little, cut open their breaſts with the knife which lay on the altar, and plucking out their hearts, offered them, while yet palpitating with life, to their diabolical idol. This had ſuch an effect upon the ſpectators, that both king and ſubjects deſired the Mexicans immediately to quit their territories and go where they pleaſed. This order was inſtantly obeyed: the whole nation took their route towards the north, until they came to a place named *Acatzitzintlan*, ſituated betwixt two lakes, and afterwards named *Mexicaltzinco;* but for ſome reaſon or other, being diſcontented with this ſituation, as indeed they ſeem very often to have been, they proceeded to *Iztacalco*, ſtill nearer to the ſite of Mexico. Here they formed the image of a little mountain of paper, and danced round it a whole night, ſinging their victory over the Xochimilcas, and reuniting thanks to their god for having freed them from the yoke of the Colhuans. Clavigero is of opinion, that by this mountain they repreſented Colhuacan, as in their pictures it was always repreſented by a hunch-backed mountain; and this is the literal ſignification of the name.

16 The firſt human ſacrifice in Mexico.

17 The city of Mexico founded.

The city of Mexico was founded in the year 1325, in the moſt incommodious ſituation we can imagine, viz. on a ſmall iſland named Tenochtitlan, in the middle of a great lake, without ground to cultivate for their ſubſiſtence, or even room ſufficient to build their habitations. Their life was therefore as miſerable here for ſome time as it had been when they were on the iſlands at the end of the lake, and they were reduced to the ſame ſhifts to maintain themſelves. To enlarge the boundaries of their iſland, they drove paliſades into thoſe parts of the water which were moſt ſhallow, terracing them with ſtones and turf, and uniting to their principal iſland ſeveral other ſmaller ones which lay in the neighbourhood. To procure to themſelves afterwards ſtones, wood, &c. for conſtructing their habitations, as well as clothing and other neceſſaries, they inſtituted a commerce with the people who dwelt on the borders of the lake, ſupplying them with fiſh, waterfowl, and other more minute inhabitants of the lake and marſhes, which they contrived to render eatable; and in return for all this they received the neceſſaries above mentioned. The greateſt effort of their induſtry, however, was the conſtruction of floating gardens, by means of buſhes and the mud of the lake; and theſe they brought to ſuch perfection that they produced maize, pepper, chia, French beans, and gourds.

18 The two factions ſeparate.

For thirteen years that the Mexicans had to ſtruggle with extreme difficulty, they remained at peace; but no ſooner did they begin to proſper and live comfortably, than the inveterate enmity betwixt the two factions broke out in all its fury. This produced a ſeparation; and one of the parties took up their reſidence on a ſmall iſland at a little diſtance to the northward, which, from a heap of ſand found there, they at firſt named *Xaltilolco*, but afterwards *Tlatelolco*, from a terrace conſtructed by themſelves. This iſland was afterwards united to that of Tenochtitlan.

About this time the Mexicans divided their city into four parts, a diviſion which ſtill ſubſiſts; each quarter having now its tutelar ſaint, as it had formerly its tutelar god. In the midſt of their city was the ſanctuary of their great god *Mexitli*, whom they conſtantly preferred to all the reſt. To him they daily performed acts of adoration: but inſtead of making any progreſs in humanity, they ſeem to have daily improved in the moſt horrible barbarities, at leaſt in their religion. The dreadful ſacrifices made of their priſoners, could only be exceeded by that which we are now about to relate.

19 Monſtrous barbarity of their religion.

Mexico.

relate. Being now on a more refpectable footing than formerly, they fent an embaffy to the petty king of Colhuacan, requefting him to fend them one of his daughters, that fhe might be confecrated the mother of their protecting god. The unfufpecting prince readily complied with their defire.—The unfortunate princefs was conducted in great triumph to Mexico; but no fooner was fhe arrived, than fhe was facrificed in a fhocking mnnner; and, to add to the horror of the deed, the body was flayed, and one of the braveft young men of the nation dreffed in her fkin. Her father, ignorant of this dreadful tranfaction, was invited by the Mexicans to be prefent at the apotheofis of his daughter, and went to fee the folemnity, and to worfhip the new divinity. He was led into the fanctuary, where the young man ftood clothed in the bloody fkin of his daughter; but the darknefs of the place prevented him from feeing what was before him. They gave him a cenfer in his hand, and fome copal to begin his worfhip; but having difcovered by the flame of the copal the horrible fpectacle, he ran out in a diftracted manner, calling upon his people to revenge the injury; but this they were not able to do at that time nor ever after.

In the year 1352 the Mexican government was changed from an ariftocracy to a monarchy. At firft they were governed by 20 lords, of whom one had an authority fuperior to the reft. This naturally fuggefted the idea of monarchy; and to this change they were alfo induced by the contemptible ftate in which their nation ftill continued, thinking that the royal dignity would confer upon it a degree of fplendour which otherwife it could not enjoy; and that by having one leader, they would be better able to oppofe their enemies. Proceeding, therefore, to elect a king, the choice fell upon Acamapitzin, a man of great eftimation among them, and defcended from Opochtli, a noble Aztecan, and a princefs of the royal family of Colhuacan. As he was yet a bachelor, they attempted to negociate a marriage, firft with the daughter of the lord of Tacuba, and then of the king of Azcapozalco: but thefe propofals being rejected with difdain, they applied to Acolmiztli lord of Coatlichan, and a defcendant of one of the three Acolhuan princes; who complied with their requeft, and the nuptials were celebrated with great rejoicings.

20 Acamapitzin the firft king of Mexico.

21 The Tlatelolcos alfo choofe a king.

In the mean time, the Tlatelolcos, the natural rivals of the Mexicans, refolved not to be behind them in any thing which had the leaft appearance of augmenting the glory of their ftate. They likewife, therefore, chofe a king; but not thinking proper to choofe him from among themfelves, they applied to the king of the Tepanecas, who readily fent them his fon; and he was crowned firft king of Tlatelolco in 1353. In this the Tlatelolcos feem to have had a defign of humbling their rivals, as well as rendering themfelves more refpectable; and therefore it is probable, that they had reprefented the Mexicans as wanting in that refpect due to the Tepanecan monarch, as having elected a king without his leave, though at the fame time they were tributaries to him. The confequence of this was, that he took a refolution to double their tribute. Hitherto they had paid only a certain number of fifh and waterfowl; but now they were ordered to bring alfo feveral thoufands of fir and willow plants to be fet in the roads and gardens of Azcapozalco, and to tranfport to the court a great floating garden, which produced vegetables of every kind known in Anahuac. This being accomplifhed with great difficulty, the king commanded them next year to bring him another garden, with a duck and fwan in it both fitting upon eggs; but fo, that on their arrival at Azcapozalco the brood might be ready to hatch. This was alfo done; and the prince had the fatisfaction of feeing the young birds come out of the eggs. The third year they were ordered to bring a live ftag along with a garden. This was more difficult than any of the former tafks; becaufe they were obliged, in order to hunt the ftag, to go to the mountains of the continent, where they were in danger of falling into the hands of their enemies; however, this alfo was accomplifhed, and the defire of the king gratified.

22 Mexicans oppreffed.

In this manner the Mexicans were oppreffed for no lefs than 50 years. They freed themfelves, however, from all their difficulties by vigorous exertions, abfurdly afcribing to the protection of that malevolent being whom they worfhipped the glory of every deliverance. Acamapitzin governed this city, which at that time comprehended the whole of his dominions, for 37 years in peace. His queen being barren, he married another wife, but without abandoning the firft; and thefe two, inftead of being rivals to one another, lived together in the utmoft harmony; the firft wife taking upon herfelf the charge of educating *Huitzilihuitl*, the fon of the fecond. He had, befides, feveral children by other women, and one named *Itzcoatl*, who afterwards proved one of the beft and moft renowned kings who fat on the throne of Mexico. He is faid alfo to have conquered four confiderable cities; but Clavigero thinks he muft in this only have been an auxiliary, it being very improbable, that while he could fcarce maintain his own territories, he fhould think of foreign conquefts.

Acamapitzin died in 1389, greatly lamented by the Mexicans, and his death was followed by an interregnum of four months. As the deceafed monarch had formally refigned his authority into the hands of his nobles, it was neceffary that a new election fhould take place; and when this was done, the choice fell upon Huitzilihuitl, the fon of Acamapitzin. As he was ftill unmarried, it was refolved, if poffible, to procure him an honourable and advantageous match. With this view, a deputation of nobility was fent to the king of Azcapozalco, requefting, in very humble terms, an alliance with one of his daughters. The expreffions made ufe of by thefe ambaffadors are faid by our author to have been particularly elegant in the Mexican language: but it is difficult to underftand how a fpeech made among a people ignorant of the art of writing could be particularly recorded at the interval of fome hundreds of years after. They are as follow: "We befeech you, with the moft profound refpect, to take compaffion on our mafter and your fervant Huitzilihuitl, confined among the thick rufhes of the lake.—He is without a wife, and we without a queen.—Vouchfafe, Sir, to part with one of your jewels or moft precious feathers. Give us one of your daughters, who may come to reign over us in a country which belongs to you."

23 Huitzilihuitl the fecond king.

This

Mexico.

24 Marries a daughter of the king of the Tepanecans.

This piece of oratory had ſuch an effect upon the king, that he granted their requeſt, and a Tepanecan princeſs was conducted in great triumph to Mexico, where the marriage was ſolemnized with the utmoſt joy. Though this princeſs brought him a ſon the firſt year of their marriage, the king, in order to ſtrengthen himſelf by freſh alliances, married alſo the daughter of another prince, by whom he had Montezuma *Ilhuicamina*, the moſt celebrated of all the Mexican kings.

As the Mexicans advanced in wealth and power, ſo did their rivals the inhabitants of Tlatelolco.— Their firſt king died in 1399, leaving his ſubjects greatly improved in civilization, and the city much enlarged and beautified. The rivalſhip which ſubſiſted between the two cities had indeed greatly contributed to the aggrandizement of both. The Mexicans had formed ſo many alliances by marriage with the neighbouring nations, had ſo much improved their agriculture and floating gardens on the lake, and had built ſo many more veſſels to ſupply their extended commerce and fiſhing, that they were enabled to celebrate their ſecular year, anſwering to A. D. 1402, with greater magnificence than they had ever done ſince they left their original country of Atztlan.

25 Unfortunate reign of Techotlala's ſon.

All this time Techotlala, the ſon of Quinatzin, continued to reign in Acolhuacan, and for 30 years enjoyed uninterrupted tranquillity; but being now very far advanced in years, and finding his end approach, he called to him his ſon Ixtlilxochitl, and recommended to him to beware of the ambitious diſpoſition of the king of Azcapozalco, as he was apprehenſive that he might attempt ſomething againſt the peace of the empire. His ſuſpicions were verified; for on the death of Techotlala, which happened in 1406, the king of Azcapozalco, without making the uſual ſubmiſſions to the new king, to whom he was a feudatory, ſet out for his own territories, with a view to ſtir up the other feudatory princes to rebellion. Having called to him the kings of Mexico and Tlatelolco, he told them, that Techotlala, who had long tyrannized over that country, being dead, he deſigned to procure freedom to the princes, ſo that each might rule his own territory entirely independent of the king of Acolhuacan; but for this purpoſe he needed their aſſiſtance, and truſted to their well-known ſpirit to take part with him in the enterpriſe. He informed them likewiſe, that in order to enſure ſucceſs, he would find means to unite other princes in the confederacy.

The new king of Acolhuacan, in the mean time, was employed in ſettling the affairs of his kingdom, and endeavouring to gain the good will of his ſubjects. The combination againſt him was ſoon diſcovered: but though Ixtlilxochitl was deſirous of heading his army in perſon, he was diſſuaded from ſo doing by his courtiers; ſo that the conduct of the war was committed to his generals. To weaken the enemy, they ravaged the territories of ſix revolted ſtates: but, notwithſtanding this, and the ſuperior diſcipline of the royal army, the war was carried on by the rebels with great obſtinacy, their armies being conſtantly recruited by freſh troops in proportion to their loſſes. At laſt, after three years of a ruinous war, the king of Azcapozalco, finding that his reſources would at laſt fail him, ſued for peace; but with a deſign of accompliſhing by treachery what he had not yet been able to do by force. His adverſary, equally reduced with himſelf, conſented to a peace, though he knew very well that the Tepanecan prince intended to obſerve it no longer than ſuited his purpoſe.

26 Chimalpopoca third king of Mexico.

In the year 1409 died Huitzilihuitl king of Mexico, who likewiſe left the right of electing a ſucceſſor to the nobility. They made choice of his brother Chimalpopoca; and from thence it became an eſtabliſhed law to chooſe one of the brothers of the deceaſed king, or, if he had no brothers, to elect one of his grandſons. While the new prince was endeavouring to ſecure himſelf on the throne, the treacherous Tezozomoc uſed all means in his power to ſtrengthen the party he had formed againſt the king of Acolhuacan. In this he was attended with ſuch ſucceſs, that the unfortunate prince found himſelf reduced to the neceſſity of wandering among the neighbouring mountains, at the head of a ſmall army, accompanied by the lords of Huexotla and Coatlichan, who remained always faithful to him. The Tepanecans diſtreſſed him to ſuch a degree, by intercepting his proviſions, that he was forced to beg them of his enemies. One of his grandſons was ſent to Otompan, a rebel ſtate, to requeſt them to ſupply their king with the proviſions he ſtood in need of, and to exhort them to abandon the cauſe of the rebels, which they had eſpouſed. No taſk could be more dangerous; yet ſuch was the magnanimity of the young prince's diſpoſition, that he readily ſet out on the journey; nor was he deterred by the information he got that there were in the place certain Tepanecans who had come on purpoſe to publiſh a proclamation from Tezozomoc. He went boldly to the moſt public place of the town, and in preſence of thoſe who publiſhed the proclamation made known his requeſt. This heroiſm, however, did not meet with the ſucceſs it deſerved. His propoſitions were derided from the moment they were made; but the people did not offer any farther inſult, until one of the meaner ſort threw a ſtone at him, exciting others of the ſame ſtamp to put him to death. The Tepanecans, who had hitherto continued ſilent, perceiving their opportunity, joined in the general cry to kill the prince, and began alſo to throw ſtones. The prince attempted firſt to defend himſelf, and afterwards to eſcape by flight; but, both being equally impoſſible, he fell under a ſhower of ſtones. The Tepanecans exulted in this act of treachery, and ſoon after cut off Ixtlixochitl himſelf, after having treacherouſly perſuaded him to a conference with two of their captains. This perfidious act was committed in ſight of the royal army, who were too weak to revenge it; the royal corpſe was ſaved with difficulty; and *Nezahualcojotl*, heir apparent to the crown, was obliged to ſhelter himſelf among the buſhes from the fury of his enemies.

27 Diſtreſs and death of the king of Acolhuacan.

28 Acolhuacan conquered by Tezozomoc.

Tezozomoc having now in a great meaſure gained his point, proceeded to pour down his troops upon thoſe cities and diſtricts which had remained faithful to the late unfortunate monarch. The people made a moſt deſperate defence, and killed vaſt numbers of their enemies; but at laſt being themſelves reduced by the calamities of war, and in danger of total extermination, they were obliged to quit their habitations and fly to other countries. The tyrant, then, finding himſelf

Mexico.

ſelf ſuperior to all his adverſaries, gave Tezcuco in fief to Chimalpopoca king of Mexico, Huexotla to Tlacacotl king of Tlatelolco; placing faithful governors in other places, and appointing Azcapozalco, the capital of his own territory, the royal reſidence and capital of Acolhuacan.

Prince Nezahualcojotl was preſent in diſguiſe at this diſpoſal of his dominions, along with ſeveral other perſons of diſtinction who were enemies of the tyrant; and ſo much was he tranſported with paſſion, that it was with difficulty he could be reſtrained from killing Tezozomoc on the ſpot, though this would certainly have been done at the expence of his own life. All the reſt of the Acolhuacan empire ſubmitted; and Nezahualcojotl ſaw himſelf for the preſent deprived of all hopes of obtaining the crown.

29 His tyranny and death.

Tezozomoc had now attained the ſummit of his ambition: but inſtead of conciliating the minds of his new ſubjects, oppreſſed them with new taxes; and being conſcious of the precarious ſituation in which he ſtood, and tormented with remorſe on account of his crimes, fell into melancholy, and was conſtantly haunted with frightful dreams. He was now become ſo old, that his body no longer retained its natural heat. He was therefore obliged to be covered up with cotton in a great cradle, not being able to ſit erect in a chair. In this miſerable condition, however, he never forgot his tyranny or cruelty. From his cradle he iſſued oppreſſive laws relating to the Acolhuacans; and almoſt with his laſt breath renewed his commands with regard to Nezahualcojotl. At laſt he expired in the year 1422, leaving the crown to his ſon Tajatzin.

30 The throne uſurped by Maxtlaton.

Tezozomoc was no ſooner dead than Maxtlaton, without paying the leaſt regard to his father's will, began to exerciſe the functions of a ſovereign. Though it was the right of Tajatzin to invite to his father's funeral whom he pleaſed, Maxtlaton took that upon himſelf. Nezahualcajotl, though not invited, came among the reſt; but though Teuctzintli, brother to Maxtlaton, inſiſted upon his being put to death, the latter oppoſed it, as it could not then be done privately, and he hoped to find another opportunity. No ſooner were the funeral ceremonies over, however, than Maxtlaton behaved in ſuch a manner to his brother Tajatzin, that the prince thought proper to retire to Chimilpopoca king of Mexico, to whom he had been particularly recommended by his father, in order to have his advice. This monarch, agreeable to the character of that age and people, adviſed him to invite his brother to an entertainment, and then murder him. Unluckily for them both, this diſcourſe was overheard by a ſervant, who in expectation of a reward informed the tyrant of what he had heard: but inſtead of this, Maxtlaton, pretending to diſbelieve his ſtory, drove the informer from his preſence with ignominy. Notwithſtanding this pretence, the tyrant had not the leaſt doubt of the truth of what was told him; and therefore determined to rid himſelf of his brother without delay. This he ſoon accompliſhed in the very ſame way that had been projected againſt himſelf. Tajatzin, along with the kings of Mexico, Tlatelolco, and ſome other feudatory princes, were invited by Maxtlaton to an entertainment. The king of Mexico prudently excuſed himſelf, but the unſuſpecting Tajatzin fell into the ſnare. He came to the place of entertainment, and was inſtantly put to death. The company were greatly alarmed; but Maxtlaton, having explained to them his reaſons for ſo doing, they not only excuſed him, but proclaimed him king; to which it is not to be doubted that their fears greatly contributed.

31 Tajatzin murdered.

32 Miſerable fate of the king of Mexico.

Though the king of Mexico eſcaped a ſudden death by his abſence at this time, it was only to periſh in a more ſlow and ignominious manner. The vengeance of Maxtlaton firſt appeared by ſending him a woman's dreſs in return to the preſent he ſent him as a feudatory; which being a reflection upon his courage, was the higheſt affront that could be offered him. This inſult, however, was quickly followed by one of a much higher nature. Having heard that one of the Mexican prince's wives was an extraordinary beauty, he enjoined ſome Tepanecan ladies, who were accuſtomed to viſit that princeſs, to invite her to ſpend ſome days with them at Azcapozalco. This being complied with, the tyrant eaſily got an opportunity of raviſhing her, and then ſent her back to her huſband. Chimilpopoca was ſo much affected by this misfortune, that he reſolved to offer himſelf up a ſacrifice to his god. Maxtlaton, however, was reſolved that he ſhould not have even this ſatisfaction. At the very time of the ceremony, therefore, he ſent a body of troops; who entering Mexico without reſiſtance, carried off the king alive, to the aſtoniſhment of the multitude; and who probably were ſo much confounded by this unexpected adventure, that they did not think of making any reſiſtance.

Chimilpopoca being carried priſoner to Azcapozalco, was confined in a ſtrong wooden cage, the common priſon for criminals. Maxtlaton ſtill was not ſatisfied: he wiſhed to get into his hands Nezahualcojotl; and with this view ſent a meſſage to him, pretending that he was willing to come to an agreement with him reſpecting the kingdom of Acolhuacan. Though the prince was well aſſured of the tyrant's treacherous intentions, he went boldly to his palace, preſented himſelf before him, and told him that he had heard of the impriſonment of the king of Mexico; he had heard alſo that he wiſhed to take away his own life; he deſired him to do ſo, and to gratify his malice. Maxtlaton was ſo ſtruck with this ſpeech, that he aſſured the prince he had not formed any deſign againſt his life, and that he neither had put to death the king of Mexico, nor would do ſo. He then gave orders for his being properly entertained, and even allowed him to pay a viſit to the king of Mexico in priſon. The unfortunate Chimilpopoca, after reciting his misfortunes, requeſted the prince not to return to court, where they would certainly fall upon ſome project for taking away his life; and having pathetically recommended to him the care of his ſubjects, made him a preſent of a gold pendant and ſome other jewels he wore; after which they took a laſt farewell.

33 He is viſited in priſon by Nezahualcojotl.

34 Itzcoatl raiſed to the throne of Mexico, who aſſiſts Nezahualcojotl.

In the mean time, the Mexicans raiſed to the throne Itzcoatl, the ſon of Acamapitzin by a ſlave, and who was accounted the moſt prudent, juſt, and brave, of all the Mexican nation. His election was no leſs pleaſing to Nezahualcojotl and his party, than it was offenſive to Maxtlaton. An alliance was quickly concluded

between

between the exiled prince and the king of Mexico; and this was ſoon followed by the commencement of hoſtilities on the part of the former. His firſt enterpriſe was againſt the city of Tezcuco, which he determined to take by aſſault, but was prevented by the ſubmiſſion of the inhabitants. He put to death, however, all the officers eſtabliſhed by the tyrant; and all the Tepanecans he found there. The very ſame day another large city named Acolman was furiouſly attacked by a detachment of his army; great numbers put to the ſword, and among the reſt the governor, who was brother to Maxtlaton; and the ſame day alſo Coatlichan was taken by the Chalceſe.

35
Dangerous embaſſy undertaken by Montezuma.

The Mexican monarch, hearing of the ſucceſſes of his ally, ſent an embaſſy to congratulate him upon them. His ambaſſador was a ſon of king Huitzilihuitl, named *Montezuma*, who for his invincible courage and great qualities was ſurnamed the *man of great heart and the archer of heaven*. The journey was extremely dangerous; but Montezuma undertook it without any fear, accompanied by another nobleman. They got in ſafety to the place where the prince was; but had the misfortune to be taken priſoners, and were carried to Chalco; the lord of which city, named Toteotzin, was an inveterate enemy to the Mexicans. By him he was immediately put in cloſe confinement, under the care of one Quateozin, who was inviolably attached to the Mexican intereſt. Orders were given to the latter to provide no ſuſtenance for the priſoners but what was preſcribed by his lord, until the mode of death which they were to ſuffer ſhould be determined. Toteotzin then ſent his priſoners to them, that they might be ſacrificed there if they thought proper. Theſe people, however, rejected the propoſal with diſdain; on which Toteotzin, thinking to regain the favour of Maxtlaton, informed him of the priſoners he had in his poſſeſſion. But Maxtlaton called him a double minded traitor, and commanded him inſtantly to ſet the priſoners at liberty. Before this anſwer arrived, however, Quateozin had inſtructed the priſoners how to make their eſcape, and directed them alſo not to return by land leſt they ſhould again be intercepted, but to embark at a certain place, and proceed by water to Mexico. They followed his advice exactly; and having got to the place to which they were directed, arrived ſafely at their city, to the great ſurpriſe and joy of the inhabitants.

36
Maxtlaton declares war againſt Mexico.

Toteotzin, enraged at the loſs of his priſoners, put Quateozin to a cruel death, deſtroying alſo all his family excepting one ſon and a daughter; of whom the latter fled to Mexico, where ſhe was highly honoured on her father's account. Maxtlaton, too, notwithſtanding his generoſity to the priſoners (which Clavigero derives from mere oppoſition to Toteotzin), prepared to wage a formidable war with the Mexicans, who had agreed to unite their troops with thoſe of the prince. The Mexican populace, terrified at engaging ſo powerful an enemy, demanded that their king ſhould ſubmit and beg for peace. So great was the tumult, that the king himſelf was obliged to conſent; and it required the utmoſt exertions of Montezuma's eloquence to perſuade the people to agree to a commencement of hoſtilities. This being done at laſt, the king next called together the chief nobility, and aſked which of them would have the courage to carry an embaſſy to the king of the Tepanecans? This adventure appeared ſo hazardous, that all of them kept a deep ſilence, until Montezuma declared himſelf willing to undertake the arduous enterpriſe. He was ordered to propoſe peace to Maxtlaton, but to accept of no diſhonourable conditions; to which he punctually adhered. Maxtlaton refuſed to give any immediate anſwer, but promiſed to give one next day, after he had conſulted his nobility. Montezuma, dreading ſome treachery if he ſtaid all night, promiſed to return next day; which he did, and was told that Maxtlaton had determined upon war. Montezuma then performed the ceremony of challenging him, by preſenting him with certain defenſive weapons, anointing his head, and fixing feathers upon it, as was cuſtomary to do with dead perſons. Laſtly, He proteſted, in the name of his maſter, that as Maxtlaton would not accept of the offered peace, he and all the Tepanecans would infallibly be ruined. Maxtlaton ſhowed not the leaſt ſign of diſpleaſure, but gave Montezuma arms in like manner to preſent to the king of Mexico; and directed him, for his perſonal ſecurity, to return in diſguiſe through a ſmall outlet from the palace. Montezuma followed his advice; but as ſoon as he found himſelf out of danger, began to inſult the Tepanecan guards; and though they ruſhed violently upon him, he not only eſcaped from their attacks, but killed one or two of them.

On his return to Mexico, the populace were again thrown into the utmoſt conſternation by the news that war was inevitable, as the chiefs of the two nations had challenged one another. They now requeſted the king to allow them to retire from their city, of which they ſuppoſed the ruin to be certain. The king encouraged them with the hopes of victory. "But if we are conquered (replied they), what will become of us?" "If that happens (anſwered the king), we are that moment bound to deliver ourſelves into your hands, to be made ſacrifices at your pleaſure." "Be it ſo (replied they), if we are conquered; but if we obtain the victory, we and our deſcendants are bound to be tributary to you; to cultivate your lands and thoſe of your nobles; to build your houſes; and to carry for you, when you go to war, your arms and baggage."

Matters being thus ſettled, intelligence was ſent to Prince Nezahualcojotl to repair with his army to Mexico, which he did without delay; and the day after his arrival a furious engagement took place. The Tepanecan army was commanded by a general named *Mazatl;* Maxtlaton himſelf not judging it proper to quit his capital. The ſoldiers on both ſides fought with the utmoſt bravery; but towards night the Mexicans, diſheartened by ſeeing the army of their enemies continually increaſing in number, began once more to loſe their courage and talk of ſurrendering. The king, greatly concerned, aſked Montezuma what ſhould be done to diſſipate the fears of the people? That brave prince replied, that they muſt fight till death; that if they died with their arms in their hands, it would be honourable; but to ſurvive their defeat, would be eternal ignominy. Nothing could be more ſalutary than this advice at ſo critical a juncture: for the Mexicans were already begun to implore the mercy of their enemies, and to promiſe to ſacrifice their chiefs, whoſe ambition had brought the whole nation 37
He is defeated and killed.

into ſuch a dilemma. On hearing this, the whole body of nobility, with the king and Montezuma at their head, aſſaulted the enemy ſo furiouſly, that they repulled them from a ditch of which they had taken poſſeſſion; after which, Montezuma, happening to encounter Mazatl the Tepanecan general, ſtruck him ſuch a blow on the head that he fell down lifeleſs. Thus the Mexicans were inſpired with freſh courage, and their enemies proportionally diſpirited: however, they retired for that night to the city, in ſome hopes of being able to retrieve their fortune next day. Maxtlaton encouraged them by every method in his power; but fortune proved ſtill more unfavourable than the day before. The Tepanecans were now entirely defeated, and the city of Azcapozalco taken. Maxtlaton, who ſeems not to have had the courage to fight, had not now the preſence of mind to fly. He attempted indeed to hide himſelf; but being quickly diſcovered, he was beaten to death with ſticks and ſtones. The city was plundered, the inhabitants butchered, and the houſes deſtroyed by the victors.

38 The Tepanecans entirely reduced.

This victory proved deciſive in favour of the confederates. Every other place of ſtrength in the country was quickly reduced, until the Tepanecans, finding themſelves on the verge of deſtruction, ſent an humble embaſſy to the king of Mexico, requeſting to be taken under his protection, and to become tributaries to him. Itzcoatl received them graciouſly; but threatened them with total extirpation if they violated the fidelity they had ſworn to him.

Itzcoatl, after this extraordinary ſucceſs, took care to have the above-mentioned contract ratified between the nobility and common people, by which the latter were bound to perpetual ſervices. Thoſe who had diſcouraged the ſoldiers in time of battle were baniſhed for ever from the ſtate of Mexico; while Montezuma and others who had diſtinguiſhed themſelves by their bravery, were rewarded with lands, as was uſual with other conquerors.

39 Nezahualcojotl made king of Acolhuacan.

Itzcoatl, now finding himſelf firmly ſeated on the throne of Mexico, ſet about performing his engagements to the Acolhuacan prince, by ſeating him on the throne of his anceſtors. Having again joined their armies, they marched againſt Huaxotla, a city which refuſed to ſubmit even though terms of pardon were offered them. Inſtead of this, they raſhly ventured a battle, in which they were entirely defeated; and were then fain to ſend a deputation of their old men, pregnant women, &c. as was cuſtomary in caſes of diſtreſs, to move the enemy to compaſſion. At laſt all obſtacles being removed, Nezahualcojotl was ſeated on the throne of Acolhuacan, the auxiliary troops were diſmiſſed, and Itzcoatl left at liberty to purſue his conqueſts, in which he was ſtill aſſiſted by the king of Acolhuacan. The firſt expedition was againſt Cojohuacan, and other two Tepanecan cities, who had not only refuſed ſubmiſſion themſelves, but excited others to ſhake off the yoke alſo. The war againſt them proved bloody. Three battles

40 Conqueſts of the Mexicans.

were fought, in which Itzcoatl gained no other advantage than making the enemy retreat a little; but in the fourth, while the two armies were hotly engaged, Montezuma, with a body of choſen troops, which he had placed in ambuſcade, attacked the rear-guard of the rebels with ſuch vigour, that they were ſoon diſordered, and obliged to fly to the city. The conquerors purſued them thither; and Montezuma perceiving that they intended to fortify themſelves in the greater temple, fruſtrated their deſign by getting poſſeſſion of it and burning the turret. By this diſaſter they were ſo much terrified, that they fled to the mountains ſouth of Cojohuacan; but even there the royal army overtook and purſued them more than 30 miles, till they came to another mountain, where, quite exhauſted with fatigue, and ſeeing no means of eſcape, they were obliged to ſurrender at diſcretion.

Having thus happily accompliſhed the conqueſt of Cojohuacan and the other rebellious cities, the two kings returned to Mexico. Itzcoatl gave great part of the Tepanecan country, with the title of king of *Tacuba*, to *Totoquihuatzin*, a grandſon of Tezozomoc, but who does not appear to have been any way concerned in his projects againſt the Mexicans. An alliance was then formed among the three kings on the 41

41 Alliance between the kings of Mexico, Acolhuacan, and Tepaneca.

following terms: The king of Tacuba held his crown on condition of ſerving the king of Mexico with all his troops, at any time when required; for which he was to have a fifth part of the ſpoils taken from the enemy. The king of Acolhuacan was likewiſe to aſſiſt the king of Mexico in war; and for this he was to have a third part of the plunder, after deducting the ſhare of the king of Tacuba; and the remainder was to belong to the king of Mexico. The kings of Tacuba and Acolhuacan were both declared honorary electors of the kings of Mexico; the real electors being four nobles: and the king of Mexico was likewiſe bound to aſſiſt in the wars of his allies whenever it was demanded.

After having thus ſettled matters among themſelves, and rewarded their ſoldiers, Itzcoatl ſet out with Nezahualcojotl for Tezcuco, where the Acolhuacan king was crowned with all poſſible ceremony. Here the new king took every method which prudence could ſuggeſt to eſtabliſh his authority on a permanent baſis; but while he was thus employed, the Xochimilcas, fearing leſt the Mexicans might conquer their country as they had done that of the Tepanecans, held a council on what was to be done to prevent ſuch a diſgrace. In this council it was determined to commence hoſtilities againſt that riſing ſtate, before it ſhould become more formidable by new conqueſts.

42 Other conqueſts.

Itzcoatl was no ſooner informed of this determination, than he ſent Montezuma with a great army againſt them. The Xochimilcas met him with one ſtill more numerous; but being worſe diſciplined, they were quickly defeated, and their city taken in a very ſhort time after. This conqueſt was followed by the reduction of Cuitlahuac, ſituated on a ſmall iſland in the lake of Chalco. Their inſular ſituation gave them confidence to attack the formidable power of the Mexicans. The king was ſo ſenſible of the difficulty of this enterpriſe, that he propoſed to attack them with the whole force of the alliance: Montezuma, however, with only a ſmall number of men of his own training, whom he furniſhed with proper veſſels, reduced them in ſeven days.

43 Montezuma I king of Mexico.

Itzcoatl died in the year 1436, at a very advanced age, in the height of proſperity, and was ſucceeded by Montezuma I. the greateſt monarch that ever ſat on the Mexican throne. Before his coronation, in order to comply with the barbarous rites of his religion,

Mexico. gion, he made war upon the Chalcese, in order to procure the prisoners who were to be sacrificed at his coronation; and scarce was this ceremony over, when a new war commenced, which terminated in the destruction of that city. This quarrel happened between the Chalcese and the Tezcucans. Two of the royal princes of Tezcuco having gone a-hunting on the mountains which overlook the plains of Chalco, while employed in the chase, and separated from their retinue, with only three Mexican lords, fell in with a troop of Chalcese soldiers; who, to gratify the cruelty of their master, carried them all prisoners to Chalco. The cruel and inconsiderate tyrant who commanded there instantly put them all to death: after which he caused their bodies to be salted, dried, and placed in an hall of his palace, where they served as supporters to the pine torches burned there for lights every evening. The king of Tezcuco, overwhelmed with grief, and to the last degree exasperated at such an inhuman act, called for the assistance of the allied
44 Chalco taken. kings. The city was attacked at once by land and water. The inhabitants, knowing that they had no mercy to expect, fought like men in despair. Even the old tyrant who commanded them, though unable to walk, caused himself to be carried in a litter among the combatants; notwithstanding which they were totally defeated, and the most severe vengeance executed upon them.

Montezuma, on his return, found himself obliged to encounter an enemy more formidable on account of his vicinity, than more powerful ones at a distance. This was the king of Tlatelolco, who had formerly conspired against the life of Itzcoatl; and finding him-
45 Tlatelolco reduced, and Moquihuix made king. self disappointed in this, had tried to reduce his power by entering into a confederacy with some of the neighbouring lords. At that time his designs proved abortive, but he resumed them in the time of Montezuma; the consequence of which was, that he was defeated and killed. One *Moquihuix* was chosen in his room; in whose election it is probable that Montezuma had a considerable share. This was followed by conquests of a much more important nature. The province of *Cuihixcas*, lying to the southward, was added to his dominions, comprehending a tract of country more than 150 miles in breadth; then, turning to the westward, he conquered another named *Tzompahuacan*. This success, however, was for a short time interrupted by a war with Atonaltzin, lord of a territory in the country of the Mixtacas. This prince, puffed up on account of the great wealth he possessed, took it into his head that he would allow no Mexican to travel through his country. Montezuma sent ambassadors to know the reason of such strange conduct; but Atonaltzin gave them no other answer than showing them some part of his wealth, making a present to the king, and desiring him from thence to observe how much the subjects of Atonaltzin loved him; and that he willingly accepted of war, which was to determine whether he should pay tribute to the Mexicans or the Mexicans to him. Montezuma having informed his allies of this insolent answer, sent a considerable army against Atonaltzin, but had the mortification to be informed of its defeat; in consequence of which the pride of Atonaltzin was increased to a great degree. Montezuma, greatly chagrined at this first check, determined Mexico. to head his next army in person; but before he could call together another, Atonaltzin had drawn into a confederacy with him the Huexotzincas and Tlascalans, who were glad of the opportunity, as they supposed, of reducing the power of the Mexicans. Their numbers, however, availed but little; Montezuma in the very first engagement totally defeated the confe- 46 Atonaltzin defeated, and the Mexican dominions enlarged.
derate army. The allies of Atonaltzin were particularly unfortunate; for such of them as were not killed in the field of battle, were destroyed by their own party out of revenge for the unfortunate event of the battle.

By this victory the Mexican monarch became master not only of the dominions of Atonaltzin, but of many other neighbouring princes, against whom he made war on account of their having put to death some Mexican merchants or couriers without any just cause. The conquest of *Cuetlachtlan* or *Cotasta*, however, which he attempted in 1457, proved a much more difficult task. This province lies on the coast of the Mexican gulf, and had been formerly inhabited by the Olmecans, whom the Tlascalans had driven out. The inhabitants were very numerous; but dreading the power of Montezuma, called in those of Tlascala, together with the Huexotzincas, to their assistance. Along with these the allies drew the Cholulans also into the confederacy; so that this seems to have been the most formidable combination that had yet been formed against the Mexican power. Montezuma collected an excellently equipped army; which, however, he did not on this occasion command in person. It contained a great number of persons of very high rank, among whom were three princes of royal blood, and *Moquihuix* king of Tlatelolco already mentioned. The combination of the three republics against Mexico was not known at court when the army set out; but Montezuma, being informed of it soon after, sent an order to his generals to return. This accorded so ill with the romantic notions of valour entertained by the Mexicans, that a consultation of the generals was held whether they should obey it or not. At last it was determined that the king's order should be obeyed; but no sooner was this agreed to than Moquihuix accused them all of cowardice, and threatened, with his own troops, unassisted, to go and conquer the enemy. His speech had such an effect upon them all, that they went to meet the confederates. The Cotastese fought with great valour, but were unable to resist the royal forces; and their allies were almost totally destroyed. Six thousand two hundred of them were taken prisoners, and soon after sacrificed to the Mexican god of war in the barbarous manner already described. The victory was said to have been owing principally to the valour and good conduct of Moquihuix, insomuch that to this day a song made in his praise on that occasion is known in Mexico. Montezuma was so well pleased with the victory, that he not only forgave the disobedience of his orders, but bestowed upon Moquihuix a princess, one of his own cousins, to wife.

During the reign of this great monarch a violent 47 Inundation and famine at Mexico.
inundation happened in Mexico. The lake, swelled by the excessive rains which fell in the year 1446, poured its waters into the city with so much violence that many

Mexico.

many houses were destroyed, and the streets inundated to such a degree that boats were everywhere made use of. The inundation was soon followed by a famine. This was occasioned by the stinting of the crop of maize in 1448; the ears while young and tender being destroyed by frost. In 1450 the crop was totally lost for want of water; and in 1451, besides the unfavourable seasons, there was a scarcity of seed. Hence, in 1452, the necessities of the people became so great, that they were obliged to sell themselves for slaves in order to procure subsistence. Montezuma permitted them to go to other countries for support; but being informed that many sold themselves for a few days provision, he ordered, by proclamation, that no woman should sell herself for less than 400 ears of wheat, nor any man for less than 500. He opened also the public granaries for the relief of the lower classes; but nothing was able to stop the progress of the famine.

48 Axayacatl succeeds Montezuma.

Montezuma was succeeded by Axayacatl, who like his predecessor instantly commenced a war, for no other reason than that he might have prisoners to sacrifice at his coronation. He pursued Montezuma's plan of conquest; in which, however, he was less successful, many of the provinces reduced by that monarch having revolted after his death, so that it was necessary to reconquer them. On his returning successful from one of these expeditions, he built a new temple, to which he gave the name of *Coatlon;* but the Tlatelolcos, whose ancient rivalship seems to have revived on the death of Montezuma, built another in opposition, which they called *Coaxolotl.* Thus the former hatred between the two nations was renewed, and a discord took place which ended in the ruin of the Tlatelolcos.

49 Death of the kings of Acolhuacan and Tacuba.

The Mexicans sustained an irreparable loss in 1469 and 1470 by the death of their allies the kings of Tacuba and Acolhuacan.

The king of Tacuba was succeeded by his son Chimalpopoca, and the Acolhuacan monarch by his son Nezahualpilli. A short time after the accession of the latter, the war broke out between the Tlatelolcos and Mexicans, which ended in the destruction of the former. King Moquihuix had been married by Montezuma to a sister of Axayacatl, now on the throne of Mexico; but it appears that this princess never was greatly the object of his affection. On the contrary, he took all methods of expressing his dislike, either out of enmity to herself, or envy of the superior greatness of her brother. Not content with this, he entered into an alliance with a great number of the neighbouring states, in order to reduce the Mexican greatness. His wife, however, being informed of this scheme, communicated the particulars to her brother; and soon after, being impatient of the ill usage she received, came to Mexico with her four sons to claim the protection of her brother. This uncommon accident exasperated the Mexicans and Tlatelolcos against each other to such a degree, that wherever they met, they fought, abused, and murdered each other. The king of Tlatelolco prepared for war with many horrid ceremonies, of which the drinking of human blood was one. A day was appointed for attacking Mexico. Xiloman, lord of Colhuacan, was to begin the attack, afterwards to pretend flight, in order to induce the Mexicans to follow him; after which the Tlatelolcos were to fall upon their rear.

50 Tlatelolco reduced, and the king killed.

For some reason, however, with which we are not acquainted, the Tlatelolcos began the attack without waiting for Xiloman; the consequence of which was, that he retired in disgust, leaving them to finish their battle the best way they could. The engagement lasted till night, when the Tlatelolcos were obliged to retire. Axayacatl, during the night, disposed of his troops in all the roads which led to Tlatelolco, appointing them to meet in the market-place. The Tlatelolcos, finding themselves attacked on all sides, retired gradually before the Mexicans, until at last they were forced into the market-place, where they found themselves worse than ever on account of its narrowness, which did not allow them room to act. The king stood on the top of the great temple, encouraging his men to exert themselves against the enemy. His words, however, had now lost their usual influence. He not only was not obeyed, but was reproached with cowardice because he did not come down and fight among the rest. At last the Mexicans arrived at the temple, and ascended to the balcony where the king was. He made a desperate defence for a little; but by a violent push in the breast was thrown backwards upon the steps of the temple, and stunned or perhaps killed by the fall.

The Tlatelolcos being thus reduced, Axayacatl next set out on an expedition against the Matlazincas, a tribe in the vale of Toluca, who still refused to submit to the Mexican yoke. Having proved successful in this expedition, he undertook to subdue also the northern part of the valley, now called *Valle d' Ixtlahuacan*, particularly *Xiquipilco*, a considerable city and state of the Otomies, whose chief was much renowned for strength and bravery. Axayacatl, who likewise valued himself on these qualities, encountered him in single combat. In this, however, he was overmatched, and received a violent wound in the thigh; after which he would have been taken prisoner, had not some young Mexicans made a desperate effort for his rescue. Notwithstanding this disaster, Axayacatl's army gained a complete victory, carrying off 11060 prisoners, among whom was the chief of the Otomies himself, and two of his officers who had attacked the king. These chiefs were put to death at an entertainment of the allied kings, the sight of their agonies not interrupting in the least the mirth of the feast; so much were they familiarized to the shedding of human blood.

51 Axayacatl wounded and in great danger.

He was succeeded by his elder brother Tizoc. He intended to have built a larger temple than any that had yet been seen in Mexico, though that originally built had been greatly enlarged by some of his predecessors. For this purpose he collected a great quantity of materials; but before he could bring his projects to bear, he was taken off by a conspiracy of his subjects. During the reign of Tizoc, the Acolhuacans made war upon the Huexotzincas, ruined their city, and conquered their territory. Nezahualpilli also, the Acolhuacan monarch, though he had already several wives, had not made any of them queen, having wished to confer that honour upon one of the royal family of Mexico. Tizoc readily gave him one of his grand-daughters, who had a sister of singular beauty named *Xocotzin*. The friendship betwixt these two ladies was such, that the one could

52 Is succeeded by Tizoc.

 not

not think of being ſeparated from the other; for which reaſon the new queen ſought and obtained permiſſion to take her ſiſter along with her to Tezcuco. Xocotzin had not been long there before the king fell in love with her, and married her with the title of queen likewiſe. Soon after this ſecond marriage, the firſt queen brought forth a ſon named *Cacamatzin*, who ſucceeded him in the throne, and was afterwards taken priſoner by the Spaniards.

53 Ahuitzotl dedicates a temple with a multitude of human victims.

Ahuitzotl, the brother of Tizoc, ſucceeded him in the kingdom of Mexico. His firſt object was to finiſh the great temple begun by his predeceſſor; and ſuch was the number of workmen, that it was completed in four years. During the time that it was building, the king employed himſelf in making war with different nations, reſerving all the priſoners he took for victims at the dedication of the temple. The number of priſoners ſacrificed at this dedication is ſaid by Torquemada to have been 72.324; by other hiſtorians 64,060. The miſerable victims were ranged in two files, each a mile and an half in length, terminating at the temple. The ſame year another temple was built by a feudatory lord, in imitation of the great one built by the king; at the dedication of which a vaſt number of priſoners were alſo ſacrificed. Theſe temples were dedicated in 1486 In 1487 happened a violent earthquake; and Chimalpopoca king of Acolhuacan died, who was ſucceeded by Totoquihuatzin II.

Ahuitzotl died in 1502, of a diſorder produced by a contuſion in his head. At the time of his death, the Mexican empire was brought to its utmoſt extent. His ſucceſſor, Montezuma *Xocojotzin* or Montezuma *Junior*, was a perſon of great bravery, beſides which he was likewiſe a prieſt, and held in great eſtimation on account of his gravity and the dignity of his deportment. His election was unanimous; and the nobles congratulated themſelves on the happineſs the country was to enjoy under him, little thinking how ſhort the duration of their happineſs or of their empire was to be.

54 Montezuma.

The firſt care of the new monarch, as uſual, was to procure victims for the barbarous ſacrifices to be made at his coronation. The people of Atlixco, who had again ſhaken off the Mexican yoke, were the ſufferers on this occaſion, being once more reduced, though not without great loſs on the part of the Mexicans, ſome of whoſe braveſt officers periſhed in the war. The ceremony of coronation was performed with ſuch pomp as had never been ſeen before in Mexico; but no ſooner was this ceremony over than Montezuma began to diſcover a pride which nobody had ſuſpected before. All his predeceſſors had been accuſtomed to confer offices upon perſons of merit, and thoſe who appeared the moſt able to diſcharge them, without any partiality as to birth or wealth. Montezuma, however, diſapproved of the conduct of his predeceſſors, under pretence that the plebeians ſhould be employed according to their rank; for that in all their actions the baſeneſs of their birth and the meanneſs of their education appeared: and in conſequence of this maxim he deprived all the commoners of the offices they held about the court, declaring them incapable of holding any for the future. All the royal ſervants now were people of rank. Beſides thoſe who lived in the palace, 600 feudatory lords and nobles came to pay court to him. They paſſed the whole day in the antichamber, where none of their ſervants were permitted to enter; converſing in a low voice, and waiting the orders of their ſovereign.—The ſervants of theſe lords were ſo numerous that they occupied three ſmall courts of the palace, and many waited in the ſtreets.

55 Magnificence diſplayed in his palace.

In every reſpect Montezuma kept up, as far as was poſſible, an extravagant appearance of dignity. His kitchen utenſils were of the fineſt earthen ware, and his tablecloths and napkins of the fineſt cotton; but none of theſe ever ſerved the emperor more than once, being immediately made a preſent of to ſome nobleman. The veſſels in which his chocolate and other drinks from cocoa were prepared, were all of gold, or ſome beautiful ſea-ſhell, or naturally-formed veſſels, curiouſly varniſhed. He had alſo gold plate, but it was uſed only on particular occaſions in the temple. The number and variety of his diſhes aſtoniſhed the Spaniards. He took great delight in the cleanlineſs of his own perſon, and of every thing about him. He bathed regularly every day, and had baths in all his palaces. Every day he wore four dreſſes, never uſing again thoſe which he had put off, but reſerving them as largeſſes for the nobility, or thoſe who had diſtinguiſhed themſelves in war. The expence of all this rendered him very diſagreeable to a great number of his ſubjects; though others were pleaſed with the readineſs he ſhowed to relieve the neceſſities of individuals, and his generoſity in rewarding his generals and miniſters who deſerved it. Among other actions worthy of imitation, he appointed the city of Colhuacan as an hoſpital for all invalids, who after having faithfully ſerved the crown either in the civil or military line, required a proviſion on account of their age and infirmities. In this place they were maintained and attended at the expence of the king.

56 His unſucceſsful war with Tlaſcala.

The reign of Montezuma, even before the arrival of the Spaniards, was far from being ſo glorious with regard to his ſucceſſes in war as thoſe of his predeceſſors had been. He reduced indeed one rebellious province, and conquered another which had never before been ſubjugated; but in his war with Tlaſcala he was by no means ſucceſsful. This was but a ſmall republic at no great diſtance from the capital, but the inhabitants were remarkable for their bravery and independent ſpirit. The neighbouring ſtates, however, who had been reduced by the Mexicans, envious of their liberty and proſperity, exaſperated the Mexicans againſt them, by repreſenting that the Tlaſcalans were deſirous of making themſelves maſters of the maritime provinces on the Mexican gulf, and that by their commerce with theſe provinces they were increaſing their wealth and power, and gaining the hearts of the people with whom they were to traffic. In conſequence of this repreſentation, ſtrong garriſons were placed on the frontiers of Tlaſcala, to obſtruct the commerce of the inhabitants, and thus to deprive them of the means of obtaining ſome of the neceſſaries of life. The Tlaſcalans complained; but received no other anſwer than that the king of Mexico was lord of all the world, and that the Tlaſcalans muſt ſubmit and pay tribute to him. The Tlaſcalans returned a ſpirited anſwer to this inſolent ſpeech, and began to fortify their frontier. They had already encloſed all the lands of the republic

blic with intrenchments; and to theſe they now added a wall of ſix miles in length on the weſt ſide, where an invaſion was moſt to be apprehended; and ſo well did they defend themſelves, that though they were frequently attacked by the neighbouring ſtates in alliance with Mexico, or ſubject to it, not one of them was able to wreſt a foot of ground from them. Thus a continual ſeries of wars and engagements took place between the ſtates of Mexico and this republic, which continued till the arrival of the Spaniards.

57 Apprehenſions entertained by the Mexicans of the arrival of a new people.

During the remainder of Montezuma's reign the empire was diſturbed by various rebellions, of which the accounts are not ſufficiently intereſting to merit a particular detail; but in the year 1508, Montezuma began to entertain apprehenſions of that fatal event which at length overtook him. An expedition having been undertaken againſt a very diſtant region named Amatla, the army in marching over a lofty mountain were attacked by a furious north wind, accompanied with ſnow; which made great havock in the army, many of them periſhing with cold, and others being killed by the trees rooted up by the wind. The remains of the army continued their march to Amatla, where they were almoſt all killed in battle. By this and other calamities, together with the appearance of a comet, the Mexicans were thrown into the utmoſt conſternation. Montezuma was ſo terrified by theſe omens, that having in vain conſulted his aſtrologers, he applied to the king of Acolhuacan, who was reported to be very ſkilful in divination. Nezahualpilli having conferred with him upon the ſubject, told Montezuma that the comet preſaged ſome calamity which was about to befal their kingdoms by the arrival of a new people: but this being unſatisfactory to the emperor, the king of Acolhuacan challenged him to a game at foot-ball, ſtaking the truth of his prediction on the iſſue of the game. Montezuma loſt the game, but did not yet acquieſce in the truth of his prediction. He therefore applied to a celebrated aſtrologer, whom it ſeems he had not yet conſulted; but he confirmed the interpretation of Nezahualpilli: for which the emperor cauſed his houſe to be pulled down, and himſelf buried in the ruins.

58 Conqueſt of Mexico undertaken by Cortes.

Mexico itſelf was firſt diſcovered, though imperfectly, by a Spaniard named *Nunez de Balboa;* but in 1518 the conqueſt of it was undertaken by a celebrated adventurer named *Ferdinando Cortes*. On the 10th of February 1519, he ſet ſail from the Havannah in Cuba; and ſoon landed on the iſland of Cozumel, on the coaſt of Yucatan, diſcovered the preceding year. Here he joined one of his officers named *Pedro d'Alvaredo*, who had arrived ſome days before, and collected ſome booty and taken a few priſoners. But the general ſeverely cenſured his conduct; and the priſoners were diſmiſſed, after they had been informed by an Indian interpreter named *Melchior*, that ſuch injuries were entirely diſagreeable to the intentions and wiſhes of Cortes. Here he muſtered his army, and found that it amounted to 508 ſoldiers, 16 horſemen, and 109 mechanics, pilots, and mariners. Having encouraged his men by a proper ſpeech, and releaſed, by means of ſome Indian ambaſſadors, a Spaniard named *Jerom de Aguilar*, who had been detained a priſoner for eight years, he proceeded to the river Tabaſco, where he hoped to be received in a friendly manner, as one Grijalva had been a ſhort time before; but, from ſome unknown cauſe, he was violently attacked by them: however, the ſuperiority of the Spaniſh arms ſoon decided the victory, and the inhabitants were obliged to own the king of Caſtile as their ſovereign.

The Spaniards then continued their courſe weſtward, to the harbour of St Juan de Ullua; where they were met by two Mexican canoes, which carried two ambaſſadors from the emperor of that country, and ſhowed the greateſt ſigns of peace and amity. Their language was unknown to Aguilar; but one of the female priſoners above mentioned underſtood it, and tranſlated it into the Yucatan tongue; after which Aguilar interpreted the meaning in Spaniſh. This ſlave was afterwards named *Donna Marina*, and proved very uſeful in their conferences with the natives.

59 State of the empire at that time.

At this time the Mexican empire, according to Dr Robertſon, was arrived at a pitch of grandeur to which no ſociety had ever attained in ſo ſhort a period. Though it had ſubſiſted only for 130 years, its dominion extended from the north to the ſouth ſea, over territories ſtretching about 500 leagues from eaſt to weſt, and more than 200 from north to ſouth; comprehending provinces not inferior in fertility, population, and opulence, to any in the torrid zone.—Though by nature Montezuma poſſeſſed a good deal of courage and reſolution; yet from the firſt moment that the Spaniards appeared on his coaſt, he diſcovered ſymptoms of timidity and embarraſſment, and all his ſubjects were embarraſſed as well as himſelf. The general diſmay which took place on this occaſion was partly owing to the ſtrange figure the Spaniards made, and the prodigious power of their arms; but partly alſo to the following circumſtance. An opinion prevailed almoſt univerſally among the Americans, that ſome dreadful calamity impended over their heads, from a race of formidable invaders who ſhould come from regions towards the riſing ſun, to overrun and deſolate their country.

By means of his two interpreters, Donna Marina and Aguilar. Cortes learned that the chiefs of the Mexican embaſſy were deputies from Pilpatoe and Teutile; the one governor of a province under the emperor, and the other the commander of all his forces in that province: the purport of their embaſſy was to inquire what his intentions were in viſiting their coaſts, and to offer him what aſſiſtance he might need in order to continue his voyage. Cortes, in his turn, alſo profeſſed the greateſt friendſhip; and informed the ambaſſadors, that he came to propoſe matters of the utmoſt conſequence to the welfare of the prince and his kingdom; which he would more fully unfold in perſon to the governor and the general.

60 Cortes lands and fortifies his camp.

Next morning, without waiting for any anſwer, he landed his troops, his horſes, and his artillery; began to erect huts for his men, and to fortify his camp.

The next day the ambaſſadors had a formal audience; at which Cortes acquainted them, that he came from Don Carlos of Auſtria, king of Caſtile, the greateſt monarch of the eaſt, and was intruſted with propoſitions of ſuch moment, that he would impart them to none but the emperor himſelf, and therefore required to be conducted immediately to the capital. This demand produced the greateſt uneaſineſs; and

61 The Indians endeavour to diſſuade him from going to the capital, but in vain.

and the ambaſſadors did all in their power to diſſuade Cortes from his deſign, endeavouring to conciliate his good will by the preſents ſent him by Montezuma. Theſe they introduced with great parade, and conſiſted of fine cotton cloth, of plumes of various colours, and of ornaments of gold and ſilver to a conſiderable value, the workmanſhip of which appeared to be as curious as the materials were rich. But theſe preſents ſerved only to excite the avidity of the Spaniards, and to increaſe their deſire for becoming maſters of a country which abounded with ſo many precious commodities. Cortes indeed could ſcarcely reſtrain himſelf ſo far as to hear the arguments made uſe of by the ambaſſadors to diſſuade him from going to the capital; and, in a haughty, determined tone, inſiſted on his former demand of being admitted to a perſonal interview with their ſovereign.

During this converſation, ſome painters in the retinue of the Mexican chiefs had been diligently employed in delineating, upon white cotton cloths, figures of the ſhips, horſes, artillery, ſoldiers, and whatever elſe attracted their eyes as ſingular.

62 Montezuma made acquainted with his deſign.

While exerting their utmoſt efforts in repreſenting all theſe wonderful things, meſſengers were immediately deſpatched to Montezuma with the pictures, and a full account of every thing that had paſſed ſince the arrival of the Spaniards, together with ſome European curioſities to Montezuma; which Cortes believed would be acceptable on account of their novelty. The Mexican monarchs had couriers poſted at proper ſtations along the principal roads; and as theſe were trained to agility by a regular education, they conveyed intelligence with ſurpriſing rapidity. Though the city in which Montezuma reſided was above 180 miles from St Juan de Ulua, Cortes's preſents were carried thither, and an anſwer returned to his demands, in a few days. As the anſwer was unfavourable, Montezuma had endeavoured to mollify the Spaniſh general by the richneſs of his preſents. Theſe conſiſted of the manufactures of the country; cotton ſtuffs ſo fine, and of ſuch delicate texture, as to reſemble ſilk; pictures of animals, trees, and other natural objects, formed with feathers of different colours, diſpoſed and mingled with ſuch ſkill and elegance as to rival the works of the pencil in truth and beauty of imitation. But what chiefly attracted their attention, were two large plates of a circular form; one of maſſive gold repreſenting the ſun, the other of ſilver repreſenting the moon. Theſe were accompanied with bracelets, collars, rings, and other trinkets of gold; and that nothing might be wanting which could give the Spaniards a complete idea of what the country afforded, ſome boxes filled with pearls, precious ſtones, and grains of gold unwrought, as they had been found in the mines or rivers, were ſent along with the reſt. Cortes received all with an appearance of the moſt profound reſpect for Montezuma; but when the Mexicans, preſuming upon this, informed him, that their maſter, though he deſired him to accept of what he had ſent as a token of his regard for the prince whom he repreſented, would not give his conſent that foreign troops ſhould approach nearer to his capital, or even allow them to continue longer in his dominions. Cortes declared, in a manner more reſolute and peremptory than formerly, that he muſt inſiſt on his firſt demand; as he could not, without diſhonour, return to his own ſovereign until he was admitted into the preſence of the prince whom he was appointed to viſit in his name.

63 Sends an unfavourable anſwer, but accompanied with rich preſents.

64 Cortes ſtill inſiſts on his demands.

The puſillanimity of the Indian monarch afforded time to the Spaniards to take meaſures which would have been out of their power had they been vigorouſly attacked on their firſt refuſal to obey his orders. Cortes uſed every method of ſecuring the affections of the ſoldiers; which indeed was very neceſſary, as many of them began to exclaim againſt the raſhneſs of his attempt in leading them againſt the whole force of the Mexican empire. In a ſhort time Teutile arrived with another preſent from Montezuma, and together with it delivered the ultimate orders of that monarch to depart inſtantly out of his dominions; and when Cortes, inſtead of complying with his demands, renewed his requeſt of audience, the Mexican immediately left the camp with ſtrong marks of ſurpriſe and reſentment. Next morning, none of the natives appeared; all friendly correſpondence ſeemed to be at an end, and hoſtilities were expected to commence every moment. A ſudden conſternation enſued among the Spaniards, and a party was formed againſt him by the adherents of Velaſques; who took advantage of the occaſion, and deputed one of their number, a principal officer, to remonſtrate, as if in name of the whole army, againſt his raſhneſs, and to urge the neceſſity of his returning to Cuba. Cortes received the meſſage without any appearance of emotion; and as he well knew the temper and wiſhes of his ſoldiery, with much complacency he pretended to comply with the requeſt now made him, and iſſued orders that the army ſhould be in readineſs next day to embark for Cuba. Upon hearing this, the troops, as Cortes had expected, were quite outrageous: they poſitively refuſed to comply with theſe orders, and threatened immediately to chooſe another general if Cortes continued to inſiſt on their departure.

65 Montezuma peremptorily commands him to leave his dominions.

Our adventurer was highly pleaſed with the diſpoſition which now appeared among his troops: nevertheleſs, diſſembling his ſentiments, he declared, that his orders for embarking had proceeded from a perſuaſion that it was agreeable to his fellow-ſoldiers, to whoſe opinion he had ſacrificed his own; but now he acknowledged his error, and was ready to reſume his original plan of operation. This ſpeech was highly applauded; and Cortes, without allowing his men time to cool, ſet about carrying his deſigns into execution. In order to give a beginning to a colony, he aſſembled the principal perſons in his army, and by their ſuffrages elected a council and magiſtrates, in whom the government was to be veſted. The perſons choſen were moſt firmly attached to Cortes; and the new ſettlement had the name of *Villa Rica de la Vera Cruz;* that is, the rich town of the true croſs.

66 Villa Rica founded.

Before this court of his own making, Cortes did not heſitate at reſigning all his authority, and was immediately re-elected chief-juſtice of the colony, and captain-general of his army, with an ample commiſſion, in the king's name, to continue in force till the royal pleaſure ſhould be farther known. The ſoldiers eagerly ratified their choice by loud acclamations; and Cortes, now conſidering himſelf as no longer accountable to any ſubject, began to aſſume a much

67 The government of the new colony veſted in Cortes.

Mexico.

much greater degree of dignity, and to exerciſe more extenſive powers than he had done before.

Cortes having thus ſtrengthened himſelf as well as he could, reſolved to advance into the country; and to this he was encouraged by the behaviour of the cacique or petty prince of Zempoalla, a conſiderable town at no great diſtance. Here he was received in the moſt friendly manner imaginable, and had a reſpect paid towards him almoſt equivalent to adoration. The cacique informed him of many particulars relating to the character of Montezuma.—He told him that he was a tyrant, haughty, cruel, and ſuſpicious; who treated his own ſubjects with arrogance, ruined the conquered provinces by his extortions, and often tore their ſons and daughters from them by violence; the former to be offered as victims to his gods, the latter to be reſerved as concubines for himſelf and favourites. Cortes, in reply, artfully inſinuated, that one great object of the Spaniards in viſiting a country ſo remote from their own was, to redreſs grievances, and to relieve the oppreſſed; and having encouraged him to hope for this interpoſition in due time, continued his march to Quiabiſlan, the territory of another cacique, and where, by the friendly aid of the Indians, a Spaniſh colony was ſoon formed.

68 Character of Montezuma given by the cacique.

During the reſidence of Cortes in theſe parts, he ſo far wrought on the minds of the caciques of Zempoalla and Quiabiſlan, that they ventured to inſult the Mexican power, at the very name of which they had been formerly accuſtomed to tremble. Some of Montezuma's officers having appeared to levy the uſual tribute, and to demand a certain number of human victims, as an expiation of their guilt in preſuming to hold intercourſe with thoſe ſtrangers whom the emperor had commanded to leave his dominions; inſtead of obeying his orders, they made them priſoners, treated them with great indignity, and, as their ſuperſtition was no leſs barbarous than Montezuma's, they threatened to ſacrifice them to their gods.

Though Cortes had now taken ſuch meaſures as in a manner enſured his ſucceſs; yet as he had thrown off all dependence on the governor of Cuba, who was his lawful ſuperior, and apprehended his intereſt at court, he thought proper, before he ſet out on his intended expedition, to take the moſt effectual meaſures againſt the impending danger. With this view, he perſuaded the magiſtrates of his colony to addreſs a letter to the king, containing a pompous account of their own ſervices, of the country they had diſcovered, &c. and of the motives which had induced them to throw off their allegiance to the governor of Cuba, and to ſettle a colony dependent on the crown alone, in which the ſupreme power, civil as well as military, had been veſted in Cortes; humbly requeſting their ſovereign to ratify what had been done by his royal authority.

Some ſoldiers and ſailors, ſecretly diſaffected to Cortes, formed a deſign of ſeizing one of the brigantines, and making their eſcape to Cuba, in order to give ſuch intelligence to the governor as might enable him to intercept the veſſel which was to carry the treaſure and deſpatches to Spain. This conſpiracy was conducted with profound ſecrecy; but at the moment when every thing was ready for execution, the ſecret was diſcovered by one of the aſſociates. The latent ſpirit of diſaffection which Cortes was now too well convinced had not been extinguiſhed amongſt his troops, gave him very great uneaſineſs. The only method which he could think of to prevent ſuch conſpiracies for the future was to deſtroy his fleet, and thus deprive his ſoldiers of every reſource except that of conqueſt: and with this propoſal he perſuaded his men to comply. With univerſal conſent therefore the ſhips were drawn aſhore, and, after being ſtripped of their ſails, rigging, iron work, and whatever elſe might be of uſe, they were broke in pieces.

Mexico.

69 Cortes burns his fleet.

Cortes having thus rendered it neceſſary for his troops to follow wherever he choſe to lead, began his march to Zempoalla with 500 infantry, 15 horſe, and ſix field pieces. The reſt of his troops being leſs fit for active ſervice, he left them as a garriſon in Villa Rica, under the command of Eſcalante, an officer of merit, and warmly attached to his intereſt. The cacique of Zempoalla ſupplied him with proviſions; and with 200 of thoſe Indians called *Tamanes*, whoſe office, in a country where tame animals were unknown, was to carry burdens, and perform all manner of ſervile labour. He offered likewiſe a conſiderable body of troops; but Cortes was ſatisfied with 400; taking care, however, to chooſe perſons of ſuch note, that they might ſerve as hoſtages for the fidelity of their maſter.

Nothing memorable happened till the Spaniards arrived on the confines of the republic of Tlaſcala. The inhabitants of that province were warlike, fierce, and revengeful, and had made conſiderable progreſs in agriculture and ſome other arts. They were implacable enemies to Montezuma; and therefore Cortes hoped that it would be an eaſy matter for him to procure their friendſhip. With this view, four Zempoallans of high rank were ſent ambaſſadors to Tlaſcala, dreſſed with all the badges of that office uſual among the Indians. The ſenate were divided in their opinions with regard to the propoſals of Cortes: but at laſt Magiſcatzin, one of the oldeſt ſenators, and a perſon of great authority, mentioned the tradition of their anceſtors, and the revelations of their prieſts; that a race of invincible men, of divine origin, who had power over the elements, ſhould come from the eaſt to ſubdue their country. He compared the reſemblance which the ſtrangers bore to the perſons figured in the traditions of Mexico, their dominion over the elements of fire, air, and water; he reminded the ſenate of their prodigies, omens, and ſignals, which had lately terrified the Mexicans, and indicated ſome very important event; and then declared his opinion, that it would be raſhneſs to oppoſe a force apparently aſſiſted by heaven, and men who had already proved, to the ſad experience of thoſe who oppoſed them, that they were invincible. This orator was oppoſed by Xicotencal, who endeavoured to prove that the Spaniards were at beſt but powerful magicians: that they had rendered themſelves obnoxious to the gods by pulling down their images and altars, (which indeed Cortes had very imprudently done at Zempoalla); and of conſequence, that they might eaſily be overcome, as the gods would not fail to reſent ſuch an outrage. He therefore voted for war, and adviſed the cruſhing of theſe invaders at one blow.

70 Sends ambaſſadors to the republic of Tlaſcala.

The advice of Xicotencal prevailed; and in conſequence of it, the ambaſſadors were detained; which

giving

Mexico. giving Cortes the alarm, he drew nearer the city of Tlaſcala. They ſuffered him with his army drawn up in good order, to paſs a ſtrong wall between two mountains, which might have been very advantageouſly defended againſt him. He had not advanced far beyond this paſs, however, before a party of Tlaſcalans with plumes were diſcovered, which denoted that an army was in the field. Theſe he drove before him by a detachment of ſix horſe, obliged them to join another party, and then reinforcing the advanced detachment, charged the enemy with ſuch vigour that they began to retire. Five thouſand Tlaſcalans then ruſhed out of their hiding places, juſt as the infantry came up to aſſiſt their ſlender body of cavalry. The enemy attacked with the utmoſt fury: but were ſo much diſconcerted by the firſt diſcharge of the fire arms, that they retreated in confuſion, furniſhing the Spaniards with an opportunity of purſuing them with great ſlaughter. Cortes, however, ſuppoſing that this could not be their whole force, advanced with the utmoſt caution, in order of battle, to an eminence, from whence he had a view of the main body of the Tlaſcalan army commanded by Xicotencal, conſiſting of no fewer than 40,000 men. By theſe the ſmall army of Cortes was entirely ſurrounded: which Xicotencal no ſooner perceived, than he contracted the circle with incredible diligence, while the Spaniards were almoſt overwhelmed with ſhowers of arrows, darts, and ſtones. It is impoſſible but in this caſe many of the Spaniards muſt have periſhed, had it not been for the inſufficiency of the Indian weapons. This circumſtance gave the Spaniards a prodigious advantage over them; and therefore the Tlaſcalans, notwithſtanding their valour and ſuperiority in number, could accompliſh no more in the preſent inſtance, than to kill one horſe and ſlightly wound nine ſoldiers.

71 The Tlaſcalans reſolve on war.

The Tlaſcalans being taught by this, and ſome ſubſequent encounters, how much they were inferior to the Spaniards, began to conceive them to be really what Magiſcatzin had ſaid; a ſuperior order of beings, againſt whom human power could not prevail. In this extremity they had recourſe to their prieſts, requiring them to reveal the cauſes of ſuch extraordinary events, and to declare what means they ſhould take to repel ſuch formidable invaders. The prieſts, after many ſacrifices and incantations, delivered their reſponſe, That theſe ſtrangers were the offspring of the ſun, procreated by his animating energy in the regions of the eaſt: that, by day, while cheriſhed with the influence of his parental beams, they were invincible; but by night, when his reviving heat was withdrawn, their vigour declined and faded like herbs in the field, and they dwindled down into mortal men. In conſequence of this, the Tlaſcalans acted in contradiction to one of their moſt eſtabliſhed maxims in war, and ventured to attack the enemy in the night time, hoping to deſtroy them when enfeebled and ſurpriſed. But the Spaniſh centinels having obſerved ſome extraordinary movements among the Tlaſcalans, gave the alarm. Immediately the troops were under arms, and ſallying out, defeated their antagoniſts with great ſlaughter, without allowing them to approach the camp. By this diſaſter the Tlaſcalans were heartily diſpoſed to peace; but they were at a loſs to form an adequate idea of the enemies they had to deal with. They could not aſcertain the nature of theſe ſurpriſing beings, or whether they were really of a benevolent or malignant diſpoſition. There were circumſtances in their behaviour which ſeemed to favour each opinion. On the one hand, as the Spaniards conſtantly diſmiſſed the priſoners whom they took, not only without injury, but often with preſents of European toys, and renewed their offers of peace after every victory; this lenity amazed people accuſtomed to the exterminating ſyſtem of war known in America, and who ſacrificed and devoured without mercy all the captives taken in battle; and diſpoſed them to entertain ſentiments favourable to their humanity. But, on the other hand, as Cortes had ſeized 50 of their countrymen who brought proviſions to their camp, and cut off their heads; this bloody ſpectacle, added to the terror occaſioned by the fire-arms and horſes, filled them with dreadful ideas of their ferocity. Accordingly they addreſſed them in the following manner: "If (ſaid they) you are divinities of a cruel and ſavage nature, we preſent to you five ſlaves, that you may drink their blood and eat their fleſh. If you are mild deities, accept an offering of incenſe and variegated plumes. If you are men, here is meat, bread, and fruit, to nouriſh you." After this addreſs, the peace was ſoon concluded, to the great ſatisfaction of both parties. The Tlaſcalans yielded themſelves as vaſſals to the crown of Caſtile, and engaged to aſſiſt Cortes in all his operations; while he took the republic under his protection, and promiſed to defend their perſons and poſſeſſions from injury and violence.

72 But are defeated and ſue for peace.

73 Which is granted.

Cortes left no method untried to gain the favour and confidence of the Tlaſcalans; which, however, he had almoſt entirely loſt, by his untimely zeal in deſtroying their idols as he had done thoſe of Zempoalla. But he was deterred from this raſh action by his chaplain Father Bartholomew de Olmedo; and left the Tlaſcalans in the undiſturbed exerciſe of their ſuperſtition, requiring only that they ſhould deſiſt from their horrid practice of offering human victims. As ſoon as his troops were fit for ſervice, he reſolved to continue his march towards Mexico, notwithſtanding the remonſtrances of the Tlaſcalans, who looked upon his deſtruction as unavoidable if he put himſelf into the power of ſuch a faithleſs prince as Montezuma. But the emperor, probably intidimated with the fame of his exploits, had reſolved to admit his viſit; and informed Cortes that he had given orders for his friendly reception at Cholula, the next place of any conſequence on the road to Mexico. Cortes was received with much ſeeming cordiality; but 6000 Tlaſcalan troops who accompanied him were obliged to remain without the town, as the Cholulans refuſed to admit their ancient enemies within their precincts. Yet two of theſe, by diſguiſing themſelves, got into the city, and acquainted Cortes that they obſerved the women and children belonging to the principal citizens retiring every night in a great hurry, and that ſix children had been ſacrificed in the great temple; a ſign that ſome warlike enterpriſe was at hand. At the ſame time Donna Marina, the interpreter, received information from an Indian woman of diſtinction, whoſe confidence ſhe had gained, that the deſtruction of the Spaniards was concerted; that a body of Mexican troops lay concealed near the town; that ſome of the ſtreets were barricaded, in others deep pits or trenches were dug,

74 Cortes continues his march for Mexico.

75 Treachery of Montezuma and the Cholulans.

Mexico. dug, and slightly covered over, as traps into which the horse might fall; that stones and missive weapons were collected on the tops of the temples, with which to overwhelm the infantry; that the fatal hour was already at hand, and their ruin unavoidable. Cortes, alarmed at this news, secretly arrested three of the chief priests, from whom he extorted a confession that confirmed the intelligence he had already received. As not a moment was to be lost, he instantly resolved to prevent his enemies, and to inflict on them such dreadful vengeance as might strike Montezuma and his subjects with terror. On a signal given, the troops rushed out, and fell upon the multitude, destitute of leaders, and so much astonished, that the weapons dropped from their hands, and they stood motionless, and incapable of defence. While the Spaniards attacked them in front, the Tlascalans did the same in the rear; the streets were filled with slaughter; the temples, which afforded a retreat to the priests and some leading men, were set on fire, and they perished in the flames. At length the carnage ceased, after the slaughter of 6000 Cholulans, without the loss of a single Spaniard. Cortes then released the magistrates; and reproaching them bitterly for their intended treachery, declared, that as justice was now appeased, he forgave the offence; but required them to recal the inhabitants who had fled, and re-establish order in the town.

76 Severe punishment of the Cholulans.

77 Disaffection of Montezuma's subjects.

From Cholula, Cortes advanced directly towards Mexico; and throughout the whole of his journey was entertained with accounts of the oppressions and cruelty of Montezuma. This gave him the greatest hope of accomplishing his design; as he now perceived that the empire was entirely divided, and no sort of unanimity prevailed among them. No enemy appeared to check his progress. Montezuma was quite irresolute; and Cortes was almost at the gates of the capital before the emperor had determined whether to receive him as a friend or oppose him as an enemy. But as no sign of open hostility appeared, the Spaniards, without regarding the fluctuations of Montezuma's sentiments, continued their march to Mexico, with great circumspection and the strictest discipline, though without seeming to suspect the prince whom they were about to visit.

78 Meeting of Cortes and Montezuma.

When they drew near the city, about 1000 persons, who appeared to be of distinction, came forth to meet them, adorned with plumes, and clad in mantles of fine cotton. Each of these, in his order, passed by Cortes, and saluted him according to the mode deemed most respectful and submissive in their country. They announced the approach of Montezuma himself, and soon after his harbingers came in sight. There appeared first 200 persons in an uniform dress, with large plumes of feathers, alike in fashion, marching two and two, in deep silence, barefooted, with their eyes fixed on the ground. These were followed by a company of higher rank, in their most showy apparel: in the midst of whom was Montezuma, in a chair or litter richly ornamented with gold and feathers of various colours. Four of his principal favourites carried him on their shoulders, others supported a canopy of curious workmanship over his head. Before him marched three officers with rods of gold in their hands, which they lifted up on high at certain intervals; and at that signal all the people bowed their heads, and hid their faces, as unworthy to look on so great a monarch. When he drew near, Cortes dismounting, advanced towards him with officious haste, and in a respectful posture. At the same time Montezuma alighted from his chair, and leaning on the arms of two of his near relations, approached with a slow and stately pace, his attendants covering the street with cotton cloths, that he might not touch the ground. Cortes accosted him with profound reverence, after the European fashion. He returned the salutation, according to the mode of his country, by touching the earth with his hand, and then kissing it. This ceremony appeared such amazing condescension in a proud monarch, who scarcely deigned to consider the rest of mankind as of the same species with himself, that all his subjects firmly believed those persons, before whom he humbled himself in this manner, to be something more than human. Accordingly, as they marched through the crowd, the Spaniards frequently, and with much satisfaction, heard themselves denominated *teules*, or *divinities*. Nothing material passed in this first interview. Montezuma conducted Cortes to the quarters which he had prepared for his reception; and immediately took leave of him with a politeness not unworthy of a court more refined: "You are now (says he), with your brothers, in your own house; refresh yourselves after your fatigue, and be happy until I return." The place allotted to the Spaniards for their lodging was a house built by the father of Montezuma. It was surrounded by a stone wall, with towers at proper distances, which served for defence as well as for ornament; and its apartments and courts were so large as to accommodate both the Spaniards and their Indian allies. The first care of Cortes was to take precautions for his security, by planting the artillery so as to command the different avenues which led to it, by appointing a large division of his troops to be always on guard, and by posting centinels at proper stations, with injunctions to observe the same vigilant discipline as if they were within sight of an enemy's camp.

In the evening Montezuma returned to visit his guests with the same pomp as in their first interview; and brought presents of such value, not only to Cortes and to his officers, but even to the private men, as proved the liberality of the monarch to be suitable to the opulence of his kingdom. A long conference ensued, in which Cortes learned what was the opinion of Montezuma with respect to the Spaniards. It was an established tradition, he told him, among the Mexicans, that their ancestors came originally from a remote region, and conquered the provinces now subject to his dominion; that after they were settled there, the great captain who conducted this colony returned to his own country, promising, that at some future period his descendents should visit them, assume the government, and reform their constitutions and laws; that, from what he had heard and seen of Cortes and his followers, he was convinced that they were the very persons whose appearance their prophecies taught them to expect; that accordingly he had received them, not as strangers, but as relations of the same blood and parentage, and desired that they might consider themselves as masters in his dominions; for both himself and his subjects should be ready to comply with their will, and even to prevent their wishes. Cortes made a reply

Mexico.

ply in his uſual ſtyle with reſpect to the dignity and power of his ſovereign, and his intention in ſending him into that country; artfully endeavouring ſo to frame his diſcourſe, that it might coincide as much as poſſible with the idea which Montezuma had formed concerning the origin of the Spaniards. Next morning, Cortes and ſome of his principal attendants were admitted to a public audience of the emperor. The three ſubſequent days were employed in viewing the city; the appearance of which, ſo far ſuperior in the order of its buildings and the number of its inhabitants to any place the Spaniards had beheld in America, and yet ſo little reſembling the ſtructure of an European city, filled them with ſurpriſe and admiration.

79 Deſcription of the city of Mexico.

Mexico is ſituated in a large plain, environed by mountains of ſuch height, that though within the torrid zone, the temperature of its climate is mild and healthful. All the moiſture which deſcends from the high grounds is collected in ſeveral lakes, the two largeſt of which, of about 90 miles in circuit, communicate with each other. The waters of the one are freſh, thoſe of the other brackiſh. On the banks of the latter, and on ſome ſmall iſlands adjoining to them, the capital of Montezuma's empire was built. The acceſs to the city was by artificial cauſeways or ſtreets, formed of ſtones and earth, about 30 feet in breadth. As the waters of the lake, during the rainy ſeaſon, overflowed the flat country, theſe cauſeways were of conſiderable length. That of Tacuba on the weſt a mile and a half; that of Tezcuco on the north-weſt three miles; that of Cuoyacan towards the ſouth ſix miles. On the eaſt there was no cauſeway, and the city could be approached only by canoes. In each of theſe cauſeways were openings at proper intervals, through which the waters flowed; and over theſe beams of timber were laid, which being covered with earth, the cauſeway or ſtreet had everywhere an uniform appearance. As the approaches to the city were ſingular, its conſtruction was remarkable. Not only the temples of their gods, but the houſes belonging to the monarch, and to perſons of diſtinction, were of ſuch dimenſions, that in compariſon with any other buildings which had been diſcovered in America, they might be termed *magnificent*. The habitations of the common people were mean, reſembling the huts of other Indians. But they were all placed in a regular manner, on the banks of the canals which paſſed through the city, in ſome of its diſtricts, or on the ſides of the ſtreets which interſected it in other quarters. In ſeveral places were large openings or ſquares, one of which, allotted for the great market, is ſaid to have been ſo ſpacious that 40,000 or 50,000 perſons carried on traffic there. In this city, the pride of the New World, and the nobleſt monument of the induſtry and art of man, while unacquainted with the uſe of iron, the Spaniards, who are moſt moderate in their computations, reckon that there were at leaſt 60,000 inhabitants.

80 Uneaſineſs of the Spaniards.

But how much ſoever the novelty of thoſe objects might amuſe or aſtoniſh the Spaniards, they felt the utmoſt ſolicitude with reſpect to their own ſituation. From a concurrence of circumſtances, no leſs unexpected than favourable to their progreſs, they had been allowed to penetrate into the heart of a powerful kingdom, and were now lodged in its capital, without having once met with open oppoſition from its monarch. The Tlaſcalans, however, had earneſtly diſſuaded them from placing ſuch confidence in Montezuma as to enter a city of ſuch a peculiar ſituation as Mexico, where that prince would have them at mercy, ſhut up as it were in a ſnare, from which it was impoſſible to eſcape. They aſſured them that the Mexican prieſts had, in the name of the gods, counſelled their ſovereign to admit the ſtrangers into the capital, that he might cut them off there at one blow with perfect ſecurity. The Spaniards now perceived, too plainly, that the apprehenſions of their allies were not deſtitute of foundation; that, by breaking the bridges placed at certain intervals on the cauſeways, or by deſtroying part of the cauſeways themſelves, their retreat would be rendered impracticable, and they muſt remain cooped up in the centre of a hoſtile city, ſurrounded by multitudes ſufficient to overwhelm them, and without a poſſibility of receiving aid from their allies.

81 Some hoſtilities between the Spaniards and Mexicans.

Before he ſet out from Cholula, Cortes had received advice from Villa Rica, that Qualpopoca, one of the Mexican generals on the frontiers, having aſſembled an army in order to attack ſome of the people whom the Spaniards had encouraged to throw off the Mexican yoke, Eſcalante had marched out with part of the garriſon to ſupport his allies; that an engagement had enſued, in which, though the Spaniards were victorious, Eſcalante, with ſeven of his men, had been mortally wounded, his horſe killed, and one Spaniard had been ſurrounded by the enemy and taken alive; that the head of this unfortunate captive, after being carried in triumph to different cities, in order to convince the people that their invaders were not immortal, had been ſent to Mexico. Cortes, though alarmed with this intelligence, as an indication of Montezuma's hoſtile intentions, had continued his march. But as ſoon as he entered Mexico he became ſenſible, that, from an exceſs of confidence in the ſuperior valour and diſcipline of his troops, as well as from the diſadvantage of having nothing to guide him in an unknown country but the defective intelligence which he received from people with whom his mode of communication was very imperfect, he had puſhed forward into a ſituation, where it was difficult to continue, and from which it was dangerous to retire. Diſgrace, and perhaps ruin, was the certain conſequence of attempting the latter. The ſucceſs of his enterpriſe depended upon ſupporting the high opinion which the people of New Spain had formed with reſpect to the irreſiſtible power of his arms. Upon the firſt ſymptom of timidity on his part, their veneration would ceaſe, and Montezuma, whom fear alone reſtrained at preſent, would let looſe upon him the whole force of his empire. At the ſame time, he knew that the countenance of his own ſovereign was to be obtained only by a ſeries of victories; and that nothing but the merit of extraordinary ſucceſs could ſcreen his conduct from the cenſure of irregularity. From all theſe conſiderations, it was neceſſary to maintain his ſtation, and to extricate himſelf out of the difficulties in which one bold ſtep had involved him, by venturing upon another ſtill bolder. The ſituation was trying, but his mind was equal to it; and after revolving the matter with deep attention, he fixed upon a plan no leſs extraordinary than daring. He determined to ſeize Montezuma in his palace, and carry him a priſoner to the

82 Cortes reſolves to ſeize Montezuma in his palace.

Mexico. the Spanish quarters. From the superstitious veneration of the Mexicans for the person of their monarch, as well as their implicit submission to his will, he hoped, by having Montezuma in his power, to acquire the supreme direction of their affairs; or at least, with such a sacred pledge in his hands, he made no doubt of being secure from any effort of their violence.

This he immediately proposed to his officers. The timid startled at a measure so audacious, and raised objections. The more intelligent and resolute, conscious that it was the only resource in which there appeared any prospect of safety, warmly approved of it, and brought over their companions so cordially to the same opinion, that it was agreed instantly to make the attempt. At his usual hour of visiting Montezuma, Cortes went to the palace, accompanied by Alvarado, Sandoval, Lugo, Velasquez de Leon, and Davila, five of his principal officers, and as many trusty soldiers. Thirty chosen men followed, not in regular order, but sauntering at some distance, as if they had no object but curiosity; small parties were posted at proper intervals, in all the streets leading from the Spanish quarters to the court; and the remainder of his troops, with the Tlascalan allies, were under arms, ready to sally out on the first alarm. Cortes and his attendants were admitted without suspicion; the Mexicans retiring, as usual, out of respect. He addressed the monarch in a tone very different from that which he had employed in former conferences; reproaching him bitterly as the author of the violent assault made upon the Spaniards by one of his officers, and demanding public reparation for the loss which he had sustained by the death of some of his companions, as well as for the insult offered to the great prince whose servants they were. Montezuma, confounded at this unexpected accusation, and changing colour either from the consciousness of guilt, or from feeling the indignity with which he was treated, asserted his own innocence with great earnestness; and, as proof of it, gave orders instantly to bring Qualpopoca and his accomplices prisoners to Mexico. Cortes replied, with seeming complaisance, that a declaration so respectable left no doubt remaining in his own mind; but that something more was requisite to satisfy his followers, who would never be convinced that Montezuma did not harbour hostile intentions against them, unless, as an evidence of his confidence and attachment, he removed from his own palace and took up his residence in the Spanish quarters, where he should be served and honoured as became a great monarch. The first mention of so strange a proposal bereaved Montezuma of speech, and almost of motion. At length he haughtily answered, "That persons of his rank were not accustomed voluntarily to give up themselves as prisoners; and were he mean enough to do so, his subjects would not permit such an affront to be offered to their sovereign." Cortes, unwilling to employ force, endeavoured alternately to soothe and intimidate him. The altercation became warm: and having continued above three hours, Velasquez de Leon, an impetuous and gallant young man, exclaimed with impatience, "Why waste more time in vain? Let us either seize him instantly, or stab him to the heart." The threatening voice and fierce gestures with which these words were uttered, struck Montezuma. The Spaniards, he was sensible, had now proceeded so far, as left him no hope that they would recede. His own danger was imminent, the necessity unavoidable. He saw both; and abandoning himself to his fate, complied with their request. Mexico.

83 The emperor carried to the Spanish quarters.

His officers were called. He communicated to them his resolution. Though astonished and afflicted, they presumed not to question the will of their master, but carried him in silent pomp, all bathed in tears, to the Spanish quarters.

84 Cortes rules the empire.

They at first pretended to treat Montezuma with great respect; but soon took care to let him know that he was entirely in their power. Cortes wished that the shedding the blood of a Spaniard should appear the most heinous crime that could be committed; and therefore not only took a most exemplary vengeance on those who had been concerned in the affair of Villa Rica, but even put the emperor himself in chains till the execution of the Mexican general was over. By these, and other insults, he at last gained entirely the ascendant over this unhappy monarch; and he took care to improve his opportunity to the utmost. He sent his emissaries into different parts of the kingdom, accompanied with Mexicans of distinction, who might serve both to guide and to protect them. They visited most of the provinces, viewed their soil and productions, surveyed with particular care the districts which yielded gold or silver, pitched upon several places as proper for future colonies, and endeavoured to prepare the minds of the people for submitting to the Spanish yoke: and while they were thus employed, Cortes, in the name and by the authority of Montezuma, degraded some of the principal officers in the empire, whose abilities or independent spirit excited his jealousy; and substituted in their place persons who he imagined would be more obsequious. One thing, however, was still wanting to complete his security. He wished to have such a command of the lake as might ensure a retreat, if, either from levity or disgust, the Mexicans should take arms against him, and break down the bridges or causeways, in order to enclose him in the city. In order to obtain this without giving disgust to the emperor or his court, Cortes artfully inflamed the curiosity of the Indians with accounts of the Spanish shipping, and those floating palaces that moved with such velocity on the water, without the assistance of oars; and when he found that the monarch himself was extremely desirous of seeing such a novelty, he gave him to understand, that nothing was wanting to his gratification besides a few necessaries from Vera Cruz, for that he had workmen in his army capable of building such vessels. The bait took with Montezuma; and he gave immediate orders that all his people should assist Cortes in whatever he should direct concerning the shipping. By this means, in a few days, two brigantines were got ready, full rigged and equipped; and Montezuma was invited on board, to make the first trial of their sailing, of which he could form no idea. Accordingly he embarked for this purpose, and gave orders for a great hunting upon the water, in order that all his people might be diverted with the novelty presented by the Spaniards. On the day appointed, the royal equipage was ready early in the morning; and the lake was covered with a multitude of boats and canoes loaded with people. The Mexicans had augmented the

85 By a pretence, he obtains leave to build two brigantines on the lake.

Mexico. the number of their rowers on board the royal barges, with an intention to difgrace the Spanifh veffels, which they regarded as clumfy, unwieldy, and heavy. But they were foon undeceived; a frefh gale ftarted up, the brigantines hoifted fail, to the utter aftonifhment of all the fpectators, and foon left all the canoes behind; while the monarch exulted in the victory of the Spaniards, without once confidering that now he had effectually rivetted his own chains.

86 Montezuma owns himfelf a vaffal to the king of Spain.

Cortes having obtained this important point, refolved to put the condefcenfion of the emperor to a trial ftill more fevere. He urged Montezuma to acknowledge himfelf a vaffal to the crown of Caftile; to hold his crown of him as fuperior, and to fubject his dominions to the payment of an annual tribute. With this requifition, humiliating as it was, Montezuma complied. He called together the chief men of his empire, and, in a folemn harangue, reminded them of the traditions and prophecies which led them to expect the arrival of a people fprung from the fame ftock with themfelves, in order to take poffeffion of the fupreme power; he declared his belief that the Spaniards were this promifed race; and that therefore he recognifed the right of their monarch to govern the Mexican empire, would lay his crown at his feet, and obey him as a tributary. While uttering thefe words, Montezuma difcovered how deeply he was affected in making fuch a facrifice. Tears and groans frequently interrupted his difcourfe. The firft mention of fuch a refolution ftruck the affembly dumb with aftonifhment. This was followed by a fullen murmur of forrow mingled with indignation; which indicated fome violent eruption of rage to be near at hand. This Cortes forefaw, and feafonably interpofed to prevent it, by declaring that his mafter had no intention to deprive Montezuma of the royal dignity, or to make any innovation upon the conftitution and laws of the Mexican empire. This affurance, added to their dread of the Spanifh arms, and the authority of their monarch's example, extorted the confent of the affembly; and the act of fubmiffion and homage was executed with all the formalities which the Spaniards pleafed to prefcribe.

Montezuma, at the requeft of Cortes, accompanied this profeffion of fealty and homage with a magnificent prefent to his new fovereign; and, after his example, his fubjects brought in very liberal contributions. The Spaniards then collected all the treafure which had been either voluntarily beftowed upon them at different times by Montezuma, or had been extorted from his people under various pretences; and having melted the gold and filver, the value of thefe amounted to 600,000 pefos. The foldiers were impatient to have it divided; and Cortes complied with their defire. A fifth of the whole was fet apart as the tax due to the king. Another fifth was allowed to Cortes as commander. The fums advanced by the governor of Cuba who had originally fitted out the expedition, were then deducted. The remainder was then divided among the army, including the garrifon of Vera Cruz, in proportion to their different ranks; and after fo many deductions, the fhare of a private man did not exceed 100 pefos. This fum fell fo far below their fanguine expectations, that it required all the addrefs, and no fmall exertions of the liberality of Cortes, to prevent an open mutiny. However, he at laft reftored tranquillity; but had no fooner efcaped this danger, than he involved himfelf, by his imprudent zeal for religion, in one much worfe. Montezuma, though often importuned, had obftinately refufed to change his religion, or abolifh the fuperftitious rites which had been for fuch a long time practifed throughout his dominions. This at laft tranfported the Spaniard with fuch rage, that, in a fally of zeal, he led out his foldiers in order to throw down the idols in the great temple by force. But the priefts taking arms in defence of their altars, and the people crowding with great ardour to fupport them, Cortes's prudence over-ruled his zeal, and induced him to defift from his rafh attempt, after diflodging the idols from one of the fhrines, and placing in their ftead an image of the Virgin Mary.

87 The Spaniards divide their treafure.

88 Cortes attempts to deftroy the Mexican idols.

89 Which produces a general difaffection.

From this moment the Mexicans began to meditate the expulfion or the deftruction of the Spaniards. The priefts and leading men held frequent meetings with Montezuma for this purpofe. But as any violent attempt might have proved fatal to the captive monarch, it was thought proper firft to try more gentle means. Having called Cortes into his prefence, he obferved, that now, as all the purpofes of his embaffy were fully accomplifhed, the gods had declared their will, and the people fignified their defire, that he and his followers fhould inftantly depart out of the empire. With this he required them to comply, or unavoidable deftruction would fall fuddenly on their heads. This unexpected requifition, as well as the manner in which it was delivered, alarmed Cortes. However, he fuppofed that more might be gained by a feigned compliance than by open refiftance; and therefore replied with great compofure, that he had already begun to prepare for his return; but as he had deftroyed the veffels in which he arrived, fome time was requifite for building other fhips. This appeared reafonable; and a number of Mexicans were fent to Vera Cruz to cut down timber, and fome Spanifh carpenters were appointed to fuperintend the work.

90 The Spaniards are commanded to depart.

91 An armament fent from Cuba againft Cortes.

Cortes flattered himfelf, that, during this interval, he might either find means to avert the threatened danger, or receive fuch reinforcements as would enable him to defend himfelf. Nine months had now elapfed fince Portocarrero and Montejo had failed with his defpatches to Spain; and he daily expected a return, with a confirmation of his authority from the king, without which all that he had done ferved only to mark him out as an object of punifhment. While he remained in great anxiety on this account, news were brought that fome fhips had appeared on the coaft. Thefe were imagined by Cortes to be a reinforcement fent him from Spain: but his joy was of fhort continuance, for a courier very foon arrived from Vera Cruz, with certain information that the armament was fitted out by Velafquez, the governor of Cuba; and inftead of bringing fuccours, threatened them with immediate deftruction.

Velafquez had been excited to this hoftile meafure chiefly through the indifcretion, or rather treachery, of the meffengers of Cortes; who, contrary to his exprefs injunctions, had landed on the ifland of Cuba, and given intelligence of all that had paffed: and Velafquez, tranfported with rage at hearing of the proceedings of Cortes, had now fent againft him this armament; confifting of 18 fhips, which carried 80 horfemen,

men, 800 infantry, of which 80 were muſketeers, and 120 croſs-bowmen, commanded by a brave officer named *Pamphilo de Narvaez;* whoſe inſtructions were, to ſeize Cortes and his principal officers, to ſend them priſoners to him, and then to complete the diſcovery and conqueſt of the country in his name. This proved a moſt afflicting piece of news to Cortes.

92 Which is defeated by that general.

Having now no reſource but in war, he left 150 men under the command of Pedro de Alvarado, an officer of great bravery, and much reſpected by the Mexicans, to guard the capital and the captive emperor; while he himſelf marched with the remainder, to meet his formidable opponent, who had taken poſſeſſion of Zempoalla. Even after being reinforced by Sandoval his governor of Vera Cruz, the force of Cortes did not exceed 250 men. He hoped for ſucceſs chiefly from the rapidity of his motions and the poſſibility of ſurpriſing his enemies; and as he chiefly dreaded their cavalry, he armed his ſoldiers with long ſpears, accuſtoming them to that deep and compact arrangement which the uſe of this formidable weapon enabled them to aſſume, As he advanced, however, he repeated his propoſals of accommodation; but theſe being conſtantly rejected, and a price ſet upon his head, he at laſt attacked Narvaez in the night-time, entirely defeated and took him priſoner, obliging all his troops to own allegiance to himſelf.

Nothing could be more ſeaſonable than this victory, by which Cortes found his army very conſiderably increaſed; for moſt of the ſoldiers of Narvaez choſe rather to follow Cortes than to return to Cuba, whither the conqueror had offered to ſend them if they choſe.

93 Dangerous ſituation of the Spaniards left at Mexico.

His affairs at Mexico, in the mean time, were in the utmoſt danger of being totally ruined; and had this deciſive victory been delayed but a few days longer, he muſt have come too late to ſave his companions. A ſhort time after the defeat of Narvaez, a courier arrived from Mexico with the diſagreeable intelligence that the Mexicans had taken arms; and having ſeized and deſtroyed the two brigantines which he had built in order to ſecure the command of the lake, had attacked the Spaniards in their quarters, killed ſome, and wounded many more, burnt their magazine of proviſions, and, in ſhort, carried on hoſtilities with ſuch fury, that though Alvarado and his men defended themſelves with undaunted reſolution, they muſt either be cut off by famine, or ſink under the multitude of their enemies. This revolt was excited by motives which rendered it ſtill more alarming. On the departure of Cortes for Zempoalla, the Mexicans flattered themſelves, that the long-expected opportunity of reſtoring their ſovereign to liberty, and driving out the Spaniards, was arrived; and conſultations were accordingly held for bringing about both theſe events. The Spaniards in Mexico, conſcious of their own weakneſs, ſuſpected and dreaded theſe machinations; but Alvarado, who had neither the prudence nor the addreſs of Cortes, took the worſt method imaginable to overcome them. Inſtead of attempting to ſoothe or cajole the Mexicans, he waited the return of one of their ſolemn feſtivals, when the principal perſons in the empire were dancing, according to cuſtom, in the court of the great temple; he ſeized all the avenues which led to it; and, allured partly by the rich ornaments which they wore in honour of their gods, and partly by the facility of cutting off at once the authors of that conſpiracy which he dreaded, he fell upon them, unarmed and unſuſpicious of danger, and maſſacred a great number; none eſcaping but ſuch as made their way over the battlements of the temple. An action ſo cruel and treacherous filled not only the city, but the whole empire, with indignation and rage; and the Mexicans immediately proceeded in the manner above mentioned.

Cortes advanced with the utmoſt celerity to the relief of his diſtreſſed companions: but as he paſſed along, had the mortification to find that the Spaniards were generally held in abhorrence. The principal inhabitants had deſerted the towns through which he paſſed; no perſon of note appeared to meet him with the uſual reſpect; nor were proviſions brought to his camp as uſual. Notwithſtanding theſe ſigns of averſion and horror, however, the Mexicans were ſo ignorant of the military art, that they again permitted him to enter the capital without oppoſition; though it was in their power to have eaſily prevented him, by breaking down the bridges and cauſeways which led to it.

94 Cortes allowed to return to Mexico;

Cortes was received by his companions with the utmoſt joy; and this extraordinary ſucceſs ſo far intoxicated the general himſelf, that he not only neglected to viſit Montezuma, but expreſſed himſelf very contemptuouſly concerning him. Theſe expreſſions being reported among the Mexicans, they all at once flew to arms, and made ſuch a violent and ſudden attack, that all the valour and ſkill of Cortes were ſcarce ſufficient to repel them. This produced great uneaſineſs among the ſoldiers of Narvaez, who had imagined there was nothing to do but to gather the ſpoils of a conquered country. Diſcontent and murmurings, however, were now of no avail; they were encloſed in a hoſtile city, and, without ſome extraordinary exertions, were inevitably undone. Cortes therefore, made a deſperate ſally; but, after exerting his utmoſt efforts for a whole day, was obliged to retire with the loſs of 12 killed, and upwards of 60 wounded. Another ſally was attempted with the like bad ſucceſs, and in it Cortes himſelf was wounded in the hand.

95 but is furiouſly attacked by the natives.

The Spaniſh general was now thoroughly convinced of his error; and therefore betook himſelf to the only reſource which was left; namely, to try what effect the interpoſition of Montezuma would have to ſoothe or overawe his ſubjects. When the Mexicans approached the next morning to renew the aſſault, that unfortunate prince, at the mercy of the Spaniards, and reduced to the ſad neceſſity of becoming the inſtrument of his own diſgrace, and of the ſlavery of his people advanced to the battlements in his royal robes, and with all the pomp in which he uſed to appear on ſolemn occaſions. At the ſight of their ſovereign, whom they had been long accuſtomed to reverence almoſt as a god, the Mexicans inſtantly forebore their hoſtilities, and many proſtrated themſelves on the ground: but when he addreſſed them in favour of the Spaniards, and made uſe of all the arguments he could think of to mitigate their rage, they teſtified their reſentment with loud murmurings; and at length broke forth

96 Montezuma killed.

Mexico.

forth with such fury, that before the soldiers, appointed to guard Montezuma, had time to cover him with their shields, he was wounded with two arrows, and a blow on his temple with a stone struck him to the ground. On seeing him fall, the Mexicans instantly fled with the utmost precipitation: but the unhappy monarch, now convinced that he was become an object of contempt even to his own subjects, obstinately refused all nourishment; and thus in a short time ended his days.

97
A terrible engagement between the Spaniards and Mexicans.

On the death of Montezuma, Cortes having lost all hope of bringing the Mexicans to any terms of peace, prepared for retreat. But his antagonists, having taken possession of a high tower in the great temple, which overlooked the Spanish quarters, and placing there a garrison of their principal warriors, the Spaniards were so much exposed to their missile weapons, that none could stir without danger of being killed or wounded. From this post, therefore, it was necessary to dislodge them at any rate; and Juan de Escobar, with a large detachment of chosen soldiers, was ordered to make the attack. But Escobar, though a valiant officer, and though he exerted his utmost efforts, was thrice repulsed. Cortes, however, sensible that not only his reputation, but the safety of his army, depended on the success of this assault, caused a buckler to be tied to his arm, as he could not manage it with his wounded hand, and rushed with his drawn sword among the thickest of the combatants. Encouraged by the presence of their general, the Spaniards returned to the charge with such vigour, that they gradually forced their way up the steps, and drove the Mexicans to the platform at the top of the tower. There a dreadful carnage began; when two young Mexicans of high rank, observing Cortes, as he animated his soldiers, resolved to sacrifice their own lives in order to cut off the author of so many calamities which desolated their country. They approached him in a suppliant posture, as if they intended to lay down their arms; and seizing him in a moment, hurried him towards the battlements, over which they threw themselves headlong, in hopes of dragging him along with them. But Cortes, by his strength and agility, disengaged himself from their grasp; so that the two Mexicans perished alone.

As soon as the Spaniards became masters of the tower, they set fire to it, and without further molestation continued the preparations for their retreat. This became the more necessary, as their enemies, astonished at this last effort of their valour, had now entirely changed their system of hostility; and, instead of incessant attacks, endeavoured, by barricading the streets, and breaking down the causeways, to cut off the communication of the Spaniards with the continent, and thus to starve an enemy whom they could not subdue. The first point to be determined, was whether they should march out openly in the face of day, when they could discern every danger, or whether they should endeavour to retire secretly in the night. The latter was preferred, partly from hopes that the superstition of the Mexicans would prevent them from attacking them in the night, and partly from their own superstition in giving credit to the predictions of a private soldier, who pretended to astrology, and assured them of success if they retreated in this manner. Towards midnight, therefore, they began their march, in three divisions. Sandoval led the van; Pedro Alvarado and Velasquez de Leon had the conduct of the rear; and Cortes commanded in the centre, where he placed the prisoners, among whom were a son and two daughters of Montezuma, together with several Mexicans of distinction, the artillery, baggage, and a portable bridge of timber intended to be laid over the breaches in the causeway. They marched in profound silence along the causeway which led to Tacuba, because it was shorter than any of the rest, and, lying most remote from the road towards Tlascala and the sea coast, had been left most entire by the Mexicans.

98
Cortes retreats with great loss.

They reached the first breach in the causeway without molestation, hoping that their retreat was undiscovered. But the Mexicans had not only watched all their motions, but made preparations for a most formidable attack. While the Spaniards were intent upon placing their bridges in the breach, and occupied in conducting their horses and artillery along it, they were suddenly alarmed with the sound of warlike instruments, and found themselves assaulted on all sides by an innumerable multitude of enemies. Unfortunately the wooden bridge was wedged so fast in the mud by the weight of the artillery, that it was impossible to remove it. Dismayed at this accident, the Spaniards advanced with precipitation to the second breach. The Mexicans hemmed them in on every side; and though they defended themselves with their usual courage, yet, crowded as they were in a narrow causeway, their discipline and military skill were of little avail; nor did the obscurity of the night allow them to derive much advantage from their fire-arms or the superiority of their other weapons. At last the Spaniards, overborne with the numbers of their enemies, began to give way, and in a moment the confusion was universal. Cortes, with about 100 foot soldiers, and a few horse, forced his way over the two remaining breaches in the causeway, the bodies of the dead serving to fill up the chasms, and reached the main land. Having formed them as soon as they arrived, he returned with such as were yet capable of service, to assist his friends in their retreat. He met with part of his soldiers who had forced their way through the enemy, but found many more overwhelmed by the multitude of their aggressors, or perishing in the lake; and heard the grievous lamentations of others whom the Mexicans were carrying off in triumph to be sacrificed to the god of war.

In this fatal retreat more than one half of Cortes's army perished, together with many officers of distinction. All the artillery, ammunition, and baggage, were lost; the greater part of the horses and above 2000 Tlascalans were killed, and only a very small part of their treasure saved. The first care of the Spanish general was to find some shelter for his wearied troops; for, as the Mexicans infested them on every side, and the people of Tacuba began to take arms, he could not continue in his present station. At last he discovered a temple seated on an eminence, in which he found not only the shelter he wanted, but some provisions; and though the enemy did not intermit their attacks throughout the day, they were without much difficulty prevented from making any impression. For

six

ſix days after, they continued their march through a barren, ill cultivated, and thinly peopled country, where they were often obliged to feed on berries, roots, and the ſtalks of green maize; at the ſame time they were haraſſed without intermiſſion by large parties of Mexicans, who attacked them on all ſides. On the ſixth day they reached Otumba, not far from the road between Mexico and Tlaſcala. Early next morning they began to advance towards it, flying parties of the enemy ſtill hanging on their rear; and amidſt the inſults with which they accompanied their hoſtilities, Donna Marina remarked, that they often exclaimed with exultation, "Go on, robbers; go to the place where you ſhall quickly meet the vengeance due to your crimes." The meaning of this threat the Spaniards did not comprehend, until they reached the ſummit of an eminence before them. There a ſpacious valley opened to their view, covered with a vaſt army as far as the eye could reach. The Mexicans, while with one body of their troops they haraſſed the Spaniards in their retreat, had aſſembled their principal force on the other ſide of the lake; and marching along the road which led directly to Tlaſcala, poſted it in the plain of Otumba, through

99 The battle of Otumba.

which they knew Cortes muſt paſs. At the ſight of this incredible multitude, which they could ſurvey at once from the riſing ground, the Spaniards were aſtoniſhed, and even the boldeſt began to deſpair. But Cortes, without allowing their fears time to operate, after warning them briefly that no alternative remained but to conquer or die, led them inſtantly to the charge. The Mexicans waited their approach with unuſual fortitude: yet ſuch was the ſuperiority of the Spaniſh diſcipline and arms, that the impreſſion of this ſmall body was irreſiſtible; and whichever way its force was directed, it penetrated and diſperſed the moſt numerous battalions. But while theſe gave way in one quarter, new combatants advanced from another; and the Spaniards, though ſucceſsful in every attack, were ready to ſink under theſe repeated efforts, without ſeeing any end to their toil, or any hope of victory. At that time Cortes obſerved the great ſtandard of the empire, which was carried before the Mexican general, advancing; and fortunately recollecting to have heard, that on the fate of it depended the event of every battle, he aſſembled a few of his braveſt officers, whoſe horſes were ſtill capable of ſervice, and, placing himſelf at their head, puſhed towards the ſtandard with ſuch impetuoſity that he bore down every thing before him. A choſen body of nobles, who guarded the ſtandard, made ſome reſiſtance, but were ſoon broken. Cortes, with a ſtroke of his lance, wounded the Mexican general, and threw him to the ground. One of his followers alighting, put an end to his life, and laid hold of the imperial ſtandard. The moment that their leader fell, and the ſtandard, towards which all directed their eyes, diſappeared, an univerſal panic ſtruck the Mexicans; and, as if the bond which held them together had been diſſolved, every enſign was lowered, each ſoldier threw away his weapons, and fled with precipitation to the mountains. The Spaniards, unable to purſue them far, returned to collect the ſpoils of the field; and theſe were ſo valuable as to be ſome compenſation for the wealth which they had loſt in Mexico; for in the enemy's army were moſt of their principal warriors dreſſed out in their richeſt ornaments, as if they had been marching to aſſured victory.

The day after this important action (being July 8. 1520), the Spaniards entered the Tlaſcalan territories, where they were received with the moſt cordial friendſhip. Cortes endeavoured to avail himſelf of this diſpoſition as much as poſſible; for which purpoſe he diſtributed among them the rich ſpoils taken at Otumba with ſuch a liberal hand, that he made himſelf ſure of obtaining from the republic whatever he ſhould deſire. He drew a ſmall ſupply of ammunition, and two or three field-pieces, from his ſtores at Vera Cruz. He deſpatched an officer of confidence with four ſhips of Narvaez's fleet to Hiſpaniola and Jamaica, to engage adventurers, and to purchaſe horſes, gunpowder, and other military ſtores. And as he knew that it would be in vain to attempt the reduction of Mexico, unleſs he could ſecure the command of the lake, he gave orders to prepare, in the mountains of Tlaſcala, materials for building 12 brigantines, ſo that they might be carried thither in pieces, ready to be put together, and launched when he ſtood in need of their ſervice. But, in the mean time, his ſoldiers, alarmed at the thoughts of being expoſed to ſuch calamities a ſecond time, preſented a remonſtrance to their general, in which they repreſented the imprudence of attacking a powerful empire with his ſhattered forces, and formally required him to return back to Cuba. All the eloquence of Cortes could now only prevail with them to delay their departure for ſome time, when he promiſed to diſmiſs ſuch as ſhould deſire it. However, this was only a pretence; for Cortes, in fact, had the conqueſt of Mexico as much at heart as ever. Without giving his ſoldiers an opportunity of caballing, therefore, he daily employed them againſt the people of the neighbouring provinces, who had cut off ſome detachments of Spaniards during his misfortunes at Mexico; and by which, as he was conſtantly attended with ſucceſs, his men ſoon reſumed their wonted ſenſe of ſuperiority.

But all the efforts of Cortes could have been of little avail, had he not unexpectedly obtained a reinforcement of Spaniſh ſoldiers. Theſe belonged to an armament fitted out by Franciſco de Garay, governor of Jamaica, who had long aimed at dividing with Cortes the glory and gain of annexing the empire of Mexico to the crown of Caſtile. They had, however, unadviſedly made their attempt on the northern provinces, where the country was poor and the inhabitants fierce and warlike; ſo that, after a ſucceſſion of diſaſters, they were now obliged to venture into Vera Cruz, and caſt themſelves upon the mercy of their countrymen; and here they alſo were ſoon perſuaded to throw off their allegiance to their maſter, and to enliſt with Cortes. About the ſame time a ſhip arrived from Spain, freighted by ſome private adventurers, with military ſtores; and the cargo was eagerly purchaſed by Cortes, while the crew, following the example of the reſt, joined him at Tlaſcala.

101 Cortes receives an unexpected reinforcement.

From theſe various quarters, the army of Cortes was augmented with 180 men and 20 horſes; by which means he was enabled to diſmiſs ſuch of the ſoldiers of Narvaez as were moſt troubleſome and diſcontented; after the departure of whom he ſtill muſtered 550 infantry, of whom 80 were armed with muſkets or croſs-

croſs-bows, 40 horſemen, and nine pieces of artillery. At the head of theſe, with 10,000 Tlaſcalans and other friendly Indians, he began his march towards Mexico, on the 28th of December, ſix months after his fatal retreat from that city.

102 He ſets out again for Mexico.

As ſoon as Cortes entered the enemy's territories, he diſcovered various preparations to obſtruct his progreſs. But his troops forced their way with little difficulty; and took poſſeſſion of Tezcuco, the ſecond city of the empire, ſituated on the banks of the lake, about 20 miles from Mexico. Here he determined to eſtabliſh his head-quarters, as the moſt proper ſtation for launching his brigantines, as well as for making his approaches to the capital. In order to render his reſidence there more ſecure, he depoſed the cacique or chief, who was at the head of that community, under pretence of ſome defect in his title, and ſubſtituted in his place a perſon whom a faction of the nobles pointed out as the right heir of that dignity. Attached to him by this benefit, the new cacique and his adherents ſerved the Spaniards with inviolable fidelity.

As the conſtruction of the brigantines advanced ſlowly under the unſkilful hands of ſoldiers and Indians, whom Cortes was obliged to employ in aſſiſting three or four carpenters who happened fortunately to be in his ſervice, and as he had not yet received the reinforcement which he expected from Hiſpaniola, he was not in a condition to turn his arms directly againſt the capital. To have attacked a city ſo populous, ſo well prepared for defence, and in a ſituation of ſuch peculiar ſtrength, muſt have expoſed his troops to inevitable deſtruction. Three months elapſed before the materials for conſtructing the brigantines were finiſhed, and before he heard any thing with reſpect to the

103 Cortes makes great progreſs.

ſucceſs of his negotiation in Hiſpaniola. This, however, was not a ſeaſon of inaction to Cortes. He attacked ſucceſſively ſeveral of the towns ſituated around the lake; and though all the Mexican power was exerted to obſtruct his operations, he either compelled them to ſubmit to the Spaniſh crown, or reduced them to ruins. Other towns he endeavoured to conciliate by more gentle means; and though he could not hold any intercourſe with the inhabitants but by the intervention of interpreters, yet, under all the diſadvantages of that tedious and imperfect mode of communication, he had acquired ſuch thorough knowledge of the ſtate of the country, as well as of the diſpoſitions of the people, that he conducted his negotiations and intrigues with aſtoniſhing dexterity and ſucceſs. Moſt of the cities adjacent to Mexico were originally the capitals of ſmall independent ſtates; and ſome of them having been but lately annexed to the Mexican empire, ſtill retained the remembrance of their ancient liberty, and bore with impatience the rigorous yoke of their new maſters. Cortes having early obſerved ſymptoms of their diſaffection, availed himſelf of this knowledge to gain their confidence and friendſhip. By offering with confidence to deliver them from the odious dominion of the Mexicans, and by liberal promiſes of more indulgent treatment if they would unite with him againſt their oppreſſors, he prevailed on the people of ſeveral conſiderable diſtricts, not only to acknowledge the king of Caſtile as their ſovereign, but to ſupply the Spaniſh camp with proviſions, and to ſtrengthen his army with auxiliary troops. Guatimozin, on the firſt appearance of defection among his ſubjects, exerted himſelf with vigour to prevent or to puniſh their revolt; but, in ſpite of his efforts, the ſpirit continued to ſpread. The Spaniards gradually acquired new allies; and with deep concern he beheld Cortes arming againſt his empire thoſe very hands which ought to have been active in his defence, and ready to advance againſt the capital at the head of a numerous body of his own ſubjects.

While, by theſe various methods, Cortes was gradually circumſcribing the Mexican power within ſuch narrow limits that his proſpect of overturning it ſeemed neither to be uncertain nor remote, all his ſchemes were well nigh defeated by a conſpiracy againſt his own perſon, and which was diſcovered only a ſhort time before it was to have been executed. Though many were concerned, Cortes did not think proper to puniſh any more than the principal ringleader, whom he cauſed immediately to be hanged; and then, without allowing them leiſure to ruminate on what had happened, and as the moſt effectual means of preventing the return of a mutinous ſpirit, he determined to call forth his troops immediately to action. Fortunately a proper occaſion for this occurred, without his ſeeming to court it. He received intelligence, that the materials for building the brigantines were at length completely finiſhed, and waited only for a body of Spaniards to conduct them to Tezcuco. The command of this convoy, conſiſting of 200 foot ſoldiers, 15 horſemen, and two field pieces, he gave to Sandoval, who by the vigilance, activity, and courage, which he manifeſted on every occaſion, was growing daily in his confidence, and in the eſtimation of his fellow-ſoldiers. The Tlaſcalans furniſhed 8000 *Tamenes*, an inferior order of men deſtined for ſervile taſks, to carry the materials on their ſhoulders, and appointed 15,000 warriors to accompany and defend them. Sandoval made the diſpoſition for their progreſs with great propriety, placing the Tamenes in the centre, one body of warriors in the front, another in the rear, with conſiderable parties to cover the flanks. To each of theſe he joined ſome Spaniards, not only to aſſiſt them in danger, but to accuſtom them to regularity and ſubordination. Parties of Mexicans frequently appeared hovering around them on the high grounds: but perceiving no proſpect of ſucceſs in attacking an enemy continually on his guard, and prepared to receive them, they did not venture to moleſt him; and Sandoval had the glory of conducting ſafely to Tezcuco a convoy on which all the future operations of his countrymen depended.

104 Mexico beſieged.

Cortes determined to attack the city from three different quarters; from Tezcuco on the eaſt ſide of the lake, from Tacuba on the weſt, and from Cuayocan towards the ſouth. Thoſe towns were ſituated on the principal cauſeways which led to the capital, and intended for their defence. He appointed Sandoval to command in the firſt, Pedro de Alvarado in the ſecond, and Chriſtoval de Olid in the third; allotting to each a numerous body of Indian auxiliaries, together with an equal diviſion of Spaniards, who, by the junction of the troops from Hiſpaniola, amounted now to 86 horſemen, and 818 foot ſoldiers; of whom 118 were armed with muſkets or croſs bows. Their train of artillery conſiſted of three battering cannon, and 15 field-

Mexico. pieces. He reserved for himself, as the station of greatest importance and danger, the conduct of the brigantines, each armed with one of his small cannon, and manned with 25 Spaniards.

As Alvarado and Olid proceeded towards the posts assigned them, they broke down the aqueducts which the ingenuity of the Mexicans had erected for conveying water into the capital, and, by the distress to which this reduced the inhabitants, gave a beginning to the calamities which they were destined to suffer. Alvarado and Olid found the towns, of which they were ordered to take possession, deserted by their inhabitants, who had fled for safety to the capital, where Guatimozin had collected the chief force of his empire, as there alone he could hope to make a successful stand against the formidable enemies who were approaching to assault him.

105 The Spaniards defeat the Mexicans, and become masters of the lake.

The first effort of the Mexicans was to destroy the fleet of brigantines, the fatal effects of whose operations they foresaw and dreaded. Though the brigantines, after all the labour and merit of Cortes in forming them, were of inconsiderable bulk, rudely constructed, and manned chiefly with landmen, hardly possessed of skill enough to conduct them, they must have been objects of terror to a people unacquainted with any navigation but that of their lake, and possessed of no vessel larger than a canoe. Necessity, however, urged Guatimozin to hazard the attack; and hoping to supply by numbers what he wanted in force, he assembled such a multitude of canoes as covered the face of the lake. They rowed on boldly to the charge, while the brigantines, retarded by a dead calm, could scarcely advance to meet them. But as the enemy drew near, a breeze suddenly sprung up; in a moment the sails were spread, and the brigantines with irresistible impetuosity broke their feeble opponents, overset many canoes, and dissipated the whole armament with such slaughter, as convinced the Mexicans, that the progress of the Europeans in knowledge and arts rendered their superiority greater on this new element than they had hitherto found it by land.

From that time Cortes remained master of the lake; and the brigantines not only preserved a communication between the Spaniards in their different stations, though at a considerable distance from each other; but were employed to cover the causeways on each side, and keep off the canoes, when they attempted to annoy the troops as they advanced towards the city. He formed the brigantines in three divisions, allotting one to each station, with orders to second the operations of the officer who commanded there. From all the three stations he pushed on the attack against the city with equal vigour; but in a manner so very different from that by which sieges are conducted in regular war, as might appear no less improper than singular to persons unacquainted with his situation. Each morning his troops assaulted the barricades which the enemy had erected on the causeways, forced their way over the trenches which they had dug, and through the canals where the bridges were broken down, and endeavoured to penetrate into the heart of the city, in hopes of obtaining some decisive advantage, which might force the enemy to surrender, and terminate the war at once; but when the obstinate valour of the Mexicans rendered the efforts of the day ineffectual, the Spaniards retired in the evening to their former quarters. Thus their toil and danger were, in some measure, continually renewed, the Mexicans repairing in the night what the Spaniards had destroyed through the day, and recovering the posts from which they had driven them. But necessity prescribed this slow and untoward mode of operation. The number of his troops was so small, that Cortes durst not, with a handful of men, attempt to make a lodgement in a city where he might be surrounded and annoyed by such a multitude of enemies. The remembrance of what he had already suffered by the ill-judged confidence with which he had ventured into such a dangerous situation, was still fresh in his mind. The Spaniards, exhausted with fatigue, were unable to guard the various posts which they daily gained; and though their camp was filled with Indian auxiliaries, they durst not devolve this charge upon them, because they were so little accustomed to discipline, that no confidence could be placed in their vigilance. Besides this, Cortes was extremely solicitous to preserve the city as much as possible from being destroyed, both as he destined it to be the capital of his conquests, and wished that it might remain as a monument of his glory. From all these considerations, he adhered obstinately, for a month after the siege was opened, to the system which he had adopted. The Mexicans, in their own defence, displayed valour which was hardly inferior to that with which the Spaniards attacked them. On land, on water, by night and by day, one furious conflict succeeded to another. Several Spaniards were killed, more wounded, and all were ready to sink under the toils of unintermitting service, which were rendered more intolerable by the injuries of the season, the periodical rains being now set in with their usual violence.

Astonished and disconcerted with the length and difficulties of the siege, Cortes determined to make one great effort to get possession of the city before he relinquished the plan which he had hitherto followed, and had recourse to any other mode of attack. With this view he sent instructions to Alvarado and Sandoval to advance with their divisions to a general assault, and took the command in person of that posted on the causeway of Cuyocan. Animated by his presence, and the expectation of some decisive event, the Spaniards pushed forward with irresistible impetuosity. They broke through one barricade after another, forced their way over the ditches and canals, and having entered the city, gained ground incessantly, in spite of the multitude and ferocity of their opponents. Cortes, though delighted with the rapidity of his progress, did not forget that he might still find it necessary to retreat; and in order to secure it, appointed Julian de Alderete, a captain of chief note in the troops which he had received from Hispaniola, to fill up the canals and gaps in the causeway as the main body advanced. That officer deeming it inglorious to be thus employed, while his companions were in the heat of action and the career of victory, neglected the important charge committed to him, and hurried on inconsiderately to mingle with the combatants. The Mexicans, whose military attention and skill were daily improving, no sooner observed this, than they carried an account of it to their monarch.

Guatimozin instantly discerned the consequences of the

Mexico.

the error which the Spaniards had committed, and, with admirable preſence of mind, prepared to take advantage of it. He commanded the troops poſted in the front to ſlacken their efforts, in order to allure the Spaniards to puſh forward, while he deſpatched a large body of choſen warriors through different ſtreets, ſome by land, and others by water, towards the great breach in the cauſeway, which had been left open. On a ſignal which he gave, the prieſts in the great temple ſtruck the great drum conſecrated to the god of war. No ſooner did the Mexicans near its doleful ſolemn ſound, calculated to inſpire them with contempt of death and with enthuſiaſtic ardour, than they ruſhed upon the enemy with frantic rage. The Spaniards, unable to reſiſt men urged on no leſs by religious fury than hope of ſucceſs, began to retire, at firſt leiſurely, and with a good countenance; but as the enemy preſſed on, and their own impatience to eſcape increaſed, the terror and confuſion became ſo general, that when they arrived at the gap in the cauſeway, Spaniards and Tlaſcalans, horſemen and infantry, plunged in promiſcuouſly, while the Mexicans ruſhed upon them fiercely from every ſide, their light canoes carrying them through ſhoals which the brigantines could not approach. In vain did Cortes attempt to ſtop and rally his flying troops; fear rendered them regardleſs of his entreaties or commands. Finding all his endeavours to renew the combat fruitleſs, his next care was to ſave ſome of thoſe who had thrown themſelves into the water; but while thus employed, with more attention to their ſituation than to his own, ſix Mexican captains ſuddenly laid hold of him, and were hurrying him off in triumph; and though two of his officers reſcued him at the expence of their own lives, he received ſeveral dangerous wounds before he could break looſe. Above 60 Spaniards periſhed in the rout; and what rendered the diſaſter more afflicting, 40 of theſe fell alive into the hands of an enemy never known to ſhow mercy to a captive.

106 Cortes repulſed in an attack.

The approach of night, though it delivered the dejected Spaniards from the attacks of the enemy, uſhered in, what was hardly leſs grievous, the noiſe of their barbarous triumph, and of the horrid feſtival with which they celebrated their victory. Every quarter of the city was illuminated; the great temple ſhone with ſuch peculiar ſplendour, that the Spaniards could plainly ſee the people in motion, and the prieſts buſy in haſtening the preparations for the death of the priſoners. Through the gloom they fancied that they diſcerned their companions by the whiteneſs of their ſkins, as they were ſtripped naked and compelled to dance before the image of the god to whom they were to be offered. They heard the ſhrieks of thoſe who were ſacrificed, and thought they could diſtinguiſh each unhappy victim by the well-known ſound of his voice. Imagination added to what they really ſaw or heard, and augmented its horror. The moſt unfeeling melted into tears of compaſſion, and the ſtouteſt heart trembled at the dreadful ſpectacle which they beheld.

Cortes, who, beſides all that he felt in common with his ſoldiers, was oppreſſed with the additional load of anxious reflections natural to a general on ſuch an unexpected calamity, could not like them relieve his mind by giving vent to its anguiſh. He was obliged to aſſume an air of tranquillity in order to revive the ſpirits and hopes of his followers. The juncture, indeed, required an extraordinary exertion of fortitude. The Mexicans, elated with their victory, ſallied out next morning to attack him in his quarters. But they did not rely on the efforts of their own arms alone: they ſent the heads of the Spaniards whom they had ſacrificed to the leading men in the adjacent provinces, and aſſured them that the god of war, appeaſed by the blood of their invaders, which had been ſhed ſo plentifully on his altars, had declared with an audible voice, that in eight days time thoſe hated enemies ſhould be finally deſtroyed, and peace and proſperity re-eſtabliſhed in the empire.

107 The Mexicans renew the attack with great fury.

A prediction, uttered with ſuch confidence, and in terms ſo void of ambiguity, gained univerſal credit among a people prone to ſuperſtition. The zeal of the provinces which had already declared againſt the Spaniards augmented, and ſeveral which had hitherto remained inactive took arms with enthuſiaſtic ardour to execute the decrees of the gods. The Indian auxiliaries who had joined Cortes, accuſtomed to venerate the ſame deities with the Mexicans, and to receive the reſponſes of their prieſts with the ſame implicit faith, abandoned the Spaniards as a race of men devoted to certain deſtruction. Even the fidelity of the Tlaſcalans was ſhaken, and the Spaniſh troops were left almoſt alone in their ſtations. Cortes, finding that he attempted in vain to diſpel the ſuperſtitious fears of his confederates by argument, took advantage, from the imprudence of thoſe who had framed the prophecy in fixing its accompliſhment ſo near at hand, to give them a ſtriking demonſtration of its falſity. He ſuſpended all military operations during the period marked out by the oracle. Under cover of the brigantines, which kept the enemy at a diſtance, his troops lay in ſafety, and the fatal term expired without any diſaſter.

His allies, aſhamed of their own credulity, returned to their ſtation. Other tribes, judging that the gods, who had now deceived the Mexicans, had decreed finally to withdraw their protection from them, joined his ſtandard; and ſuch was the levity of a ſimple people, moved by every ſlight impreſſion, that, in a ſhort time after ſuch a general defection of his confederates, Cortes ſaw himſelf, if we may believe his own account, at the head of 150,000 Indians. Even with ſuch a numerous army, he found it neceſſary to adopt a new and more wary ſyſtem of operation. Inſtead of renewing his attempts to become maſter of the city at once, by ſuch bold but dangerous efforts of valour as he had already tried, he made his advances gradually, and with every poſſible precaution againſt expoſing his men to any calamity ſimilar to that which they ſtill bewailed. As the Spaniards puſhed forward, the Indians regularly repaired the cauſeways behind them. As ſoon as they got poſſeſſion of any part of the town, the houſes were inſtantly levelled with the ground. Day by day, the Mexicans, forced to retire as their enemies gained ground, were hemmed in within more narrow limits. Guatimozin, though unable to ſtop the career of the enemy, continued to defend his capital with obſtinate reſolution, and diſputed every inch of ground. But the Spaniards, having not only varied their mode of attack, but, by order of Cortes, having changed the weapons with

108 Cortes adopts a more cautious method of proceeding.

Mexico. with which they fought, were again armed with the long Chinantlan ſpears, which they had employed with ſuch ſucceſs againſt Narvaez; and, by the firm array in which this enabled them to range themſelves, they repelled, with little danger, the looſe aſſault of the Mexicans; incredible numbers of whom fell in the conflicts, which they renewed every day. While war waſted without, famine began to conſume them within the city. The Spaniſh brigantines, having the entire command of the lake, rendered it impoſſible to receive any ſupply of proviſions by water. The vaſt number of his Indian auxiliaries enabled Cortes to ſhut up the avenues to the city by land. The ſtores which Guatimozin had laid up were exhauſted by the multitudes which crowded into the capital to defend their ſovereign and the temples of their gods. Not only the people, but perſons of the higheſt rank, felt the utmoſt diſtreſſes of want. What they ſuffered brought on infectious and mortal diſtempers, the laſt calamity that viſits beſieged cities, and which filled up the meaſure of their woes.

109 Guatimozin refuſes to ſubmit on any terms.

But, under the preſſure of ſo many and ſuch various evils, the ſpirit of Guatimozin remained firm and unſubdued. He rejected with ſcorn every overture of peace from Cortes; and, diſdaining the idea of ſubmitting to the oppreſſors of his country, determined not to ſurvive its ruin. The Spaniards continued their progreſs. At length all the three diviſions penetrated into the great ſquare in the centre of the city, and made a ſecure lodgment there. Three-fourths of the city were now reduced, and laid in ruins. The remaining quarter was ſo cloſely preſſed, that it could not long withſtand aſſailaints who attacked it from their new ſtation with ſuperior advantage, and more aſſured expectation of ſucceſs. The Mexican nobles, ſolicitous to ſave the life of a monarch whom they revered, prevailed on Guatimozin to retire from a place where reſiſtance was now vain, that he might rouſe the more diſtant provinces of the empire to arms, and maintain there a more ſucceſsful ſtruggle with the public enemy. In order to facilitate the execution of this meaſure, they endeavoured to amuſe Cortes with overtures of ſubmiſſion, that, while his attention was employed in adjuſting the articles of pacification, Guatimozin might eſcape unperceived. But they made this attempt upon a leader of greater ſagacity and diſcernment than to be deceived by their arts. Cortes ſuſpecting their intention, and aware of what moment it was to defeat it, appointed Sandoval, the officer on whoſe vigilance he could moſt perfectly rely, to take the command of the brigantines, with ſtrict injunctions to watch every motion of the enemy. Sandoval, attentive to the charge, obſerving ſome large canoes crowded with people rowing along the lake with extraordinary rapidity, inſtantly gave the ſignal to chaſe. Gracia Holguin, who commanded the fleeteſt brigantine, ſoon overtook them, and was preparing to fire on the foremoſt canoe, which ſeemed to carry ſome perſon whom all the reſt followed and obeyed. At once the rowers dropt their oars, and all on board, throwing down their arms, conjured him with cries and tears to forbear, as the emperor was there. Holguin eagerly ſeized his prize; and Guatimozin, with a dignified compoſure, gave himſelf up into his hands, requeſting only that no inſult might be offered to the empreſs or his children. When conducted to Cortes, he appeared neither with the ſullen fierceneſs of a barbarian, nor with the dejection of a ſupplicant. "I have done," ſaid he, addreſſing himſelf to the Spaniſh general, "what became a monarch. I have defended my people to the laſt extremity. Nothing now remains but to die. Take this dagger," laying his hand on one which Cortes wore, "plant it in my breaſt, and put an end to a life which can no longer be of uſe."

110 He is taken priſoner.

111 Mexico ſubmits.

As ſoon as the fate of their ſovereign was known, the reſiſtance of the Mexicans ceaſed; and Cortes took poſſeſſion of that ſmall part of the capital which yet remained undeſtroyed. Thus terminated the ſiege of Mexico, the moſt memorable event in the conqueſt of America. It continued 75 days, hardly one of which paſſed without ſome extraordinary effort of one party in the attack, or of the other in the defence of a city, on the fate of which both knew that the fortune of the empire depended. As the ſtruggle here was more obſtinate, it was likewiſe more equal, than any between the inhabitants of the Old and New Worlds. The great abilities of Guatimozin, the number of his troops, the peculiar ſituation of his capital, ſo far counterbalanced the ſuperiority of the Spaniards in arms and diſcipline, that they muſt have relinquiſhed the enterpriſe, if they had truſted for ſucceſs to themſelves alone. But Mexico was overturned by the jealouſy of neighbours who dreaded its power, and by the revolt of ſubjects impatient to ſhake off its yoke. By their effectual aid, Cortes was enabled to accompliſh what, without ſuch ſupport, he would hardly have ventured to attempt. How much ſoever this account of the reduction of Mexico may detract, on the one hand, from the marvellous relations of ſome Spaniſh writers, by aſcribing that to ſimple and obvious cauſes which they attribute to the romantic valour of their countrymen, it adds, on the other, to the merit and abilities of Cortes, who, under every diſadvantage, acquired ſuch an aſcendant over unknown nations, as to render them inſtruments towards carrying his ſcheme into execution.

The exultation of the Spaniards, on accompliſhing this arduous enterpriſe, was at firſt exceſſive. But this was quickly damped by the cruel diſappointment of thoſe ſanguine hopes which had animated them amidſt ſo many hardſhips and dangers. Inſtead of the inexhauſtible wealth which they expected from becoming maſters of Montezuma's treaſures, and the ornaments of ſo many temples, their rapaciouſneſs could collect only an inconſiderable booty amidſt ruins and deſolation (A). Guatimozin, aware of his impending fate, had ordered what remained of the riches amaſſed by his anceſtors to be thrown into the lake. The Indian auxiliaries, while the Spaniards were engaged in con-

 flict

(A) The gold and ſilver according to Cortes, amounted only to 120,000 peſos, (Relat. 280, A.) a ſum far inferior to that which the Spaniards had formerly divided in Mexico.

 flict with the enemy, had carried off the moſt valuable part of the ſpoil. The ſum to be divided among the conquerors was ſo ſmall, that many of them diſdained to accept of the pittance which fell to their ſhare, and all murmured and exclaimed; ſome againſt Cortes and his confidants, whom they ſuſpected of having ſecretly appropriated to their own uſe a large portion of the riches which ſhould have been brought into the common ſtock; others againſt Guatimozin, whom they accuſed of obſtinacy, in refuſing to diſcover the place where he had hidden his treaſure.

Arguments, entreaties, and promiſes, were employed in order to ſoothe them; but with ſo little effect, that Cortes, from ſolicitude to check this growing ſpirit of diſcontent, gave way to a deed which ſtained the glory of all his great actions. Without regarding the former dignity of Guatimozin, or feeling any reverence for thoſe virtues which he had diſplayed, he ſubjected the unhappy monarch, together with his chief favourite, to torture, in order to force from them a diſcovery of the royal treaſures, which it was ſuppoſed they had concealed. Guatimozin bore whatever the refined cruelty of his tormentors could inflict, with the invincible fortitude of an American warrior. His fellow-ſufferer, overcome by the violence of the anguiſh, turned a dejected eye towards his maſter, which ſeemed to implore his permiſſion to reveal all that he knew. But the high-ſpirited prince, darting on him a look of authority mingled with ſcorn, checked his weakneſs, by aſking, "Am I now repoſing on a bed of flowers?" Overawed by the reproach, he perſevered in his dutiful ſilence, and expired. Cortes, aſhamed of a ſcene ſo horrid, reſcued the royal victim from the hands of his torturers, and prolonged a life reſerved for new indignities and ſufferings.

112 Guatimozin tortured.

113 The Spaniards become maſters of the whole Mexican empire.

The fate of the capital, as both parties had foreſeen, decided that of the empire. The provinces ſubmitted one after another to the conquerors. Small detachments of Spaniards marching through them without interruption, penetrated, in different quarters, to the great Southern ocean, which, according to the ideas of Columbus, they imagined would open a ſhort as well as eaſy paſſage to the Eaſt Indies, and ſecure to the crown of Caſtile all the envied wealth of thoſe fertile regions; and the active mind of Cortes began already to form ſchemes for attempting this important diſcovery. In his after-ſchemes, however, he was diſappointed; but Mexico hath ever ſince remained in the hands of the Spaniards.

114. Ancient diviſions of Mexico.

The *ancient* kingdom of Mexico, properly ſo called, was divided into ſeveral provinces, of which the vale of Mexico itſelf was the fineſt in every reſpect. It is ſurrounded by verdant mountains, meaſuring upwards of 120 miles in circumference at their baſe. A great part of this vale is occupied by two lakes, the upper one of freſh water, but the lower one brackiſh, communicating with the former by means of a canal. All the water running from the mountains is collected in this lower lake, on account of its being in the bottom of the valley; hence it was ready, when ſwelled by extraordinary rains, to overflow the city of Mexico, as has been already obſerved. This delightful region contained the three imperial cities of Mexico, Acolhuacan, and Tlacopan; beſides 40 others, with innumerable villages and hamlets; but the moſt conſiderable of theſe, according to Clavigero, now ſcarcely retain one-twentieth part of their former magnificence. The principal inland provinces to the northward were the Otomies; to the ſouth-weſt the Malatzincas and Cuitlatecas; to the ſouth the Tlahuicas and Cohuixcas; to the ſouth-eaſt, after the ſtates of Itzocan, Jauhtepac, Quauhquecollon, Atlixco, Tehuacan, and others, were the great provinces of the Mixtecas, the Zapotecas, and the Chiapanecas; towards the eaſt were the provinces of Tepayacac, the Popolocas, and Totonacas. The maritime provinces on the Mexican gulf were Coatzacualco and Cuetlachtlan, called by the Spaniards *Cotaſta*. On the Pacific ocean were thoſe of Coliman, Zacatollan, Tototepec, Tecuantepec, and Zoconochco.

The province of the Otomies began in the northern part of the vale of Mexico, extending through the mountains to the north to the diſtance of 90 miles from the city of Mexico; the principal cities being Tollan or Tula, and Xilotepec: the latter made the capital of the country by the Spaniards. Beyond the ſettlements of the Otomies, the country for more than a thouſand miles in extent was inhabited only by barbarous and wandering ſavages.

The Malatzinca province contained the valley of Tolocan, and all the country from *Taximaroa* to the frontier of the kingdom of Michuacan. The valley of Tolocan is upwards of 40 miles long from ſouth-eaſt to north-weſt, and 30 in breadth where broadeſt. Its principal city, named alſo *Tolocan*, is ſituated at the foot of a high mountain covered with ſnow, 30 miles diſtant from Mexico.

The country of the Cuitlatecas extended from north-eaſt to ſouth-weſt, upwards of 200 miles, extending as far as the Pacific ocean. Their capital was named Mexcaltepec, once a great and populous city, ſituated upon the ſea-coaſt; but of which the ruins are now ſcarcely viſible. That of the Tlahuicas was named Quauhnahuac, and ſituated about 40 miles to the ſouthward of Mexico. The province extended almoſt 60 miles ſouthward, commencing from the ſouthern mountains of the vale of Mexico.

The country of the Cohuixcas extended on the ſouthward as far as the Pacific ocean, through that part where at preſent the port and city of Acapulco lie. It was divided into the ſtates of Tzompanco, Chilapan, Tlapan, and Tiſtla; the latter a very hot and unwholeſome country. To this province belonged a place named *Tlachco*, celebrated for its ſilver mines.

The province of the Mixtecas extended from *Acatlan*, a place diſtant about 120 miles from Mexico, as far as the Pacific ocean towards the ſouth-eaſt. The inhabitants carried on a conſiderable commerce, and had ſeveral well-inhabited cities and villages. To the eaſt of the Mixtecas were the Zapotecas, ſo called from their capital Teotzapotlan. In their diſtrict was the valley of Huaxyacac, now Oaxaca or Guaxaca.

The province of Mazatlan lay to the northward of the Mixtecas; and to the northward and eaſtward of the Zapotecas was *Ghimantla*, having their capitals of the ſame name with their provinces. The Chiapanecas, Zoqui, and Queleni, were the laſt of the Mexican provinces towards the ſouth-eaſt. On the ſide of the mountain Popocatepec and around it lay ſeveral ſtates, of

Mexico.

of which the moſt conſiderable were Cholallan and Huexotzinco. Theſe two having, with the aſſiſtance of the Tlaſcalans, ſhaken off the Mexican yoke, re-eſtabliſhed their former ariſtocratical government. The Cholulans poſſeſſed a ſmall hamlet called Cuitlaxcoapan, in the place where the Spaniards afterwards founded the city of Angelopoli, which is the ſecond of New Spain.

To the eaſtward of Cholula lay a conſiderable ſtate named Tepeyacac; and beyond that the Popolocas, whoſe principal cities were Tecamachalco and Quecholac. To the ſouthward of the Popolocas was the ſtate of Tahuacan, bordering upon the country of the Mixtecas; to the eaſt, the maritime province of Cuetlachtlan; and to the north the Totonacas. The extent of this province was 150 miles, beginning from the frontier of Zacatlan, a ſtate diſtant about 80 miles from the court, and terminating in the gulf of Mexico. Beſides the capital, named *Mizquihuacan*, this country had the beautiful city of Chempoallan, ſituated on the coaſt of the gulf; remarkable for being that by which the Spaniards entered the Mexican empire.

Coliman was the moſt northerly of the provinces on the Pacific ocean; the capital, named alſo Coliman, being in lat. 19. long. 92. W. Towards the ſouth-eaſt was the province of Zacotlan, with its capital of the ſame name; then came the coaſt of the Cuitlatecas; after it that of the Cohuixcans, in which was the celebrated port of Acapulco. The *Jopi* bordered on the Cohuixca coaſt; and adjoining to that the Mixteca country, now called *Xicayan;* next to that was the large province of Tecuantepec; and laſtly, that of Xoconochco.

This province, the moſt ſoutherly of the Mexican empire, was bounded on the eaſt and ſouth-eaſt by the country of Xochitepec, which did not belong to Mexico; on the weſt by Tecuantepec; and on the ſouth by the ocean. The capital, called alſo *Xoconochco*, was ſituated between two rivers, in 14 degrees of latitude and 103. W. longitude. On the Mexican gulf there were, beſides the country of the Totonecas, the provinces of Cuetlachtlan and Coatzacualco; the latter bounded on the eaſt by the ſtates of Tabaſco and the peninſula of Yucatan. The province of Cuetlachtlan comprehended all the coaſt between the rivers Alvarado and Antigua, where the province of the Totonecas began.

115 Climate.

The climate of this vaſt country varies very much according to the ſituation of its different parts. The maritime places are hot, unhealthy, and moiſt. The lands which lie in the neighbourhood of high mountains, the tops of which are always covered with ſnow, muſt of neceſſity be cold; and Clavigero informs us, that he has been on a mountain not more than 25 miles diſtant from the city of Mexico, where there was white froſt and ice even in the dog-days. "All the other inland countries (ſays our author), where the greateſt population prevailed, enjoy a climate ſo mild and benign, that they neither feel the rigour of winter nor the heats of ſummer. It is true, in many of theſe countries, there is frequently white froſt in the three months of December, January, and February, and ſometimes even it ſnows; but the ſmall inconvenience which ſuch cold occaſions continues only till the riſing ſun: no other fire than his rays is neceſſary to give warmth in winter; no other relief is wanted in the ſeaſon of heat but the ſhade: the ſame clothing which covers men in the dog-days defends them in January, and the animals ſleep all the year under the open ſky.

116 Cauſes of mildneſs of the climate.

"This mildneſs and agreeableneſs of climate under the torrid zone is the effect of ſeveral natural cauſes entirely unknown to the ancients, who did not believe it to be inhabited; and not well underſtood by ſome moderns, by whom it is believed unfavourable to thoſe who live in it. The purity of the atmoſphere, the ſmaller obliquity of the ſolar rays, and the longer ſtay of this luminary above the horizon in winter, in compariſon of other regions farther removed from the equator, concur to leſſen the cold, and to prevent all that horror which disfigures the face of nature in other climes. During that ſeaſon a ſerene ſky and the natural delights of the country are enjoyed; whereas, under the frigid, and even for the moſt part under the temperate zones, the clouds rob man of the proſpect of heaven, and the ſnow buries the beautiful productions of the earth. No leſs cauſes combine to temper the heat of ſummer. The plentiful ſhowers which frequently water the earth after mid-day from April or May to September or October; the high mountains, continually loaded with ſnow, ſcattered here and there through the country of Anahuac; the cool winds which breathe from them in that ſeaſon; and the ſhorter ſtay of the ſun above the horizon, compared with the circumſtances of the temperate zone, transform the climes of thoſe happy countries into a cool and cheerful ſpring. But the agreeableneſs of the climate is counterbalanced by thunder ſtorms, which are frequent in ſummer, particularly in the neighbourhood of the mountain of Tlaſcala; and by earthquakes, which are at all times felt, though with leſs danger than terror. Storms of hail are neither more frequent nor more ſevere than in Europe."

117 Mexican volcanoes.

One undoubted inconvenience which Mexico has is that of volcanoes. One named by the Spaniards *Volcan d'Orizaba* is higher than the peak of Teneriffe, according to the Jeſuit Tallandier, who meaſured them both. It began to ſend forth ſmoke in the year 1545, and continued burning for 20 years, but has not diſcovered any ſymptoms of eruption ſince that time. It is of a conical figure; and may be ſeen at 50 leagues diſtance. The top is always covered with ſnow, but the lower part with woods of pine and other valuable timber. It is about 90 miles to the eaſtward of the capital.

Two other mountains, named *Popocatepec* and *Iztaccihuatl*, which lie near each other, at the diſtance of 33 miles to the ſouth-eaſt of Mexico, are likewiſe ſurpriſingly high. Clavigero ſuppoſes the former to be higher than the higheſt of the Alps, conſidering the elevated ground on which the baſe of it ſtands. It has a crater more than half a mile wide; from which, in the time of the Mexican kings, great quantities of ſmoke and flame iſſued. In the 17th century it frequently threw out great ſhowers of aſhes upon the adjacent places; but in the 18th century hardly any ſmoke has been obſerved. This mountain is named by the Spaniards *Volcan*, and the other *Sierra Nevada*. The latter has alſo ſometimes emitted flames.

Both

Mexico. Both of them have their tops always covered with ſnow in ſuch quantities, that the maſſes which fall down upon the neighbouring rocks ſupply the cities of Mexico, Gelopoli, Cholula, and all the adjacent country to the diſtance of 40 miles, with that commodity; of which the conſumpt is ſo great, that in 1746 the impoſt upon what was conſumed in the city of Mexico amounted to 15,222 Mexican crowns; ſome years after it amounted to 20,000; and is now in all probability a great deal more.

Beſides theſe volcanoes, there are others in Mexico of a very remarkable height. The great chain of mountains called the *Andes* is continued through the iſthmus of Panama and through all Mexico, until they are loſt in the unknown mountains of the north. The moſt conſiderable of that chain is known in Mexico by the name of *Sierra Madre*, particularly in Cinaloa and Tarahumara, provinces no leſs than 1200 miles diſtant from the capital.

118 Rivers and lakes. Mexico is well watered by very conſiderable rivers, though none of them are comparable to thoſe of South America. Some of theſe run into the gulf of Mexico, and others into the Pacific ocean. The Alvarado has its principal ſource among the mountains of the Zapotecas, and diſcharges itſelf by three navigable mouths into the Mexican gulf, at the diſtance of 30 miles from Vera Cruz. The moſt celebrated of the rivers which run into the Pacific ocean is that called by the Spaniards *Guadalaxara* or *Great River*. It riſes in the mountains of Toloccan; and after running a courſe of more than 600 miles, diſcharges itſelf into the ocean in 22° latitude.

There are likewiſe in this country ſeveral lakes of very conſiderable magnitude; but thoſe of Nicaragua, Chapallan, and Pazquaro, which are of the greateſt extent, did not belong to the ancient Mexican empire. The moſt remarkable were thoſe in the vale of Mexico, upon which the capital of the empire was founded. Of theſe, the freſh water one, called the *lake of Chalco*, extended in length from eaſt to weſt 12 miles, as far as the city of Xochimilco; from thence, taking a northerly direction, it incorporated itſelf by means of a canal with the lake of Tezcuco; but its breadth did not exceed ſix miles. The other, named the *lake of Tezcuco*, extended 15, or rather 17 miles from eaſt to weſt, and ſomething more from ſouth to north; but its extent is now much leſs, by reaſon of the Spaniards having diverted the courſe of many of the ſtreams which run into it. This lake is ſalt, which Clavigero ſuppoſes to ariſe from the nature of the ſoil which forms its bed.

Beſides theſe, there are a number of ſmaller lakes, ſome of which are very delightful. There is a vaſt variety of mineral waters, of the nitrous, ſulphureous, and aluminous kinds, ſome of them ſo hot that meat may be boiled in them. At Tetuhuacan is a kind of petrifying water, as well as in ſeveral other parts of the empire. One of them forms a kind of ſmooth white ſtones, not diſpleaſing to the taſte; the ſcrapings of which taken in broth are celebrated as a diaphoretic, probably without any good reaſon. The doſe for a perſon not difficult to be ſweated is one dram of the ſcrapings. Many of the rivers of Mexico afford ſurpriſing and beautiful caſcades; particularly the great river Guadalaxara, at a place called *Tempizque*, 15 miles to the ſouthward of that city. Along a deep river called *Atoyaque* is a natural bridge, conſiſting of a vaſt mound of earth, along which carriages paſs conveniently. Clavigero ſuppoſes it to have been the fragment of a mountain thrown down by an earthquake, and then penetrated by the river.

119 Natural productions. The mineral productions of Mexico are extremely valuable, ſuch as gold and ſilver in abundance, two ſpecies of copper, tin, lead, mercury, ſulphur, alum, vitriol, amber, and aſphaltum. It alſo produces diamonds, amethyſts, cats-eyes, cornelians, and ſome green ſtones reſembling emeralds, as alſo quarries of jaſper and marble of various colours. There are ſaid to be whole mountains of loadſtone, and a fine white talc which may be burnt into an excellent plaſter.

The ſoil is capable of producing all the neceſſaries, and even the luxuries of human life. Hiſtorians mention no fewer than 1200 plants which are all indigenous, or natives of the country; but as theſe are ſaid to be chiefly medicinal, we muſt conclude that provident nature has furniſhed them with many more which are intended for nouriſhment.

This country abounds with a great variety of flowers, numbers of which are peculiar to itſelf, while many exotics even rival them in luxuriance, ſuch in particular as are imported from Europe. Water-melons, apples, pears, peaches, apricots, figs, &c. are among the exotics, which thrive in a manner equal to any of the indigenous productions. All the maritime countries abound with cocoa-nut trees, of which Hernandez mentions four kinds, the ſmalleſt of which is moſtly uſed for chocolate and other drinks.

Prior to the introduction of corn from Europe, maize was the principal grain of Mexico, and of which there were ſeveral ſpecies. It was brought from America to Spain, and from thence to the other countries of Europe. The principal kind of pulſe uſed by the people was the French bean, the different ſpecies of which exceeded in number thoſe of the maize; and one of them in particular not only ſupported the poorer claſs, but even the Spaniſh nobility deemed it a luxury. Hiſtorians enumerate five ſpecies of eſculent roots, excluſive of many culinary vegetables imported from the Canaries, Spain, and other European countries. This country produces a variety of palm trees, from the fibres of the leaves of one ſpecies of which the Mexicans manufacture thread. The timber trees are numerous, and, in reſpect of quality, ſaid to be inferior to none in the world. There are whole woods of cedars and ebonies, and ſome trees mentioned by Clavigero are of a moſt ſtupendous magnitude. This author mentions one that meaſured 107 Paris feet in height; and Acoſta ſpeaks of one that was 16 fathoms in circumference. A remarkable fir tree hollowed by lightning, contained within it 100 young men, according to the teſtimony of the archbiſhop of Toledo, who went to view it in the year 1770.

120 Medicinal and aromatic gums. This country abounds alſo with aromatic and medicinal trees, producing gums, reſins, &c. From one of theſe a balſam is produced not in the leaſt inferior to the celebrated balſam of Mecca. It is of a reddiſh black or yellowiſh white, of a ſharp bitter taſte, and of a ſtrong but moſt grateful odour. It is common in the provinces of Panuco and Chiapan, and other warm countries.

The

Mexico. The tree producing liquid amber, the liquid ſtorax of the Mexicans, is of a large ſize, the leaves ſimilar to thoſe of the maple, indented, white in one part and dark in the other, diſpoſed of in threes; the fruit is thorny and round, but polygonous, with the ſurface and the angles yellow; the bark of the tree partly green and partly tawny. By inciſions in the trunk they extract that valuable ſubſtance named *liquid amber*, and the oil of the ſame name, which is ſtill more valuable. Liquid amber is likewiſe obtained from a decoction of the branches, but it is inferior to that obtained from the trunk.

The name *copalli* in Mexico is generic, and common to all the reſins; but eſpecially ſignifies thoſe made uſe of for incenſe. There are ten ſpecies of theſe trees yielding reſins of this kind; the principal of which is that from which the COPAL is got, ſo well known in medicine and varniſhes. A great quantity of this was made uſe of by the ancient Mexicans, and is ſtill uſed for ſimilar purpoſes by the Spaniards. The *tecopalli* or *tepecopalli* is a reſin ſimilar to the incenſe of Arabia; which diſtils from a tree of moderate ſize that grows in the mountains, having a fruit like an acorn, and containing the nut enveloped in a mucilage, within which there is a ſmall kernel uſeful in medicine.

The *mizquitl*, or mezquite, is a ſpecies of true acacia, and the gum diſtilling from it is ſaid to be the true gum arabic. It is a thorny ſhrub, with branches irregularly diſpoſed, the leaves ſmall, thin, and pinnated; the flowers being like thoſe of the birch-tree. Of the elaſtic gum, which is found in plenty in Mexico, the natives were in uſe to make foot-balls, which, though heavy, have a better ſpring than thoſe filled with air. With this they varniſh their hats, cloaks, boots, and great coats, in a manner ſimilar to what is done in Europe with wax; and by which means they are rendered all water proof.

121 Mexican animals. The quadrupeds found in Mexico at the arrival of the Spaniards, were lions, tygers, wild cats, bears, wolves, foxes, the common ſtags, white ſtags, bucks, wild goats, badgers, polecats, weaſels, martins, ſquirrels, polatucas, rabbits, hares, otters, and rats. All theſe animals are ſuppoſed to be common to both continents. The white ſtag, whether it be the ſame ſpecies of the other or not, is undoubtedly common to both, and was known to the Greeks and Romans. The Mexicans call it the *king of the ſtags*. M. Buffon imagines the white colour of this creature to be the effect of captivity; but Clavigero ſays, that it is found wild, and of the ſame white colour, on the mountains of New Spain. In many other points, he alſo controverts the opinions of this celebrated naturaliſt, who will not allow the lion, tyger, or rabbit, to be natives of America.

Clavigero enumerates the quadrupeds common to New Spain with the reſt of the continent of America. Among theſe he will not allow a place to the Peruvian ſheep, the *huanaco*, and ſloth; all of which are peculiar to South America. Hernandez indeed makes mention of the Peruvian ſheep, and gives a drawing of it; but this was only on account of a few individuals brought thence from Peru, which the Mexicans called by that name, in the ſame manner as he deſcribes ſeveral animals of the Philippine iſles; not that they had ever been bred in Mexico, or found in any country of North America, unleſs it was ſome individual carried there, as they are carried as a curioſity from Europe. The animals which he allows to be common to both countries are, the Mexican hog, the moufete, the opoſſum, the armadillo, the *techichi*, a ſmall animal reſembling a dog; which being perfectly dumb, gave occaſion to a report that the Mexican dogs could not bark. The fleſh of this animal was eaten by them, and was eſteemed agreeable and nouriſhing food. After the conqueſt of Mexico, the Spaniards having neither large cattle nor ſheep, provided their markets with this quadruped; by which means, the ſpecies ſoon came to be extinct, though it had been very numerous. The land-ſquirrel is very numerous in the kingdom of Michuacan, has great elegance of form, and is extremely graceful in its movements; but it cannot be tamed, and bites moſt furiouſly every perſon who approaches it.

Beſides theſe, there are ſea lions, ratoons, and that voracious animal named the *tapir*. Oviedo informs us, that he has ſeen it at one bite tear off two or three hand-breadths of ſkin from a hound, and at another a whole leg and thigh. The fleſh is eatable, and its ſkin is valued on account of its being ſufficiently ſtrong to reſiſt muſket-balls. There are likewiſe great numbers of monkeys of many different kinds; ſome of which have heads reſembling thoſe of dogs. Some of them are ſtrong and fierce, equalling a man in ſtature when they ſtand upright.

Among the animals peculiar to Mexico, is one named *coyoto*, which appears to have been inaccurately deſcribed by natural hiſtorians; ſome making it one ſpecies and ſome another. It is about the ſize of a maſtiff, but more ſlender. The eyes are yellow and ſparkling, ears ſmall, pointed, and erect; the ſnout blackiſh, ſtrong limbs, and the feet armed with large crooked nails. The tail is thick and hairy, the ſkin a mixture of black, brown, and white; and the voice is compounded of the howl of the wolf and the bark of the dog. It purſues the deer, and will ſometimes even attack men. Its uſual pace is a trot, but ſo quick that a horſe at the gallop can ſcarcely overtake it. The *tlalcojotl* or *tlalcoyoto* is about the ſize of a middling dog, and the largeſt animal that lives under the earth. Its head has ſome reſemblance to that of a cat; but in colour and length of hair it reſembles the lion.—It has a long thick tail, and feeds upon poultry and ſmall animals, which it catches in the night-time. The *tepeizuintli*, or mountain-dog, though it is but of the ſize of a ſmall dog, is ſo bold that it attacks deer, and ſometimes kills them. Its hair and tail are long, the body black, but the head, neck, and breaſt, white. M. Buffon reckons this animal the ſame with the glutton, but Clavigero denies it. Another animal, larger than the two foregoing, is called the *xoloitzcuintli*. Some of theſe are no leſs than four feet in length. It has a face like the dog, but tuſks like the wolf, with erect ears, the neck groſs, and the tail long.—It is entirely deſtitute of hair, excepting only the ſnout, where there are ſome thick crooked briſtles. The whole body is covered with a ſmooth, ſoft, aſh-coloured ſkin, ſpotted partly with black and tawny. This ſpeices of animals, as well as the two former, are almoſt totally extinct. A Lyncean academician named

Mexico. named *Giovanni Fabri*, has endeavoured to prove that the xoloitzcuintli is the ſame with the wolf of Mexico; but this is denied by Clavigero.

A curious animal of the mole kind is called *tozan* or *tuza*. It is about the ſize of an European mole, but very different otherwiſe. The body is about ſeven or eight inches long, and well made; the ſnout like that of a mouſe, the ears ſmall and round, with the tail ſhort. The mouth is armed with very ſtrong teeth, and its paws are furniſhed with ſtrong crooked nails, with which it digs its habitation in the earth. It is extremely deſtructive to the corn fields by the quantity of grain it ſteals, and to the highways by the number of holes it makes in them; for when, on account of the dimneſs of its ſight, it cannot find its firſt hole, it makes another, and ſo on. It digs the earth with its claws and two canine teeth which it has in the upper jaw.

122 Mexican birds. The birds are ſo numerous, and of ſuch various appearances and qualities, that Mexico has been called the country of birds, as Africa is of quadrupeds. Hernandez deſcribes above 200 peculiar to the country. He allows to the eagles and hawks of Mexico a ſuperiority over thoſe of Europe; and the falcons of this country were formerly eſteemed ſo excellent, that, by the deſire of Philip II. a hundred of them were ſent every year over to Spain. The largeſt, the moſt beautiful, and the moſt valuable kind of eagles, is called by the Mexicans *itzquauhtli*, and will purſue not only the larger kinds of birds, but quadrupeds, and even men.

The ravens of Mexico do not, like thoſe of other countries, feed upon carrion, but ſubſiſt entirely by ſtealing corn. The carrion is devoured by the birds called in South America *gallinazzi*, in Mexico *zopilots* and *aure*. By Hernandez they are ſaid to be a ſpecies of ravens; but, according to Clavigero, they are very different, not only in their ſize, but in the ſhape of their head, their flight, and their voice.

The aquatic birds are very numerous, and of great variety.—There are at leaſt 20 ſpecies of ducks, a vaſt number of geeſe, with ſeveral kinds of herons, great numbers of ſwans, quails, water rails, divers, king's fiſhers, pelicans, &c. The multitude of ducks is ſometimes ſo great, that they cover the fields, and appear at a diſtance like flocks of ſheep. Some of the herons and egrets are perfectly white, ſome aſh-coloured; others have the plumage of the body white, while the neck, with the tops and upper part of the wings, and part of the tail, are enlivened with a bright ſcarlet, or beautiful blue.

Numbers of the other claſſes of birds are valuable for their fleſh, plumage, or ſong, while ſome are remarkable for their extraordinary inſtinct or other properties. Clavigero enumerates more than 70 ſpecies of thoſe which afford an agreeable and wholeſome food. Beſides the common fowls which were brought from the Canaries to the Antilles, and from theſe to Mexico, there were, and ſtill are, fowls peculiar to the country itſelf. Theſe partly reſemble the common fowl and partly the peacock, whence they had the name of *gallipavos* from the Spaniards. From Mexico they were imported into Europe, where they have multiplied very faſt, eſpecially in Italy, though the common fowls have multiplied much more in Mexico.

There are great numbers of birds valuable on account of their plumage, which was made uſe of by the Mexicans in their excellent moſaic works; an art which ſeems now to be totally loſt. Peacocks have been carried from the old continent to Mexico; but, not being attended to, have propagated very ſlowly. The birds remarkable for their ſong are likewiſe very numerous; among which that called the *centxonitl*, by Europeans the *mocking-bird*, is the moſt remarkable, on account of its counterfeiting naturally the notes of all others it hears. There are great numbers of beautiful parrots; and there is a bird which counterfeits the human voice, but in a kind of burleſque tone, and will follow travellers a great way. The *tzacua* is remarkable for its inſtinct. Birds of this kind live in ſociety, every tree being a village or city to them, having great numbers of neſts in the neighbourhood of each other, all hanging from the boughs. One of them, whoſe office it is to be the head or guard of the village, reſides in the middle of the tree; from which it flies about from one neſt to another, viſiting them all, and after ſinging a little, returns to its place, while the reſt continue perfectly ſilent. If any bird of a different ſpecies approaches the tree, he flies to it, and with his bill and wings endeavours to drive it off; but if a man or any large animal comes near, he flies ſcreaming to another tree; and if at that time any of his fellows happen to be returning to their neſts, he meets them, and, changing his note, obliges them to retire again: as ſoon as he perceives the danger over, he returns to his wonted round of viſiting the neſts.

Mexico, like all other American countries, abounds with reptiles, many of them of an enormous ſize. 123 Reptiles. The crocodiles are not leſs to be dreaded than thoſe of Africa or Aſia, and there are likewiſe ſome of thoſe monſtrous ſerpents met with in the Eaſt Indies and in South America: though happily the ſpecies of thoſe terrible creatures ſeems to be nearly extinct, as they are ſeldom to be found but in ſome ſolitary wood, or other remote place. There are great numbers of lizards, ſome of which the people ſuppoſe to be poiſonous; but Clavigero thinks this opinion ill founded. There are ſeveral kinds of poiſonous ſerpents, of which the rattleſnake is one.

The aquatic animals are innumerable. Clavigero 124 Aquatic animals. mentions a ſpecies of frogs ſo large that a ſingle one will weigh a pound, and which are excellent food.—Of fiſh proper for food, he ſays that he has counted upwards of 100 ſpecies, without taking in the turtle, crab, lobſter, or any other cruſtaceous animal. The ſharks are well known for their voracity. A whole ſheep's ſkin, and even a large butcher's knife, has been found in the belly of one of them. They are accuſtomed to follow veſſels, to devour any filth that is thrown overboard: and, according to Oviedo, they have been known to keep up with ſhips ſailing before a fair wind for no leſs than 500 miles. The bottetto is a fiſh about eight inches in length, but exceſſively thick. While this fiſh lies alive upon the beach, it ſwells whenever it is touched to an enormous ſize, and boys often take pleaſure in making it burſt with a kick. The liver is ſo poiſonous as to kill with ſtrong convulſions in half an hour after it is eaten.

Of flying and other minute inſects, the number is 125 Inſects. prodigiouſly great. There are a variety of beetles: ſome

Mexico. ſome of a green colour make a great noiſe in flying; on which account children are fond of them. There are great numbers of ſhining beetles, which make a delightful appearance at night, as well as the luminous flies which abound in the country. There are ſix kinds of bees and four kinds of waſps; of which laſt, one collects wax and honey of a very ſweet taſte; another is called the *wandering waſp* from its frequent change of abode; and in conſequence of theſe changes, it is conſtantly employed in collecting materials for its habitations. The lake of Mexico abounds with a kind of fly, the eggs of which are depoſited upon the flags and ruſhes in ſuch quantities as to form large maſſes. Theſe are collected by the fiſhermen, and carried to market for ſale. They are eaten by both Mexicans and Spaniards, and have much the ſame taſte as the caviare of fiſh. There are abundance of gnats in the moiſt places and lakes; but the capital, though ſituated upon a lake, is entirely free from them. The butterflies are in vaſt numbers, and their wings glow with colours far ſuperior to thoſe of Europe; the figures of ſome of them are given by Hernandez. But notwithſtanding its beauties and advantages, Mexico is ſubject to the dreadful devaſtations of locuſts, which ſometimes occaſion the moſt deſtructive famines.

There are ſome of the worms of Mexico made uſe of by the inhabitants as food; others are poiſonous. There are great numbers of ſcolopendræ and ſcorpions, ſome of the former growing to an immenſe ſize. Hernandez ſays, that he has ſeen ſome of them two feet long and two inches thick. The ſcorpions are very numerous; and in the hot parts of the country their poiſon is ſo ſtrong as to kill children, and give terrible pain to adults. Their ſting is moſt dangerous during thoſe hours of the day in which the ſun is hotteſt. There is a miſchievous kind of tick, which in the hot countries abounds among the graſs. From thence it eaſily gets upon the clothes, and from them upon the ſkin. There it fixes with ſuch force, from the particular figure of its feet, that it can ſcarcely be got off. At firſt it ſeems nothing but a ſmall black ſpeck, but in a ſhort time enlarges to ſuch a degree, from the blood which it ſucks, that it equals the ſize of a bean, and then aſſumes a leaden colour. If it is not ſpeedily removed, a wound is made ſimilar to that which the nigera or chegoe makes.

126
Silk and cochineal.

Mexico produces ſilk-worms: and the manufacture of ſilk might be carried on to great advantage, were it not prohibited for ſome political reaſons. Beſides the common ſilk, there is another found in the woods, very white, ſoft, and ſtrong. It grows on the trees in ſeveral maritime places, particularly in dry ſeaſons. Unleſs by poor people, however, this ſilk is not turned to any uſe, partly from inattention to their intereſts, but "chiefly (ſays our author) from the obſtructions which would be thrown in the way of any one who ſhould attempt a trade of that kind. We know from Cortes's letters to Charles V. that ſilk uſed to be ſold in the Mexican markets; and ſome pictures are ſtill preſerved, done by the ancient Mexicans upon a paper made of ſilk."

Cochineal is one of the moſt valuable products of Mexico, and great care is taken to rear the inſect in different parts; but the beſt is that which comes from the province of Mizteca. Some have reckoned that more than 2500 bags of cochineal are ſent every year from Mizteca to Spain; and the trade in that article carried on by the city of Oaxaca is computed at 200,000 crowns value.

127
General deſcription of the inhabitants.

Though Mexico was originally inhabited by a number of different nations, yet all of them reſembled each other pretty much, not only in character, but in external appearance. "They generally rather exceed (ſays Clavigero) than fall under the middle ſize, and are well proportioned in all their limbs. They have good complexions, narrow foreheads, black eyes, clean, firm, white, and regular teeth; thick, black, coarſe, gloſſy hair; thin beards, and generally no hair upon their legs, thighs, and arms, their ſkin being of an olive colour. There is ſcarcely a nation no earth in which there are fewer perſons deformed; and it would be more difficult to find a ſingle hump-backed, lame, or ſquint-eyed man among a thouſand Mexicans, than among a hundred of any other nation. The unpleaſantneſs of their colour, the ſmallneſs of their foreheads, the thinneſs of their beards, and the coarſeneſs of their hair, are ſo far compenſated by the regularity and fine proportion of their limbs, that they can neither be called very beautiful nor the contrary, but ſeem to hold a middle place between the extremes. Their appearance neither engages nor diſguſts; but among the young women of Mexico, there are many very beautiful and fair, whoſe beauty is at the ſame time rendered more winning by the natural ſweetneſs of their manner of ſpeaking, and by the pleaſantneſs and natural modeſty of their whole behaviour. They become gray-headed and bald earlier than the Spaniards; and although moſt of them die of acute diſeaſes, it is not very uncommon among them to attain the age of a hundred. They are now, and ever have been, moderate in eating, but their paſſion for ſtrong liquors is carried to the greateſt exceſs. Formerly they were kept within bounds by the ſeverity of the laws; but now that theſe liquors are become ſo common, and drunkenneſs is unpuniſhed, one half of the people ſeem to have loſt their ſenſes; and this, together with the poor manner in which they live, expoſed to all the baneful impreſſions of diſeaſe, and deſtitute of the means of correcting them, is undoubtedly the principal cauſe of the havock which is made among them by epidemical diſorders.

"Many perſons allow the Mexicans to poſſeſs a great talent of imitation, but deny them that of invention; a vulgar error, which is contradicted by the ancient hiſtory of that people. Their minds are affected by the ſame variety of paſſions with thoſe of other nations, but not to an equal degree. The Mexicans ſeldom exhibit thoſe tranſports of anger, or frenzies of love, which are ſo common in other countries. They are ſlow in their motions; and ſhow a wonderful tenacity and ſteadineſs in thoſe works which require time and long-continued attention. They are moſt patient of injury and hardſhip; and where they ſuſpect no evil intention, are moſt grateful for any kindneſs ſhown: but ſome Spaniards, who cannot diſtinguiſh patience from inſenſibility, nor diſtruſt from ingratitude, ſay proverbially, that the Indians are alike inſenſible

Mexico.

insensible to injuries or benefits. That habitual distrust which they entertain of all who are not of their nation, prompts them often to lie and betray; so that good faith certainly has not been respected among them so much as it deserves. They are by nature taciturn, serious, and austere; and show more anxiety to punish crimes than to reward virtues.

"Generosity and perfect disinterestedness are the principal features of their character. Gold with the Mexicans has not that value which it enjoys elsewhere. They seem to give without reluctance what has cost them the utmost labour to acquire. The neglect of selfish interests, with the dislike which they bear to their rulers, and consequently their aversion to perform the tasks imposed by them, seem to have been the only grounds of that much exaggerated indolence with which the Americans have been charged; and, after all, there is no set of people in that country who labour more, or whose labour is more necessary. The respect paid by the young people to the old, and by children to their parents, seem to be feelings that are born with them. Parents are very fond of their children; but the affection which husbands bear to their wives is certainly less than that which wives bear to their husbands; and it is very common for the men to love their neighbours wives better than their own.

"Courage and cowardice seem alternately so to affect their minds, that it is often difficult to determine whether the one or the other predominates. They meet dangers with intrepidity, when they proceed from natural causes, but are easily terrified by the stern look of a Spaniard. That stupid indifference about death and eternity, which many authors have thought inherent in the character of every American, is peculiar only to those who are yet so rude and uninformed as to have no idea of a future state."

128 Of the Toltecas and Chichemecas.

The Toltecas, who first inhabited Mexico, were accounted much more polished than those who came after them, insomuch that in after ages it was customary to distinguish people of ingenuity and learning by the name of Toltecas. They always lived in society, collected into cities, under the government of kings, and had regular laws. They were more addicted to the arts of peace than of war; and it was to them that the succeeding nations owned themselves indebted for their knowledge of the culture of grain, cotton, pepper, &c. They understood the art of casting gold and silver, and melting them in whatever forms they pleased, acquiring also great reputation from their skill in cutting gems of all kinds; and they were besides well versed in the sciences of astronomy and chronology.

According to the ancient histories of these people, they observed, about a hundred years before the Christian era, how far the solar year exceeded the civil one; supplying the defect, as we do, by the addition of a day once in four years. In the year 660, while their monarchy continued in Tula, a celebrated astronomer, named Huematzin, assembled with the king's consent all the wise men of the nation; and with their assistance painted a famous book named *Teoamoxtli*, or "divine book," in which were represented, in very plain figures, the origin of the Indians, their dispersion after the confusion of tongues at Babel, their journey in Asia, their first settlements in America, the founding of the kingdom of Tula, and their progress till that time: but these, and other accounts of their great knowledge and accuracy, favour too much of exaggeration, or perhaps invention, from both which it is impossible to clear the Spaniards when speaking of American affairs.

129 Their progress in agriculture.

The Chichemecas derived their knowledge of agriculture from the Toltecas, and of consequence the Mexicans also. Being destitute of ploughs or animals of sufficient strength to assist them in their labour, they made use of an instrument of hard copper, which they called *coatl* or *coa*, but differing in shape either from a spade or mattock. They used copper axes to cut trees, the figure of which was the same with ours; only that they put the axe into the eye of the handle, instead of putting the handle into the eye of the axe as we do. They had several other instruments of agriculture, but the forms of them are not mentioned by historians. They watered their fields by means of the rivers and small torrents which came from the mountains; raising dams to collect them, and forming canals to conduct them properly to the places which required moisture. They used enclosures of stone, as well as hedges for the fields, using for their hedges the aloe plant, which is well calculated for the purpose; and what reparations were necessary they gave in December. They dibbled their maize: a method of sowing more slow indeed than the ordinary one, but which certainly repays the trouble by a vastly larger crop, as well as by saving a very considerable quantity of seed. Close to the newly sown fields they commonly erected a small tower of wood, where a man kept watch, in order to drive away the birds that came to feed upon the grain; a custom still preserved among the Spaniards.

130 Magnificent gardens.

In the cultivation of their gardens, the Mexicans were extremely skilful and magnificent; planting in them not only kitchen herbs, but fruit trees, medicinal herbs, and flowers, with great taste and regularity. Some of the royal gardens excited the admiration of the Spaniards so much, that Cortes, in a letter to Charles V. informed him that the garden at Huaxtepec was the most extensive, the most beautiful, and most delightful, that had ever been beheld. It was six miles in circumference, and watered by a beautiful river which crossed it; and there were pleasure houses erected at proper distances from one another. It was for many years preserved by the Spaniards.——The plants most cultivated, next to maize, were cotton, cocoa, and aloe; which last served a great many useful purposes. See Aloe.

131 Tame animals.

Though they had not the advantage of the larger quadrupeds, as horses, oxen, or sheep, they bred up an immense number of quadrupeds unknown in Europe. Private persons brought up the small quadrupeds already mentioned, resembling little dogs; as well as turkeys, quails, geese, ducks, and other kinds of fowl. In the houses of the great men were bred fish, deer, rabbits, and a variety of birds; and in the royal palaces, almost all the species of quadrupeds and winged animals to be found in these kingdoms were kept, as well as a great number of aquatic animals and reptiles. According to Clavigero, Montezuma II. surpassed all the kings in the world in this kind of magnificence;

and

Mexico. and there never was a nation equal to the Mexicans in the care they took in taming animals.

132 Paintings. Painting was an art in great requeſt among the Mexicans, and one of very great uſe; as it was only by means of paintings that they recorded their hiſtories. This art they derived, like others, from the Toltecas. Some of theſe paintings were mere images of their gods, kings, heroes, or of terreſtrial objects. Others were hiſtorical, containing an account of particular events; others mythological, of which a volume is preſerved in the great library of the order of Bologna: others were codes of law, civil and religious; while ſome were chronological, aſtronomical, or aſtrological; in which were repreſented their calendar, the poſition of the ſtars, changes of the moon, eclipſes, and prognoſtications and variations of the weather. Great numbers of theſe were burned by the ſuperſtitious Spaniards, who imagined that they contained ſome emblems of heathen worſhip. They had likewiſe geographical paintings, which ſerved not only to ſhow the extent and boundaries of their poſſeſſions, but likewiſe the ſituation of places, the direction of the coaſts, and the courſe of the rivers. In his firſt letter to Charles V. Cortes ſays, that having made inquiries if there was any ſecure harbour for veſſels on the Mexican coaſt, Montezuma preſented him with a painting of the whole coaſt, from the port of Vera Cruz, at that time called *Chalchiuhuecan*, to the river Coatzacualco. Another author informs us alſo, that Cortes, in a long and difficult voyage which he made to the bay of Honduras, made uſe of a chart preſented to him by the lords of Coatzacualco, in which all the places and rivers were marked from the coaſt of Coatzacualco to Huejacallan.

The cloth on which paintings were done was made of the thread of the aloe or a kind of palm; or they painted on ſheep's ſkins or upon paper. This laſt was made of the leaves of a certain kind of aloe, ſteeped like hemp, and afterwards waſhed, ſtretched, and ſmoothed. They uſed alſo the bark of other trees, prepared with gum: but we are ignorant of the method they uſed in the manufacture. This paper is ſimilar in thickneſs to the European paſteboard, but ſofter, ſmoother, and more eaſy for writing. In general it was made up in very long ſheets, which they preſerved in rolls, or folded like bed ſkreens. The volume of Mexican paintings, preſerved in the library of Bologna, is a thick ſkin, ill dreſſed, compoſed of different pieces painted all over, and folded up in that manner. The beautiful colours which they employed both in their paintings and in their dyes, were obtained from wood, leaves, and the flowers of different plants, as well as from various animal ſubſtances. Their white was made from a kind of ſtone which burns into a fine plaſter; or from a mineral, which after being made into a paſte worked like clay, and formed into ſmall balls, turns white in the fire like Spaniſh white. Their *black* was got from another mineral, which has a diſagreeable ſmell, or from the ſoot of a kind of pine collected in ſmall earthen veſſels. They obtain *blue* and *azure* colours from indigo; but their mode of obtaining theſe was very different from that uſed by the moderns. They put the branches of the plant into hot, or rather lukewarm, water; and after having ſtirred them about for a ſufficient time with a ſtick or ladle, they paſſed the water, when impregnated with the dye, into certain pots or cups, in which they let it remain until the ſolid part of the dye was depoſited; after which they poured off the water. This ſediment was firſt dried in the ſun, and afterwards put between two plates before a fire until it grew hard. They had another plant which likewiſe afforded a blue colour, but inferior to the indigo. *Red* was obtained from the ſeeds of the achiot or rocou, and *purple* from cochineal. Their *yellows* were ochre, and a colour extracted from the beautiful flower of a plant reſembling artemiſia. With nitre theſe flowers afforded a fine orange colour; and by means of alum they extracted other colours.

The Mexican painters were by no means arrived at much perfection in the knowledge of light and ſhade, or of deſign; nevertheleſs, in ſome of the ancient paintings, particularly in the portraits of their kings, the proportions were exactly obſerved. Beſides paintings, however, the Mexicans are ſaid to have employed hieroglyphics and characters; but this is abſolutely denied by Clavigero; who tells us, that "they repreſented material things by their proper figures; but, in order to ſave labour, paper, and colours, they contented themſelves with repreſenting part of an object, which was ſufficient to make it underſtood. But as we cannot underſtand the writings of others till we have learned to read them; in like manner thoſe American authors, who ſay that the Mexicans made uſe of characters, required to have been firſt inſtructed in the Mexican manner of repreſenting objects, in order to have been able to underſtand the paintings which ſerved them in place of writing. When they would repreſent any perſon, they painted a man, or a human head, and over it a figure expreſſing the meaning of his name, as appears in the figures of the Mexican kings. To expreſs a city or village, they painted in like manner a figure which ſignified the ſame thing, with its name. To form their hiſtories or annals, they painted on the margin of the cloth or paper the figures of the years in ſo many ſquares, and at the ſide of each ſquare the event or events which happened that year: and if, on account of the number of years, the hiſtory of which they meant to relate, they could not all be contained in one canvas, they were continued on another. With reſpect to the order of repreſenting the years and events, it was at the liberty of the hiſtorian to begin at whichever angle of the piece he pleaſed; but at the ſame time conſtantly obſerving, that if the painting began at the upper angle of the right-hand, he proceeded towards the left; but if it began, as it moſt commonly did, at the upper angle of the left hand, he proceeded ſtraight downwards. If he painted the firſt year at the lower angle of the left, he continued towards the right; but if he began at the lower angle of the right, he painted ſtraight upwards: ſo that on the upper part of his canvas he never painted from left to right, nor ever on the lower part from right to left; never advanced upwards from the left, nor downwards from the right. When this method of the Mexicans is underſtood, it is eaſy to diſcover at firſt ſight which is the beginning and which the ending of any hiſtorical painting. Their paintings, however, ought not to be conſidered as a regular full hiſtory, but only as monuments and aids of tradition. We cannot expreſs too ſtrongly

133 They did not uſe hieroglyphics or characters.

Mexico.

ſtrongly the care which parents and maſters took to inſtruct their children and pupils in the hiſtory of the nation. 134 Careful to preſerve their traditions. They made them learn ſpeeches and diſcourſes which they could not expreſs by the pencil; they put the events of their anceſtors into verſe, and taught them to ſing them. This tradition diſpelled the doubts and undid the ambiguity which paintings alone might have occaſioned; and, by the aſſiſtance of thoſe monuments, perpetuated the memory of their heroes and of virtuous examples, their mythology, rites, laws, and cuſtoms.

135 Preſerved the memory of events by knotted threads. "Nor did that people only make uſe of tradition, paintings, and ſongs, to preſerve the memory of events, but alſo of threads of different colours and differently knotted. This curious method of the repreſentation of things, however much uſed in Peru, does not appear to have been employed in the province of Anahuac, if not in the moſt early ages; for no traces of ſuch monuments are now to be found. Boturini ſays, that after the moſt diligent ſearch, he with difficulty found one in a place in Tlaſcala, the threads of which were already waſted and conſumed by time. If thoſe who peopled South America ever paſſed the country of Anahuac, they poſſibly might have left there this art, which was afterwards abandoned for that of painting, introduced by the Toltecans or ſome other nation ſtill more ancient."

136 Their knowledge in ſculpture. The Mexicans arrived at greater perfection in ſculpture, caſting of metals, and moſaic works, than in painting. Sculpture was likewiſe one of the arts exerciſed by the ancient Toltecans; but the Mexicans had ſculptors among them when they left their native country of Atztlan. Several of the Toltecan ſtatues, however, were preſerved till the time of the conqueſt, particularly that of the idol Tlaloc, placed upon the mountain of the ſame name, and ſome gigantic ſtatues in one of their temples. Stone and wood were the uſual materials of their ſtatues: the former was worked with a chiſſel made of flint; and, in ſpite of the unfitneſs of the inſtrument, ſuch was the phlegmatic nature of the people, that they ſurmounted every difficulty ariſing from the tedioufneſs of the work. In their ſtatues they learned to expreſs all the attitudes and poſtures of which the human body is capable. They obſerved the proportions exactly, and could when neceſſary execute the moſt delicate ſtrokes with the chiſſel. They not only made entire ſtatues, but cut out in wood and in ſtone figures in baſſo relievo; of which kind are thoſe of Montezuma II. and one of his ſons, recorded with praiſes by Acoſta. They alſo made ſtatues of clay and wood, employing for theſe a chiſſel of copper. The number of their ſtatues was in proportion to that of their idols; but ſo active were the Spaniſh prieſts in deſtroying theſe, that there is now ſcarce any veſtige of them remaining. The foundation of the firſt church in Mexico was laid with idols; on which occaſion many thouſand ſtatues of their gods were neceſſarily broke in pieces. 137 Excelled in the art of caſting metals. In caſting of metals, however, the Mexicans greatly excelled their works either of painting or ſculpture. "The miracles they produced of this kind (ſays Clavigero), would not be credible, if, beſides the teſtimony of thoſe who ſaw them, a great number of curioſities of this kind had not been ſent from Mexico to Europe. The works of gold and ſilver ſent in preſents from the conqueror Cortes to Charles V. filled the goldſmiths of Europe with aſtoniſhment; who, as ſeveral authors of that period atteſt, declared that they were altogether inimitable. The Mexican founders made both of gold and ſilver the moſt perfect images of natural bodies. They made a fiſh in this manner, which had its ſcales alternately one of ſilver and the other of gold; a parrot with a moveable head, tongue, and wings; and an ape with a moveable head and feet, having a ſpindle in its hand in the attitude of ſpinning. They ſet gems in gold and ſilver, and made moſt curious jewellery of great value. In ſhort, theſe ſort of works were ſo admirably finiſhed, that even the Spaniſh ſoldiers, all ſtung with the ſame wretched thirſt for gold, valued the workmanſhip above the materials. This wonderful art, formerly practiſed by the Toltecas, the invention of which they aſcribed to one of their gods, has been entirely loſt by the debaſement of the Indians, and the indolent neglect of the Spaniards. We are doubtful if there are any remains of thoſe curious works; at leaſt we apprehend that it would be more eaſy to find them in ſome of the cabinets of Europe than in all New Spain. Covetouſneſs to profit by the materials muſt unqueſtionably have conquered all deſire to preſerve them as curioſities." The works of the Mexicans in gold and ſilver, executed with the hammer, were much inferior to thoſe of the Europeans.

But of all the works executed by the ancient Mexicans, thoſe of moſaic were the moſt curious, as well as moſt highly valued by themſelves. 138 Beautiful moſaic. Theſe were made of the feathers of birds; and for procuring them they reared a great number of thoſe birds of fine plumage, with which the country abounded, not only in the royal palaces, but alſo in private houſes; and at certain ſeaſons they carried off the feathers for theſe purpoſes, or to ſell them at market. They valued particularly the feathers of the humming birds, on account of their ſmallneſs, fineneſs, and various colours; and in theſe, as well as other birds of fine plumage, nature ſupplied them not only with all the colours producible by art, but likewiſe with many which art cannot imitate. Their moſaic works, as well as indeed all others of the Mexicans, required infinite patience. At the undertaking of every work of this kind ſeveral artiſts aſſembled; and having agreed upon a deſign, and fixed their meaſures and proportions, each artiſt charged himſelf with the execution of a certain part of the image, and exerted himſelf ſo diligently in it, that he frequently ſpent a whole day in adjuſting a feather; firſt trying one and then another, viewing it ſometimes one way, then another, until he found one which gave his part that ideal perfection propoſed to be attained. When the part which each artiſt undertook was done, they aſſembled again to form the entire image from them. If any part happened to be in the leaſt deranged, it was wrought again until it was perfectly finiſhed. They laid hold of the feathers with ſmall pincers, that they might not do them the leaſt injury, and paſted them on the cloth with ſome glutinous matter; then they united all the parts upon a little table or a plate of copper, and flattened them ſoftly until they left the ſurface of the image ſo equal and ſmooth, that it appeared to be the work of a pencil. Theſe works were prodigiouſly admired by the Spaniards.

139 Their architecture. The Mexicans were ſkilled in architecture even before

Mexico. fore they left their native country; and many edifices still remain which were constructed by them during their frequent journeys from one place to another. At their first arrival on the lake, they had no other materials to build their houses with but reeds and mud, until the success of their commerce allowed them to purchase better materials. When the city came to its perfection, the houses of the principal people were constructed of stone and lime: they consisted of two floors, having halls, large court-yards, and chambers fitly disposed: the roofs were flat and terraced; the walls so well whitened, polished, and shining, that they appeared to the Spaniards when at a distance to have been constructed of silver. The floor was paved with plaster, perfectly level, plain, and smooth. Many of their houses were crowned with battlements and turrets; and their gardens had fish ponds, and the walks of them symmetrically laid out. The large houses had in general two entrances, the principal one to the street, the other to the canal: they had no wooden doors to their houses, but covered the entrance with small reeds, from whence they suspended a string of cocoa shells, or some other materials which would make a noise, so as to awake the attention of the family when any person lifted up the reeds to enter the house. —The houses of the poorer sort were constructed of reeds, unburnt bricks, stone, or mud; and the roofs made of a kind of a long hay which grows plentifully in the fields, particularly in the warm parts of the country. For this purpose they used also the leaves of the aloe placed in the manner of tiles, to which they bear some resemblance both in thickness and shape. One of the columns or supports of these houses was generally a tree in the vigour of its growth; by which means, besides the pleasure derived from its foliage and shade, they saved themselves some labour and expence. These houses had one or more apartments according to the circumstances of the family.

The ancient Mexicans understood the method of constructing arches or vaults, as appears from some remains of their buildings as well as from their paintings. They had likewise cornices and other ornaments of architecture. They had also square or cylindrical columns; but it is not known whether they had any capitals or not. They frequently adorned them with figures in *basso relievo;* but their great ambition was to have them all made out of one stone. The foundations of the large houses in the capital were laid upon beams of cedar driven into the ground, on account of its want of solidity; and the same method is still practised by the Spaniards. The roofs of these were made of cedar, fir, cypress, pine, &c. In the royal palaces the columns were of marble or even of alabaster, which the Spaniards mistook for jasper. In the reign of Ahuizotl a new kind of stone, named *tetzontli*, was discovered in the Mexican lake, which was ever afterwards made use of for building. It is hard, light, and porous like a sponge; by which means the lime adheres very firmly to it. It is valued likewise on account of its colour, which is a blood red. Some of the pavements were chequered with marble and other valuable stones.

140 Remarkable aqueducts.

The most remarkable pieces of Mexican architecture were their aqueducts. There were two which conveyed the water to the capital from the distance of two miles. These were constructed of stone and cement five feet high, and two paces broad, upon a road for that purpose upon the lake; by which the water was brought to the entrance of the city, from whence it was sent forth in smaller channels to supply the different fountains. The famous aqueduct of Chempoallan, which was done in the 16th century, is worthy of being ranked among the greatest in Europe. The conductor of this work was a Franciscan missionary named *Tembleque;* and it was executed with great skill by the Chempoallese. The water was brought from a great distance, and the country through which it must pass was mountainous and rocky; but every difficulty was overcome by the industry of the Mexicans. The aqueduct, including all the turnings and windings, exceeded 30 miles in length. The principal difficulty consisted in crossing three great precipices, over which they were obliged to construct three bridges, the first of 47, the second of 13, and the third of 67 arches. The largest arch was 100 feet high, and 61 broad; so that a large vessel could have passed under it. It must, however, be observed, that, in executing this undertaking, the Mexicans were undoubtedly assisted by European tools, and the directions of European workmen; so that we cannot with strict propriety call it one of their works.

141 Excellent jewellers.

They were expert jewellers, and understood the art of cutting and polishing the stones, as well as of setting them. The gems most common in their country were the emeralds, amethysts, carnelians, turquoises, and some others. Emeralds were so common, that no lord or noble wanted them; and none of them died without having one fixed to his lip, that it might serve him, as they imagined, in the other world, instead of a heart. When Cortes returned the first time to Spain, he brought with him five emeralds, valued, by the jewellers there, at 100,000 ducats. The first was in the form of a rose; the second of an horn; the third of a little fish with eyes of gold; the fourth in the form of a bell, with a fine pearl for a clapper. The fifth was a small cup with a foot of gold, and four little golden chains which united in a pearl in the form of a button. For this alone the Genoese merchants offered 40,000 ducats, in order to sell it again to the grand signior. Besides these, he had two emerald vases valued at 300,000 ducats; but these last were last by shipwreck in the unfortunate expedition of Charles V. against Algiers. There are no such gems wrought at present, nor is it even known where the emerald mines are situated; though it is said there are still some large pieces of this precious stone, in some of the churches; but the priests take care to secure them with iron chains, lest they should be carried off.

142 Manufactures of different kinds.

In other more common manufactures the Mexicans were by no means deficient. The earthen ware of Cholula was much praised by the Spaniards; and they had the art of ornamenting this kind of ware with various colours, though they did not understand the making of glass. Their carpenters wrought with instruments of copper; and there are still remains of their labours which display a tolerable skill. Almost every one was acquainted with the method of making cloth. Being destitute of wool, common silk, lint, or hemp, they were obliged to supply the deficiency by other materials. For wool they substituted cotton, for

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for silk they used feathers, the wool of the hare or rabbit; and instead of lint and hemp, they used the fibrous part of the leaves of the aloe. From these last they obtained a thread as fine as from lint; and from some species they had a coarser sort resembling hemp. To obtain this thread they soaked the leaves in water, cleaned them, exposed them to the sun, and then beat them till they were fit to be spun. Sometimes they interwove with their cotton the finest down on the belly of the rabbits or hares, after having spun it into thread; and of these they made most beautiful cloths, which were particularly used for winter waistcoats for the lords. Their cotton manufactures were equal to any produced in Europe; they wove them with different figures and colours, representing different animals and flowers. Of feathers interwoven with cotton they made mantles and bed-curtains, carpets, gowns, &c. These were exceedingly beautiful; but this kind of manufacture is now lost, though there are still some of these garments in the possession of the principal lords, who wear them upon solemn occasions.

143 Their horrible religion.

All these advances towards civilization, however, in the ancient Mexicans, were much more than counterbalanced by the horrible barbarities they committed in their religious ceremonies, and in which they exceeded every nation on earth. Human sacrifices were indeed in use among all the ancient heathens; but such prodigious massacres at the dedication of their temples are unheard of in history. Whether they used these barbarous sacrifices in their own country, or whether the practice began with that of the four Xochimilca prisoners, is not known; but as they only used their prisoners or slaves whom they bought in this way, it is impossible that, during the infancy of their state, the number of human victims could have been very great. Most of those unhappy creatures perished by having their breasts opened, and their hearts pulled out; some were drowned, others starved to death with hunger; and sometimes they were burnt. Prisoners of high

144 Gladiatorian sacrifice.

rank were allowed to die by what Clavigero calls the *gladiatorian* sacrifice, which was performed in the following manner: Near to the greater temple of large cities, in an open space of ground sufficient to contain an immense number of people, was a round terrace eight feet high, upon which was placed a large round stone resembling a millstone in shape, but much larger, almost three feet high, well polished, and having figures cut upon it. On this stone, which was called *temalcatl*, the prisoner was placed, armed with a shield and short sword, and tied by one foot. Here he was encountered by a Mexican officer or soldier better armed than himself. If the prisoner was vanquished, he was carried, dead or alive, to the temple, where his heart was taken out and offered in the usual manner; but if he conquered six combatants, he gained his life and liberty. An instance, however, is given in which this custom was infringed; for the Huetzotzincas having taken the principal lord of Cholula, a man of singular bravery, he overcame seven combatants; notwithstanding which he was put to death; but on this account the Huetzotzincas were rendered for ever infamous among these nations.

145 Number of human victims annually sacrificed.

Historians differ concerning the number of victims who perished annually in these sacrifices: Clavigero inclines to think it was 20,000, but others make it much more. Zumarraga, the first bishop of Mexico, says in a letter of the 12th of June 1531, addressed to the general chapter of his order, that in that capital alone there were above 20,000 victims annually sacrificed. Some authors, quoted by Gomara, say that 50,000 were annually sacrificed in the various parts of the empire. Acosta says, that there was a certain day of the year on which they sacrificed 5000 victims, and another on which 20,000 were sacrificed. According to others they sacrificed, on the mountain Tepeyacac only, 20,000 annually to one of their female deities. On the other hand, Bartholomew de las Casas reduces the number of human victims to 50 or at most to 100. "We are strongly of opinion (says Clavigero), that all these authors have erred in the number; Las Casas by diminution, and the rest by exaggerating the truth."

146 Their monstrous austerities.

Besides the cruelties which they practised upon others, the Mexicans were accustomed to treat themselves with the most inhuman austerities, thinking that the diabolical rage of their deities would be appeased by human blood. "It makes one shudder (says Clavigero), to read the austerities which they practised upon themselves, either in atonement for their transgressions, or in preparation for their festivals. They mangled their flesh as if it had been insensible, and let their blood run in such profusion as if it had been a superfluous fluid in the body. The effusion of blood was frequent and daily with some of their priests. They pierced themselves with the sharpest spines of the aloe, and bored several parts of their bodies, particularly their ears, lips, tongue, and the fat of their arms and legs. Through the holes which they made with these spines they introduced pieces of cane, the first of which were small; but every time this penitential suffering was renewed, a thicker piece was made use of. The blood which flowed from them was carefully collected in the leaves of the plant *acxoyatl*. They fixed the bloody spines in little balls of hay, which they exposed upon the battlements of the walls of the temple, to testify the penance which they did for the people. Those who exercised such severities upon themselves within the enclosure of the greater temple of Mexico, bathed in a pond that was formed there, and which, from being always tinged with blood, was called *ezapan*."

147 Their dress.

The dress of the Mexicans was very simple; that of the men consisted only of a large belt or girdle, the two ends of which hung down before and behind; the women wore a square mantle, about four feet long; the two ends were tied upon the breast or upon one shoulder. The Mexican gown was also a piece of square cloth, in which the women wrapped themselves from the waist down to the middle of the leg. They wore also a small under vest or waistcoat without sleeves, named *huepilli*.

The dress of the poorer sort was made of the thread of the mountain palm, or of coarse cotton; but those of better station wore the finest cotton embellished with various colours, and figures of animals or flowers; or woven with feathers, or the fine hair of the rabbit, &c. The men wore two or three mantles, and the women three or four vests, and as many gowns, putting the longest undermost, so that a part of each of them might be seen. Their shoes were only soles of leather, or coarse cloth of the mountain palm tied with

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with ftrings; but thofe of the great people were adorned with ribbands of gold and jewels. They all wore long hair, and thought themfelves difhonoured by being fhaved, or having their hair clipped, except the confecrated virgins in the temple. The women wore it loofe; but the men tied it up in different forms, and adorned their heads with fine feathers, both when they danced and went to war. With this fimplicity, however, they mixed no fmall quantity of extravagance. Befides feathers and jewels, with which they ufed to adorn their heads, they wore ear-rings, pendants at their upper lip, as well as many at their nofes, necklaces, bracelets for the hands and arms, as well as certain rings like collars which they wore about their legs. The ear-rings of the poor were fhells, pieces of cryftal, amber, &c.; but the rich wore pearls, emeralds, amethyfts, or other gems fet in gold.

Inftead of foap the Mexicans ufed a kind of fruit called *copalxocotl;* the pulp of which is white, vifcous, and very bitter, makes water white, raifes a froth, and will clean linen like foap. They ufed alfo a kind of root named *amolli*, which is not unlike the *faponaria* of the old continent. It is now more ufed for wafhing the body, efpecially the head, than for clothes. Clavigero fays, that there is a kind of this root which dyes the hair of a golden colour, and that he has been witnefs to this effect on the hair of an old man.

148 Modern inhabitants, &c.

The principal inhabitants of Mexico, in modern times, are Spaniards fent thither by the court, to fill the pofts of government. They are obliged, like thofe in the mother country who afpire to any ecclefiaftical, civil, or military employments, to prove that there have been neither heretics, Jews, Mohammedans, nor any perfon in their family who has been called before the inquifition for four generations. Merchants who are defirous of going to Mexico, as well as to other parts of America, without becoming colonifts, are compelled to obferve the fame forms. They are alfo obliged to fwear that they have 300 palms of merchandife, their own property, in the fleet in which they embark, and that they will not carry their wives with them. On thefe abfurd conditions they become the principal agents of the European commerce with the Indies. Though their charter is only to continue three years, and a little longer for countries more remote, it is of great importance. To them alone belongs the right of felling, as commiffioners, the major part of the cargo. If thefe laws were obferved, the merchants ftationed in the new world would be confined to difpofe of what they have received on their own account.

The predilection which adminiftration has for Spaniards born in Europe, has reduced the Spanifh Creoles to acquiefce in fubordinate ftations. The defcendants of the companions of Cortes, and of thofe who came after them, being conftantly excluded from all places of honour or of truft that were any way confiderable, have feen the gradual decay of the power that fupported their fathers. The habit of being obliged to bear that unjuft contempt with which they have been treated, has at laft made them become really contemptible. They have totally loft, in the vices which originate from indolence, from the heat of the climate, and from a fuperfluous enjoyment of all things, that firmnefs and that fort of pride which have ever characterized their nation. A barbarous luxury, fhameful pleafures, and romantic intrigues, have enervated all the vigour of their minds; and fuperftition hath completed the ruin of their virtues. Blindly devoted to priefts too ignorant to enlighten them by their inftructions, too depraved to edify them by their example, and too mercenary to attend to both thefe duties of their function, they have no attachment to any part of their religion but that which enfeebles the mind; and have neglected what might have contributed to rectify their morals.

The Meftees, who conftitute the third order of citizens, are held in ftill greater contempt. It is well known that the court of Madrid, in order to replenifh a part of that dreadful vacancy which the avarice and cruelty of the conquerors had occafioned, and to regain the confidence of thofe who had efcaped their fury, encouraged as much as poffible the marriage of Spaniards with Indian women. Thefe alliances, which became pretty common throughout all America, were particularly frequent in Mexico, where the women had more underftanding and were more agreeable than in other places. The Creoles transferred to this mixed progeny the contemptuous flight they received from the Europeans. Their condition, equivocal at firft, in procefs of time was fixed between the whites and the blacks.

Thefe blacks are not very numerous in Mexico. As the natives are more intelligent, more robuft, and more induftrious, than thofe of the other colonies, they have hardly introduced any Africans except fuch as were required either to indulge the caprice, or perform the domeftic fervice, of rich people. Thefe flaves, who are much beloved by their mafters, on whom they abfolutely depend, who purchafed them at an extravagant price, and who make them the minifters of their pleafures, take advantage of the high favour they enjoy, to opprefs the Mexicans. They affume over thefe men, who are called *free*, an afcendant which keeps up an implacable hatred between the two nations. The law has ftudied to encourage this averfion, by taking effectual meafures to prevent all connexion between them. Negroes are prohibited from having any amorous correfpondence with the Indians; the men, on pain of being mutilated; the women, of being feverely punifhed. On all thefe accounts, the Africans, who in other fettlements are enemies to the Europeans, are in the Spanifh Indies their warm friends.

Authority has no need of this fupport, at leaft in Mexico, where population is no longer what it was formerly. The firft hiftorians, and thofe who copied them, have recorded, that the Spaniards found there 10,000,000 of fouls. This is fuppofed to have been the exaggerated account of conquerors, to exalt the magnificence of their triumph; and it was adopted, without examination, with fo much the more readinefs, as it rendered them the more odious. We need only trace with attention the progrefs of thofe ruffians who at firft defolated thefe fine countries, in order to be convinced that they had not fucceeded in multiplying men at Mexico and the adjacent parts, but by depopulating the centre of the empire; and that the provinces which are remote from the capital, differed in nothing from the other deferts of South and North

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Mexico. America. It is making a great conceffion, to allow that the population of Mexico has only been exaggerated one-half: for it does not now much exceed 2,000,000.

149 Mexicans cruelly treated by the Spaniards.

It is generally believed, that the firft conquerors maffacred the Indians out of wantonnefs, and that even the priefts incited them to thefe acts of ferocity. Undoubtedly thefe inhuman foldiers frequently fhed blood without even an apparent motive; and certainly their fanatic miffionaries did not oppofe thefe barbarities as they ought to have done. This was not, however, the real caufe, the principal fource of the depopulation of Mexico; it was the work of a flow tyranny, and of that avarice which exacted from its wretched inhabitants more rigorous toil than was compatible with their conftitution and the climate.

This oppreffion was coeval with the conqueft of the the country. All the lands were divided between the crown, the companions of Cortes, and the grandees or minifters who were moft in favour at the court of Spain. The Mexicans, appointed to the royal domains, were deftined to public labours, which originally were confiderable. The lot of thofe who were employed on the eftates of individuals was ftill more wretched. All groaned under a dreadful yoke; they were ill fed; they had no wages given them; and fervices were required of them, under which the moft robuft men would have funk. Their misfortunes excited the compaffion of Bartholomew de las Cafas.

150 Bartholomew de las Cafas takes their part.

This man, fo famous in the annals of the new world, had accompanied his father in the firft voyage made by Columbus. The mildnefs and fimplicity of the Indians affected him fo ftrongly, that he made himfelf an ecclefiaftic, in order to devote his labours to their converfion. But this foon became the leaft of his attention. As he was more a *man* than a *prieft*, he felt more for the cruelties exercifed againft them than for their fuperftitions. He was continually hurrying from one hemifphere to the other, in order to comfort the people for whom he had conceived an attachment, or to foften their tyrants. This conduct, which made him be idolized by the one and dreaded by the other, had not the fuccefs he expected. The hope of ftriking awe, by a character revered among the Spaniards, determined him to accept the bifhoprick of Chiapa in Mexico. When he was convinced that this dignity was an infufficient barrier againft that avarice and cruelty which he endeavoured to check, he abdicated it. It was then that this courageous, firm, difinterefted man, accufed his country before the tribunal of the whole univerfe. In his account of the tyranny of the Spaniards in America, he accufes them of having deftroyed 15,000,000 of Indians. They ventured to find fault with the acrimony of his ftyle; but no one convicted him of exaggeration. His writings, which indicate the amiable turn of his difpofition, and the fublimity of his fentiments, have ftamped a difgrace upon his barbarous countrymen, which time hath not, and never will, efface.

151 Their condition rendered fomewhat eafier.

The court of Madrid, awakened by the reprefentations of the virtuous Las Cafas, and by the indignation of the whole world, became fenfible at laft, that the tyranny it permitted was repugnant to religion, to humanity, and to policy; and refolved to break the chains of the Mexicans. Their liberty was now only conftrained by the fole condition, that they fhould not quit the territory where they were fettled. This precaution owed its origin to the fear that was entertained of their going to join the wandering favages to the north and fouth of the empire.

With their liberty their lands ought alfo to have been reftored to them; but this was not done. This injuftice compelled them to work folely for their oppreffors. It was only decreed, that the Spaniards, in whofe fervice they laboured, fhould ftipulate to keep them well, and pay them to the amount of 5l. 5s. a-year.

From thefe profits the tribute impofed by government was fubtracted, together with 4s. 4½d. for an inftitution which it is aftonifhing the conquerors fhould have thought of eftablifhing. This was a fund fet apart in each community, and appropriated to the relief of fuch Indians as were decayed or indifpofed, and to their fupport under private or public calamities.

The diftribution of this fund was committed to their caciques. Thefe were not the defcendants of thofe whom they found in the country at the time of the conqueft. The Spaniards chofe them from among thofe Indians who appeared the moft attached to their interefts; and were under no apprehenfions at making thefe dignities hereditary. Their authority was limited to the fupporting the police in their diftrict, which in general extended eight or ten leagues; to the collecting the tribute of thofe Indians who laboured on their own account, that of the others being ftopt by the mafters whom they ferved; and to the preventing their flight by keeping them always under their infpection, and the not fuffering them to contract any engagement without their confent. As a reward of their fervices, thefe magiftrates obtained from government a property. They were permitted to take out of the common ftock 2½d. annually for every Indian under their jurifdiction. At laft they were empowered to get their fields cultivated by fuch young men as were not yet fubject to the poll tax; and to employ girls, till the time of their marriage, in fuch occupations as were adapted to their fex, without allowing them any falary except their maintenance.

Thefe inftitutions, which totally changed the condition of the Indians of Mexico, irritated the Spaniards to a degree not to be conceived. Their pride would not fuffer them to confider the Americans as free men; nor would their avarice permit them to pay for labour which hitherto had coft them nothing. They employed themfelves fucceffively, or in combination, craft, remonftrances, and violence, to effect the fubverfion of an arrangement which fo ftrongly contradicted their warmeft paffions; but their efforts were ineffectual. Las Cafas had raifed up for his beloved Indians protectors who feconded his defign with zeal and warmth. The Mexicans themfelves, finding a fupport, impeached their oppreffors before the tribunals; and even the tribunals that were either weak or in the intereft of the court. They carried their refolution fo far, as even unanimoufly to refufe to work for thofe who had treated any of their countrymen with injuftice. This mutual agreement, more than any other circumftance, gave folidity to the regulations

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gulations which had been decreed. The other, preſcribed by the laws, was gradually eſtabliſhed. There was no longer any regular ſyſtem of oppreſſion; but merely ſeveral of thoſe particular vexations which a vanquiſhed people, who have loſt their government, can hardly avoid from thoſe who have ſubdued it.

Theſe clandeſtine acts of injuſtice did not prevent the Mexicans from recovering from time to time, certain detached portions of that immenſe territory of which their fathers had been deſpoiled. They purchaſed them of the royal domain, or of the great proprietors. It was not their labour which enabled them to make theſe acquiſitions: for this they were indebted to the happineſs of having diſcovered, ſome of them mines, others treaſures which had been concealed at the time of the conqueſt. The greateſt number derived their reſources from the prieſts and monks, to whom they owed their exiſtence.

Even thoſe who experienced a fortune leſs propitious, procured for themſelves, by the ſole profits of their pay, more conveniences than they had enjoyed before they underwent a foreign yoke. We ſhould be very much deceived, were we to judge of the ancient proſperity of the inhabitants of Mexico by what has been ſaid of its emperor, its court, its capital, and the governors of its provinces. Deſpotiſm had there produced thoſe fatal effects which it produces everywhere. The whole ſtate was ſacrificed to the caprices, pleaſures, and magnificence, of a ſmall number of perſons.

The government drew conſiderable advantages from the mines which it cauſed to be worked, and ſtill greater from thoſe which were in the hands of individuals. The ſalt works greatly added to its revenue. Thoſe who followed agriculture, at the time of harveſt paid in a kind of a third of all the produce of the lands, whether they belonged to them as their own property, or whether they were only the farmers of them. Men who lived by the chaſe, fiſhermen, potters, and all mechanics, paid the ſame proportion of their induſtry every month. Even the poor were taxed at certain fixed contributions, which their labour or their alms might put them in a condition to pay.

The Mexicans are now leſs unhappy. Our fruits, our corn, and our cattle, have rendered their food more wholeſome, agreeable, and abundant. Their houſes are better built, better diſpoſed, and better furniſhed. Shoes, drawers, ſhirts, a garment of wool or cotton, a ruff, and a hat, conſtitute their dreſs. The dignity which it has been agreed to annex to theſe enjoyments has made them better economiſts, and more laborious. This caſe, however, is far from being univerſal; it is even very uncommon in the vicinity of the mines, towns, and great roads, where tyranny ſeldom ſleeps; but we often find it with ſatisfaction in remote parts, where the Spaniards are not numerous, and where they have in ſome meaſure become Mexicans.

The employments of this people are very various. The moſt intelligent, and thoſe who are in eaſy circumſtances, devote themſelves to the moſt neceſſary and moſt uſeful manufactures, which are diſperſed through the whole empire. The moſt beautiful manufactures are eſtabliſhed among the people of Tlaſcala. Their old capital, and the new one, which is called *Angelos*, are the centre of this induſtry. Here they manufacture cloth that is pretty fine, callicoes that have an agreeable appearance, certain ſlight ſilks, good hats, gold lace, embroidery, lace, glaſſes, and a great deal of hardware.

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The care of flocks affords a maintenance to ſome Mexicans, whom fortune or nature have not called to more diſtinguiſhed employments. America, at the time it was diſcovered, had neither hogs, ſheep, oxen, horſes, nor even any domeſtic animal. Columbus carried ſome of theſe uſeful animals to St Domingo, from whence they were generally diſperſed; and in Mexico, more than in any other place, theſe have multiplied prodigiouſly. They count their horned cattle by thouſands, whoſe ſkins are become an object of conſiderable exportation. The horſes are degenerated, but the quality is compenſated by the number. Hogs lard is here ſubſtituted for butter. Sheep's wool is dry, coarſe, and bad, as it is everywhere between the tropics.

The vine and olive tree have experienced the ſame degeneracy. The cultivation of them was at firſt prohibited, with a view of leaving a free market for the commodities of the mother country. In 1706, permiſſion was given to the Jeſuits, and a little afterwards to the marquis Del Valle, a deſcendant from Cortes, to cultivate them. The attempts have not proved ſucceſsful. The trials, indeed, that have been made, have not been abandoned; but no perſon has ſolicited the liberty of following an example which did not promiſe any great emoluments. Other cultures have been more ſucceſsful. Cotton, ſugar, ſilk, cocoa, tobacco, and European corn, have all thriven in ſome degree. The Spaniards are encouraged to proſecute the labours which theſe cultures require, from the happy circumſtance of their having diſcovered iron mines, which were entirely unknown to the Mexicans, as well as ſome mines of a kind of copper that is hard enough to ſerve for implements of huſbandry. All theſe articles, however, for want of men and induſtry, are merely conſumed within the country.—There is only the vanilla, indigo, and cochineal, which make part of the trade of Mexico with other nations.

New Mexico, ſo called becauſe of its being diſcovered later than Old Mexico, a country of America, is bounded on the north by high mountains, beyond which is a country altogether unknown; by Louiſiana on the eaſt; by New Spain on the ſouth; and on the weſt by the gulf of California, and the Rio Colorado; extending, it is ſaid, above 1000 miles from eaſt to weſt, and about 900 from ſouth to north; but the twentieth part of the country within theſe limits is neither cultivated nor inhabited either by Spaniards or Indians. As it lies in the midſt of the temperate zone, the climate, in general, is very pleaſant; the ſummers, though very warm, are neither ſultry nor unwholeſome; and the winters, though pretty ſharp, are far from being inſupportable, and, for the moſt part clear and healthy.

The greateſt encomiums are laviſhed on the fertility of the ſoil, the richneſs of the mines, and the variety of valuable commodities produced in this country. It is ſaid to be beautifully diverſified with fields, meadows, riſing

rising grounds, and rivers; abounding with fruit and timber trees, turquoises, emeralds, and other precious stones, mines of gold and silver, a great variety of wild and tame cattle, fish and fowls. Upon the whole, we may safely affirm, that New Mexico is among the pleasantest, richest, and most plentiful countries in America, or any other part of the world. There are few great or navigable rivers in it: the most considerable are, the Rio Solado and Rio del Norte, which, with several smaller streams, fall into the gulf of Mexico. On the coast of the gulf are divers bays, ports, and creeks, which might be easily converted into excellent harbours, if the Spaniards were possessed of any portion of that commercial spirit which animates the other maritime nations of Europe.

The Spanish writers tell us, that New Mexico is inhabited by a great variety of Indian nations or tribes, totally unconnected with each other; but the principal are the Apaches, a brave, warlike, resolute people; fond of liberty, and the inveterate enemies of tyranny and oppression. About the close of the 17th century, thinking themselves aggrieved by the Spanish government, they made a general insurrection, and did a great deal of mischief; but were at last obliged to submit, and have since been curbed by stronger garrisons. Most of the natives are now Christians. When the Spaniards first entered this country, they found the natives well clothed, their lands cultivated, their villages neat, and their houses built with stone. Their flocks also were numerous, and they lived more comfortably than most of the other savages of America. As to religion, they were idolaters, and worshipped the sun and moon; but whether they offered human sacrifices, we are not sufficiently informed.

The number of provinces in this country is not well ascertained: some writers making them only five, others 10, 15, 20, and 25; but adding no description, either of them or the towns contained in them, excepting the capital, Santa Fé, which we are told stands near the source of the Rio del Norte, in 36° of north latitude, and about 130 leagues from the gulf: that it is a well built, handsome, rich town; and the seat of the bishop, suffragan of Mexico, as well as the governor of the province, who is subordinate to the viceroy of Mexico or New Spain.

MEZERAY, Francis Eudes de, an eminent French historian, the son of Isaac Eudes a surgeon, was born at Rye, in Lower Normandy, in 1610; and took the surname of *Mezeray*, from a hamlet near Rye. Having performed his studies at Caen, he discovered a strong inclination to poetry; but going to Paris, he, by the advice of one of his friends, applied himself to the study of politics and history, and procured the place of commissary at war, which he held for two campaigns. He then shut himself up in the college of St Barbe, in the midst of books and manuscripts; and, in 1643, published the first volume of the History of France, in folio; and some years after, the other two volumes. Mezeray in that work surpassed all who had written the history of France before him, and was rewarded by the king with a pension of 4000 livres. In 1668, he published an Abridgement of his History of France, in three volumes 4to, which was well received by the public; but as he inserted in that work the origin of most of the taxes, with very free reflections, M. Colbert complained of it, when Mezeray promised to correct what he had done in a second edition; but those corrections being only palliations, the minister caused half of his pension to be suppressed. Mezeray complained of this in very severe terms; when he obtained no other answer than the suppression of the other half. Vexed at this treatment, he resolved to write on subjects that could not expose him to such disappointments; and composed his treatise on the origin of the French, which did him much honour. He was elected perpetual secretary to the French academy; and died in 1683. He is said to have been a man extremely negligent in his person, and so careless in his dress, that he might have passed for a beggar rather than for what he was. He was actually seized one morning by the *archers des pauvres*, or parish officers; which mistake was so far from provoking him, that he was highly diverted with it, and told them, that he was not able to walk on foot, but that as soon as a new wheel was put to his chariot, he would attend them wherever they thought proper." He used to study and write by candle light, even at noon-day in summer; and, as if there had been no sun in the world, always waited upon his company to the door with a candle in his hand. With regard to religion, he affected Pyrrhonism; which however was not, it seems, so much in his heart as in his mouth. This appeared from his last sickness; for having sent for those friends who had been the most usual witnesses of his licentious talk about religion, he made a sort of recantation, which he concluded with desiring them "to forget what he might formerly have said upon the subject of religion, and to remember, that Mezeray dying was a better believer than Mezeray in health." Besides his history, he also wrote, 1. A continuation of the history of the Turks. 2. A French translation of John de Salisbury's Latin treatise on the vanities of the court. 3. There are attributed to him several satires against the government; and in particular, those that bear the name of *Sandricourt*.

MEZIERS, a strong town of France in the department of Ardennes, with a citadel. It was besieged with a powerful army by Charles V. who was obliged to raise the siege in 1521. It is seated on the river Maese, partly upon a hill, and partly in a valley, in E. Long. 4. 48. N. Lat. 49. 46.

MEZIRIAC, Claude Gaspar Backet Sieur de, one of the most ingenious men of the 17th century, was born at Bresse, of an ancient and noble family. He was a good poet in French, Italian, and Latin; an excellent grammarian, a great Greek scholar, and an admirable critic. He was well versed in the controversies, both in philosophy and religion; and was deeply skilled in algebra and geometry, of the former of which he gave proof by publishing the six books of Diophantus, enriched with a very able commentary and notes. In his youth he spent a considerable time at Paris and at Rome; at which last place he wrote a small collection of Italian poems, in competition with Vaugelas, who was there at the same time; among which there are imitations of the most beautiful similes contained in the first eight books of the Æneid. He also translated Ovid's Epistles; a great part of which he illustrated with very curious commentaries of his own. Whilst

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he was at Paris, they talked of making him preceptor of Louis XIII. upon which he left the court in great haſte, and afterwards declared that he had never felt ſo much pain upon any occaſion of his life; for he ſeemed to have already upon his ſhoulders the important weight of the whole kingdom. He undertook the tranſlation of all Plutarch's works, with notes; which he had brought nearly to a concluſion, when he died at Bourg, in Breſſe, anno 1638, at 45 years of age. He left behind him ſeveral finiſhed works, that were not printed.

MEZUZOTH, in the Jewiſh cuſtoms, certain pieces of parchment which the Jews fix to the door-poſts of their houſes, taking that literally which Moſes commands them, ſaying, "Thou ſhalt never forget the laws of thy God, but thou ſhalt write them upon the poſts of thy houſe, and on thy gates." This expreſſion means nothing elſe, but that thou ſhalt always remember them, whether thou comeſt into thy houſe or goeſt out. But the Hebrew doctors imagined, that the lawgiver meant ſomething more than this. They pretended that, to avoid making themſelves ridiculous, by writing the commandments of God without their doors, or rather to avoid expoſing themſelves to the profanation of the wicked, they ought at leaſt to write them on a parchment, and to encloſe it in ſomething. Therefore they wrote theſe words upon a ſquare piece of parchment prepared on purpoſe, with a particular ink, and a ſquare kind of character. Deut. vi. 4, 5, 6, 7, 8, 9. "Hear, O Iſrael, the Lord our God is one Lord," &c.—Then they left a little ſpace, and afterwards went on, Deut. xi. 13. "And it ſhall come to paſs if thou ſhalt hearken diligently to my commandments," &c. as far as, "Thou ſhalt write them upon the door-poſts of thy houſe," &c. After this they rolled up the parchment, and put it into a caſe of reeds or other matter; they wrote on the end of the caſe the word *Shaddai*, which is one of the names of God; and they put it at the doors of their houſes, chambers, and all places moſt frequented; they fixed it to the knockers of the door, on the right ſide; and as often as they entered in or went out they touched it in this place, with the end of their finger, which they afterwards kiſſed out of devotion. The Hebrew word *mezuza* properly ſignifies the door-poſts of a houſe; but it is alſo given to this roll of parchment now mentioned.

MEZZOTINTO, a particular manner of repreſenting figures on copper, ſo as to form prints in imitation of painting in Indian ink. See ENGRAVING.

The invention of this art has been uſually attributed to Prince Rupert. But Baron Heinikin, a very judicious and accurate writer upon the ſubject of engraving, aſſerts, with great appearance of truth, that it was a lieutenant-colonel de Siegan, an officer in the ſervice of the landgrave of Heſſe, who firſt engraved in this manner; and that the print which he produced was a portrait of the princeſs Amelia Elizabeth of Heſſe, engraved in the year 1643. Prince Rupert learned the ſecret from this gentleman, and brought it into England when he came over the ſecond time with Charles II. Prince Rupert's print of An Executioner holding a Sword in one Hand and a Head in the other, a half length, from Spagnoletto, is dated 1658. This art has never been cultivated with ſucceſs in any country but England.

The prince laid his grounds on the plate with a channelled roller: but one Sherwin, about the ſame time, laid his grounds with a half-round file, which was preſſed down with a heavy piece of lead. Both theſe grounding tools have been laid aſide for many years; and a hand tool, reſembling a ſhoemaker's cutting board knife, with a fine crenelling on the edge, was introduced by one Edial, a ſmith by trade, who afterwards became a mezzotinto painter.

It is very different from the common way of engraving. To perform it, they rake, hatch, or punch, the ſurface of the plate all over with a knife, or inſtrument made for the purpoſe, firſt one way, then the other, acroſs, &c. till the ſurface of the plate be thus entirely furrowed with lines or furrows, cloſe and as it were contiguous to each other; ſo that, if an impreſſion was then taken from it, it would be one uniform blot or ſmut. This done, the deſign is drawn or marked on the ſame face; after which, they proceed with burniſhers, ſcrapers, &c. to expunge and take out the dents or furrows, in all the parts where the lights of the piece are to be; and that more or leſs as the lights are to be ſtronger or fainter; leaving thoſe parts black which are to repreſent the ſhadows or deepenings of the draught.

As it is much eaſier to ſcrape or burniſh away parts of a dark ground correſponding with the outline of any deſign ſketched upon it, than to form ſhades upon a light ground by an infinite number of hatches, ſtrokes, and points, which muſt all terminate with exactneſs on the outline, as well as differ in their force and manner; the method of ſcraping, as it is called, in mezzotinto, conſequently becomes much more eaſy and expeditious than any other method of engraving. The inſtruments uſed in this kind of engraving are cradles, ſcrapers, and burniſhers.

In this engraving, the plate muſt be prepared and poliſhed in the ſame manner as for other engraving; and afterwards divided equally by lines parallel to each other, and traced out with very ſoft chalk.—The diſtance of theſe lines ſhould be about one-third of the length of the face of the cradle which is to be uſed, and theſe lines ſhould be marked with capital letters, or ſtrokes of the chalk. The cradle is then to be placed exactly betwixt the two firſt lines, and paſſed forwards in the ſame direction; being kept as ſteady as poſſible, and preſſed upon with a moderate force. The ſame operation muſt be repeated with reſpect to all the other lines; till the inſtrument has thus paſſed over the whole ſurface of the plate.—Other lines muſt be then drawn from the extremities of the other two ſides, in the ſame manner; which, interſecting the firſt at right angles, will with them form ſquares; and the ſame operation muſt be repeated with the cradle as in the caſe of the firſt. New lines muſt then be drawn diagonally, and the cradle paſſed betwixt them as before; and when the firſt diagonal operation is performed, the lines muſt be croſſed at right angles as the former, and the cradles paſſed betwixt them in the ſame manner.—The plate having undergone the action of the cradle, according to the diſpoſition of the firſt order of lines, a ſecond ſet muſt be formed, having the ſame diſtances from each other as the firſt. But they muſt be ſo

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so placed as to divide those already made into spaces one-third less than their whole extent; i. e. every one after the first on each side will take in one-third of that before it, e. g. beginning at A, of which the first third must be left out; a third of B will consequently be taken in, and so of the rest. These lines of the second order must be marked with small letters, or lesser strokes, to distinguish them from the first: and the same treatment of the plate must be pursued with respect to them as was practised for the others. When this second operation is finished, a third order of lines must be made; the first of which, e. g. in A, must omit two-thirds of it, and consequently take in two-thirds of B, &c. By these means, the original spaces will be exactly divided into equal thirds; and the cradle must be again employed betwixt these lines as before.—When the whole of this operation is finished, it is called *one turn;* but in order to produce a very dark and uniform ground, the plate must undergo the repetition of all these several operations for above twenty times; beginning to pass the cradle again betwixt the first lines, and proceeding in the same manner through all the rest. When the plate is prepared with a proper ground, the sketch must be chalked on it, by rubbing the paper on the backside with chalk. It is also proper to overtrace it afterwards with black lead or Indian ink. The scraping is then performed, by paring or cutting away the grain of the ground in various degrees; so that none of it is left in the original state except in the touches of the strongest shade. The general manner of proceeding is the same as drawing with white upon black paper. The masses of light are first begun with; and those parts which go off into light in their upper part, but are brown below: the reflections are then entered upon; after which the plate is blackened with a printer's blacking-ball made of felt, in order to discover the effect: and then the work is proceeded with; observing always to begin every part in the places where the strongest lights are to be.

The art of scraping mezzotintos has been applied to the printing with a variety of colours, in order to produce the resemblance of paintings. The inventor of the method of doing this was J. C. Le Blon, a native of Frankfort, and pupil of Carlo Marata, between the years 1720 and 1730. It was established by the inventor on this principle, that there are three primitive colours, of which all the rest may be composed by mixing them in various proportions; that any two of these colours being mixed together, preserve their original power, and only produce a third colour such as their compound must necessarily give; but if transparent colours be mixed, and three primitive kinds compounded together, they destroy each other, and produce black, or a tendency to it, in proportion to the equality or inequality of the mixture; and that if, therefore, these three colours be laid, either separately or upon each other, by three plates, engraved correspondently on these principles to the colouring of the design, the whole variety of teints necessary may be produced. The requisites, therefore, to the execution of any design in this method of printing are as follows: 1. To settle a plan of the colouring to be imitated; showing where the presence of each of the three simple colours is necessary, either in its pure state or combined with some other, to produce the effect required; and to reduce this plan to a painted sketch of each, in which not only the proper outlines, but the degree of strength should be expressed. 2. To engrave three plates according to this plan, which may print each of the colours exactly in the places where, and proportion in which, they are wanted. 3. To find three transparent substances proper for printing with these three primitive colours. The manner in which M. Le Blon prepared the plates was as follows: The three plates of copper were first well fitted with respect to size and figure to each other, and grounded in the same manner as those designed for mezzotinto prints: and the exact place and boundary of each of the three primitive colours, conformably to the design, were sketched out on three papers, answering in dimensions to the plate. These sketches were then chalked on the plates; and all the parts of each plate that were not to convey the colour to which it was appropriated to the print, were entirely scraped away, as in forming the light of mezzotinto prints. The parts that were to convey the colours were then worked upon; and where the most light or diluted teints of the colour were to be, the grain in the ground was proportionably taken off; but where the full colour was required, it was left entire. In this regard was had, not only to the effects of the colour in its simple state, but to its combined operation, either in producing orange-colour, green, or purple, by its admixture with one alone; and likewise to its forming brown, gray, and shades of different degrees, by its co-operation with both the others. But though the greatest part of the engraving was performed in the mezzotinto manner, yet the graver was employed occasionally for strengthening the shades, and for correcting the outline where it required great accuracy and steadiness. It was found necessary sometimes to have two separate plates for printing the same colour, in order to produce a stronger effect: but the second plate, which was used to print upon the first, was intended only to glaze and soften the colours in particular parts that might require it. With respect to the black and brown teints, which could not be so conveniently produced in a due degree by the mixture of the colours, umber and black were likewise used.

With respect to the order in which the plates are to be applied, it may be proper to observe, that the colour which is least apparent in the picture should be laid on first; that which is betwixt the most and least apparent next; and that which predominates last; except where there may be occasion for two plates for the same colour, as was before mentioned; or where there is any required for adding browns and shades.

M. Le Blon applied this art to portraits, and showed, by the specimens he produced, the possibility of its being brought, by farther improvements, to afford imitations of painting which might have some value. It is nevertheless much better adapted to the simpler subjects, where there are fewer intermixtures of colours; and where the accuracy of the reflections, and demi-teints, are not so essentially necessary to the truth of the design, from the greater latitude of form, and disposition of the colour, as in plants, anatomical figures, and some subjects of architecture. But perhaps plates engraved

graved or rather finished with the tool, particularly with respect to the outline, would be better accommodated in some of these cases than those prepared only by scraping.

M. Cochin remarks, at the end of an account he has given of M. le Blon's manner, that though this ingenious artist confined his method principally to the use of three colours; yet, should this invention be again taken up and cultivated, there would be more probability of success in using a greater variety; and that several different kinds might be printed by one plate, provided they were laid on in their respectively proper places by printing-balls, which should be used for that colour only. His hint might however be very greatly improved, by the further assistance of pencils, accommodated to the plates, for laying on the colours in the proper parts.—For the method of taking off mezzotinto prints on glass, see *Back-painting*.

MIASMA, among physicians, a particular kind of effluvia, by which certain fevers, particularly intermittents, are produced.

MICA, *Muscovy glass*, or *Glimmer*, a species of mineral substance. See Mineralogy *Index*.

MICAH, or *The Book of Micah*, a canonical book of the Old Testament, written by the prophet Micah, who is the sixth of the twelve lesser prophets. He is cited by Jeremiah, and prophesied in the days of Jotham, Ahaz, and Hezekiah. He censures the reigning vices of Jerusalem and Samaria, and denounces the judgements of God against both kingdoms. He likewise foretels the confusion of the enemies of the Jews, the coming of the Messiah, and the glorious success of his church.

MICHAEL, or Michel, (i. e. *who is like to God?*) The scripture account of Michael is, that he was an archangel, who presided over the Jewish nation, as other angels did over the Gentile world, as is evident of the kingdoms of Persia and Greece, (Dan. x. 13.); that he had an army of angels under his command (Rev. xii. 7.); that he fought with the Dragon, or Satan and his angels; and that, contending with the Devil, he disputed about the body of Moses, (Jude 9.). As to the combat between Michael and the Dragon, some authors understand it literally, and think it means the expulsion of certain rebellious angels, with their head or leader, from the presence of God. Others take it in a figurative sense; and refer it, either to the contest that happened at Rome between St Peter and Simon Magus, in which the apostle prevailed over the magician, or to those violent persecutions under which the church laboured for three hundred years, and which happily ceased when the powers of the world became Christian. Among the commentators who maintain the former opinion is Grotius; and among those who take it in a figurative sense are Hammond and Mede.

The contest about the body of Moses is likewise taken both literally and figuratively. Those who understand it literally are of opinion, that Michael by the order of God hid the body of Moses after his death; and that the Devil endeavoured to discover it, as a fit means to entice the people to idolatry, by a superstitious worship of his relics. But this dispute is figuratively understood to be a controversy about rebuilding the temple, and restoring the service of God among the Jews at Jerusalem; the Jewish church being fitly enough styled the body of Moses. It is thought by some, that this story of the contest between Michael and the Devil was taken by St Jude out of an apocryphal book called *The Assumption of Moses*.

The Romish church celebrates three appearances of Michael, of which no mention is made in scripture, and which have happened, they say, a long time after the age of the apostles. The first appearance of this archangel was at Colossæ in Phrygia, but at what time is uncertain. The second is that of Mount Garganus, in the kingdom of Naples, about the end of the fifth century. The third is his appearance to Aubert bishop of Avranches, upon a rock called the *Tomb*, where at this day is the abbey of St Michael. This was about the year 706. The first of these festivals is observed on the 6th of September, the second on the 8th of May, and the last on the 16th of October. It has been supposed, that it was Michael the archangel who conducted the Israelites in their journey through the wilderness, (see Exod. xxxii. 20, 23, and xxxiii. 2.); that it was he who appeared to Moses in the burning bush; who appeared to Joshua in the fields of Jericho, and to Gideon and Manoah the father of Samson; and, in a word, to him have been imputed the greatest part of the most remarkable appearances either in the Old or New Testament.

Michael Angelo. See Angelo.

Mount Michael, formerly one of the most celebrated state prisons of France, lies about 20 miles from Granville. It is a rock situated in the middle of the bay of Avranches; and is only accessible at low water. Nature has completely fortified one side, by its craggy and almost perpendicular descent, which renders it impracticable to mount it by any address or courage, however consummate. The other parts are surrounded by walls fenced with semilunar towers after the Gothic manner; but sufficiently strong, together with the advantage of its situation, to render it impregnable to any attack. At the foot of the mountain begins a street or town, which winds round its base to a considerable height. Above are chambers where state prisoners are kept, and where there are other buildings intended for residence. On the summit is erected the abbey itself, occupying a prodigious space of ground, and of a strength and solidity equal to its enormous size; since it has for many centuries withstood all the injuries of the weather; to which it is so much exposed. In an apartment, called the *Sale de Chavalerie*, the knights of St Michael used to meet in solemn convocation on important occasions. They were the defenders and guardians of this mountain and abbey, as those of the Temple, and of St John of Jerusalem, were of the holy sepulchre. The hall in which they met is very spacious, but rude and barbarous. At one end is a painting of the archangel, the patron of their order; and in this hall Louis XI. first instituted and invested with the insignia of knighthood the chevaliers of the cross of St Michael. There is a miserable dark apartment, or rather dungeon, in which many eminent persons were formerly confined. In the middle of it is a cage, composed of prodigious bars of wood; and the wicket which gives entrance into it is 10 or 12 inches in thickness. The inside of it comprises about 12 or 14 feet square, and it is nearly 20 in height. Towards

Michael.

wards the latter end of the 17th century, a newfwriter in Holland, who had prefumed to print fome very fevere and farcaftic reflections on Madame de Maintenon, was confined in this place. Some months after his publication, he was induced, by a perfon fent exprefsly for that purpofe, to make a tour into French Flanders. The moment he had quitted the Dutch territories, he was put under arreft; and immediately, by his majefty's exprefs command, conducted to Mount Michael, where he was fhut up in this cage. Here he lived upwards of 23 years; and here he at length expired. During the long nights of winter, no candle or fire was allowed him. He was not permitted to have any book. He faw no human face, except the gaoler, who came once every day to prefent him, through a hole in the wicket, with his little portion of bread and wine. No inftrument was given him with which he could deftroy himfelf: but he found means at length to draw out a nail from the wood, with which he engraved, or cut on the bars of his cage, certain fleurs de lis and armorial bearings, which formed his only employment and recreation. They are very curioufly performed confidering the rudenefs of his inftrument.

The fubterraneous chambers in this mountain are faid to be fo numerous, that the gaolers themfelves do not know them. There are certain dungeons called *aubliettes*, into which they were accuftomed anciently to let down malefactors guilty of very heinous crimes: they provided them with a loaf of bread and a bottle of wine, and then they were totally forgotten, and left to perifh by hunger in the dark vaults of the rock. This punifhment, however, has not been inflicted by any king in the laft or prefent century.

Here alfo is a remarkable chamber, in one corner of which is a kind of window: between this and the wall of the building is a very deep fpace, of near 100 feet perpendicular, at the bottom of which is another window opening to the fea. It is called the *Hole of Montgomeri;* and the hiftory of it is as follows: In the year 1559, Henry II. king of France was unfortunately killed at a tournament by the count de Montgomeri *. He was a Huguenot; and having efcaped the maffacre of Paris, made head againft the royal forces in Normandy, fupported by Queen Elizabeth with arms and money. Being driven from his fortreffes in thefe parts, he retired to a rock called the *Tombelaine*. This is another fimilar to Mount Michael; only three quarters of a league from it, and of nearly equal dimenfions. At that time there was a caftle upon it, which has fince been demolifhed, and of which fcarce any veftiges now remain. From this fortrefs, acceffible only at low-water, he continually made excurfions, and annoyed the enemy, who never dared to attack him. He coined money, laid all the adjacent country under contribution, and rendered himfelf univerfally dreaded. Defirous, however, to furprife Mount Michael, he found means to engage one of the monks refident in the abbey; who promifed to give him the fignal for his enterprife by difplaying a handkerchief. The monk having made the fignal, betrayed him, and armed all his affociates, who waited Montgomeri's arrival. The chieftan came, attended by 50 chofen foldiers, all defperate, and capable of any attempt. They croffed the fand; and having placed their fcaling-ladders, mounted one by one. As they came to the top, they were defpatched, each in turn, without noife. Montgomeri, who followed laft, difcovered the perfidy, and efcaped with only two of his men, with whom he regained the Tombelaine. They preferve with great care the ladders and grappling irons ufed on this occafion. The count was at laft befieged and taken prifoner, by the marefchal de Matignon, in 1574, at Domfront, in Normandy; and Catharine de Medicis, who hated him for having been, though innocently, the caufe of her hufband's death, caufed him to be immediately executed.

* See *France*, No. 140.

The church of Mount Michael is a great curiofity. It ftands on nine pillars of moft enormous dimenfions, built on the folid rock. Each of them appears to be about 25 feet in circumference: befides thefe, there are two others much inferior in fize, on which the centre of the church refts, and over which is the tower. The following is the legendary account of the origin of this church: In the reign of Childibert II. there was a bifhop of Avranches named *St Aubert*. To this holy man the archangel Michael was pleafed to appear one night, and ordered him to go to this rock to build a church. St Aubert treated this as a dream; upon which the angel appeared a fecond time; and being ftill difobeyed, he returned a third time, when, by way of imprinting his command upon the faint's memory, he made a hole in his fkull, by touching it with his thumb. The fkull is ftill preferved in the treafury of the church. It is enclofed in a little fhrine of gold, and a cryftal, which opens over the orifice, admits the gratification of curiofity by the minuteft examination of it. The hole is of a fize and fhape proportionable to the thumb faid to have produced it; but it is impoffible to determine whether it has been really made by a knife or any other way. It is not to be fuppofed that the faint would forget fuch a fenfible mark of the angel's difpleafure; he therefore immediately repaired to the rock, and conftructed a fmall church, as he had been commanded. Here, however, true hiftory fupplies the place of fable; and informs us, that it was in 966 when Richard the fecond duke of Normandy began to build the abbey. It was completed about the year 1070, under William the Conqueror, though many other additions were made by fucceeding abbots.

In the treafury of the church are innumerable other relics: among which fome few have a real and intrinfic value. There is a fine head of Charles VI. of France, cut in a cryftal, and the reprefentation of a cockle-fhell in gold, weighing many pounds, given by Richard II. duke of Normandy, when he founded the abbey. There is an arm faid to belong to *St Richard* king of England; but who this faint was it muft be very difficult to determine. Such is the hiftory of the prifon, abbey, and church of Mount Michael previous to the revolution; they have probably undergone fome changes fince that period.

St Michael's.

St MICHAEL'S, a borough town of Cornwall, between St Columb and Truro, 247 miles from London. Though one of the oldeft boroughs in the county by prefcription, and of great note in the Saxon times, it is a mean hamlet in the parifhes of Newland and St Enidore; yet it is governed by a portreeve, chofen yearly by a jury of the chief inhabitants, out of the fix chief tenants, called deputy lords of the manor, becaufe they hold lands in the borough. Here is

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is no market, but two fairs. A court-leet is held here twice a year. This place was formerly called Modiſhole, and afterwards Michael. Its liſt of members begins in the 6th of Edward VI.

St Michael's Mount, in the county of Cornwall, in the corner of Mount's Bay, is a very high rock, only divided by the tide from the main land, ſo that it is land and iſland twice a-day. The town here was burnt by the French in the reign of King Henry VIII. At the bottom of this mount, in digging for tin, there have been found ſpear heads, battle axes, and ſwords, of braſs, all wrapt up in linen. The county is contracted here into a ſort of iſthmus, ſo that it is ſcarcely four miles between the Channel and the Severn ſea.—Large trees have been driven in by the ſea between this mount and Penzance.

MICHAELIS, John David, a celebrated biblical critic, and author of many eſteemed works, was the eldeſt ſon of Dr Chriſtian Benedict Michaelis, profeſſor in the univerſity of Halle in Lower Saxony, and was born at that place, Feb. 27. 1717. His father devoted him at an early age to an academical life; and with that view he received the firſt part of his education in a celebrated Pruſſian ſeminary, called the *Orphan houſe*, at Glanche, in the neighbourhood of his native place. He commenced his academical career at Halle in 1733, and took his maſter's degree in the faculty of philoſophy in 1739. In 1741 he made an excurſion to this country, where his ſuperior knowledge of the oriental languages, which was conſiderably increaſed by his indefatigable reſearches in the Bodleian library at Oxford, introduced him to the acquaintance, and gained him the eſteem, of our firſt literary characters; with ſeveral of whom, and particularly Biſhop Lowth, he was in correſpondence for many years. On his return to Halle, after an abſence of fifteen months, he began to read lectures on the hiſtorical books of the Old Teſtament, which he continued after his removal to Gottingen in 1745. In 1746 he was appointed profeſſor extraordinary, and ſoon after profeſſor of philoſophy, in that univerſity. The next year he obtained a place of ſecretary to the Royal Society there, of which he was director in 1761, and was ſoon afterwards made aulic counſellor by the court of Hanover. In 1764 his diſtinguiſhed talents, but chiefly a publication relative to a journey to Arabia, which was undertaken by ſeveral literary men, at the expence of the king of Denmark, in conſequence of his application by means of Count Bernſdorff, procured him the honour of being choſen a correſpondent, and afterwards foreign member, of the Academy of Inſcriptions at Paris, of whom the inſtitution admitted only eight; and in the ſame year he became a member of the ſociety of Haerlem. In 1775, Count Hopkin, who eighteen years before had prohibited the uſe of his writings at Upſal, when he was chancellor of that univerſity, prevailed upon the king of Sweden to confer on him the order of the Polar Star, as a national compenſation. In 1786 he was raiſed to the diſtinguiſhed rank of privy counſellor of juſtice by the court of Hanover; and in 1788 received his laſt literary honour, by being unanimouſly elected a fellow of the Royal Society of London.—His great critical knowledge of the Hebrew language, which he diſplayed in a new tranſlation of the Bible, and in other works, raiſed him to a degree of eminence almoſt unknown before in Germany; and his indefatigable labours were only equalled by his deſire of communicating the knowledge he acquired to the numerous ſtudents of all countries who frequented his admirable lectures, which he continued to deliver on various parts of the ſacred writings in half-yearly courſes, and on the Hebrew, Arabic, and Syriac languages, to the laſt year of his life. He was profeſſor in the univerſity of Gottingen 45 years, and, during that long period, he filled the chair with dignity, credit, and uſefulneſs. He died October 22. 1791, aged 74. He is ſaid to have left behind him ſeveral valuable MSS. Of the works that were publiſhed during his life-time, and which are very numerous, a catalogue, in the order of their publication, is given in the *Gentleman's Magazine* for March 1792.

MICHAELMAS, or *Feaſt of St Michael and all Angels*, a feſtival of the Chriſtian church, obſerved on the 29th of September. See Michael.

MICKLE, William Julius, the celebrated tranſlator of the Luſiad, was the ſon of the reverend Alexander Mickle a Scotiſh clergyman, who had formerly been a diſſenting miniſter in London, an aſſiſtant to the reverend Dr Watts, and one of the tranſlators of Bayle's Dictionary. This gentleman having reſided a few years in London, was preſented to the church of Langholm in Scotland, where he married; and our author was one of the younger ſons. He was born about the year 1735, and was educated by his father. In his early years his paſſion for poetry frequently diſcovered itſelf; though till the age of 13 he did not ſhow any particular attachment to books. At that time having accidentally met with Spencer's Faery Queen, he became enamoured of his manner of writing, and inſtantly began to imitate him. After the death of his father, he came to Edinburgh to reſide with an uncle who was a brewer there, and who admitted him into a ſhare of his buſineſs; not being qualified to ſucceed in this line, he went to London about the time of the concluſion of the war which began in 1755, with a view to procure a commiſſion in the marine ſervice. Here he was diſappointed; but introduced himſelf to the firſt Lord Lyttelton, to whom he ſent one of his poems. From his Lordſhip, however, he received no other favour than being admitted to ſeveral interviews, and encouraged to perſevere in his poetical plans.

So cloſely did our author cultivate the ſtudy of the muſes, that before he was 18 years of age he had written two tragedies and half an epic poem; but all theſe were committed to the flames. The firſt of his poems which appeared in print was publiſhed in one of the Edinburgh magazines, and entitled, "On paſſing through the Parliament Cloſe of Edinburgh at Midnight." This was afterwards inſerted in A Collection of Original Poems by a Scotch gentleman, vol. ii. p. 137.

From the time of Mr Mickle's arrival in London till the year 1765, it is not known how he employed his time, though it is probable that he was employed in ſome branch of the printing buſineſs; and in 1765 he engaged himſelf as corrector to the Clarendon preſs. This year he publiſhed the poem which firſt brought him into notice, entitled, "Pollio, an Elegiac Ode, written in the Wood near R—— (Roſlin) Caſtle," Mickle.

4to. This was an elegy written on the death of his brother; which, previous to its publication, had been ſhown to Lord Lyttelton, and received ſome corrections from him. The latter, in an epiſtle to the author, ſpoke of it as equal to any thing of the kind in our language. In 1767 he publiſhed a poem called "The Concubine, in two cantos, after the manner of Spencer," 4to; and in 1769 he publiſhed, "A Letter to Mr Harwood, wherein ſome of his evaſive gloſſes, falſe tranſlations, and blundering criticiſms, in ſupport of the Arian Hereſy, contained in his literal tranſlation of the New Teſtament, are pointed out and confuted," 8vo: and next year he publiſhed "Mary Queen of Scots, an Elegy;" "Hengiſt and Mary, a Ballad;" and "Knowledge, an Ode;" in Pearch's Collection of Poems. In 1770 he publiſhed "Voltaire in the Shades, or Dialogues on the Deiſtical Controverſy," 8vo. The Elegy on Mary had been ſubmitted to the judgement of Lord Lyttleton, who declined to criticiſe it, not for its deficiency in poetical merit, but from thinking differently from the author concerning that unfortunate princeſs.

About this time Mr Mickle was a frequent writer in the Whitehall Evening Poſt; but a more important work now engaged his attention. When no more than 17 years of age he had read Caſtara's tranſlation of the Luſiad of Camoens into French, and then projected the deſign of giving an Engliſh tranſlation of it. From this, however, he was prevented by various avocations till the year 1771, when he publiſhed the firſt book as a ſpecimen: and having prepared himſelf by acquiring ſome knowledge of the Portugueſe language, he determined to apply himſelf entirely to this work. With this view he quitted his reſidence at Oxford, and went to a farm houſe at Foreſt-hill, where he purſued his deſign with unremitting aſſiduity till the year 1775, when the work was entirely finiſhed.

During the time that Mr Mickle was engaged in this work, he ſubſiſted entirely by his employment as corrector of the preſs; and on his quitting that employment he had only the ſubſcriptions he received for his tranſlation to ſupport him. Notwithſtanding theſe difficulties, he adhered ſteadily to the plan he had laid down, and completed it in about five years.

When his work was finiſhed, Mr Mickle applied to a perſon of great rank, with whom his family had been connected, for permiſſion to dedicate it to him. Permiſſion was granted, and his patron honoured him with a very polite letter; but after receiving a copy, for which an extraordinary price was paid for the binding, he did not think proper to take any notice of the author. At laſt a gentleman of high rank in the political world, a firm friend to the author, and who afterwards took him under his protection, waited on the patron, and heard him declare that he had not read the work, but that it had been repreſented not to have the merit it was at firſt ſaid to poſſeſs. The applauſe with which the work was received, however, ſoon baniſhed from the author's mind thoſe diſagreeable ſenſations which had been occaſioned by the contemptuous neglect of his patron, as well as ſome ſevere criticiſms which had been circulated concerning it. A ſecond edition was prepared in 1778, with a plate prefixed to it, executed by the celebrated artiſt Mortimer; on whom Mr Mickle wrote an epitaph in 1779. This year alſo he publiſhed a pamphlet, entitled, "A Candid Examination of the Reaſons for depriving the Eaſt India Company of its Charter, contained in The Hiſtory and Management of the Eaſt India Company from its Commencement to the Preſent Time; together with ſome Strictures on the Self-Contradictions and Hiſtorical Errors of Dr Adam Smith, in his Reaſons for the Abolition of the ſaid Company," 4to. About this time ſome of his friends thought of recommending him to the king as deſerving of a penſion; but this ſcheme was never put in execution. Dr Lowth biſhop of London, would have put him into orders, and provided for him in the church; but this was not agreeable to our author's diſpoſition. While he was meditating a publication of all his poems, in which he would moſt probably have found his account, he was appointed ſecretary to Commodore Johnſtone, who had lately obtained the command of the Romney man of war. In November 1779 he arrived at Liſbon, and was named by his patron joint agent for the prizes which were taken. In this capital and its neighbourhood he reſided more than ſix months, being every where received with every mark of politeneſs and attention; and during this period he compoſed his poem called "Almada Hill," which in 1781 was publiſhed in quarto. He collected alſo many particulars concerning the manners of the Portugueſe, which he intended alſo to have publiſhed. During his ſtay at Liſbon the Royal Academy was opened; and Mr Mickle, who was preſent at the ceremony of its commencement, had the honour to be admitted a member under the preſidency of Don John of Braganza, duke of Lafoens. His preſence being thought neceſſary in England to attend to the proceedings of the courts of law reſpecting the condemnation of ſome of the prizes, he did not accompany the Commodore in his laſt expedition, nor did he go any more to ſea. In 1782 he publiſhed "The Prophecy of Queen Emma, an ancient Ballad lately diſcovered, written by Johannes Turgottus, prior of Durham, in the reign of William Rufus; to which is added by the Editor, an Account of the Diſcovery, and Hints towards a Vindication of the Authenticity, of the Poems of Oſſian and Rowley," 8vo.

In June this year Mr Mickle married Miſs Tomkins, daughter of the perſon with whom he reſided at Foreſt-hill, while engaged in tranſlating the Luſiad. Having received ſome fortune with this lady, as well as made ſome money himſelf when in the ſervice of Commodore Johnſtone, he now enjoyed a comfortable independence. He afterwards fixed his reſidence at Wheatley in Oxfordſhire, and devoted his time to the reviſion of his poetical works, which he propoſed to publiſh by ſubſcription. During the laſt ſeven years of his life he was employed in writing for the European Magazine. The Fragments of Leo, and ſome of the moſt approved reviews of books, in that periodical work, were of his production. He died after a ſhort illneſs, on the 25th of October 1788, at Wheatley, leaving one ſon behind him. His poetry poſſeſſes much beauty, variety, harmony of numbers, and vigour of imagination: his

Microcosm || Micrometer.

his life was without reproach; his foibles were few and inoffensive; his virtues many; and his genuis very considerable.

MICROCOSM, a Greek term signifying the *little world*; used by some for *man*, as being supposed an epitome of the universe or great world.

MICROGRAPHY, the description of objects viewed with the assistance of a microscope. See *Microscopic objects*.

MICROMETER, an astronomical instrument, by which small angles, or the apparent magnitudes of objects viewed through telescopes or microscopes are measured with great exactness.

Micrometer first invented by Gascoigne.

1. The first TELESCOPIC micrometers were only mechanical contrivances for measuring the image of an object in the focus of the object-glass. Before these contrivances were thought of, astronomers were accustomed to measure the field of view in each of their telescopes, by observing how much of the moon they could see through it, the semidiameter being reckoned at 15 or 16 minutes; and other distances were estimated by the eye, comparing them with the field of view. Mr Gascoigne, an English gentleman, however, fell upon a much more accurate method before the year 1641, and had a Treatise on Optics prepared for the press; but he was killed during the civil wars in the service of Charles I. and his manuscript was never found. His instrument, however, fell into the hands of Mr R. Townly *, who says, that by the help of it he could mark above 40,000 divisions in a foot.

* Phil. Transf. N° 25.

2. Mr Gascoigne's instrument being shown to Dr Hooke, he gave a drawing and description of it, and proposed several improvements †. Mr Gascoigne divided the image of an object in the focus of the object glass, by the approach of two pieces of metal ground to a very fine edge, in the place of which Dr Hooke would substitute two fine hairs stretched parallel to one another.

† See *Phil. Transf. Abr.* vol. i. p. 217. *Hooke's Posthumous Works*, p. 497, 498; and *Phil. Transf* xlviii. p. 190.

Huygens's micrometer.

3. Mr Huygens measured the apparent diameters of the planets, by first determining the quantity of the field of view in his telescope; which, he says, is best done by observing the time that a star takes up in passing over it, and then preparing two or three long and slender brass plates, of various breadths, the sides of which are very straight, and converging to a small angle. In using these pieces of brass, he made them slide in two slits, made in the sides of the tube, opposite to the place of the image, and observed in what place it just covered the diameter of any planet, or any small distance that he wanted to measure ‡. It was observed, however, by Sir Isaac Newton, that the diameters of planets, measured in this manner, will be larger than they should be, as all lucid objects appear to be when they are viewed upon dark ones.

‡ *Systema Saturnium*, p. 82.

Marquis of Malvasia's micrometer.

4. In the Ephemerides of the Marquis of Malvasia, published in 1662, it appears that he had a method of measuring small distances between fixed stars and the diameters of the planets, and also of taking accurate draughts of the spots of the moon by a net of silver wire, fixed in the focus of the eye-glass. He likewise contrived to make one of two stars pass along the threads of this net, by turning it, or the telescope, as much as was necessary for that purpose; and he counted, by a pendulum-clock, beating seconds, the time that elapsed in its passage from one wire to another, which gave him the number of minutes and seconds of a degree contained between the intervals of the wires of his net, with respect to the focal length of his telescope.

Micrometer.

Auzout's micrometer.

5. In 1666, Messrs Auzout and Picard published a description of a micrometer, which was nearly the same with that of the Marquis of Malvasia, excepting the method of dividing it, which they performed with more exactness by a screw. In some cases they used threads of silk, as being finer than silver wires. Dechales also recommends a micrometer consisting of fine wires, or silken threads, the distances of which were exactly known, disposed in the form of a net, as peculiarly convenient for taking a map of the moon.

De la Hire's micrometer.

6. M. de la Hire says, that there is no method more simple or commodious for observing the digits of an eclipse than a net in the focus of the telescope. These, he says, were generally made of silken threads; and that for this particular purpose six concentric circles had also been made use of, drawn upon oiled paper; but he advises to draw the circles on very thin pieces of glass with the point of a diamond. He also gives several particular directions to assist persons in the use of them.

Common micrometer. Plate CCCXXXV. Fig. 1.

7. *Construction of Different Micrometers.* The first we shall describe is the common micrometer. Let ABCD be a section of the telescope at the principal focus of the object-glass, or where the wires are situated, which are placed in a short tube containing the eye-glass, and may be turned into any position by turning that tube; mn is a fine wire extended over its centre; vw, xy, are two parallel wires well defined, and perpendicular to mn; vw is fixed, and xy moves parallel to it by means of a screw, which carries two indexes over a graduated plate, to show the number of revolutions and parts of a revolution which it makes. Now to measure any angle, we must first ascertain the number of revolutions and parts of a revolution corresponding to some known angle, which may be thus done: 1st, Bring the inner edges of the wires exactly to coincide, and set each index to o; turn the screw, and separate the wires to any distance; and observe the time a star m is in passing along the wire mn from one vertical wire to the other: for that time, turned into minutes and seconds of a degree, will be the angle answering to the number of revolutions, or the angle corresponding to the distance. Thus, if $d=$ cos. of the star's declination, we have $15'dm$, the angle corresponding to this distance; and hence, by proportion, we find the angle answering to any other. 2*dly*, Set up an object of a known diameter, or two objects at a given distance, and turn the screw till the vertical wires become tangents to the object, or till their opening just takes in the distance of the two objects upon the wire mn; then from the diameter, or distance of the two objects from each other, and their distance from the glass, calculate the angle, and observe the number of revolutions and parts corresponding. 3*dly*, Take the diameter of the sun on any day, by making the wires tangents to the opposite limbs, and find, from the nautical almanac, his diameter on that day. Here it will be best to take the upper and lower limbs of the sun when on the meridian, as he has then no motion perpendicular to the horizon. If the edges do not coincide when the indexes stand at o, we must allow for the error. Instead of making a proportion, it is better to have a table calculated to show the angle correspond-

Micrometer.

ing to every revolution and parts of a revolution. But the observer must remember, that when the micrometer is fixed to telescopes of different focal lengths, a new table must be made. The whole system of wires is turned about in its own plane, by turning the eye-tube round with the hand, and by that means the wire *mn* can be thrown into any position, and consequently angles in any position may be measured. Dr Bradley added a small motion by a rack and pinion to set the wires more accurately in any position.

8. But the micrometer, as now contrived, is of use, not only to find the angular distance of bodies in the field of view at the same time, but also of those which, when the telescope is fixed, pass through the field of view successively; by which means we can find the difference of their right ascensions and declinations.

Fig. 2. Let A *a*, B *b*, C *c*, be three parallel and equidistant wires, the middle one bisecting the field of view; HOR a fixed wire perpendicular to them passing through the centre of the field; and F *f*, G *g*, two wires parallel to it, each moveable by a micrometer screw, as before, so that they can be brought up to HOR, or a little beyond. Then to find the angular distance of two objects, bring them very near to B *b*, and in a line parallel to it, by turning about the wires, and bring one upon HOR, and by the micrometer screw make F *f* or G *g* pass through the other; then turn the screw till that wire coincides with HOR, and the arc which the index has passed over shows their angular distance. If the objects be further remote than you can carry the distance of one of the wires F *f*, G *g* from HOR, then bring one object to F *f* and the other to G *g*; and turn each micrometer screw till they meet, and the sum of the arcs passed over by each index gives their angular distance. If the objects be two stars, and one of them be made to run along HOR, or either of the moveable wires as occasion may require, the motion of the other will be parallel to these wires, and their difference of declinations may be observed with great exactness; but in taking any other distances, the motion of the stars being oblique to them, it is not quite so easy to get them parallel to B *b*; because if one star be brought near, and the eye be applied to the other to adjust the wires to it, the former star will have gotten a little away from the wire. Dr Bradley, in his account of the use of this micrometer, published by Dr Maskelyne in the Philosophical Transactions for 1772, thinks the best way is to move the eye backwards and forwards as quick as possible; but it seems to be best to fix the eye at some point between, by which means it takes in both at once sufficiently well defined to compare them with B *b*. In finding the difference of declinations, if both bodies do not come into the field of view at the same time, make one run along the wire HOR, as before, and fix the telescope and wait till the other comes in, and then adjust one of the moveable wires to it, and bring it up to HOR, and the index gives the difference of their declinations. The difference of time between the passage of the star at either of the cross moveable wires, and the transit of the other star over the cross fixed wire (which represents a meridian), turned into degrees and minutes, will give the difference of right ascension. The star has been here supposed to be bisected by the wire; but if the wire be a tangent to it, allowance must be made for the breadth of the wire, provided the adjustment be made for the coincidence of the wires. In observing the diameters of the sun, moon, or planets, it may perhaps be most convenient to make use of the outer edges of the wires, because they appear most distinct when quite within the limb: but if there should be any sensible inflection of the rays of light in passing by the wires, it will be best avoided by using the inner edge of one wire and the outward edge of the other; for by that means the inflection at both limbs will be the same way, and therefore there will be no alteration of the relative position of the rays passing by each wire. And it will be convenient in the micrometer to note at what division the index stands when the moveable wire coincides with HOR; for then you need not bring the wire when a star is upon it up to HOR, only reckon from the division at which the index then stands to the above division.

The divided object-glass micrometer hinted at by Mr Savery.

9. With a micrometer thus adapted to a telescope, Mr S. Savery of Exeter proposed a new way of measuring the difference between the greatest and least apparent diameters of the sun, although the whole of the sun was not visible in the field of view at once. The method we shall briefly describe. Place two object-glasses instead of one, so as to form two images whose limbs shall be at a small distance from each other; or instead of two perfect lenses, he proposed to cut a single lens into four parts of equal breadths by parallel lines, and to place the two segments with their straight sides against each other, or the two middle frustums with their opposite edges together; in either case, the two parts which before had a common centre and axis, have now their centres and axes separated, and consequently two images will be formed as before by two perfect lenses. Another method in reflectors was to cut the large concave reflector through the centre, and by a contrivance to turn up the outer edges whilst the straight ones remained fixed; by which means the axis of the two parts became inclined, and formed two images. Two images being formed in this manner, he proposed to measure the distance between the limbs when the diameters of the sun were the greatest and least, the difference of which would be the difference of the diameters required. Thus far we are indebted to Mr Savery for the idea of forming two images; and the admirable uses to which it was afterwards applied, we shall next proceed to describe.

Improved by Mr John Dollond.

10. The divided object-glass micrometer, as now made, was contrived by the late Mr John Dollond, and by him adapted to the object-end of a reflecting telescope, and has been since by the present Mr P. Dollond his son applied with equal advantage to the end of an achromatic telescope. The principle is this: The object-glass is divided into two segments in a line drawn through the centre; each segment is fixed in a separate frame of brass, which is moveable, so that the centres of the two segments may be brought together by a handle for that purpose, and thereby form one image of an object; but when separated they will form two images, lying in a line passing through the centre of each segment; and consequently the motion of each image will be parallel to that line, which can be thrown into any position by the contrivance of another handle to turn

Micrometer.

turn the glaſs about in its own plane. The braſs-work carries a vernier to meaſure the diſtance of the centres of the two ſegments. Now let E and H be the centres of the two ſegments, F their principal focus, and PQ two diſtant objects in FE, FH, produced, or the oppoſite limbs of the ſame object PBQD; then the images of P and Q, formed by each ſegment, or the images of the oppoſite limbs of the object PBQD, coincide at F: hence two images mzF, nxF of that object are formed, whoſe limbs are in contact; therefore the angular diſtance of the points P and Q is the ſame as the angle which the diſtance EH ſubtends at F, which, as the angles ſuppoſed to be meaſured are very ſmall, will vary as EH extremely nearly; and conſequently if the angle correſponding to one interval of the centres of the ſegments be known, the angle correſponding to any other will be found by proportion. Now to find the interval for ſome one angle, take the horizontal diameter of the ſun on any day, by ſeparating the images till the contrary limbs coincide, and read off by the vernier the interval of their centres, and look into the nautical almanac for the diameter of the ſun on that day, and you have the correſponding angle. Or if greater exactneſs be required than from taking the angle in proportion to the diſtances of their centres, we may proceed thus:—Draw FG perpendicular to EH, which therefore biſects it; then one half EH, or EG, is the tangent of half the angle EFH; hence, half the diſtance of their centres is to the tangent of half the angle correſponding to that diſtance as half any other diſtance of the centres is to the tangent of half the correſponding angle (A). (Fig. 3.)

11. From this the method of meaſuring ſmall angles is manifeſt; for we conſider P, Q either as two objects whoſe images are brought together by ſeparating the two ſegments, or as the oppoſite limbs of one object PBQA, whoſe images, formed by the two ſegments E, H, touch at F; in the former caſe, EH gives the angular diſtance of the two objects; and in the latter, it gives the angle under which the diameter of the object appears. In order to find the angular diſtance of two objects, therefore, ſeparate the ſegments till the two images which approach each other coincide; and to find the diameter of an object, ſeparate the ſegments till the contrary limbs of the images touch each other, and read off the diſtance of the centres of the ſegment from the vernier (B), and find the angle as directed in the laſt article. Hence appears one great ſuperiority in this above the wire micrometer; as, with the one any diameter of an object may be meaſured with the ſame eaſe and accuracy; whereas with the other we cannot with accuracy meaſure any diameter, except that which is at right angles to the direction of motion.

12. But, beſides theſe two uſes to which the inſtrument ſeems ſo well adapted, Dr Maſkelyne * has ſhown, how it may be applied to find the difference of right aſcenſions and declinations. For this purpoſe, two wires at right angles to each other, biſecting the field of view, muſt be placed in the principal focus of the eye-glaſs, and moveable about in their own plane.—Let HCRc be the field of view, HR and Cc the two wires; turn the wires till the weſternmoſt ſtar (which is the beſt, having further to move) run along ROH; then ſeparate the two ſegments, and turn about the micrometer till the two images of the ſame ſtar lie in the wire Cc; and then, partly by ſeparating the ſegments, and partly by raiſing or depreſſing the teleſcope, bring the two innermoſt images of the two ſtars to appear and run along ROH, as a, b, and the vernier will give the difference of their declinations; becauſe, as the two images of one of the ſtars coincided with Cc, the image of each ſtar was brought perpendicularly upon HR, or to HR in their proper meridian. And, for the ſame reaſon, the difference of their times of paſſing the wire COc will give their difference of right aſcenſions. Theſe operations will be facilitated, if the teleſcope be mounted on a polar axis. If two other wires KL, MN, parallel to Cc, be placed near H and R, the obſervation may be made on two ſtars whoſe difference of meridians is nearly equal to HR the diameter of the field of view, by bringing the two images of one of the ſtars to coincide with one of theſe wires. If two ſtars be obſerved whoſe difference of declinations is well ſettled, the ſcale of the micrometer will be known. (Fig. 4.)

* Phil. Tranſ. 1771.

13. It has hitherto been ſuppoſed, that the images of the two ſtars can be both brought into the field of view at once upon the wire HOR: but if they cannot, ſet the micrometer to the difference of their declinations as nearly as you can, and make the image which comes firſt run along the wire HOR, by elevating or depreſſing the teleſcope; and when the other ſtar comes in, if it do not alſo run along HOR, alter the

(A) If the object is not diſtant let f be the principal focus; then Ff : FG :: FG : FK (FG being produced to meet a line joining the apparent places of the two objects P, Q,), ∴ dividendo, fG : FG :: GK : FK, and alternando, fG : GK :: FG : FK :: (by ſimilar triangles) EH : PQ, hence $\frac{EH}{fG}=\frac{PQ}{GK}$, therefore the angle ſubtended by EH at $f=$ the angle ſubtended by PQ at G; and conſequently, as fG is conſtant, the angle meaſured at G is, in this caſe, alſo proportional to EH. The inſtrument is not adapted to meaſure the augular diſtance of bodies, one of which is near and the other at a diſtance, becauſe their images would not be formed together.

(B) To determine if there be any error in the adjuſtment of the micrometer ſcale, meaſure the diameter of any ſmall well-defined object, as Jupiter's equatoreal diameter, or the longeſt axis of Saturn's ring, both ways, that is, with o on the vernier to the right and left of o on the ſcale, and half the difference is the error required. This error muſt be added to or ſubtracted from all obſervations, according as the diameter meaſured with o on the vernier, when advanced on the ſcale, is leſs or greater than the diameter meaſured the other way. And it is alſo evident, that half the ſum of the diameters thus meaſured gives the true diameter of the object.

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the micrometer till it does, and half the sum of the numbers shown by the micrometer at the two separate observations of the two stars on the wire HOR will be the difference of their declinations. That this should be true, it is manifestly necessary that the two segments should recede equally in opposite directions; and this is effected by Mr Dollond in his new improvement of the object-glass micrometer.

Fig. 5.

14. The difference of right ascensions and declinations of Venus or Mercury in the sun's disk and the sun's limb may be thus found. Turn the wires so that the north limb *n* of the sun's image AB, or the north limb of the image V of the planet, may run along the wire RH, which therefore will then be parallel to the equator, and consequently C*c* a secondary to it; then separate the segments, and turn about the micrometer till the two images V*v* of the planet pass C*c* at the same time, and then by separating the segments, bring the north limb of the northernmost image V of the planet to touch HR, at the time the northernmost limb *n* of the southernmost image AB of the sun touches it, and the micrometer shows the difference of declinations of the northernmost limbs of the planet and sun, for the reason formerly given (Art. 11.) we having brought the northernmost limbs of the two innermost images V and AB to HR, these two being manifestly interior to *v* and the northernmost limb N of the image PQ. In the same manner we take the difference of declinations of their southernmost limbs; and half the difference of the two measures (taking immediately one after another) is equal to the difference of the declinations of their centres, without any regard to the sun's or planet's diameters, or error of adjustment of the micrometer; for as it affects both equally, the difference is the same as if there were no error: and the difference of the times of the transits of the eastern or western limbs of the sun and planet over C*c* gives the difference of their right ascensions.

15. Instead of the difference of right ascensions, the distance of the planet from the sun's limb, in lines parallel to the equator, may be more accurately observed thus: Separate the segments, and turn about the wires and micrometer, so as to make both images V, *v*, run along HR, or so that the two intersections I, T of the sun's image may pass C*c* at the same time. Then bring the planet's and sun's limbs into contact, as at V, and do the same for the other limb of the sun, and half the difference gives the distance of the centre of the planet from the middle of the chord on the sun's disk parallel to the equator, or the difference of the right ascensions of their centres, allowing for the motion of the planet in the interval of the observations, without any regard to the error of adjustment, for the same reason as before. For if you take any point in the chord of a circle, half the difference of the two segments is manifestly the distance of the point from the middle of the chord; and as the planet runs along HR, the chord is parallel to the equator.

Fig. 6.

In like manner, the distances of their limbs may be measured in lines perpendicular to the equator, by bringing the micrometer into the position already described, (Art. 13.), and instead of bringing V to HR, separate the segments till the northernmost limbs coincide as at V; and in the same manner make their southernmost images to coincide, and half the difference of the two measures, allowing for the planet's motion, gives the difference of the declinations of their centres. Fig. 7.

Hence the true place of a planet in the sun's disc may at any time of its transit be found; and consequently the nearest approach to the centre and the time of ecliptic conjunction may be deduced, although the middle should not be observed.

16. But however valuable the object-glass micrometer undoubtedly is, difficulties sometimes have been found in its use, owing to the alteration of the focus of the eye, which will cause it to give different measures of the same angle at different times. For instance, in measuring the sun's diameter, the axis of the pencil coming through the two segments from the contrary limbs of the sun, as PF, QF, fig. 3. crossing one another in the focus F under an angle equal to the sun's semidiameter, the union of the limbs cannot appear perfect, unless the eye be disposed to see objects distinctly at the place where the images are formed; for if the eye be disposed to see objects nearer to or further off than that place, in the latter case the limbs will appear separated, and in the former they will appear to lap over (c). This imperfection led Dr Maskelyne to inquire, whether some method might not be found of producing two distinct images of the sun, or any other object, by bringing the axis of each pencil to coincide, or very nearly so, before the formation of the images, by which means the limbs when brought together would not be liable to appear separated from any alteration of the eye; and this he found would be effected by the refraction of two prisms, placed either without or within the telescope; and on this principle, placing the prisms within, he constructed a new micrometer, and had one executed by Mr Dollond, which upon trial answered as he expected. The construction is as follows.

Disadvantage of the object-glass micrometer.

17. Let AB be the object-glass; *ab* the image, suppose of the sun, which would have been formed in the principal focus Q; but let the prisms PR, SR be placed to intercept the rays, and let EF, WG, be two rays proceeding from the eastern and western limbs of the sun, converging, after refraction at the lens, to *a* and *b*; and suppose the refraction of the prisms to be such, that in fig. 8. the ray EFR, after refraction at R

Dr Maskelyne's prismatic micrometer. Fig. 8, 9.

(c) For if the eye can see distinctly an image at F, the pencils of rays, of which PF, QF are the two axes, diverging from F, are each brought to a focus on the retina at the same point; and therefore the two limbs appear to coincide: but if we increase the refractive power of the eye, then each pencil is brought to a focus, and they cross each other before the rays come to the retina, consequently the two limbs on the retina will lap over; and if we diminish the refractive power of the eye, then each pencil being brought to a focus beyond the retina, and not crossing till after they have passed it, the two limbs on the retina must be separated.

Micrometer.

R by the prifm PR, may proceed in the direction RQ; and as all the rays which were proceeding to *a* fuffer the fame refraction at the prifm, they will all be refracted to Q; and therefore, inftead of an image *a b*, which would have been formed by the lens alone, an image Q *c* is formed by thofe rays which fall on the prifm PR; and for the fame reafon, the rays falling on the prifm SR will form an image Q *d*: and in fig. 9. the image of the point *b* is brought to Q, by the prifm PR, and confequently an image Q *d* is formed by thofe rays which fall on PR: and for the fame reafon, an image Q *c* is formed by the rays falling on SR. Now in both cafes, as the rays EFR, WGR, coming from the two oppofite limbs of the fun, and forming the point of contact of the two limbs, proceed in the fame direction RQ, they muft thus accompany each other through the eye-glafs and alfo through the eye, whatever refractive power it has, and therefore to every eye the images muft appear to touch. Now the angle *a* R *b* is twice the refraction of the prifm, and the angle *a* C *b* is the diameter of the fun; and as thefe angles are very fmall, and have the fame fubtenfe *a b*, we have the angle *a* R *b* : angle *a* C *b* :: CQ : RQ.—Now as CQ is conftant, and alfo the angle *a* R *b* being twice the refraction of the prifm, the angle *a* C *a* varies as RQ. Hence the extent of the fcale for meafuring angles becomes the focal length of the object-glafs, and the angle meafured is in proportion to the diftance of the prifms from the principal focus of the object-glafs; and the micrometer can meafure all angles (very fmall ones excepted, for the reafon given in Art. 19.) which do not exceed the fum of the refractions of the prifms; for the angle *a* C *b*, the diameter of the object to be meafured, is always *lefs* than the angle *a* R *b*, the fum of the refractions of the prifms, except when the prifms touch the object glafs, and then they become *equal*. The fcale can never be out of adjuftment, as the point o, where the meafurement begins, anfwers to the focus of the object-glafs, which is a fixed point for all diftant objects, and we have only to find the value of the fcale anfwering to fome known angle: for inftance, bring the two limbs of the fun's images into contact, and meafure the diftance of the prifms from the focus, and look in the nautical almanac for the fun's diameter, and you get the value of the fcale.

Fig. 8. 18. In fig. 8. the limb Q of the image Q *c*, is illuminated by the rays falling on the object glafs between A and F, and of the image Q *d* by thofe falling between B and G; but in fig. 9. the fame limbs are illuminated by the rays falling between B and F, A and G refpectively, and therefore will be more illuminated than in the other cafe; but the difference is not confiderable in achromatic telefcopes, on account of the great aperture of the object glafs compared with the diftance FG.

It might be convenient to have two fets of prifms, one for meafuring angles not exceeding 36′, and therefore fit for meafuring the diameters of the fun and moon, and the lucid parts and diftances of the cufps in their eclipfes; and another for meafuring angles not much greater than 1′, for the conveniency of meafuring the diameters of the planets. For as QC : QR : : fum of the refractions of the prifms : angle *a* C *b*, the apparent diameter of the object, it is evident that if you diminifh the third term, you muft increafe the fecond in the fame ratio, in order to meafure the fame angle; and thus by diminifhing the refractive angle of the prifms, you throw them further from Q, and confequently avoid the inconvenience of bringing them near to Q, for the reafon in the next paragraph; and at the fame time you will increafe the illumination in a fmall degree. The prifms muft be achromatic, each compofed of two prifms of flint and crown glafs, placed with their refracting angles in contrary directions, otherwife the images will be coloured.

19. In the conftruction here defcribed, the angle meafured becomes evanefcent when the prifms come to the principal focus of the object-glafs, and therefore o on the fcale then begins: but if the prifms be placed in the principal focus they can have no effect, becaufe the pencil of rays at the junction of the prifms would then vanifh, and therefore it is not practicable to bring the two images together to get o on the fcale. Dr Mafkelyne, therefore, thought of placing another pair of prifms within, to refract the rays *before* they came to the other prifms, by which means the two images would be formed into one before they came to the principal focus, and therefore o on the fcale could be determined. But to avoid the error arifing from the multiplication of mediums, he, inftead of adding another pair of prifms, divided the object-glafs through its centre, and fliding the fegments a little it feparated the images, and then by the prifms he could form one image very diftinctly, and confequently could determine o on the fcale; for by feparating the two fegments you form two images, and you will feparate the two pencils fo that you may move up the two prifms, and the two pencils will fall on each refpectively, and the two images may be formed into one. In the inftrument which Dr Mafkelyne had made, o on the fcale was chofen to be about $\frac{1}{3}$ of the focal length of the object-glafs, and each prifm refracted 27′. By this means all angles are meafured down to o.

20. In the Philofophical Tranfactions for 1779, Mr Ramfden has defcribed two new micrometers, which he contrived with a view of remedying the defects of the object-glafs micrometer.

21. 1. One of thefe is a *catoptric* micrometer, which, befide the advantage it derives from the principle of reflection, of not being difturbed by the heterogeneity of light, avoids every defect of other micrometers, and can have no aberration, nor any defect arifing from the imperfection of materials or of execution; as the extreme fimplicity of its conftruction requires no additional mirrors or glaffes to thofe required for the telefcope; and the feparation of the images being effected by the inclination of the two fpecula, and not depending on the focus of any lens or mirror, any alteration in the eye of an obferver cannot affect the angle meafured. It has peculiar to itfelf the advantages of an adjuftment, to make the images coincide in a direction perpendicular to that of their motion; and alfo of meafuring the diameter of a planet on both fides of the zero, which will appear no inconfiderable advantage to obfervers who know how much eafier it is to afcertain the contact of the external edges of two images than their perfect coincidence.

Ramfden's reflecting micrometer.

22. A reprefents the fmall fpeculum divided into two equal parts; one of which is fixed on the end of the arm B; the other end of the arm is fixed on a fteel Fig. 10.

axis

Micrometer.

axis X, which croſſes the end of the teleſcope C. The other half of the mirror A is fixed on the arm D, which arm at the other end terminates in a ſocket y, that turns on the axis X; both arms are prevented from bending by the braces $a\,a$. G repreſents a double ſcrew, having one part e cut into double the number of threads in an inch to that of the part g: the part e having 100 threads in one inch, and the part g 50 only. The ſcrew e works in a nut F in the ſide of the teleſcope, while the part g turns in a nut H, which is attached to the arm B; the ends of the arms B and D, to which the mirrors are fixed, are ſeparated from each other by the point of the double ſcrew preſſing againſt the ſtud h, fixed to the arm D, and turning in the nut H on the arm B. The two arms B and D are preſſed againſt the direction of the double ſcrew $e\,g$ by a ſpiral ſpring within the part n, by which means all ſhake or play in the nut H, on which the meaſure depends, is entirely prevented.

From the difference of the threads on the ſcrew at e and g, it is evident, that the progreſſive motion of the ſcrew through the nut will be half the diſtance of the ſeparation of the two halves of the mirror; and conſequently the half mirrors will be moved equally in contrary directions from the axis of the teleſcope C.

23. The wheel V fixed on the end of the double ſcrew has its circumference divided into 100 equal parts, and numbered at every fifth diviſion with 5, 10, &c. to 100, and the index I ſhows the motion of the ſcrew with the wheel round its axis, while the number of revolutions of the ſcrew is ſhown by the diviſions on the ſame index. The ſteel ſcrew at R may be turned by the key S, and ſerves to incline the ſmall mirror at right angles to the direction of its motion. By turning the finger-head T, the eye-tube P is brought nearer or farther from the ſmall mirror, to adjuſt the teleſcope to diſtinct viſion; and the teleſcope itſelf hath a motion round its axis for the conveniency of meaſuring the diameter of a planet in any direction. The inclination of the diameter meaſured with the horizon is ſhown in degrees and minutes by a level and vernier on a graduated circle, at the breech of the teleſcope.

Fig. 11.

A correction to be applied to the angle.

24. Beſides the table for reducing the revolutions and parts of the ſcrew to minutes, ſeconds, &c. it will require a table for correcting a ſmall error which ariſes from the excentric motion of the half-mirrors. By this motion their centres of curvature will approach a little towards the large mirror: the equation for this purpoſe in ſmall angles is inſenſible; but when angles to be meaſured exceed ten minutes, it ſhould not be neglected. Or, the angle meaſured may be corrected by diminiſhing it in the proportion the verſed ſine of the angle meaſured, ſuppoſing the eccentricity radius, bears to the focal length of the ſmall mirror."

25. Mr Ramſden preferred Caſſegrain's conſtruction of the reflecting teleſcope to either the Gregorian or Newtonian; becauſe in the former, the errors of one ſpeculum are corrected by thoſe of the other. From a property of the reflecting teleſcope, not generally known, that the apertures of the two ſpecula are to each other very nearly in the proportion of their focal lengths, it follows, that their aberrations will be in the ſame proportion; and theſe aberrations will be in the ſame direction, if the two ſpecula are concave; or in contrary directions, if one ſpeculum is concave and the other convex. In the Gregorian teleſcope, both ſpecula being concave, the aberration at the ſecond image will be the ſum of the aberrations of the two mirrors; but in the Caſſegrainian teleſcope one mirror being concave and the other convex, the aberration at the ſecond image will be the difference between the two aberrations. By aſſuming ſuch proportions for the *foci* of the ſpecula as are generally uſed in the reflecting teleſcope, which is about as 1 to 4, the aberration in the Caſſegrainian conſtruction will be to that in the Gregorian as 3 to 5.

Mr Ramſden's eye-glaſs micrometer.

26. The other is a *dioptric* micrometer, or one ſuited to the principle of refraction. This micrometer is applied to the erect eye-tube of a refracting teleſcope, and is placed in the conjugate focus of the firſt eye-glaſs: in which poſition, the image being conſiderably magnified before it comes to the micrometer, any imperfection in its glaſs will be magnified only by the remaining eye-glaſſes, which in any teleſcope ſeldom exceeds five or ſix times. By this poſition alſo the ſize of the micrometer glaſs will not be the $\frac{1}{100}$ part of the area which would be required if it was placed in the object-glaſs; and, notwithſtanding this great diſproportion of ſize, which is of great moment to the practical optician, the ſame extent of ſcale is preſerved, and the images are uniformly bright in every part of the field of the teleſcope.

Plate CCCXXXVI.

27. Fig. 12. repreſents the glaſſes of a refracting teleſcope; $x\,y$, the principal pencil of rays from the object-glaſs O; $t\,t$ and $u\,u$, the axis of two oblique pencils; a, the firſt eye-glaſs; m, its conjugate focus, or the place of the micrometer; b the ſecond eye-glaſs; c the third; and d the fourth, or that which is neareſt the eye. Let p be the diameter of the object-glaſs, e the diameter of a pencil at m, and f the diameter of the pencil at the eye; it is evident, that the axes of the pencils from every part of the image will croſs each other at the point m; and e, the width of the micrometer-glaſs, is to p the diameter of the object-glaſs, as $m\,a$ is to $g\,o$, which is the proportion of the magnifying power at the point m; and the error cauſed by an imperfection in the micrometer glaſs placed at m will be to the error, had the micrometer been at O, as m is to p.

Fig. 13.

28. Fig. 13. repreſents the micrometer; A, a convex or concave lens biſected by a plane acroſs its centre; one of theſe ſemi-lenſes is fixed in a frame B, and the other in the frame E; which two frames ſlide on a plate H, and are preſſed againſt it by thin plates $a\,a$: the frames B and E are moved in contrary directions by turning the button D: L is a ſcale of equal parts on the frame B; it is numbered from each end towards the middle with 10, 20, &c. There are two verniers on the frame E, one at M and the other at N, for the convenience of meaſuring the diameter of a planet, &c. on both ſides the zero. The firſt diviſion on both theſe verniers coincides at the ſame time with the two zeros on the ſcale, L; and, if the frame is moved towards the right, the relative motion of the two frames is ſhown on the ſcale L by the vernier M; but if the frame B be moved towards the left, the relative motion is ſhown by the vernier N.—This micrometer has a motion round the axis of viſion, for the convenience of meaſuring the diameter of a planet, &c. in any direction, by turning

2

Micrometer.

ing an endlefs fcrew F; and the inclination of the diameter meafured with the horizon is fhown on the circle *g* by a vernier on the plate V. The telefcope may be adjufted to diftinct vifion by a fcrew, which moves the whole eye-tube with the micrometer nearer to or farther from the object-glafs, as telefcopes are generally made; or the fame effect may be produced without moving the micrometer, by fliding the part of the eye tube *m* on the part *n*, by help of a fcrew or pinion.

Difadvantages of the common micrometer.

29. Notwithftanding thefe improvements on micrometers, they are ftill liable to many fources of error. The imperfections of the wire micrometer, (which was ftill the moft correct inftrument for meafuring fmall angles) when employed to determine the diftance of clofe double ftars, have been ably pointed out by Dr Herfchel.

30. When two ftars are taken between the parallel wires the diameters muft be included. Dr Herfchel * has in vain attempted to find lines fufficiently thin to extend them acrofs the centres of the ftars fo that their thicknefs might be neglected. The threads of the filk-worm, with fuch lenfes as he ufes, are fo much magnified that their diameter is more than that of many of the ftars. Befides, if they were much fmaller, the deflection of light would make the attempt to meafure the diftance of the centres this way fruitlefs; for he has always found the light of the ftars to play upon thofe lines and feparate their apparent diameters into two parts. Now fince the fpurious diameters of the ftars thus included, are continually changing with the ftate of the air, and the length of time we look at them, we are, in fome refpect, left at an uncertainty; and our meafures taken at different times, and with different degrees of attention, will vary on that account. Nor can we come at the true diftance of the centres of any two ftars, unlefs we know the femidiameters of the ftars themfelves; for different ftars have different apparent diameters, which, with a power of 227, may differ from each other as far as two feconds (D).

* *Phil. Tranf.* 1782.

31. The next imperfection arifes from a deflection of light upon the wires when they approach very near to each other; for if this be owing to a power of repulfion lodged at the furface, it is eafy to fee that fuch powers muft interfere with each other, and give the meafures larger in proportion than they would have been if the repulfive power of one wire had not been oppofed by a contrary power of the other wire.

32. Another difadvantage of thefe micrometers is an uncertainty of the real zero. The leaft alteration in the fituation and quantity of light will affect the zero; and a change in the pofition of the wires will fometimes produce a difference. To remove this difficulty Dr Herfchel always found his zero while the apparatus preferved the fituation which it had when his obfervations were made; but this introduces an additional obfervation.

33. The next imperfection, is that every micrometer hitherto ufed requires either a fcrew, or a divided bar and pinion, to meafure the diftance of the wires or the two images. Thofe acquainted with works of this kind are fenfible how difficult it is to have fcrews perfectly equal in every thread or revolution of each thread; or pinions and bars that fhall be fo evenly divided as to be depended upon in every leaf and tooth to the two or three thoufandth part of an inch: and yet, on account of the fmall fcale of thofe micrometers, thefe quantities are of the greateft confequence; an error of a fingle thoufandth part inducing in moft inftruments a miftake of feveral feconds.

34. The greateft imperfection of all is, that the wires require to be illuminated; and when Dr Herfchel had double ftars to meafure, one of which was very obfcure, he was obliged to be content with lefs light than is neceffary to make the wires diftinct; and feveral ftars on this account could not be meafured at all, though not too clofe for the micrometer.

Dr Herfchel, therefore, was led to direct his attention to the improvement of thefe inftruments; and the refult of his endeavours has been a very ingenious *lamp-micrometer*, which is not only free from the imperfections above fpecified, but alfo poffeffes the advantages of a large fcale.

Dr Herfchel's lamp-micrometer. Fig. 14.

35. It is reprefented in fig. 14. where ABGCFE is a ftand nine feet high, upon which a femicircular board *qhogp* is moveable upwards or downwards, and is held in its fituation by a peg *p* put into any one of the holes of the upright piece AB. This board is a fegment of a circle of fourteen inches radius, and is about three inches broader than a femicircle, to give room for the handles *r* D, *e* P, to work. The ufe of this board is to carry an arm L, thirty inches long, which is made to move upon a pivot at the centre of the circle, by means of a ftring, which paffes in a groove upon the edge of the femicircle *pgohq*; the ftring is faftened to a hook at *o* (not expreffed in the figure, being at the back of the arm L), and paffing along the groove from *oh* to *q* is turned over a pulley at *q*, and goes down to a fmall barrel *e*, within the plane of the circular board, where a double-jointed handle *e* P commands its motion. By this contrivance, we fee, the arm L may be lifted up to any altitude from the horizontal pofition to the perpendicular, or be fuffered to defcend by its own weight below the horizontal to the reverfe perpendicular fituation. The weight of the handle P is fufficient to keep the arm in any given pofition; but if the motion fhould be too eafy, a friction fpring applied to the barrel will moderate it at pleafure.

36. In front of the arm L a fmall flider, about three inches long, is moveable in a rabbet from the end L towards the centre backwards and forwards. A ftring is faftened to the left fide of the little flider, and goes towards L, where it paffes round a pulley at *m*, and returns under the arm from *m*, *n*, towards the centre, where it is led in a groove on the edge of the arm, which is of a circular form, upwards to a barrel (raifed above the plane of the circular board) at *r*, to which the handle *r* D is faftened. A fecond ftring is faftened to the flider, at the right fide, and goes towards the centre, where it paffes over a pulley *n*; and the weight *w*, which is fufpended by the end of this ftring, returns the flider towards the centre, when a contrary turn of the handle permits it to act.

37. By *a* and *b* are reprefented two fmall lamps, two inches high, $1\frac{1}{2}$ in breadth by $1\frac{1}{4}$ in depth. The fides, back, and top, are made fo as to permit no light to be feen, and the front confifts of a thin brafs fliding door. The flame in the lamp *a* is placed three-tenths of an inch from

(D) Thefe imperfections are remedied in the inftrument defcribed in p. 801.

Micrometer.

from the left side, three-tenths from the front, and half an inch from the bottom. In the lamp *b* it is placed at the same height and distance, measuring from the right side. The wick of the flame consists only of a single very thin lamp cotton thread; for the smallest flame being sufficient, it is easier to keep it burning in so confined a place. In the top of each lamp must be a little slit lengthways, and a small opening in one side near the upper part, to permit the air to circulate to feed the flame. To prevent every reflection of light, the side opening of the lamp *a* should be to the right, and that of the lamp *b* to the left. In the sliding door of each lamp is made a small hole with the point of a very fine needle just opposite the place where the wicks are burning, so that when the sliders are shut down, and every thing dark, nothing shall be seen but two fine lucid points of the size of two stars of the third or fourth magnitude. The lamp *a* is placed so that its lucid point may be in the centre of the circular board where it is fixed. The lamp *b* is hung to the little slider which moves in the rabbet of the arm, so that its lucid point, in an horizontal position of the arm, may be on a level with the lucid point in the centre. The moveable lamp is suspended upon a piece of brass fastened to the slider by a pin exactly behind the flame, upon which it moves as a pivot. The lamp is balanced at the bottom by a leaden weight, so as to remain upright, when the arm is either lifted above or depressed below the horizontal position. The double-jointed handles *r*D, *e*P, consist of deal rods, 10 feet long, and the lowest of them may have divisions, marked upon it near the end P, expressing exactly the distance from the central lucid point in feet, inches, and tenths.

38. Hence we see, that a person at a distance of 10 feet may govern the two lucid points, so as to bring them into any required position south or north preceding or following from 0 to 90° by using the handle P, and also to any distance from six-tenths of an inch to five or six and twenty inches by means of the handle D. If any reflection or appearance of light should be left from the top or sides of the lamps, a temporary screen, consisting of a long piece of pasteboard, or a wire frame covered with black cloth, of the length of the whole arm, and of any required breadth, with a slit of a half an inch broad in the middle, may be affixed to the arm by four bent wires projecting an inch or two before the lamps, situated so that the moveable lucid point may pass along the opening left for that purpose.

Fig. 15.

Fig. 15. represents part of the arm L, half the real size; S the slider; *m* the pulley, over which the cord *xtyz* is returned towards the centre; *v* the other cord going to the pulley *n* of fig. 14. R the brass piece moveable upon the pin *c*, to keep the lamp upright. At R is a wire rivetted to the brass piece, upon which is held the lamp by a nut and screw. Fig. 16. 17. represent the lamps *a*, *l*, with the sliding doors open, to show the situation of the wicks. W is the leaden weight with a hole *d* in it, through which the wire R of fig. 15. is to be passed when the lamp is to be fastened to the slider S. Fig. 18 represents the lamp *a* with the sliding door shut; *l* the lucid point; and *ik* the openings at the top, and *s* at the sides, for the admission of air.

Fig. 16, 17.

Fig. 18.

39. The motions of this micrometer are capable of great improvement by the application of wheels and pinions, and other mechanical resources; but as the principal object is only to be able to adjust the two lucid points to the required position and distance, and to keep them there for a few minutes, while the observer measures their distance, it will be unnecessary to say more upon the subject.

Method of applying the lamp micrometer.

40. It is well known that we can with one eye look into a telescope, and see an object much magnified, while the other eye may see a scale upon which the magnified picture is thrown. In this manner Dr Herschel generally determined the power of his telescopes; and any one who has been accustomed to make such observations will seldom mistake so much as one in fifty in determining the power of an instrument, and that degree of exactness is fully sufficient for the purpose.

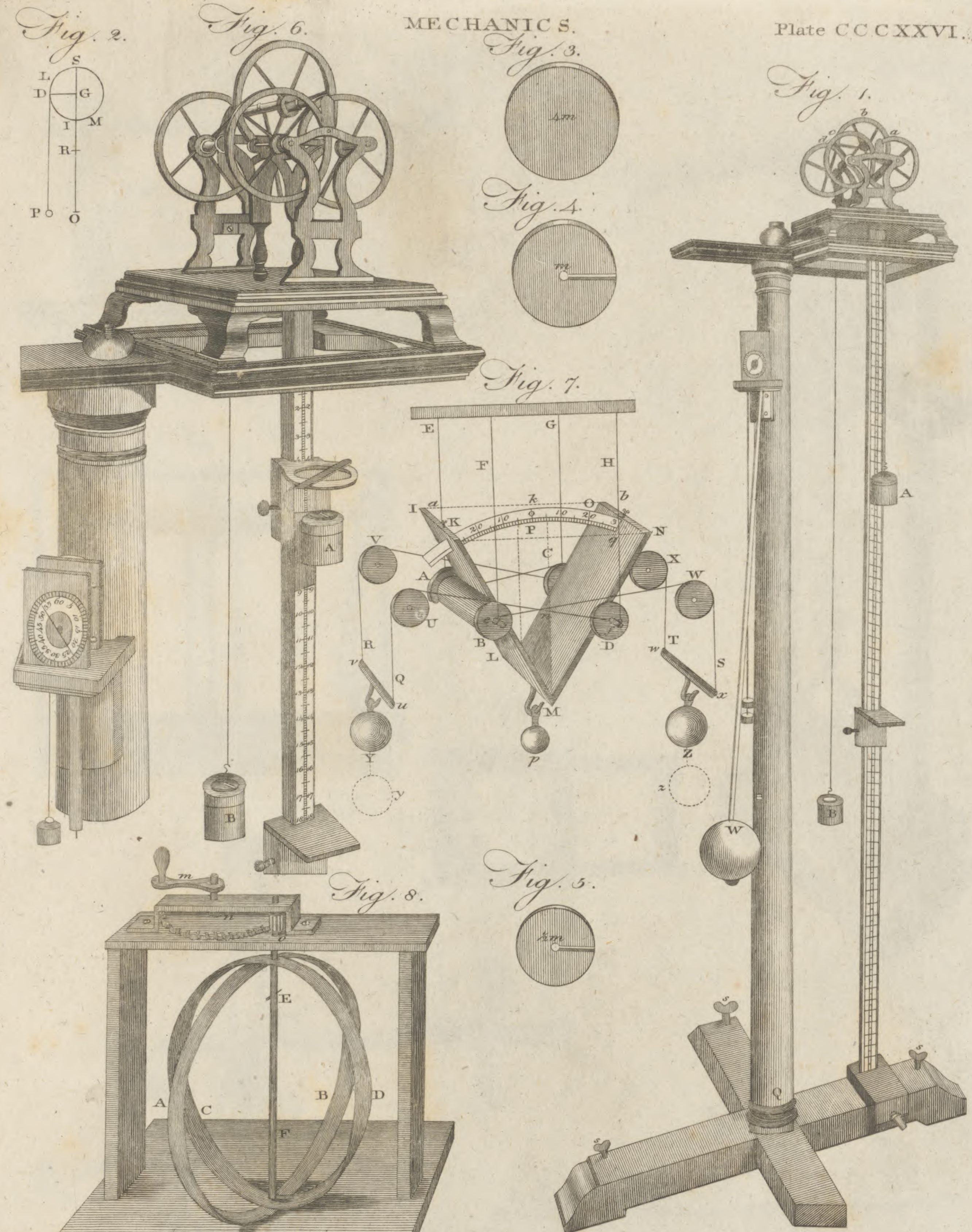
41. When Dr Herschel uses this instrument he puts it at ten feet distance from the left eye, in a line perpendicular to the tube of his Newtonian telescope, and raises the moveable board to such a height that the lucid point of the central lamp may be upon a level with the eye. The handles, lifted up, are passed through two loops fastened to the tube, just by the observer, to as to be ready for his use. The end of the tube is cut away, so as to leave the left eye entirely free to see the whole micrometer.

42. The telescope being directed to a double star, it is viewed with the right eye, and at the same time with the left it is seen projected upon the micrometer: then, by the handle P, the arm is raised or depressed so as to bring the two lucid points to a similar situation with the two stars; and, by the handle D, the moveable lucid point is brought to the same distance of the two stars, so that the two lucid points may be exactly covered by the stars.

43. With a rule, divided into inches and fortieth parts, the distance of the lucid points is thus determined with the greatest accuracy; and the measure thus obtained is the tangent of the magnified angle under which the stars are seen to a radius of ten feet; therefore, the angle being found and divided by the power of the telescope, the real angular distance of the centres of a double star is ascertained. On September 25. 1781, Dr Herschel measured α Herculis with this instrument. Having caused the two lucid points to coincide with the stars, he found the radius or distance of the central lamp from the eye 10 feet 4.15 inches; the tangent or distance of the two lucid points 50.6 fortieth parts of an inch; this gives the magnified angle 35′, and dividing by the power 460, we obtain 4″ 34‴ for the distance of the centres of the two stars. The scale of the micrometer at this convenient distance, with the power of 460, is above a quarter of an inch to a second; and by putting on a power of 932, we obtain a scale of more than half an inch to a second, without increasing the distance of the micrometer; whereas the most perfect micrometers, with the same instrument, had a scale of less than the two thousandth part of an inch to a second.

Mr Brewster's micrometer.

44. Mr Brewster has lately directed his attention to the improvement of micrometers, and has invented one in particular which appears to be highly deserving of notice in this place. In this instrument a pair of *fixed* wires is made to subtend different angles by varying the magnifying power of the telescope, by sliding one tube within another; whereas in all other micrometers with wires



A. Bell Prin. Wal. Sculptor fecit.

Fig. 1.

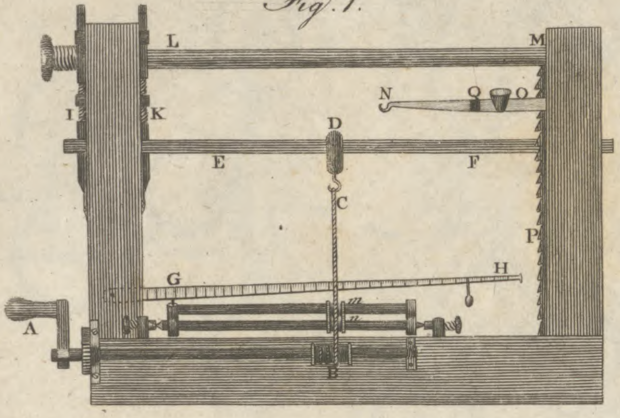


Fig. 2.

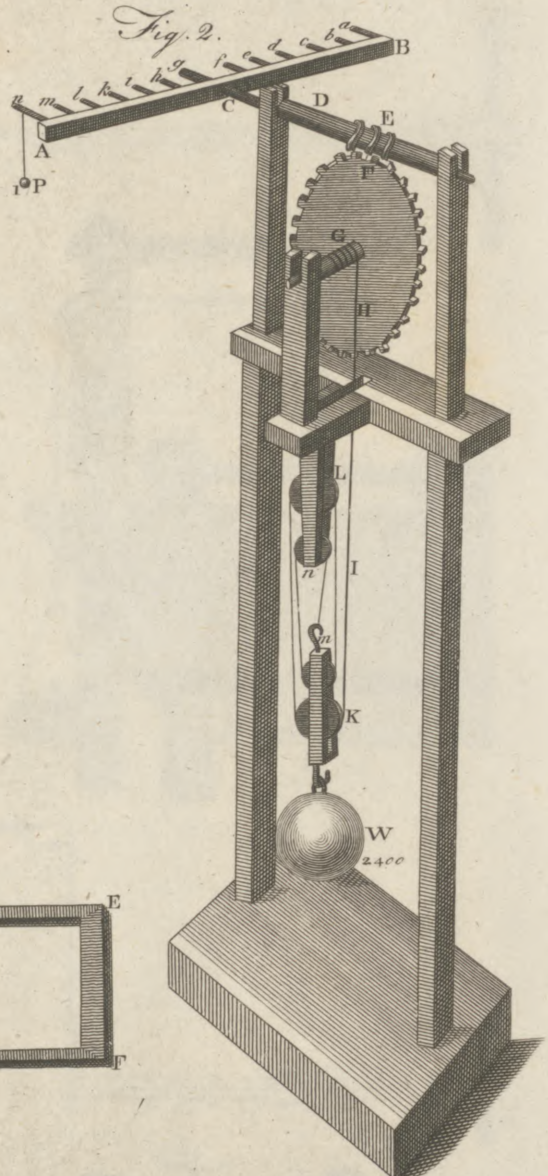


Fig. 3.

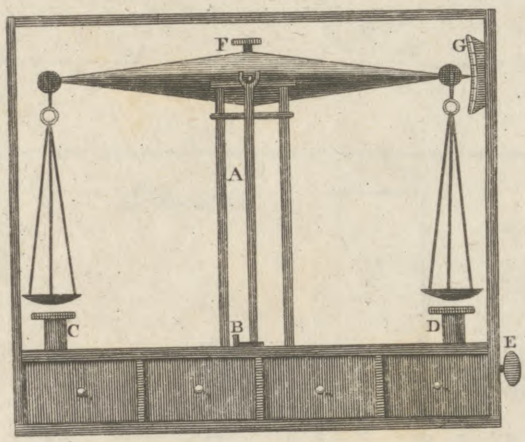


Fig. 4.

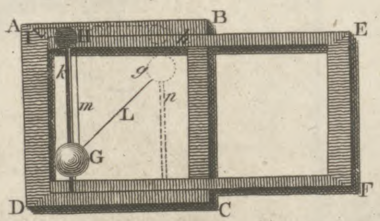


Fig. 6.

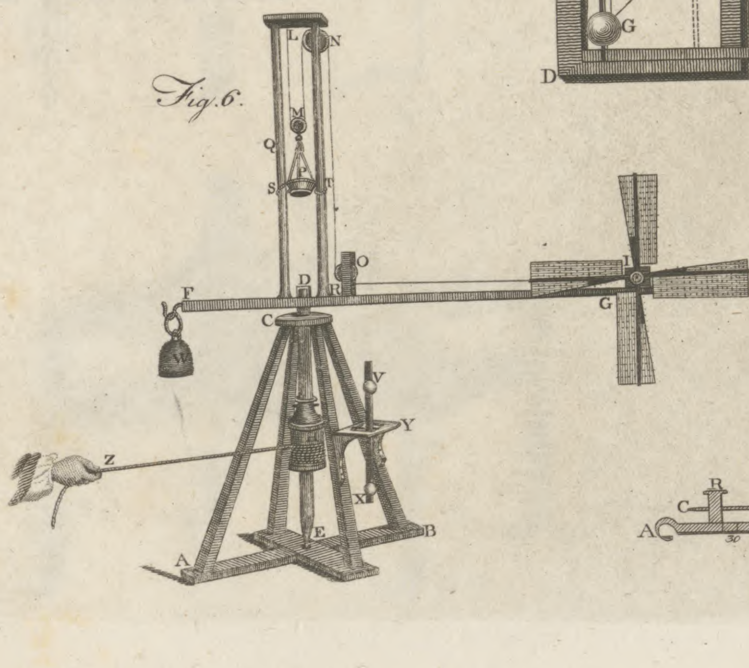
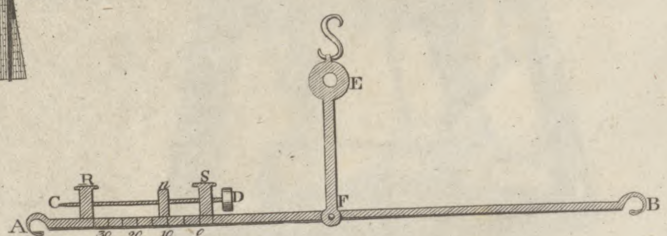
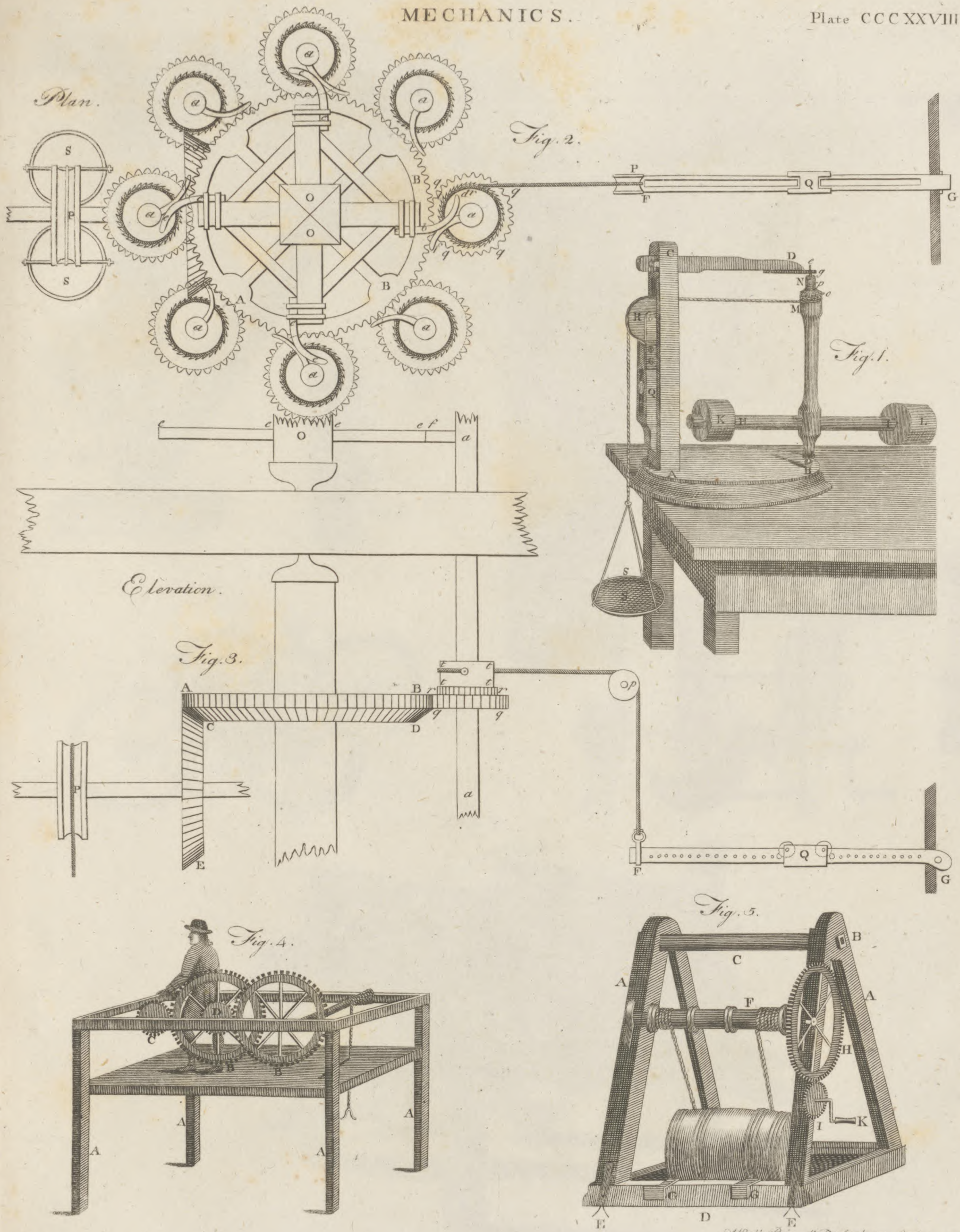


Fig. 5.



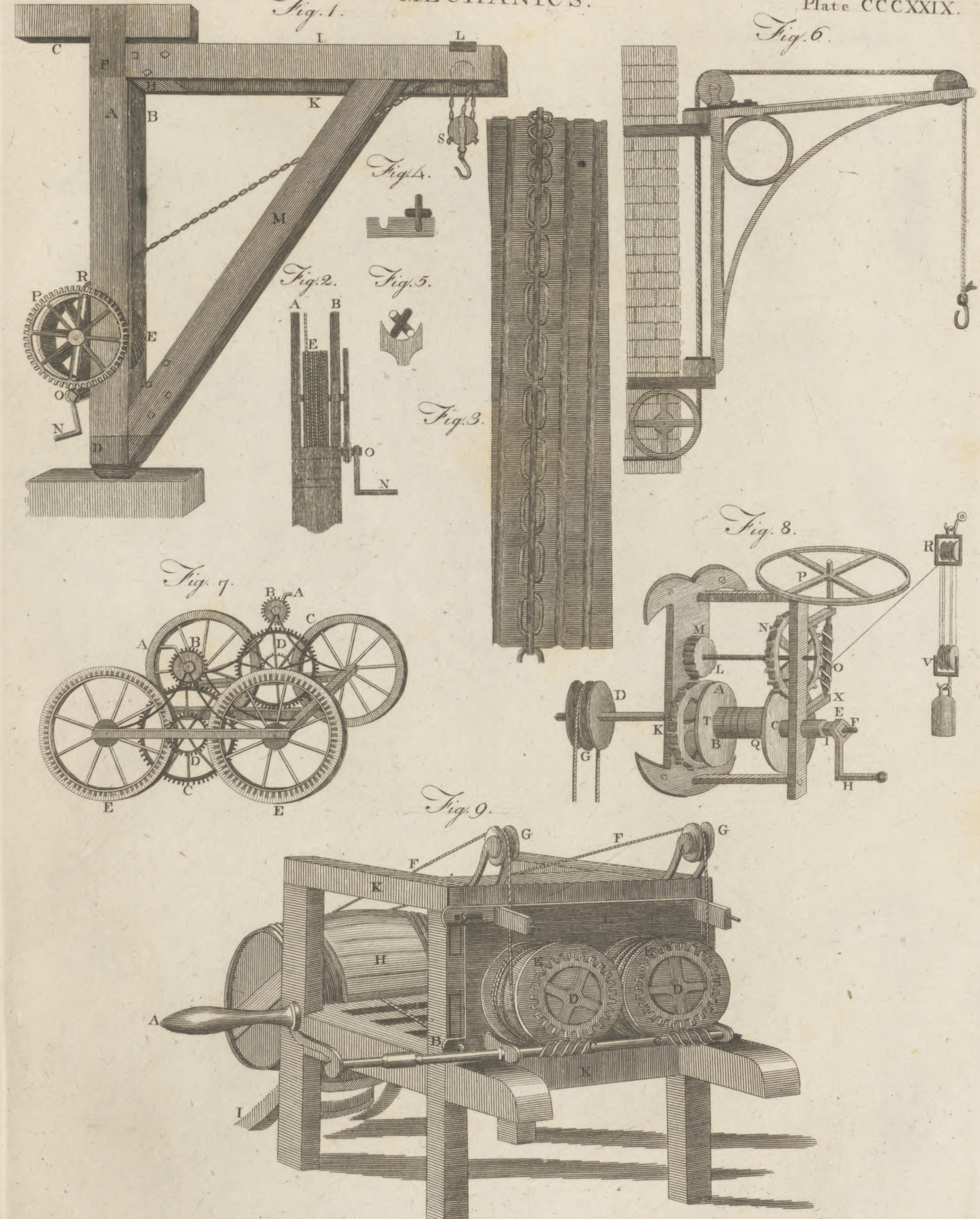
A Bell Prin. Wal. Sculptor fecit.



A. Bell Prin. Wal. Sculptor fecit.

MECHANICS.

Plate CCCXXIX.



A.Bell Prin. Wal. Sculptor fecit.

Vauloue's Pile Engine.

Fig. 2.

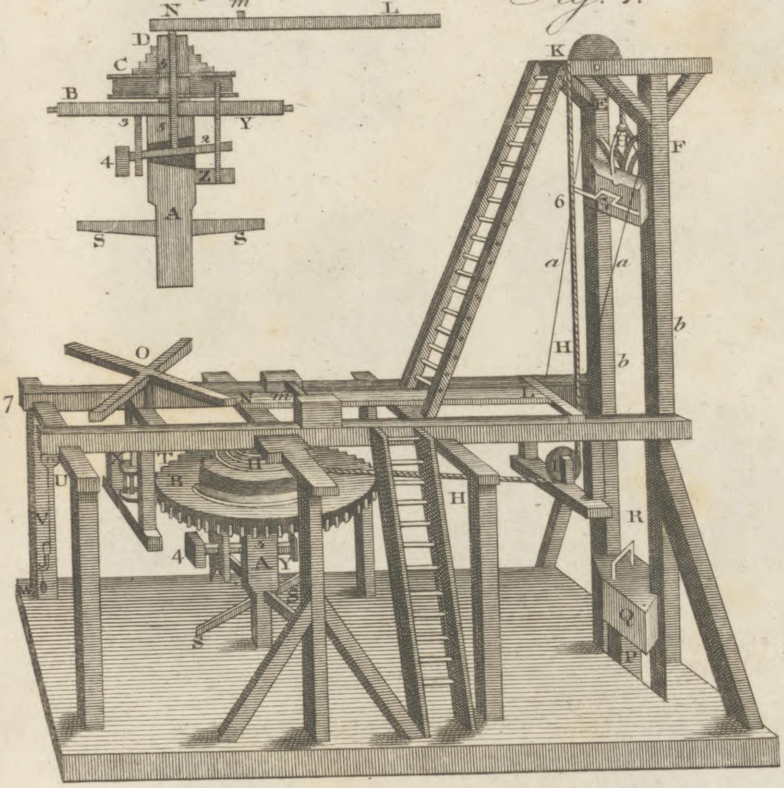


Fig. 1.

Bunce's Pile Engine.

Fig. 4.

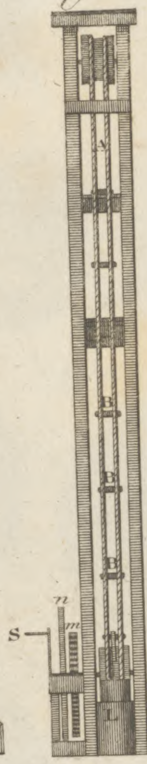


Fig. 3.

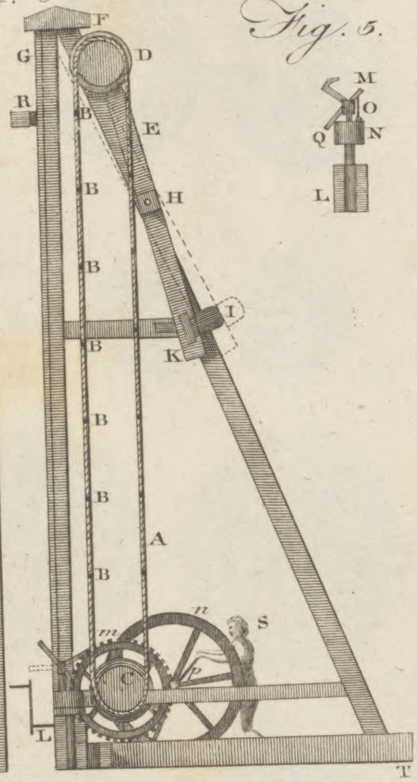
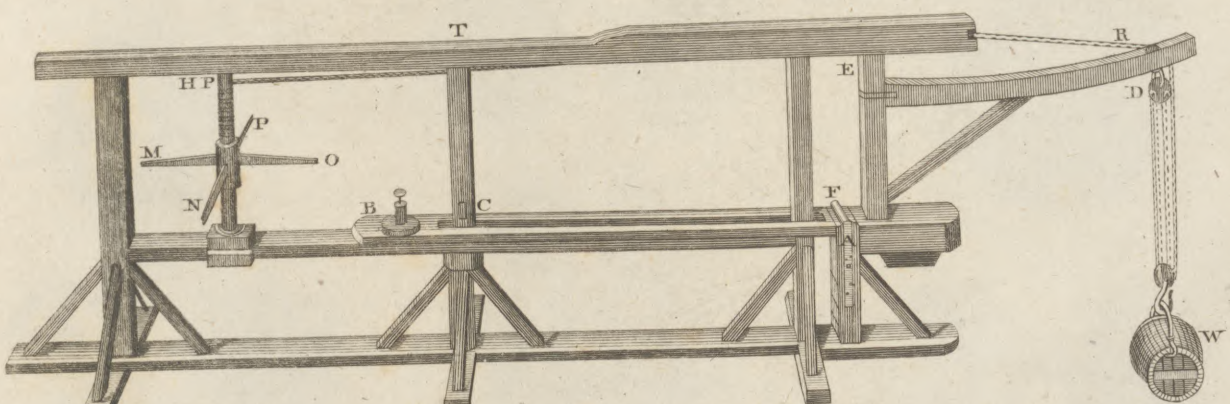


Fig. 5.

Andren's Weighing Crane.

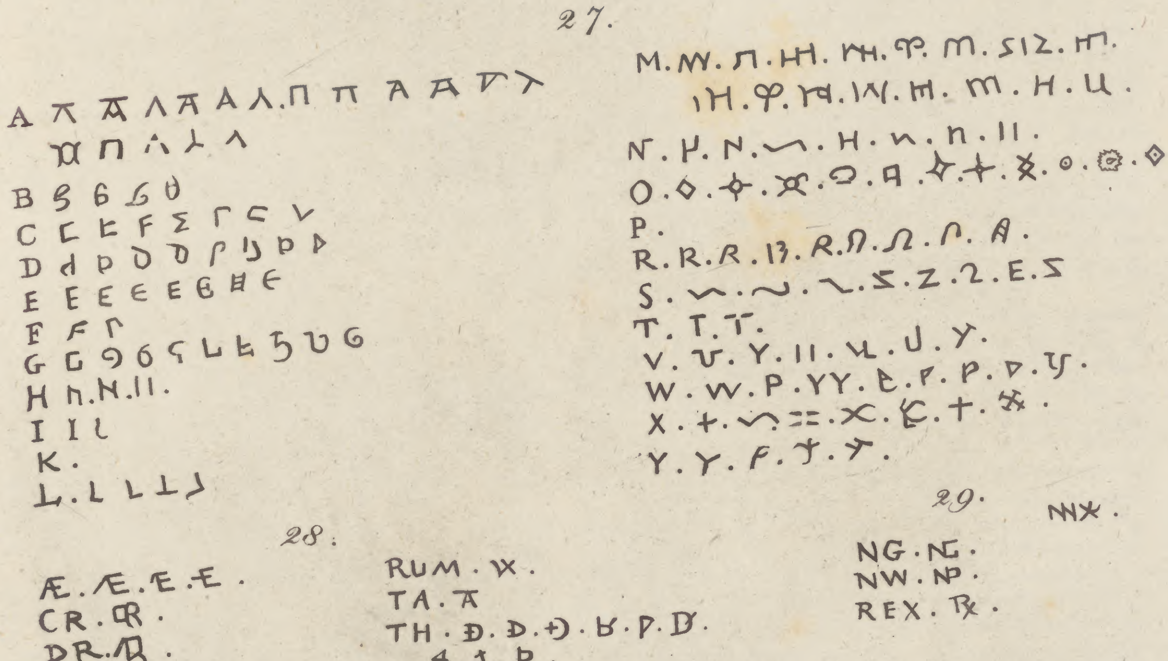
Fig. 6.



A. Bell Prin. Wal. Sculptor fecit.

MEDALS. Plate CCCXXXI.

A.Bell Prin. Wal. Sculptor fecit.



A. Bell Prin. Wal. Sculptor fecit.

Micrometer.

wires this effect is produced by mechanical contrivances. Mr Brewſter's method of ſhutting and opening the wires optically is therefore free from all thoſe ſources of error to which other micrometers are ſubject, and renders it particularly uſeful to the practical aſtronomer; while the mode of changing the magnifying power by the motion of a ſecond object glaſs affords a length of ſcale equal to the local diſtance of the principal object-glaſs. The ſame principle is peculiarly applicable to the Gregorian teleſcope; for the magnifying power of this inſtrument can be changed by merely increaſing or diminiſhing the diſtance of the eye-piece from the large ſpeculum.

45. In the common micrometer, which can manifeſtly, as well as Mr Cavallo's and Mr Brewſter's, be uſed in the menſuration of diſtances, the focal length of the teleſcope to which it is attached remains always the ſame; ſo that a correction computed from an optical theorem muſt be applied to every angle that is meaſured: but in Mr Brewſter's teleſcope and micrometer, the focal length varies in the ſame proportion as the diſtance of the object; and conſequently no correction of the angles can be neceſſary. To obviate the neceſſity of having a ſtand for the inſtrument, which would prevent its uſefulneſs at ſea, Mr Brewſter divides the ſecond or moveable object-glaſs into two, as in the divided object-glaſs micrometer. By this contrivance two images are formed, and theſe images are ſeparated or made to form different angles at the eye, by bringing the moveable object-glaſs nearer to the fixed one. In determining the angle, therefore, we have only to bring the two images of the object into contact; and ſuch contact the eye is capable of aſcertaining even during the agitation of a carriage, as the two images retain the ſame relative poſition whatever be their abſolute motion.

This ingenious inſtrument, being formed with ſliding tubes, is very portable and convenient; and will be found extremely uſeful to military gentlemen, and others who may wiſh to aſcertain diſtances without a more cumberſome apparatus. *Haüy's Nat. Phil. by Gregory*, v. ii. p. 427.

46. Mr Brewſter, we underſtand, ſtill continues to direct his attention to the ſubject of micrometers, keeping in view the improvement of theſe inſtruments, not only in greater accuracy of conſtruction, but alſo in their more extenſive application to various practical purpoſes. An account of thoſe uſes and improvements is to form the ſubject of an appropriate publication; and, if we are rightly informed, the author deems them of ſufficient importance to ſecure to himſelf, by patent, the excluſive right to the advantages which he thinks will ariſe from uſing them.

Cavallo's mother-of-pearl micrometer.

47. A very ſimple micrometer for meaſuring ſmall angles with the teleſcope has been invented by Mr Cavallo *. It conſiſts of a thin and narrow ſlip of mother-of-pearl finely divided, and ſituated in the focus of the eye-glaſs of a teleſcope, juſt where the image of the object is formed. It is immaterial whether the teleſcope be a refractor or a reflector, provided the eye-glaſs be a convex lens.

* *Ph. Tranſ.* 1771. p. 283.

The ſimpleſt way of fixing it is to ſtick it upon the diaphragm, which generally ſtands within the tube, in the focus of the eye-glaſs. When thus fixed, the diviſions of the micrometrical ſcale will appear very diſtinct, unleſs the diaphragm is not exactly in the focus; in which caſe, the ſcale muſt be placed accurately in the focus of the eye-glaſs, either by moving the diaphragm, or by interpoſing any thin ſubſtance, ſuch as paper or card between it and the ſcale. This conſtruction is fully ſufficient, when the teleſcope is always to be uſed by the ſame perſon; but when different perſons are to uſe it, then the diaphragm which ſupports the micrometer muſt be conſtructed ſo as to be eaſily moved backwards or forwards, though that motion need not be greater than about $\frac{1}{8}$ or $\frac{1}{10}$ of an inch.

Fig. 19.

The ſcale of the micrometer is repreſented in fig. 19. which is about four times greater than one which Mr Cavallo has adapted to a three-feet achromatic teleſcope that magnifies about 84 times. It is ſomething leſs than the 24th part of an inch broad; its thickneſs is equal to that of common writing paper; and the length of it is determined by the breadth of the field of view. The diviſions are 200ths of an inch, and the lines which form them reach from one edge of the ſcale to about the middle of it, excepting every fifth and tenth diviſion, which are longer. Two diviſions of the ſcale in the teleſcope already mentioned are very nearly equal to one minute; and as a quarter of one of thoſe diviſions may be eaſily diſtinguiſhed by the eye, an angle of one-eighth part of a minute, or of $7''\frac{1}{2}$, may be meaſured with it.

Fig 20.

In looking through a teleſcope furniſhed with ſuch a micrometer, the field of view appears divided by the micrometer ſcale, the breadth of which occupies about $\frac{1}{7}$th of the aperture; and as the ſcale is ſemitranſparent, that part of the object which is behind it may be diſcerned ſufficiently well to aſcertain the diviſion, with which its borders coincide. Fig. 20. ſhows the appearance of the field of the teleſcope with the micrometer, when directed to the title page of the Philoſophical Tranſactions, in which it appears that the thickneſs of the letter C is equal to three-fourths of a diviſion, the diameter of the O is equal to three diviſions, and ſo on.

48. After having adapted this micrometer to the teleſcope, we muſt then aſcertain the value of the diviſions. It is hardly neceſſary to mention in this place, that though thoſe diviſions meaſure the chords of the angles, and not the angles or arches themſelves, and the chords are not as the arches, yet in ſmall angles the chords, arches, ſines, and tangents, follow the ſame proportion ſo very nearly, that the difference may be ſafely neglected: ſo that if one diviſion of this micrometer is equal to one minute, we may conclude, that two diviſions are equal to two minutes, three diviſions to three minutes, and ſo on. In order to aſcertain the value of the diviſions of this micrometer, the following ſimple and accurate method may be adopted.

Mark upon a wall the length of ſix inches, by making two dots or lines ſix inches aſunder, or by fixing a ſix inch ruler upon a ſtand; then place the teleſcope before it ſo that the ruler or ſix-inch length may be at right angles with the direction of the teleſcope, and juſt 57 feet $3\frac{1}{2}$ inches diſtant from the object-glaſs of the teleſcope: this done, look through the teleſcope at the ruler or other extenſion of ſix inches, and obſerve how many diviſions of the micrometer are equal to it, and that ſame number of diviſions is equal to half a degree, or 30′ as may be ſhewn by plane trigonometry.

49. When this value has been once aſcertained, any other angle meaſured by any other number of diviſions is determined by ſimple proportion. Thus, if the diameter of the ſun ſeen through the ſame teleſcope, be equal to

12 diviſions, ſay as $11\frac{1}{2}$ diviſions are to 30 minutes, ſo are 12 diviſions to $\left(\frac{12' \times 30'}{11.5}\right)$ $31'.3$, which is the required diameter of the ſun.

Notwithſtanding the facility of this calculation, a ſcale may be made anſwering to the diviſions of a micrometer, which will ſhow the angle correſponding to any number of diviſions by mere inſpection. Thus, for the above-mentioned ſmall teleſcope, the ſcale is repre-

Fig. 21. ſented in fig. 21. AB is a line drawn at pleaſure; it is then divided into 23 equal parts, and thoſe diviſions which repreſent the diviſions of the micrometer that are equal to one degree, are marked on one ſide of it. The line then is divided again into 60 equal parts, which are marked on the other ſide of it; and theſe diviſions repreſent the minutes which correſpond to the diviſions of the micrometer: thus the figure ſhows, that ſix diviſions of the micrometer are equal to $15\frac{1}{2}$ minutes, $11\frac{1}{2}$ diviſions are nearly equal to 29 minutes, &c. What has been ſaid of minutes may be ſaid of ſeconds alſo, when the ſcale is to be applied to a large teleſcope.

50. We ſhall therefore add ſome practical rules to render this micrometer uſeful to perſons unacquainted with trigonometry and the uſe of logarithms.

Problem I. The angle, not exceeding one degree, which is ſubtended by an extenſion of one foot perpendicular to the axis of the teleſcope being given, to find its diſtance from the object-glaſs of the teleſcope.

Rule 1. If the angle be expreſſed in minutes, ſay, as the given angle is to 60, ſo is 687.55 to a fourth proportional, which gives the anſwer in inches.—2. If the angle be expreſſed in ſeconds, ſay, as the given angle is to 3600, ſo is 687.55 to a fourth proportional, which expreſſes the anſwer in inches.

Example. At what diſtance is a globe of one foot diameter when it ſubtends an angle of two ſeconds?

$$2'' : 3600'' :: 687.55 : \frac{3600 \times 687.55}{2} = 1237590$$

inches, or $103132\frac{1}{2}$ feet, which is the anſwer required.

Problem II. The angle, not exceeding one degree, which is ſubtended by any known extenſion, being given, to find its diſtance from the object-glaſs of the teleſcope.

Rule. Proceed as if the extenſion were of one foot by Problem I. and call the anſwer B; then, if the extenſion in queſtion be expreſſed in inches, ſay, as 12 inches are to that extenſion, ſo is B to a fourth proportional, which is the anſwer in inches; but if the extenſion in queſtion be expreſſed in feet, then you need only multiply it by B, and the product is the anſwer in inches.

Example. At what diſtance is a man ſix feet high, when he appears to ſubtend an angle of 30″.

By Problem I. if the man were one foot high, the diſtance would be 82506 inches; but as he is ſix feet high, therefore multiply 82506 by 6, and the product gives the required diſtance, which is 495036 inches, or 41253 feet.

For greater conveniency, eſpecially in travelling, or in ſuch circumſtances in which one has not the opportunity of making even the eaſy calculations required in thoſe problems, the following two tables have been computed; the firſt of which ſhows the diſtance anſwering to any angle from one minute to one degree, which is ſubtended by a man, the height of which has been called an extenſion of ſix feet; becauſe, at a mean, ſuch is the height of a man when dreſſed with hat and ſhoes on.

Thus, if it is required to meaſure the extenſion of a ſtreet, let a foot ruler be placed at the end of the ſtreet; meaſure the angle it ſubtends, which ſuppoſe to be 36′, and in the table you will have the required diſtance oppoſite 36′, which is $95\frac{1}{2}$ feet. Thus alſo a man who appears to be 49′ high, is at the diſtance of 421 feet.

Angles ſubtended by an Extenſion of one Foot at different Diſtances.

Angles.	Diſtances in Feet.	Angles.	Diſtances in Feet
Min. 1	3437,7	Min. 31	110,9
2	1718,9	32	107,4
3	1145,9	33	104,2
4	859,4	34	101.1
5	687,5	35	98,2
6	572,9	36	95,5
7	491,1	37	92,9
8	429,7	38	90,4
9	382,0	39	88,1
10	343,7	40	85,9
11	312,5	41	83.8
12	286,5	42	81,8
13	264,4	43	79,9
14	245,5	44	78,1
15	229,2	45	76,4
16	214,8	46	74,7
17	202,2	47	73,1
18	191,0	48	71,6
19	180,9	49	70,1
20	171,8	50	68,7
21	162,7	51	67,4
22	156,2	52	66,1
23	149,4	53	64,8
24	143,2	54	63,6
25	137,5	55	62,5
26	132,2	56	61,4
27	127,3	57	60,3
28	122,7	58	59,2
29	118,5	59	58,2
30	114,6	60	58,3

Angles ſubtended by an Extenſion of ſix Feet at different Diſtances.

Angles.	Diſtances in Feet	Angles.	Diſtances in Feet.
Min. 1	20626,8	14	1473,3
2	10313,	15	1375.
3	6875,4	16	1298,1
4	5156,5	17	1213,3
5	4125,2	18	1145,9
6	3437,7	19	1085,6
7	2946,6	20	1031,4
8	2578,2	21	982,2
9	2291,8	22	937,6
10	2062,6	23	896,8
11	1875,2	24	859,4
12	1718,8	25	825.
13	1586,7	26	793,3

Angles.

Angles.	Diftances in Feet.	Angles.	Diftance in Feet.
Min. 27	763,9	Min. 44	46 88
28	736,6	45	45 84
29	711,3	46	448,4
30	687.5	47	438 9
31	665,4	48	429,7
32	644,5	49	421.
33	625.	50	412,5
34	606,6	51	404,4
35	589,3	52	396,7
36	572,9	53	389,2
37	557,5	54	381,9
38	542,8	55	375,
39	528,9	56	368,3
40	515,6	57	361,9
41	503,1	58	355,6
42	491,1	59	349,6
43	479,7	60	343,7

Mr Brewfter's circular mother-of-pearl micrometer.

51. The following is the account of a micrometer invented by Mr Brewfter, of the circumftances which led to the invention, and of its advantages. We fhall give it in his own words *.

* Phil. Mag. vol. xxix. p. 48.

" In the winter of 1805 (he obferves), when I was employed in delineating the furface of the moon, I wifhed to meafure the diameter of the lunar fpots by applying Mr Cavallo's micrometer to a thirty-inch achromatic telefcope made by Berge. But as the eye-piece was moved by a rack and pinion, and confequently could not turn round its axis, the micrometer muft have remained ftationary, and could only meafure angles in one direction. This difficulty, indeed, might have been furmounted by a mechanical contrivance for turning the diaphragm about its centre, or more fimply by giving a motion of rotation to the tube which contains the third and fourth eye-glaffes. Such a change in the eye-piece, however, was both inconvenient and difficult to be made. Mr Cavallo's micrometer, therefore, has this great difadvantage, that it cannot be ufed in reflecting telefcopes, or in any achromatic telefcope where the adjuftment of the eye-piece is effected by rackwork, unlefs the ftructure of thefe inftruments is altered for the purpofe. Another difadvantage of this micrometer arifes from the flip of mother-of-pearl paffing through the centre of the field. The picture in the focus of the eye-glafs is broken into two parts, and the view is rendered ftill more unpleafant by the inequality of the fegments into which the field is divided. In addition to thefe difadvantages, the different divifions of the micrometer are at unequal diftances from the eye-glafs which views them, and therefore can neither appear equally diftinct nor fubtend equal angles at the eye.

" Finding that Mr Cavallo's inftrument laboured under thefe imperfections, I thought of a circular mother-of-pearl micrometer which is free from them all, and has likewife the advantage of a kind of diagonal fcale, increafing in accuracy with the angle to be meafured. This micrometer, which I got executed by Miller and Adie, optical inftrument-makers in Edinburgh, and which I have often ufed, both in determining fmall angles in the heavens and fuch as are fubtended by terreftrial objects, is reprefented in fig. 27. which exhibits its appearances in the focus of the fourth eye-glafs. The black ring, which forms part of the figure, is the diaphragm, and the remaining part is a ring of mother-of-pearl, having its interior circumference divided into 360 equal parts. The mother-of-pearl ring, which appears connected with the diaphragm, is completely feparate from it, and is fixed at the end of a brafs tube which is made to move between the third eye-glafs and the diaphragm, fo that the divided circumference may be placed exactly in the focus of the glafs next the eye. When the micrometer is thus fitted into the telefcope, the angle fubtended by the whole field of view, or by the diameter of the innermoft circle of the micrometer, muft be determined either by meafuring a bafe or by the paffage of an equatoreal ftar, and the angles fubtended by any number of divifions or degrees will be found by a table conftructed in the following manner.

Micrometer. Plate CCCXXXVI. Fig. 27.

52. " Let A mpn B, fig. 28. be the interior circumference of the micrometer fcale, and let mn be the object to be meafured. Bifect the arch mn in p, and draw C m, C p, C n. The line C p will be at right angles to mn, and therefore mn will be twice the fine of half the arch mn. Confequently, AB : mn = rad. fine of $\frac{1}{2}\,mpn$; therefore $mn \times \mathrm{R} = \text{fin. } \frac{1}{2}\,mpn \times \mathrm{AB}$, and $mpn = \dfrac{\text{fin. } \frac{1}{2}\,mpn \times \mathrm{AB}}{\mathrm{R}} = \dfrac{\text{fin. } \frac{1}{2}\,mpn}{\mathrm{R}} \times \mathrm{AB}$; a formula by which the angle fubtended by the chord of any number of degrees may be eafily found. The firft part of the formula, viz. $\dfrac{\text{fin. } \frac{1}{2}\,mpn}{\mathrm{R}}$ is conftant, while AB varies with the fize of the micrometer and with the magnifying power which is applied. We have therefore computed the following table, containing the value of the conftant part of the formula for every degree or divifion of the fcale.

Fig. 28.

Deg.	Conftant Part of the Formula	Deg.	Conftant Part.	Deg.	Conftant Part.	Deg.	Conftant Part.
1	.0087	21	.1822	41	.3502	61	.5075
2	.0174	22	.1908	42	.3584	62	.5150
3	.0262	23	.1994	43	.3665	63	.5225
4	.0349	24	.2079	44	.3746	64	.5299
5	.0436	25	.2164	45	.3827	65	.5373
6	.0523	26	.2250	46	.3907	66	.5446
7	.0610	27	.2334	47	.3987	67	.5519
8	.0698	28	.2419	48	.4067	68	.5592
9	.0785	29	.2504	49	.4147	69	.5664
10	.0872	30	.2588	50	.4226	70	.5735
11	.0958	31	.2672	51	.4305	71	.5807
12	.1045	32	.2756	52	.4384	72	.5878
13	.1132	33	.2840	53	.4462	73	.5948
14	.1219	34	.2923	54	.4540	74	.6018
15	.1305	35	.3007	55	.4617	75	.6088
16	.1392	36	.3090	56	.4695	76	.6157
17	.1478	37	.3173	57	.4771	77	.6225
18	.1564	38	.3256	58	.4848	78	.6293
19	.1650	39	.3338	59	.4924	79	.6361
20	.1736	40	.3420	60	.5000	80	.6428

Micrometer.

Mr Brewster's circular micrometer.

Deg.	Constant Part of the Formula	Deg.	Constant Part.	Deg.	Constant Part.	Deg.	Constant Part
81	.6494	106	.7986	131	.9100	156	.9781
82	.6561	107	.8039	132	.9135	157	.9799
83	.6626	108	.8090	133	.9171	158	.9816
84	.6691	109	.8141	134	.9205	159	.9833
85	.6756	110	.8192	135	.9239	160	.9848
86	.6820	111	.8241	136	.9272	161	.9863
87	.6884	112	.8290	137	.9304	162	.9877
88	.6947	113	.8339	138	.9336	163	.9890
89	.7009	114	.8387	139	.9367	164	.9903
90	.7071	115	.8434	140	.9397	165	.9914
91	.7133	116	.8480	141	.9426	166	.9925
92	.7193	117	.8526	142	.9455	167	.9936
93	.7254	118	.8572	143	.9483	168	.9945
94	.7314	119	.8616	144	.9511	169	.9954
95	.7373	120	.8660	145	.9537	170	.9962
96	.7431	121	.8704	146	.9563	171	.9969
97	.7490	122	.8746	147	.9588	172	.9976
98	.7547	123	.8788	148	.9613	173	.9981
99	.7604	124	.8829	149	.9636	174	.9986
100	.7660	125	.8870	150	.9659	175	.9990
101	.7716	126	.8910	151	.9681	176	.9994
102	.7771	127	.8949	152	.9703	177	.9996
103	.7826	128	.8988	153	.9724	178	.9998
104	.7880	129	.9026	154	.9744	179	1.0000
105	.7934	130	.9063	155	.9763	180	1.0000

53. "In order to find the angle ſubtended by any number of degrees, we have only to multiply the conſtant part of the formula correſponding to that number in the table by AB, or the angle ſubtended by the whole field. Thus if AB is 30 minutes, as it happens to be in the micrometer which I have conſtructed, the angle ſubtended by 1 degree of the ſcale will be $30' \times .009 =$ $16\frac{1}{2}$ ſeconds, and the angle ſubtended by 40 degrees will be $30' \times .342 = 10'\ 15.6''$; and by making the calculation it will be found that as the angle to be meaſured increaſes, the accuracy of the ſcale alſo increaſes; for when the arch is only 1 or 2 degrees, a variation of 1 degree produces a variation of about 16 ſeconds in the angle; whereas when the arch is between 170 and 180, the variation of a degree does not produce a change much more than one ſecond in the angle. This is a moſt important advantage in the circular ſcale, as in Cavallo's micrometer a limit is neceſſarily put to the ſize of the diviſions.

"It is obvious, from an inſpection of fig. 27. that there is no occaſion for turning the circular micrometer round its axis, becauſe the divided circumference lies in every poſſible direction. In fig. 2. for example, if the object has the direction *a b* it will be meaſured by the arch *a o b*, and if it lies in the line *c d* it will be meaſured by the arch *c r d*.

"In the circular micrometer which I have been in the habit of uſing, AB, or the diameter of the field of view, is exactly half an inch, the diameter of the braſs tube in which it is fixed is one inch, the length of the tube half an inch, and the degrees of the divided circumference $\frac{1}{115}$th of an inch."

54. II. The micrometer has not only been applied to teleſcopes, and employed for aſtronomical purpoſes; but there have alſo been various contrivances for adapting it to MICROSCOPICAL obſervations. Mr Leeuwenhoeck's method of eſtimating the ſize of ſmall objects was by comparing them with grains of ſand, of which 100 in a line took up an inch. Theſe grains he laid upon the ſame plate with his objects, and viewed them at the ſame time. Dr Jurin's method was ſimilar to this; for he found the diameter of a piece of fine ſilver wire, by wrapping it as cloſe as he could about a pin, and obſerving how many rings made an inch; and he uſed this wire in the ſame manner as Leeuwenhoeck employed his ſand. Dr Hooke looked upon the magnified object with one eye, while at the ſame time he viewed other objects placed at the ſame diſtance with the other eye. In this manner he was able, by the help of a ruler, divided into inches and ſmall parts, and laid on the pedeſtal of the microſcope, to caſt as it were the magnified appearance of the object upon the ruler, and thus exactly to meaſure the diameter which it appeared to have through the glaſs; which being compared with the diameter as it appeared to the naked eye, ſhowed the degree in which it was magnified.

Micrometer.

Application of the micrometer to microſcopes.

55. Mr Martin * recommended ſuch a micrometer for a microſcope as had been applied to teleſcopes: for he adviſes to draw a number of parallel lines on a piece of glaſs, with the fine point of a diamond, at the diſtance of one fortieth of an inch from one another, and to place it in the focus of the eye-glaſs. By this method, Dr Smith contrived to take the exact draught of objects viewed by a double microſcope; for he adviſes to get a lattice, made with ſmall ſilver wires or ſquares, drawn upon a plain glaſs by the ſtrokes of a diamond, and to put it into the place of the image, formed by the object-glaſs: then by transferring the parts of the object, ſeen in the ſquares of the glaſs or lattice upon ſimilar correſponding ſquares drawn on paper, the picture may be exactly taken. Mr Martin alſo introduced into compound microſcopes another micrometer, conſiſting of a ſcrew.

* *Martin's Optics*, p. 277.

65. The mode of actual admeaſurement (Mr Adams obſerves †) is without doubt the moſt ſimple that can be uſed; as by it we comprehend, in a manner, at one glance, the different effects of combined glaſſes; and as it ſaves the trouble, and avoids the obſcurity, of the uſual modes of calculation: but many perſons find it exceedingly difficult to adopt this method, becauſe they have not been accuſtomed to obſerve with both eyes at once. To obviate this inconvenience, the late Mr Adams contrived an inſtrument called the *Needle-Micrometer*, which was firſt deſcribed in his *Micrographia Illuſtrata*; and of which, as now conſtructed, we have the following deſcription by his ſon Mr George Adams in the ingenious Eſſays above quoted.

† *Microſcopical Eſſays*, p. 59.

This micrometer conſiſts of a ſcrew, which has 50 threads to an inch; this ſcrew carries an index, which points to the diviſions on a circular plate, which is fixed at right angles to the axis of the ſcrew. The revolutions of the ſcrew are counted on a ſcale, which is an inch divided into 50 parts; the index to theſe diviſions is a flower-de luce marked upon the ſlider, which carries the needle point acroſs the field of the microſcope. Every revolution of the micrometer ſcrew meaſures $\frac{1}{50}$th part of an inch, which is again ſubdivided by means of the diviſions on the circular plate, as

Micrometer. as this is divided into 20 equal parts, over which the index passes at every revolution of the screw; by which means we obtain with ease the measure of 1000th part of an inch: for 50, the number of threads on the screw in one inch, being multiplied by 20, the divisions on the circular plate are equal to 1000; so that each division on the circular plate shows that the needle has either advanced or receded 1000th part of an inch.

57. To place this micrometer on the body of the microscope, open the circular part FKH, fig. 25. by taking out the screw G, throw back the semicircle FK, which moves upon a joint at K; then turn the sliding tube of the body of the microscope, so that the small holes which are in both tubes may exactly coincide, and let the needle *g* of the micrometer have a free passage through them; after this, screw it fast upon the body by the screw G. The needle will now traverse the field of the microscope, and measure the length and breadth of the image of any object that is applied to it. But further assistance must be had, in order to measure the object itself, which is a subject of real importance; for though we have ascertained the power of the microscope, and know that it is so many thousand times, yet this will be of little assistance towards ascertaining an accurate idea of its real size; for our ideas of bulk being formed by the comparison of one object with another, we can only judge of that of any particular body, by comparing it with another whose size is known: the same thing is necessary, in order to form an estimate by the microscope; therefore, to ascertain the real measure of the object, we must make the point of the needle pass over the image of a known part of an inch placed on the stage, and write down the revolutions made by the screw, while the needle passed over the image of this known measure; by which means we ascertain the number of revolutions on the screw, which are adequate to a real and known measure on the stage. As it requires an attentive eye to watch the motion of the needle point as it passes over the image of a known part of an inch on the stage, we ought not to trust to one single measurement of the image, but ought to repeat it at least six times; then add the six measures thus obtained together, and divide their sum by six, or the number of trials; the quotient will be the mean of all the trials. This result is to be placed in a column of a table next to that which contains the number of the magnifiers.

Fig. 25.

Fig. 22, 23, 24. 58. By the assistance of the sectoral scale, we obtain with ease a small part of an inch. This scale is shown at fig. 22, 23, 24, in which the two lines *ca*, *cb*, with the side *a b*, form an isosceles triangle; each of the sides is two inches long, and the base still only of one-tenth of an inch. The longer sides may be of any given length, and the base still only of one tenth of an inch. The longer lines may be considered as the line of lines upon a sector opened to one-tenth of an inch. Hence whatever number of equal parts *ca*, *cb* are divided into, their transverse measure will be such a part of one-tenth as is expressed by their divisions. Thus if it be divided into ten equal parts, this will divide the inch into 100 equal parts; the first division next *c* will be equal to 100th part of an inch, because it is the tenth part of one-tenth of an inch. If these lines are divided into twenty equal parts, the inch will be by that means divided into 200 equal parts. Lastly, if *ab*, *ca*, are made three inches long, and divided into 100 equal parts, we obtain with ease the 1000th part. The scale is represented as solid at fig. 23. but as perforated at fig. 22. and 24. so that the light passes through the aperture, when the sectoral part is placed on the stage.

59. To use this scale, first fix the micrometer, fig. 25. to the body of the microscope; then fit the sectoral scale, fig. 24. in the stage, and adjust the microscope to its proper focus or distance from the scale, which is to be moved till the base appears in the middle of the field of view; then bring the needle point *g*, fig. 25. (by turning the screw L) to touch one of the lines *c a*, exactly at the point answering to 20 on the sectoral scale. The index *a* of the micrometer is to be set to the first division, and that on the dial plate to 20, which is both the beginning and end of its divisions; we are then prepared to find the magnifying power of every magnifier in the compound microscope which we are using.

60. *Example.* Every thing being prepared agreeable to the foregoing directions, suppose you are desirous of ascertaining the magnifying power of the lens marked N° 4. turn the micrometer screw until the point of the needle has passed over the magnified image of the tenth part of one inch; then the division, where the two indices remain, will show how many revolutions, and parts of a revolution, the screw has made, while the needle point traversed the magnified image of the one-tenth of an inch; suppose the result to be 26 revolutions of the screw, and 14 parts of another revolution, this is equal to 26 multiplied by 20, added to 14; that is, 534,000 parts of an inch.—The 26 divisions found on the straight scale of the micrometer, while the point of the needle passed over the magnified image of one-tenth part of an inch, were multiplied by 20, because the circular plate CD, fig. 25. is divided into 20 equal parts; this produced 520; then adding the 14 parts of the next revolution, we obtain the 534,000 parts of an inch, or five tenths and 3400 parts of another tenth, which is the measure of the magnified image of one-tenth of an inch, at the aperture of the eye-glasses or at their foci. Now if we suppose the focus of the two eye-glasses to be one inch, the double thereof is two inches; or if we reckon in the 1000th part of an inch, we have 2000 parts for the distance of the eye from the needle point of the micrometer. Again, if we take the distance of the image from the object at the stage at 6 inches, or 6000, and add thereto 2000, double the distance of the focus of the eye-glass, we shall have 8000 parts of an inch for the distance of the eye from the object; and as the glasses double the image, we must double the number 534 found upon the micrometer, which then makes 1068: then, by the following analogy, we shall obtain the number of times the microscope magnifies the diameter of the object; say, as 240, the distance of the eye from the image of the object, is to 800, the distance of the eye from the object; so is 1068, double the measure found on the micrometer, to 3563, or the number of times the microscope magnifies the diameter of the object. By working in this manner, the magnifying power of each lens used with the compound microscope may be easily found, though the result will

Fig. 25.

 be

Micrometer.

be different in different compound microscopes, varying according to the combination of the lenses, their distance from the object and one another, &c.

61. Having discovered the magnifying power of the microscope, with the different object-lenses that are used therewith, our next subject is to find out the real size of the objects themselves, and their different parts: this is easily effected, by finding how many revolutions of the micrometer screw answer to a known measure on the sectoral scale or other object placed on the stage; from the number thus found, a table should be constructed, expressing the value of the different revolutions of the micrometer with that object lens, by which the primary number was obtained. Similar tables must be constructed for each object lens. By a set of tables of this kind, the observer may readily find the measure of any object he is examining; for he has only to make the needle point traverse over this object, and observe the number of revolutions the screw has made in its passage, and then look into his table for the real measure which corresponds to this number of revolutions, which is the measure required.

Description of Mr Coventry's micrometers for microscopes.

62. Mr Coventry of Southwark has favoured us with the description of a micrometer of his own invention; the scale of which, for minuteness, surpasses every instrument of the kind of which we have any knowledge, and of which, indeed, we could scarcely have formed a conception, had he not indulged us with several of these instruments, graduated as underneath.

The micrometer is composed of glass, ivory, silver, &c. on which are drawn parallel lines from the 10th to the 10,000th part of an inch. But an instrument thus divided, he observes, is more for curiosity than use: but one of those which Mr Coventry has sent us is divided into squares, so small that sixteen millions of them are contained on the surface of one square inch, each square appearing under the microscope true and distinct; and though so small, it is a fact, that animalcula are found which may be contained in one of these squares.

The use of micrometers, when applied to microscopes, is to measure the natural size of the object, and how much that object is magnified. To ascertain the real size of an object in the single microscope, nothing more is required than to lay it on the micrometer, and adjust it to the focus of the magnifier, noticing how many divisions of the micrometer it covers. Suppose the parallel lines of the micrometer to be the 1000th of an inch, and the object covers two divisions; its real size is 500ths of an inch; if five, 200ths, and so on.

But to find how much the object is magnified, is not mathematically determined so easily by the single as by the compound microscope: but the following simple method (says Mr Coventry) I have generally adopted, and think it tolerably accurate. Adjust a micrometer under the microscope *o*, say the 100th of an inch of divisions, with a small object on it; if square, the better: notice how many divisions one side of the object covers, suppose 10: then cut a piece of white paper something larger than the magnified appearance of the object: then fix one eye on the object through the microscope, and the other at the same time on the paper, lowering it down till the object and the paper appear level and distinct: then cut the paper till it appear exactly the size of the magnified object; the paper being then measured, suppose an inch square: Now, as the object under the magnifier, which appeared to be one inch square, was in reality only ten hundredths, or the tenth of an inch, the experiment proves that it is magnified ten times in length, one hundred times in superfices, and one thousand times in cube, which is the magnifying power of the glass; and, in the same manner, a table may be made of the power of all the other glasses.

In using the compound microscope, the real size of the object is found by the same method as in the single: but to demonstrate the magnifying power of each glass to greater certainty, adopt the following method.—Lay a two-feet rule on the stage, and a micrometer level with its surface (an inch suppose, divided into 100 parts): with one eye see how many of those parts are contained in the field of the microscope, (suppose 50); and with the other, at the same time, look for the circle of light in the field of the microscope, which with a little practice will soon appear distinct; mark how much of the rule is intersected by the circle of light, which will be half the diameter of the field. Suppose eight inches; consequently the whole diameter will be sixteen. Now, as the real size of the field, by the micrometers, appeared to be only 50 hundredths, or half an inch, and as half an inch is only one 32d part of 16 inches, it shows the magnifying power of the glass to be 32 times in length, 1024 superfices, and 32,768 cube (E).

63. Another way of finding the magnifying power of compound microscopes, is by using two micrometers of the same divisions; one adjusted under the magnifier, the other fixed in the body of the microscope in the focus of the eye-glass. Notice how many divisions of the micrometer in the body are seen in one division of the micrometer under the magnifier, which again must be multiplied by the power of the eye-glass. Example: Ten divisions of the micrometer in the body are contained in one division under the magnifier; so far the power is increased ten times: now, if the eye-glass be one inch focus, such glass will of itself magnify about seven times in length, which, with the ten times magnified before, will be seven times ten, or 70 times in length, 4900 superficies, and 343,000 cube.

"If (says Mr Coventry) these micrometers are employed in the solar microscope, they divide the object into squares on the screen in such a manner as to render it extremely easy to make a drawing of it. And (says he) I apprehend they may be employed to great advantage with such a microscope as Mr Adams's lucernal; because this instrument may be used either by day or night, or in any place, and gives the actual magnifying power without calculation."

The

(E) It will be necessary, for great accuracy, as well as for comparative observations, that the two-feet rule should always be placed at a certain distance from the eye: eight inches would, in general, be a proper distance.

Fig. 1.

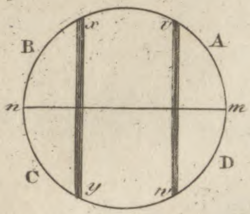


Fig. 3.

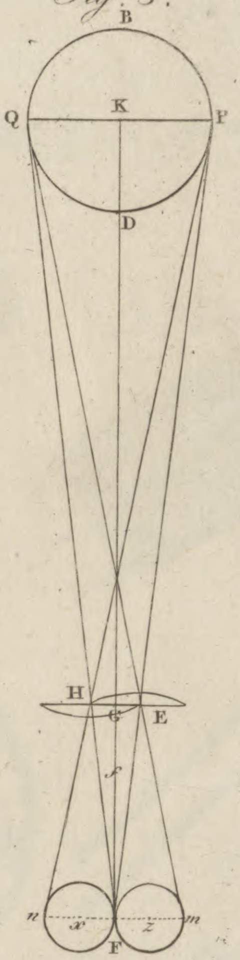


Fig. 8.

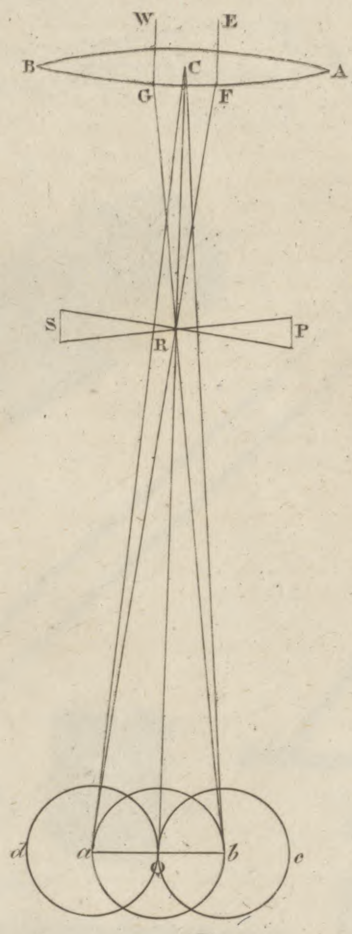


Fig. 9.

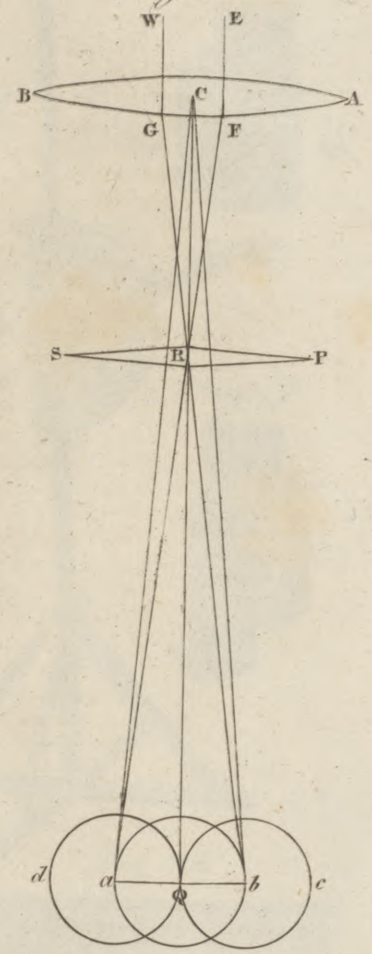


Fig. 4.

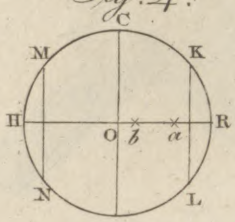


Fig. 5.

Fig. 6.

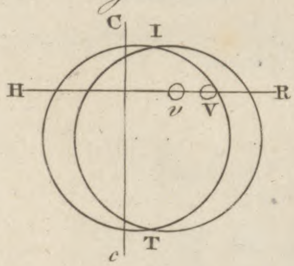


Fig. 7.

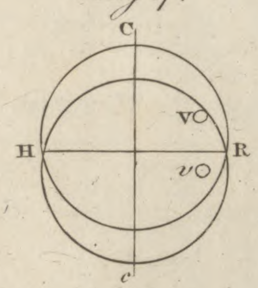


Fig. 10.

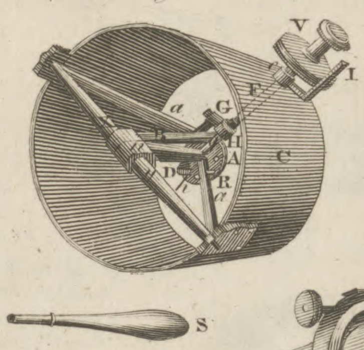
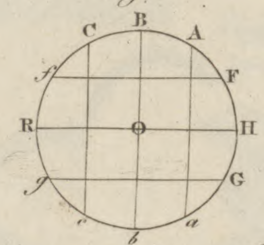


Fig. 2.



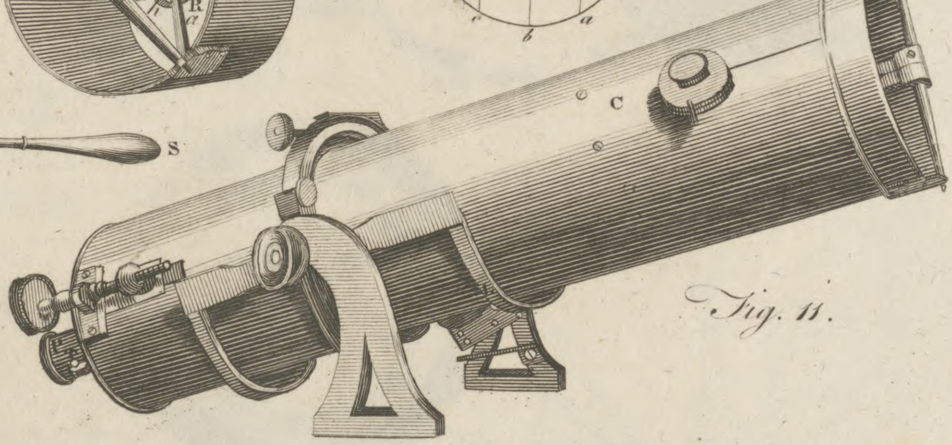
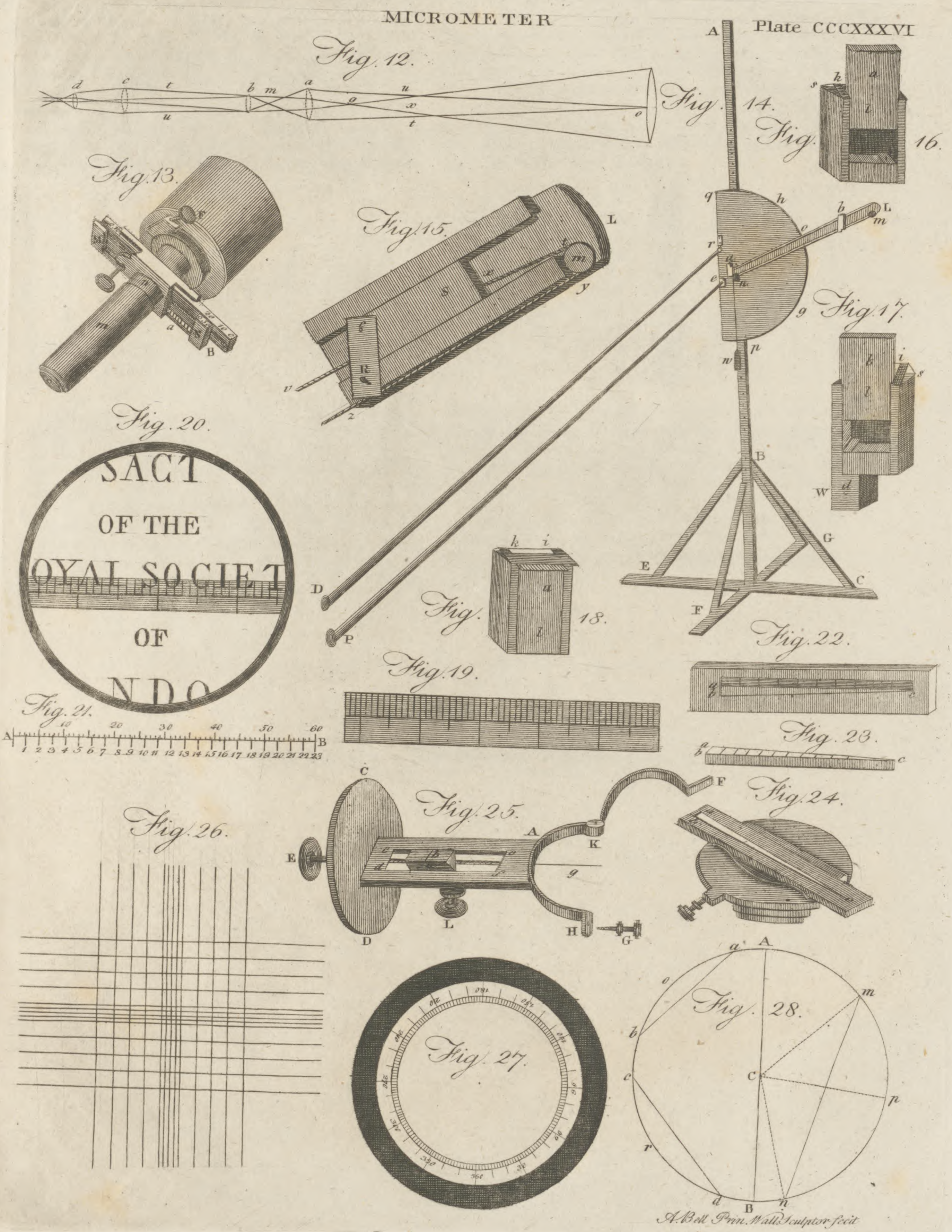


Fig. 11.

A. Bell Prin. Wal. Sculptor fecit.

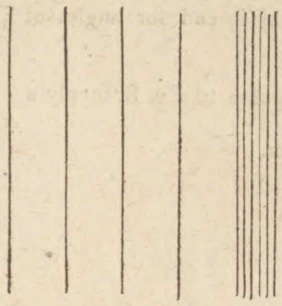


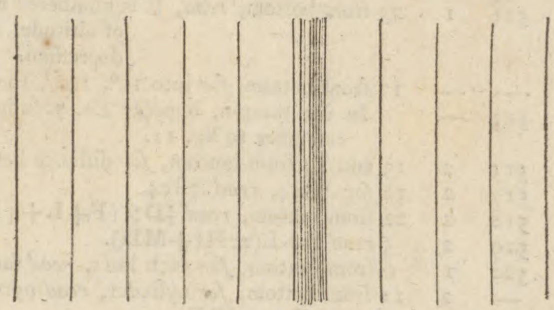
A. Bell Prin. Wall Sculptor fecit

Micrometer.

The case with which we have been favoured by Mr Coventry contains six micrometers, two on ivory and four on glass. One of those on ivory is an inch divided into one hundred parts, every fifth line longer than the intermediate ones, and every tenth longer still, for the greater ease in counting the divisions under the microscope, and is generally used in measuring the magnifying power of microscopes. The other ivory one is divided into squares of the 50th and 100th of an inch, and is commonly employed in measuring opaque objects.

Those made of glass are for transparent objects, which, when laid on them, show their natural size.— That marked on the brass 100, are squares divided to the 100th of an inch: that marked 5000 are parallel lines forming nine divisions, each division the 1000th of an inch; the middle division is again divided into 5, making divisions to the 5000th of an inch. That marked 10,000 is divided in the same manner, with the middle division divided into 10, making the 10,000th of an inch. Example:





The glass micrometer without any mark is also divided, the outside lines into 100th, the next into 1000th, and the inside lines into the 4000th of an inch: these are again crossed with an equal number of lines in the same manner, making squares of the 100th, 1000th, and 4000th of an inch, thus demonstrating each other's size. The middle square of the 1000th of an inch (see fig. 26.) is divided into sixteen squares; now as 1000 squares in the length of an inch, multiplied by 1000, gives one million in an inch surface; by the same rule, one of those squares divided into 16 must be the sixteen millionth part of an inch surface. See fig. 26. which is a diminished view of the apparent surface exhibited under the magnifier N° 1. of Wilson's microscope. In viewing the smallest lines, Mr Coventry uses N° 2. or 3.; and they are all better seen, he says, by candle than by day-light.

Micrometer, Micropus.

MICROPUS, BASTARD CUDWEED: A genus of plants belonging to the syngenesia class, and in the natural method ranking under the 49th order, *Compositæ*. See BOTANY *Index*.

END OF THE THIRTEENTH VOLUME.

ERRATA.

Page.	Col.	Line.
511	1	25 from bottom, *read*, It is numbered each way; from 0 to 90° towards the eye end for angles of altitude, and from 0 to 50° towards the object end for angles of depreſſion.
—	—	10 from bottom, *for* into 10°, *read*, to every 10°.
513	—	In the margin, oppoſite *Ex.* 7. ſupply a reference to fig. 10. and oppoſite to *Ex.* 8. ſupply a reference to fig. 11.
515	2	13 and 14 from bottom, *for* diſtance between, *read* diſtance between them.
517	2	12 *for* .7844, *read* .7854.
518	2	22 from bottom, *read* $\frac{1}{7}$D × (F+L+4 E+2 R).
519	2	5 *read* F+L(=HI+MD).
520	1	6 from bottom, *for* each lines, *read* ſuch lines.
—	2	11 from bottom, *for* cylinder, *read* pyramid.
521	1	15 *for* AE, *read* RE.
523	2	18 *for* Prob. 3. read Prob. 6.
525	1	31 *for* .5230, *read* .5236, and col. 2. line 7. *for* CA, *read* CA^2.
526	2	26 *for* .1077, *read* 1077; and in line 34. *for* .009, &c. *read* .000928371.
527	2	10 from bottom, *for* as EB at A, *read* as EB at B.
528	2	5 *for* $39^2 \times 32^2$, *read* 39×32^2, and line 6. *for* — *read* =

In the article METHODISTS, *paſſim*, *for* Hanſon, *read* Hampſon.

DIRECTIONS FOR PLACING THE PLATES OF VOL. XIII.

PART I.

Plate CCCXVI—CCCXXX. to face	-	page 136
CCCXXXI. CCCXXXII.	- -	184

PART II.

CCCXXXIII. CCCXXXIV.	- -	528
CCCXXXV. CCCXXXVI.	- -	806